DRAFT RETROFIT HANDBOOK

ISLINGTON
For a more eaual future

Acknowledgements

Islington expresses gratitude to Bioregional, Bath and North East Somerset Council's Planning Team and Donald Insall Architects who's work has greatly contributed to the development of the Handbook.

Draft published on 6th January 2025

Legal Disclaimer

Forward

Tackling climate change is a major priority for Islington Council. Buildings are the largest source of carbon emissions in Islington, generating 84% of all emissions. We will need to reduce carbon emissions from heating our homes by 95% in order to reach the net zero targets set by the Government. The energy efficiency improvements we make in our own homes can collectively make a big difference to the planet.

This handbook aims to help residents to play their part in the borough's response to the Climate Emergency. Everyone is at a different stage of their retrofit journey. Whether you have already completed several projects, or are just considering works, the guidance in this handbook should help you make an informed decision on your next steps.

The landscape for retrofitting is constantly changing both in terms of legislation and available techniques and technologies. This handbook will therefore be updated over time and is part of a package of measures that the Council has put together to work with residents, business and other key stakeholders in the borough on this issue.

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About the Retrofit Handbook

Purpose of the Handbook

To motivate and support residents and businesses in Islington to reduce carbon emissions associated with their building's by;

- demonstrating a variety of 'retrofit journeys' can be delivered over a period of time, at different budgets, to different building types to make the process more accessible and affordable,
- providing easy to use guidance and useful information on how retrofit can be carried out successfully, including:
  - how effective different measures are in retaining heat or using less energy,
  - how much measures are likely to cost,
  - when measures require Planning Permission and Listed Building Consent.

How to use the Handbook

The Handbook is organised into four chapters which can be referred to separately or read together, depending on your needs and interest.

Information in the first three chapters can be applied to both homes and business premises. Chapter 4 is just for residential properties.

You can quickly navigate to chapters using the buttons on the interactive panel at the bottom of the page.

Key terms

Retrofit:
The introduction of measures to an existing building to reduce energy consumption and improve the building's ability to retain heat.

The retrofit journey:
The process of planning and installing a combination of retrofit measures to reduce the building's energy consumption and improve its ability to retain heat.

1. The Retrofit Journey

Explore the process of the retrofit journey; how to plan and install a combination of retrofit measures. The questions here should guide you in understanding what you want to achieve and where to focus first.

2. Key Considerations

Find out information that will help you to plan a successful retrofit journey that maximises energy benefits, considers embodied carbon, understands the importance of airflow to avoid condensation and considers retrofit in older and heritge buildings.

3. Retrofit Measures

Specific information on retrofit options, costs, effectiveness, embodied carbon considerations, permissions required and images of the measures

4. Common Home Types

Retrofit journeys are modelled on four Islington home types to provide worked examples of what measures work well for each home type.

Islington Council's other available planning guidance on Climate Action

One draft SPD, two guidance documents and free advice service

Permitted Development Guide for Net Zero Works

This document is helpful if:

- **you want to install an external retrofit measure,**
- **you want to find out if planning permission is required.**

Permitted development means that development does not require planning permission. This guide supports residents and businesses to find out what kind of development is 'permitted development' according to the Town and Country Planning (General Permitted Development) (England) Order 2015 (as amended).

Guide to Repairing and Upgrading Windows in Listed Buildings and Conservation Areas

This document is helpful if:

- **you plan to repair or upgrade windows in a Listed Building or a conservation area,**
- **you wish to find out what is likely to be acceptable and when Listed Building consent will be required.**

Draft Climate Action Supplementary Planning Document (SPD)

This document is helpful if:

- **your development needs planning permission,**
- **you need advice on what planning policies apply,**
- **you need to find out what infomation is needed to show you comply with Islington policy.**

The Climate Action SPD provides additional guidance on the implementation of Islington's Local Plan policies relating to Climate Action.

The SPD contains a chapter on Retrofit that presents planning considerations for air source heat pumps, solar panels, windows and external wall insulation and cycle storage.

Free pre-application planning advice for retrofit works to reduce carbon emissions

The Council wants to encourage residents and local small/micro businesses to implement retrofitting measures in their buildings. We also recognise that planning rules can sometimes be complex. Where works are proposed to an existing residential or small business property and these works relate solely to the delivery of energy efficiency, renewable energy generation and/or sustainability improvement measures, there will be no charge for the Council's pre-application service. Should any works be included in a pre-application submission that are not directly and solely relevant to these measures, at the discretion of officers, then the relevant pre-application fee for these works would be applicable.

How is Islington Council supporting Climate Action beyond planning?

The Council is landlord to over 36,000 households and owns 922 other buildings in the borough. Reducing emissions from our estate will require increased funding from central Government and careful investment of the Council's own funding.

We are investing in low carbon heating systems e.g. at Bevin Court and Holford House and connecting larger buildings and communal heating systems to low carbon heat networks using waste heat e.g. at Bunhill. We are working with the Government via the Social Housing Decarbonisation Fund and the Public Sector Decarbonisation Scheme to improve the energy efficiency of homes and buildings, to install solar panels and to install Air Source Heat Pumps. Flagship examples include the decarbonisation of the Waste and Recycling Centre, the Archway Leisure Centre, proposals for the Harvist Estate and more. We have Heat Decarbonisation Plans for 110 more sites.

Our new building standards already exceed the energy efficiency requirements of the London Plan, are heat network ready and include their own low carbon systems e.g. the Air Source Heat Pumps at Finsbury Leisure Centre, Newington Barrow Way GP surgery and the Toffee Park adventure playground.

The Council is supporting residents to improve the energy efficiency of their homes and to reduce their carbon emissions through our energy advice, energy doctors and DIY small measures program. You can find out more on the Council's Climate action web page

We are working with the Mayor of London to support and fund community solar schemes, and we support local businesses to reduce emissions through our Energising Small Businesses and our Larger Energy Grant schemes.

Islington Council has a Construction Directory online that you can use to find a wide range of local suppliers including some who specialise in retrofitting. Look for the "Retrofit service provider" on the web page.

Finally, we are looking forward to promoting central government schemes to support residents to further improve the energy efficiency of their homes and to switch from polluting gas boilers to heat interface units connected to a low carbon heat network.

Solar panels installed on the Islington Waste and Recycling Centre in May 2024

1. The Retrofit Journey

What is the retrofit journey?

The retrofit journey is the process of planning and installing a combination of retrofit measures to bring an existing building's energy performance up to a higher standard, so that the building will need to use less energy.

In this handbook we present six stages of the retrofit journey, adapted from the LETI Climate Emergency Retrofit Guide. These stages are expanded upon overleaf.

1. Set goals and budget
2. Understand the building
3. Evaluate which measures to carry out
4. Identify steps to get to your goal
5. Buy materials and install
6. Monitor success and set further goals

Everyone's journey will be different depending on the scale, budget, state of repair and heritage context of their building. Even a simple measure such as draughtproofing a door is part of the retrofit journey.

Chapter 2. Key Considerations includes advice on approaching Pre-1920's buildings and retrofit and Retrofitting Listed Buildings and buildings within Conservation Areas

Adapting the retrofit journey to suit your circumstances

A comprehensive package of retrofit measures can be very costly, and some measures may not be practical for renters and leaseholders to install. The handbook presents simple DIY measures that are likely to be suitable for most.

If you wish to undertake a more comprehensive retrofit journey, we suggest you seek advice from a suitably qualified retrofit expert who can help you with the next steps. PAS 2035 is the British Standard for Retrofitting Buildings. For more information, see "Appendix 1. Comprehensive guide to the Retrofit Journey".

The retrofit journey

1. Set goals and budget

- Are your priorities to reduce emissions, to reduce bills or to improve indoor air quality and comfort?
- How much can you afford to spend on measures?
- Is any funding available?

2. Understand the building needs

- Where is most heat lost?
- Is the building in a Conservation Area or is it Listed?
- Does anything need upgrading or replacing anyway?
- See "4. Common Home Types" Chapter for information on risks and opportunities.

3. Evaluate which measures to carry out

- Prioritise measures according to cost, energy savings, embodied carbon and practicality,
- Is there anything you can do yourself?

4. Identify steps to get to your goal

- Is Planning Permission, Listed Building Consent or Building Control approval required? See the "3. Retrofit Measures" for more details

5. Plan, buy materials and install

- Depending on the scope of your project, you may need to commission an expert to install some measures.

6. Monitor success and set further goals

- Analyse your energy bills and compare them with your pre-retrofit bills to see how much carbon emissions you are saving.
- Plan your next retrofit project!

2. Key Considerations

This section presents key considerations that we encourage you to familiarise yourselves with before you begin your retrofit journey. The following topics will support you to maximise the benefits of retrofit, while minimising the risks:

- **Whole building approach,**
- **Electrification of heat,**
- **Ventilation to avoid moisture damage**
- **Embodied carbon impacts,**
- **Disruption to the living environment,**
- **Older buildings and retrofit,**
- **Retrofitting Listed Buildings and buildings within Conservation Areas.**

The whole building approach to retrofit

The "whole building approach" is a way of approaching retrofit that considers a building as a collection of systems that work together to affect energy consumption. These systems include insulation, ventilation, heating and cooling and factor in occupant behaviour. The whole building approach maximises the benefits (carbon savings and thermal comfort) and minimises the risks (disruption, damp or mould) by taking into account the context of the building, the retrofit priorities and budget. Critically, it acknowledges the impact one retrofit measure may have on another. The approach takes this information into account to inform the selection and sequencing of measures, suitable for different contexts over a period of time.

It is important to ensure that your retrofit journey does not result in damp and mould caused by increased condensation and moisture often associated with improved insultation. This is especially important for buildings constructed before 1920. This topic is discussed in more detail in the "Ventilation to avoid moisture damage" , "Pre-1920's buildings and retrofit" and the "Retrofitting Listed Buildings and buildings within Conservation Areas" chapters.

The electrification of heat

Gas boilers are the dominant heating system within Islington, serving around two-thirds of homes. In areas with Victorian and Georgian properties this increases to over 80% of homes. Flats built in the 20th century are more commonly heated by electricity, but gas heating still accounts for a significant proportion of these properties.

Burning gas to create heat is carbon intensive, (emitting around 200gCO2/kWh). Historically the use of electricity was even more intensive (around 520gCO2/kWh in 2012). However, in recent years the collapse in coal power generation and large increase in wind power generation has reduced the grid carbon intensity of electricity significantly (to 162gCO2/kWh in 2023). This is around 20% lower than gas on a per unit basis. The grid is expected to decarbonise further as part of National Grid's target to reach net zero emissions by 2050.

Heat pumps enable homes to move away from gas boilers and should be the primary focus for homes with suitable access to outdoor space. Heat pumps have significant performance and running-cost benefits when compared with other electrical heating systems. See the "3. Retrofit Measures" for more details on heat pumps.

Ventilation to avoid moisture damage

Before undertaking any energy efficiency measures, you need to ask "***how will this impact on the flow of air? Will this cause a risk of condensation and mould?"***

Avoiding heat leakage through air tightness and insulation measures is a central concern when retrofitting buildings. The relationship between airtightness and ventilation, particularly relating to the flow of moisture, is critical in traditional homes. Moisture inside buildings originates from a number of sources, wet ground and weather, its occupants breathing and from activities like cooking and washing. This moisture needs to leave the home somehow. Wind-driven air infiltration and leakage provides over half of the ventilation of homes in the UK that have not been retrofitted.

Insulation materials should be selected to complement moisture flows, otherwise there are risks of creating condensation and damp. Damp walls can lead to the growth of mould which can result in serious health issues for residents, affect the thermal comfort of the property and damage the property.

In some cases, designing measures around moisture flows means selecting "vapour open" insulation materials, which allow for the transmission of moisture through them. In other cases, it means installing ventilation systems to ensure moisture is released and is not trapped between elements of the built fabric.

Some retrofit measures, like internal wall insulation, result in a greater risk of condensation. This occurs when cold elements of the building's exterior (eg. an exterior wall), meet warm elements of the building's interior (an internal wall). This is known as a "thermal bridge," see the diagram below. Moisture develops here and can cause damage to the building and damp. It is important to appoint a PAS 2035 Retrofit Coordinator when installing wall insulation as they will be able to advise you on how to mitigate the risks most effectively.

See the "2. Key Considerations" and "4. Common Home Types" Chapters for more details on ventilation, insulation and draughtproofing and which strategies might be most appropriate for you.

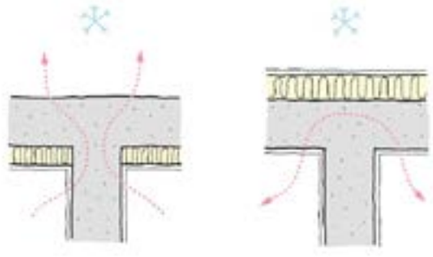


Diagram showing internal wall insulation (left, and external wall insulation (right) demonstrating potential for thermal bridging when warm elements of the building meet the cold exterior.

Embodied carbon and retrofit

Retrofitting homes delivers significant operational carbon savings and health benefits. However, there are environmental impacts associated with making the products that enable our homes to be more efficient. For example, the production processes for insulation materials, window frames and the refrigerants used in heat pumps can 'embody' a significant amount of carbon emissions. Further discussion on embodied carbon of these material is provided within Appendix X.

The benefits of retrofitting measures often outweigh the impacts of their embodied carbon, but it is always worth considering ways to reduce embodied carbon during a retrofit project. One way is to require the use of low carbon materials throughout a project – some suppliers have calculated the embodied carbon in their products and will be able to state their carbon footprint. Choosing quality materials that are durable, and preferably reusable or recyclable, will help to reduce the life-cycle emissions of the retrofit. This is consistent with Islington's approach to Whole Life-cycle Carbon and the circular economy, as set out in Chapters 9 and 10 of the draft Climate Action SPD.

Decorative finishes, paints, glues and plasters can also have a significant large environmental impact which should ideally be considered and minimised as part of any retrofit or renovation project. If using any contractors, make it clear that low embodied carbon is a key objective for your project.

The following online tools can help with the calculation of embodied carbon emissions from a project:

- One Click Life Cycle Assessment
- LETI Embodied Carbon Primer

Disruption to the living environment

Some retrofit measures may be more disruptive than others. For example, to install internal wall insulation you will need to move all of your belongings out of the area to be insulated.

However, opportunities to minimise disruption do exist!

If you need to carry out repairs you might explore adding retrofitting measures into your existing plan. For example, if your roof needed to be fixed, this requires scaffolding. Could you explore installing solar panels or external wall installation at the same time? This can reduce disruption and the cost of enabling works. As a more comprehensive retrofit project, it would be advisable to consult a PAS 2035 Retrofit Coordinator for this combination of measures. We have provided a guide to whole-house retrofit within "Appendix 1. Comprehensive guide to the Retrofit Journey" which includes potential trigger points you could plan your retrofit around.

There are retrofit measures that are designed to minimise disruption, for example the remote-controlled robot to spray insulation under suspended timber floors. The lack of disruption is sometimes a trade-off with energy efficiency so this needs to be considered carefully.

A person installing loft insulation.

Pre-1920's buildings and retrofit

Retrofitting older buildings requires a different approach to ensure their heritage value is sustained and unintentional damage is avoided, but there are lots of good options for improving energy and carbon performance, and in most cases they can be made significantly more sustainable.

Key considerations when dealing with older buildings include:

- **Start with the 'whole building approach'**: Consider the whole building, its context and all the factors affecting energy use when devising an energy efficiency strategy rather than just focusing on one retrofit measure. Consider short-term and long-term strategies and plan ahead to make sure work is carried out in a coordinated way. See Historic England's website on the whole building approach.
- **Understanding building moisture movement:** Older buildings function differently from modern ones. They are made from permeable materials and their proper functioning relies on moisture being able to freely move through the structure and evaporate away. Some retrofit measures can prevent this from happening and cause serious problems with moisture build-up.
- **Understanding building fabric:** Some retrofit measures will require significant consequential works. It is important to have regard to the specific circumstances of older buildings that are often built to flex and move more than modern buildings. See Historic England's web page on Materials for Historic Building Repairs for more information.
- **Seek professional advice where appropriate:** Some retrofit measures for older buildings are complex and can be costly and harmful if they go wrong. Get advice from a qualified retrofit coordinator or other experienced professional who has experience with retrofit of older buildings before starting. The British Standards Institution recommends minimum qualifications for retrofit co-ordinators in their PAS 2035 document which is part of their Retrofit Standards Framework. For traditionally constructed dwellings this includes holding a Level 3 Award in Energy Efficiency for Older and Traditional Buildings.
- **Address condition issues first:** Ensure the building is in good condition and is not damp before starting. If it is not in good condition, the retrofit measures are likely to be less effective.
- **Consider the long-term health of the building**: Be aware of the risks associated with retrofit projects, understand the probable useful life of retrofit measures, and choose options that are reversible if needed.
- **Consider heritage significance**: Older buildings that are Listed or within a Conservation Area are protected through the planning system. In these cases retrofit proposals must be designed to preserve their special interest (see the next page for further details).

See the Sustainable Traditional Buildings Alliance Guidance Wheel for more information on how retrofit measures interact with each other.

A Victorian terraced house in Islington

Retrofitting Listed Buildings and buildings within Conservation Areas

Islington has a large number of historic buildings, many of which are Listed Buildings or are in Conservation Areas. It is essential that these buildings are not excluded from the retrofit process. They have been enjoyed by multiple generations who adapted them to suit their needs. If properly cared for, they can be enjoyed by future residents of Islington into the next century and beyond. Improving these historic buildings to reduce carbon emissions and to adapt to a changing climate is essential. It is also the best way to make sure buildings remain viable and useful and are preserved for future generations to enjoy.

Retrofitting Listed Buildings requires a different approach, and measures must be designed so that the special character of Listed Buildings and Conservation Areas is protected. However, there are lots of good options for improving energy efficiency and sustainability that are suitable for heritage buildings and in most cases these buildings can be made significantly more sustainable. Heritage constraints often lead to better retrofits as extra care and consideration about which materials and techniques to use for traditional buildings is required.

When retrofitting buildings in a Conservation Area, proposals that would affect the external appearance of the building must be designed to preserve the character and appearance of that conservation area (e.g. choosing replacement windows that would replicate the appearance of the originals). However, there are no special requirements for internal changes to buildings in conservation areas because these will not have any impact on the character of the area.

When retrofitting Listed Buildings, any changes (whether internal or external) will need to be carefully designed to preserve the special architectural and historic interest of the building: internal spaces and features often make an important contribution to the significance of these buildings. In general, proposals should be designed so that they do not adversely affect the character and appearance of the building or the rooms within it and should avoid harm to historic building fabric and features. This document does not cover the considerations relating to retrofit of Listed Buildings in detail. Residents and property managers are advised to refer to Historic England's comprehensive library of detailed advice about retrofitting Listed Buildings. They should consider seeking pre-application advice from the Council when preparing proposals. Listed Building Consent will be required for most retrofit measures.

3. Retrofit Measures

A range of retrofit measures to deliver different objectives

Your home can be understood as a combination of systems. These systems have been split into five categories; measures to reduce heat loss, energy, ventilation, transport and biodiversity and water measures. You might prioritise one measure, or a combination of measures to create your home's Retrofit Journey.
If one measure is not possible in your context, there will almost always be another way to improve your home's performance. The table below links to information on each measure. See the Retrofitting Islington's Housing Chapter for combinations of measures suitable to some of Islington's housing types to explore groupings of measures for your Retrofit journey.
The list presented here is not exhaustive, there are many more measures available.

Reducing heat loss

To maximise efficiency/ reduce heat leakage

- Draught-proofing doors
- Draught-proofing chimneys
- Draught-proofing loft hatches
- Draught-proofing timber floors
- Draught-proofing service holes in external walls
- Draught-proofing cracks in interior walls/ceilings
- Roof and Loft Insulation
- Repairing and improving historic windows
- Window replacement
- Door replacement
- Solid and timber floor insulation
- External wall insulation
- Internal wall insulation
- Cavity Wall Insulation

Energy

Efficient supply of energy and renewable energy generation

- Thermostatic radiator valves (TRVs), Smart thermostats and flow controls
- LED lighting
- Solar panels
- Air source heat pumps
- Ground source heat pumps

Ventilation

Regulation of airflow to reduce moisture risks and indoor air pollution

- Trickle vents
- Extract and mechanical ventilation and heat recovery systems

Transport

Promotion of sustainable transport

- Cycle Storage
- Off-street electric vehicle charging points

Biodiversity and Water measures

Increase biodiversity and urban cooling, decrease surface water flood risk

- Water butts
- Rainwater harvesting system
- Greywater recycling system
- Green roofs
- Bird and bat boxes
- Ponds
- Compost heaps
- Mini wildflower meadow or wildlife patch

Retrofit Measures Impact Matrix

The retrofit measures impact matrix provides an overview of the retrofit measures' energy impact rating, an indication of their cost and the amount of disruption the measure is likely to cause to the occupants of the building.

These ratings are generalised to provide a simplified overview of how common measures tend to perform. Factors such as the type and efficiency of the building's heating system will have an impact on the energy efficiency rating so this should only be a rough guide

We have calculated a priority rating using energy impact, cost and disruption to highlight which measures are cheapest and effective.

While this table looks at how measures perform separately, we recommend you plan your retrofit journey to respond to specific circumstances, taking the "The whole building approach to retrofit" to maximise benefits and minimise risks. If you are carrying out other works to a building, these might represent a "trigger point" for you to install a retrofit measure or combination of measures at the same time.

The data informing the matrix is sourced from a study by Bioregional, used to inform aspects of the Retrofit Handbook, except the cost of Ground Source Heat Pumps which was informed by the Energy Saving Trust.

Key showing upfront cost ranges

Range	Upfront cost
Low	£0 - £1,500
Medium-low	£1,501 - £5,000
Medium	£5,001 - £30,000
Medium-high	£30,001 - £65,000
High	£65,000 - £150,000

Measure	Energy impact	Cost	Disruption	Priority Rating
Timber Floor Draughtproofing	Medium-low	Medium	Medium-high	Low
Door Draughtproofing	Medium-low	Low	Low	High
Window Draughtproofing	Medium-low	Medium-low	Low	Medium-high
Chimney Draughtproofing	Medium-low	Medium-low	Low	Medium-high
Loft hatch Insulation	Medium-low	Medium-low	Low	Medium-high
Timber Floor Insulation	Medium-low	Medium	Medium	Medium-low
Filling external holes and gaps	Medium-low	Medium	Low	Medium
Filling internal cracks in ceilings walls	Medium-low	Medium-low	Low	Medium-high
Roof and loft insulation	High	Medium (Medium-high for flat roof)	Low - Loft (Medium - Flat roof)	High
Window replacement	High /Medium-high	Medium-high	Medium	Medium
Secondary Glazing	Medium-high	Medium	Medium	Medium
Window Shutters	Medium-low	Medium-low	Medium	Medium
External shading and awnings	Low	Medium-low	Low	Medium

Measure	Energy impact	Cost	Disruption	Priority Rating
Solid and timber floors insulation	Medium	Medium-high	High	Low
Door replacement	Medium	Medium	Medium-low	Medium-low
Cavity Wall Insulation	Medium-high	Medium-high	High	Low
Internal Wall Insulation/ Thin	High	High	High	Low
Externally Applied Solid Wall Insulation	High	Medium-high	Medium	Medium
Heating controls, smart thermostats and flow controls	Medium	Medium-low	Low	High
LEDs	Medium-high	Medium-low	Low	High
Solar Photovoltaics	Medium	Medium-high	Medium	Medium-low
Solar Thermal	Medium	Medium-high	Medium	Medium-low
Air Source Heat Pumps	High	Medium-high	Medium	Medium
Ground Source Heat Pumps	Medium-high	High	Medium-high	Medium
Extractors, Mechanical Ventilation and Heat Recovery	Low/ Med Low	Medium	Medium-high	Medium
Electric Vehicle Charging	High	Medium	Low	High

DIY Retrofit Measures

For some residents, larger retrofitting measures may not be possible due to financial constraints or the potential disruption to daily life. However, there are immediate, low-cost steps that can be taken to enhance the energy efficiency of your home. These smaller improvements not only offer quick energy savings, but can also pave the way for larger retrofit projects in the future, by helping you to understand where your home is losing the most energy.

By making small, incremental improvements, you can reduce energy loss, make savings on your energy bills, increase comfort, and develop energy-saving habits that will benefit you in the long term.

Benefits of DIY energy efficicency measures

- **Quick and Affordable:** Many of these measures are low-cost, widely available, and easy to install, with minimal disruption.
- **Improve the Thermal Comfort of Your Home:** Small measures, such as draught proofing, can significantly reduce cold draughts, helping to maintain a stable indoor temperature and creating a more comfortable living environment.
  Laying a carpet or flooring on suspended timber floors can have a big impact on comfort!
- **Identify Energy Loss Hotspots**: These measures can help you identify areas of your home where energy is being wasted, allowing you to prioritise future retrofitting projects based on where the most energy is lost.
- **Develop Long-Lasting Habits**: Simple changes can develop energy-saving behaviors that last, helping you build a more sustainable lifestyle

The following retofit measures can be carried out by yourself:

- Filling internal cracks in ceilings walls*
- Filling external holes and gaps*
- Timber Floor Insulation*
- Loft hatch Insulation
- Chimney Draughtproofing
- Window Draughtproofing
- Door Draughtproofing
- Timber Floor Draughtproofing
- Loft insulation
- Heating controls, smart thermostats and flow controls
- LEDs

If you carry out all of these measures together, cumulatively they can have a significant impact on the thermal performance of the building.

Energy Saving Tips

Free Quick Wins for Around Your Home

It is easy to miss out on energy savings depending on how you use your building.

- **Turn down your thermostat by just 1°C:** This can save you as much as £125 a year whilst maintaining a comfortable temperature. If you are or live with elderly, ill or have small children, then it's important that the temperature doesn't go below 18°C.
- **Adjust radiator valves:** Only heat rooms that are in use, reducing wasted energy in unoccupied spaces.
- **Only boil the water you need:** Boiling only one cup of water instead of filling the whole kettle can save up to £15 a year.
- **Heat the body, not the home:** Focus initially on staying warm by wearing additional layers and using blankets instead of heating the entire home.
- **Conduct an energy efficiency audit:** Use the Centre for Sustainable Energy's guide to identify hotspots and the energy usage of different appliances around your home
- **Turn off standby mode:** Appliances on standby still consume energy. Turn them off at the wall to reduce wasted electricity. If sockets are in hard to reach locations i.e. behind the TV cabinet, you can purchase standby saves which can allow you switch off power at the socket using a small remote.
- **Set radiators on a timer:** Program your heating to come on only when needed, avoiding unnecessary heating. The Centre for Sustainable Energy has produced some explainer videos on how to program your thermostats.
- **Dry clothes in well-ventilated rooms:** Instead of using a tumble dryer, which consumes a lot of energy, opt for air drying. A dehumidifier can also help reduce moisture and speed up the drying process.
- **Wash clothes at 30°C:** Washing at a lower temperature saves energy and helps prolong the lifespan of your clothing.
- **Fix dripping taps:** A dripping tap can waste more than 5,300 litres of water per year. Ensure taps are fully turned off and address any leaks.
- **Shorten shower times:** Keep your showers to four minutes. This can save up to £95 a year on water and energy bills.
- **Lower your combi boiler's flow temperature:** Most combi boilers are set at around 80°C, this can be lowered to reduce your flow temperature. Saving you 6-8% on your heating bill. You can lower the flow temperature to between 80-60°C, this should be no lower than 60°C as this can allow bacteria to grow.
- ***Move Furniture away from radiators*:** Furniture next to radiators can prevent the hot air from reaching the room, being absorbed by the furniture instead. Leaving a gap between radiators can allow hot air from your radiators to circulate effectively round your room.

Additional Support and Resources

Learn more about improving your home's comfort and energy efficiency at the Council's Energy Advice Pages

You can also access further support through the SHINE services, which provide advice on how to stay warm, manage energy bills, arrange Energy Doctor Visits and access grants for energy-saving measures.

Draughtproofing doors

At a glance

Energy: Medium-low

Cost: Medium-low

Disruption: Low

DIY: Yes

Planning permission: Not required

Listed Building Consent: Not normally required unless it would affect significant elements. This measure is likely to be acceptable if it is designed to be sensitive to the building's listing

How does it work?

Heat is lost through ill-fitting or worn doors.

Rubber, foam or brush strip seals can be attached to doors, letter boxes and key holes to reduce heat loss.

Glazed panels over door windows can also be draught-proofed

Ventilation

Airflow to the building can be reduced through this measure. Moisture risk should be avoided installing or maintaining air-bricks or trickle vents.

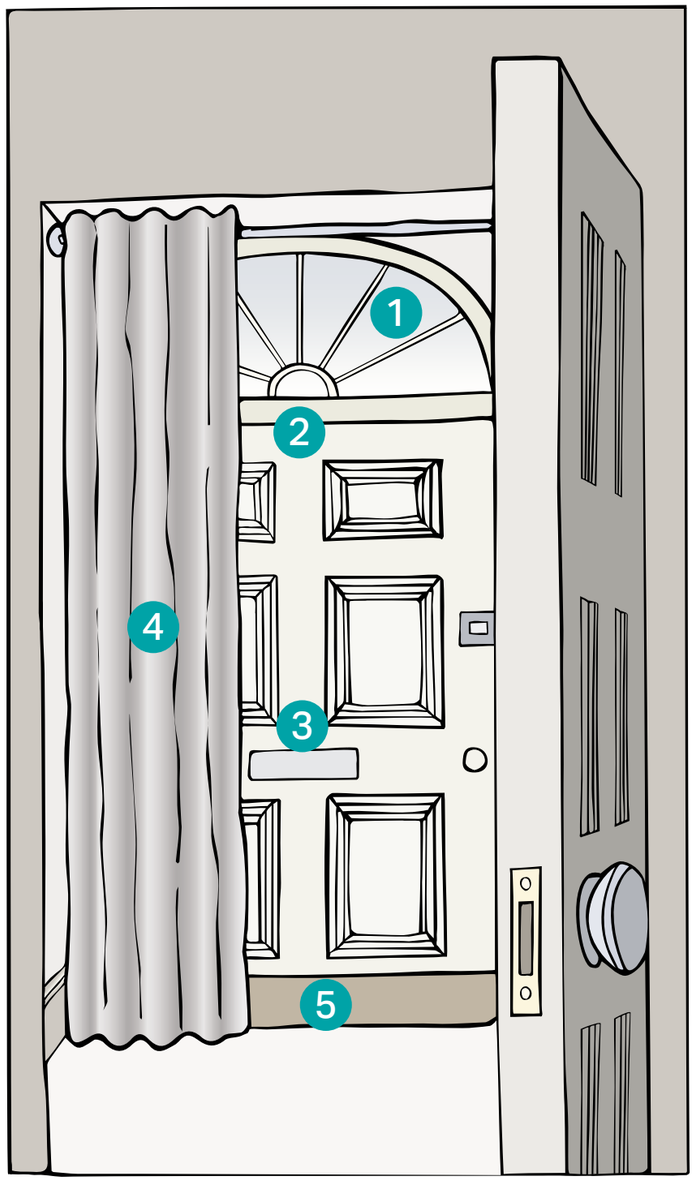
Practical Considerations and tips

The majority of draughtproofing measures are DIY and low cost. You can attach strips of thick fabric, felt, or belts to the edge of doors and windows to create draught excluders or cover letter boxes with heavy fabric attached at the top.

If using adhesive strips, make sure to follow manufacturers guidance on strip position, and ensure the surface is clean and dry before application.

Technical Considerations

1. Over door windows, glazed panels, and the panels of the door themselves can be upgraded to improve their thermal performance.
2. The door should be repaired to ensure a good fit with its frame and the junction between the two upgraded with brush seal draught strips or similar.
3. A draught excluding letterbox flap and cover for the keyhole will close easy routes for draughts to enter the home.
4. A heavy curtain will reduce heat loss and limit draughts when the door is closed.
5. A draught excluder is an effective way to prevent cold air entering through a door



Draught-proofing chimneys

At a glance

Energy Impact: Medium-low

Cost: Per balloon - Low, Per register plate Medium

Disruption: Low

DIY: Balloon - Yes, Register Plate - No

Planning permission: not required

Listed Building Consent: not normally required unless it would affect significant elements. This measure is likely to be acceptable if it is designed to be sensitive to the building's listing

How does it work

As much as 80% of the heat from a room can pass through a chimney flue. Draughtproofing can be achieved through inserting a chimney balloon or installing a register plate.

Ventilation

Chimneys provide an important air-pathway in older homes and shouldn't be permanently closed. Breathable and natural materials are recommended for chimney balloons to allow for some infiltration. Chimney plates can be opened and closed to support air-flow and ventilation.

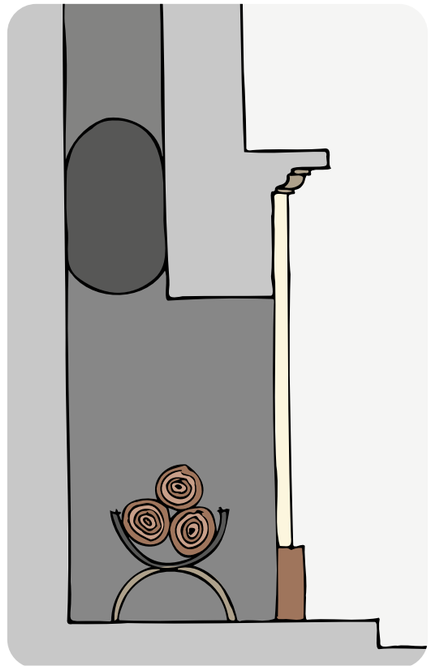
Technical considerations: Chimney balloon / draught-excluder

- A chimney balloon or draught excluder is a simple DIY installation fitted within easy reach at the foot of the flue. The airbag or excluder adopts the shape of the flue as it is inflated/ installed and provides an air cell/ barrier which acts as a thermal buffer to insulate against heat loss, as well as a physical barrier to reduce draughts.
- The existing flue remains unaltered and capable of functioning normally when the chimney balloon is deflated.
- Balloons and excluders are available in a range of sizes to suit flues but can also be made to measure.

If using a chimney balloon or removable chimney draught excluder, it is extremely important that you remember to remove it your fireplace is in use!

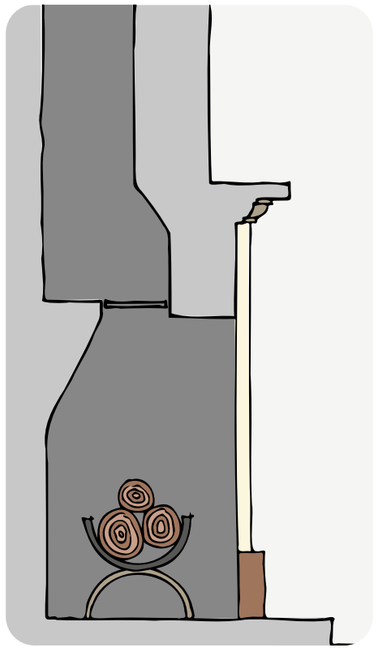
Embodied Carbon

Chimney draught excluders made out of sheep's wool are also available, they have a lower embodied carbon value than a plastic balloon.



Technical considerations: Chimney register plate

- The existing flue remains unaltered and capable of functioning normally when the register plate is opened.
- A register plate will need regular cleaning as soot, nesting material and other debris can accumulate on the upper surface and this may present a fire hazard if left.
- A register plate is normally made of steel, set within a simple frame. The frame is mechanically secured to the masonry of the chimney and its perimeter is usually sealed with fire cement or a rope gasket to produce a close fit. An opening 'flap-door' allows smoke to pass when the flue is in use and can be adjusted to provide different degrees of ventilation at other times.
- The open fireplace can easily be used when required.
- A professional should install a register plate as it is made to measure and requires permanent fitting.



Draught-proofing loft hatches

At a glance

Energy Impact: Medium-low

Cost: Medium-low

Disruption: Low

DIY: Yes

Planning permission: not required

Listed Building Consent: not normally required unless it would affect significant elements. This measure is likely to be acceptable if sensitive to the listing

How does it work?

Draughtproofing the loft hatch and surrounding area can reduce air leakage.

Use insulating strips and draught excluders to seal around the loft hatch, and make sure the hatch itself is insulated.

Correctly installed new loft hatches can provide improved energy efficiency, preventing heat loss and draughts.

Ventilation

Moisture risk should be avoided by ensuring existing air-flows are maintained, and by using air-bricks or trickle vents.

Draught-proofing timber floors

At a glance

Energy Impact: Medium-low

Cost: DIY Medium-low, Professional Medium

Disruption: Medium

DIY: Yes

Planning permission: not required

Listed Building Consent: not normally required unless it would affect significant elements. This measure is likely to be acceptable if its design is sensitive to significant elements of the building's listing. See Historic England Guidance

How does it work?

Suspended timber floors are designed to be ventilated from below to protect the floor timbers from moisture, but these draughts can be unwelcome in the home.

Sealing gaps in the floorboard and underneath the skirting with caulk sealant, timber fillets or compression strips can be effective in reducing draughts.

Laying a carpet or airtight membrane above the floorboards is another option

Ventilation

Suspended timber floors were designed to allow air movement and prevent issues of dry and wet rot and woodworm. Smart air-bricks are a useful strategy to ensure airflow reaches the floor voids.

General Considerations

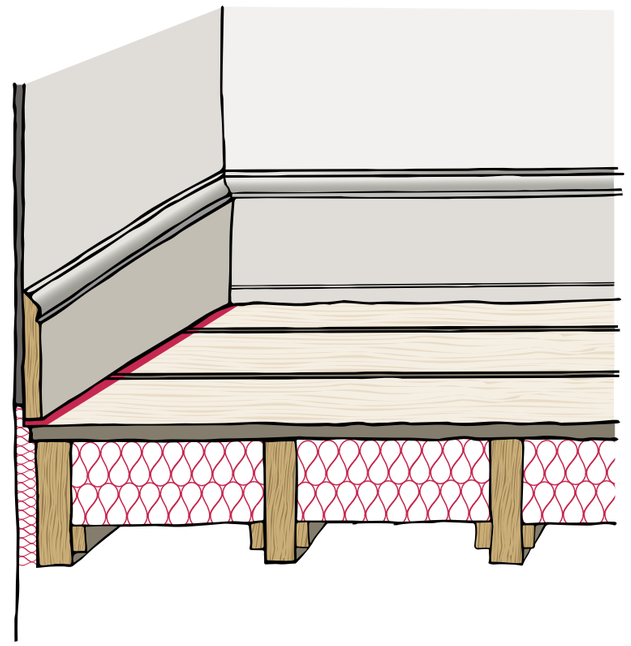
Sealing the gaps between floorboards, known as caulking, affects the appearance of the floor and can make floorboards harder to lift in the future.

Embodied Carbon

Natural materials such as timber and sheep's wool can be selected to reduce embodied carbon

Technical Considerations

- Fill smaller gaps with plaster, decorator filler, or mastic to close air-paths between the interior and a floor void.
- With larger gaps, where floors have 'relaxed', timber fillets may be necessary to effectively close the joint.
- Hardboard coverings and underlays beneath carpets can also be effective at reducing draughts
- Closing these gaps with a compressible caulking strip (preferable as it allows expansion and contraction of the boards) a filler, mastic or timber slips will help prevent draughts. In severe cases it may even be necessary to lift and relay the boards.
- Floor voids and the spaces behind cornices and panelling should be insulated as described to the right. Where there are larger gaps, these can be sealed with compacted compressible insulation such as mineral wool or sheep wool.



Draught-proofing service holes in external walls

At a glance

Energy Impact: Medium-low

Cost: DIY – Low, Professional Medium

Disruption: Low

DIY: Yes

Planning permission: not required

Listed Building Consent: not normally required unless it would affect significant elements. This measure is likely to be acceptable if its design is sensitive to significant elements of the building's listing.

How does it work?

Poorly finished service penetrations for ventilation and boiler flues can create constant air leakage pathways in a façade owing to consistent heat losses and wasted energy.

Improved air tightness around ductwork can reduce air leakage in the property. Holes in outside walls are typically due to:

Soil stacks and waste pipes, Electricity cables, Gas pipes, Telephone and internet cables, Cable TV, etc.

Ventilation

Service penetrations through the façade can become traps for condensation build-up, ultimately leading to compromised finishes and leading to more significant structural issues at later dates. Selling them properly will reduce this risk.

Considerations

Air tightness foam can be used (other foams can shrink). Fill the holes from the outside first, then the inside. Air tightness tape can be used for larder gaps.

When carrying out redecoration works with service penetrations, such as kitchen and bathrooms, consider sealing air leakage pathways. Removing redundant ventilation should be considered.

Draught-proofing cracks in interior walls/ceilings

At a glance

Energy Impact: Low -Medium

Cost: DIY – Low, Professional –Medium-low

Disruption: Low

DIY: Yes

Planning permission: not required

Listed Building Consent: not normally required unless it would affect significant elements. This measure is likely to be acceptable if its design is sensitive to significant elements of the building's listing.

How does it work?

Cracks and gaps develop in buildings either because they were built poorly or, more likely, because they have simply moved over time. Fixing them is an easy and cheap maintenance measure to improve airtightness of your home.

Ventilation

Ensure ventilation pathways, such as air-bricks and trickle vents are in place and maintained.

Considerations

DIY Measures are appropriate for small cosmetic cracks in ceilings and walls. This can be done using filler/caulk. Use filler where the hole doesn't move (such as a screw hole in plasterboard) or decorators' caulk or mastic where the hole might move (such as the gap between skirting boards and walls).

Professional works can include: patch repairs to cracks in ceilings and existing walls with liquid applied air tightness membrane, parge coats to walls sealing cracks and reducing leakage pathways, an additional blower door test after implementation of measures to identify and remedy any outstanding issues.

If retrofitting an older building, ensure you use appropriate materials that are breathable and flexible. Applying rigid materials can cause damage if they don't move with the building.

Draught-proofing and improving windows

At a glance

Energy Impact: Medium-low

Cost: DIY Low, Professional – Medium-low

Disruption: Low

DIY: Yes

Planning permission: not required

Listed Building Consent: not normally required unless it would affect significant elements. This measure is likely to be acceptable if it is designed to be sensitive to the building's listing.

How does it work?

Draught-proofing windows using flexible rubber, rigid foam or mastic seals fitted into the window frame joints can reduce air leakage.

Repairs to frames and replacement of glass within frames can be explored.

Ventilation

Moisture risk should be avoided by maintaining existing air-flows and using air-bricks or trickle vents.

Considerations

Before draughtproofing, windows need to be in a good state of repair. They may need re-hanging and repairing professionally.

Care should be taken to ensure the strength of the frame is not compromised.

Types of seal available

Compression Seal

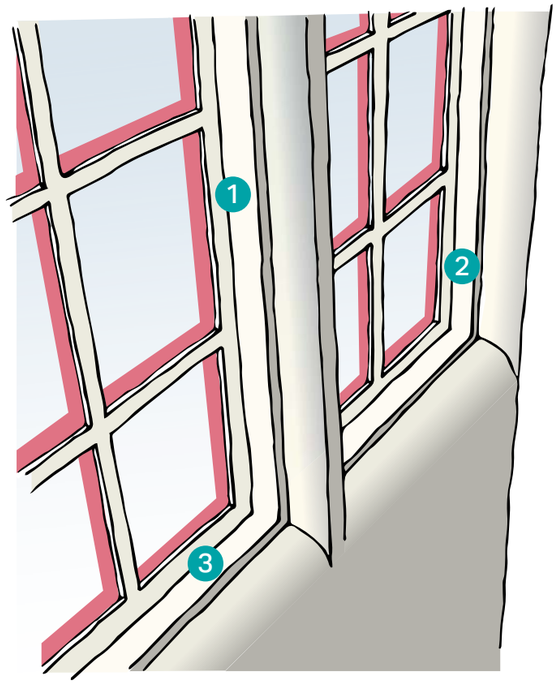
Mastic Tape

Brush Seal

Wiper Seal

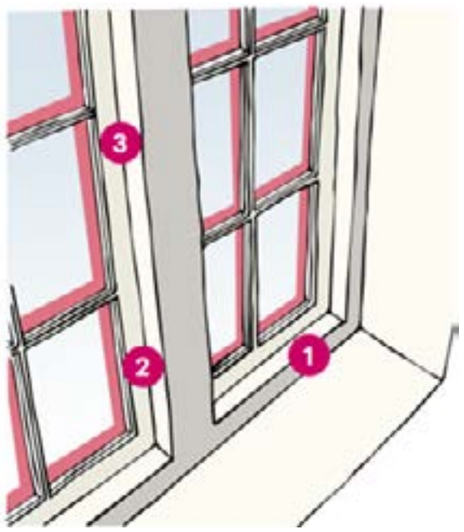
Metal framed window

1. Compression and wiping seals can be discreetly fitted at the perimeter of the window.
2. A simple draughtproofing technique is to apply seals around the window where the glass meets the frame, using a tape applied to the frame. This achieves a good fit, with minimal impact on the building fabric and can be applied when re-decorating.
3. The gap between a metal window and its frame or surround can account for a significant amount of the heat loss. Improving the fit of the window by keeping it in good repair will help and draughtproofing will ensure the energy lost is kept to a minimum.



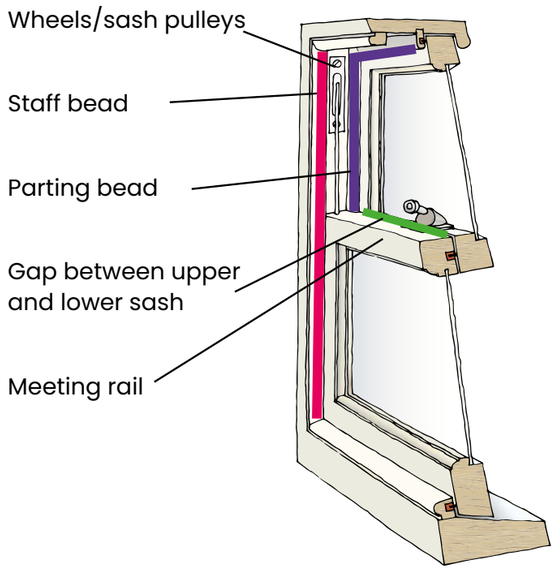
Timber framed window

1. The gap between window and the window surround should be reduced to reduce air movement.
2. A simple mastic bead tape can reversibly seal components without damage and can be part of the routine re-decoration of a window.
3. Pin-on or self-adhesive weather-strip components are available which can be fitted at the junction between window and the window surround. Alternatively, professionally fitted systems are available which can be fully rebated into the joinery.



Timber sash window

- Staff bead and parting-bead can be replaced with components incorporating brush seals for draughtproofing (although this is not the case with traditional/historic building fabric).
- The gap between the upper and lower sash can be improved with the addition of a mastic bead or brush seal. Draughtproofing will need to be applied around the whole sash and may also be needed for the gaps where the wheels are.
- Systems are available which are rebated into the joinery and are almost invisible when fitted. Where there are original windows, the secondary glazing should match the opening pattern e.g. meeting rail position should be matched.



Upgrading glass in existing frames

- Consent would be required on a listed building.
- A range of glass products are available on the market with improved thermal performance including 'Low E' glass and ultra-slimline double-glazed units which can often be mounted in existing frames.
- Alternatively, adhesive films can be applied to existing glass to improve its thermal performance or reduce solar gain.

Useful links

There is more information about repairing and improving older windows in the Islington Quick Guide to upgrading windows (2024).

Traditional Windows: their care, repair and upgrading (Historic England 2017) contains detailed information on the history and significance of traditional windows and guidance on maintenance, repair andupgrading.

Energy Efficiency and Historic Buildings: Draught-proofing windows and doors (Historic England 2016) is part of a suite of guidance documents on energy efficiency in historic buildings and provides detailed advice on draught-proofing windows and doors.

Modifying Windows and Doors in Historic Buildings | Historic England (Web page) provides detailed information and links about improvements to windows in older buildings.

SPAB Technical advice note: Repair of Wood Windows (Society for the protection of Ancient Buildings) provides guidance on repairing traditional timber windows.

Repairing and improving historic windows

Windows in Conservations Areas

If you live in a non-listed building in a conservation area, you will usually need to obtain planning permissions to replace windows. Please refer to our Permitted Development Guide for Net-Zero Works for information about permission requirements for alterations to windows (and other retrofit works) in conservation areas and non-listed buildings.

You will need to consider how your proposed changes will affect the character and appearance of the conservation area:

- If you live in a building that makes a positive contribution to the character and appearance of the conservation area, it will usually be acceptable to replace traditional windows with well-designed double-glazed windows. The replacement windows should closely match the original design and materials. This will mean replicating the glazing pattern of the historic windows, which will usually involve the incorporation of integral glazing bars and frame construction from traditional and sustainable materials (e.g. timber).
- If you live in a building that does not makes a positive contribution to the character and appearance of the conservation area, or you want to replace a modern window such a window in a recent extension, there may be scope to change the style or material. You will need to ensure the new windows would not detract from the appearance of the building or the character of the area. They should be appropriately designed and of good quality.

Further technical details can be found in sections 3.6, 3.7 and 7.3 of the Council's Guide to Repairing and Upgrading Windows in Listed Buildings and Conservation Areas.

Windows in Listed Buildings

There is a range of good options available for improving windows in listed buildings. If you live in a listed building, you must choose solutions that will preserve or enhance the building, its features, and its special interest.

Windows that contribute to special interest

Most windows in listed buildings are of heritage interest and make an important contribution to the significance of the building.

- This includes any windows that are part of the original building. It often also includes windows that were added as part of a later addition or alteration to the building.
- This includes windows where the glazing and/or frame have been partially or completely replaced in the past if the replacement work is in keeping with the original style.

Please refer to sections 4.1 and 4.2 of Islington's Guide to Repairing and Upgrading Windows in Listed Buildings and Conservation Areas for more detailed guidance on assessing the significance of windows in listed buildings.

Windows that contribute to special interest should usually be retained. We recommend overhauling and carrying out repairs to these windows where required. Refer to section 3.1 of Islington's Guide to Repairing and Upgrading Windows in Listed Buildings and Conservation Areas for guidance on repairing windows.

- Retained windows can usually be upgraded to improve thermal performance by draught proofing, restoring or reinstating shutters, and/or installing secondary glazing. If there is no surviving historic glass it is often possible to replace glass in existing frames with thermally efficient glass or with slimline double-glazed units. Please refer to sections 3.2, 3.3 and 3.4 of Islington's Guide to Repairing and Upgrading Windows in Listed Buildings and Conservation Areas for detailed guidance.
- Replacing the window with an accurate replica will usually be acceptable if the window is beyond reasonable repair or if the window has already been replaced in its entirety with an accurate replica since the building was listed. It is usually possible to incorporate slimline double-glazed units in the replica window to improve thermal performance. Please refer to section 3.5 of Islington's Guide to Repairing and Upgrading Windows in Listed Buildings and Conservation Areas for detailed guidance.
- If a window has been inappropriately replaced or altered in the past in a way that detracts from the significance of the building (e.g. UPVC has been installed), it will usually be acceptable to replace it with a well-designed double-glazed windows that more closely replicates the original design and appearance. Please refer to section 3.6 of Islington's Guide to Repairing and Upgrading Windows in Listed Buildings and Conservation Areas for detailed guidance.

Windows that don't contribute to special interest

New windows that have been added to a listed building more recently do not usually contribute to the special interest of the building. This includes:

- Windows that are part of a recent extension
- Modern rooflights that have been inserted into the roof
- Non-historic patio doors

Windows that don't contribute to special interest can usually be replaced with double glazed units subject to detailed design considerations. Please refer to sections 3.6 and 3.7 of Islington's Guide to Repairing and Upgrading Windows in Listed Buildings and Conservation Areas for detailed guidance."

Trickle vents

At a glance

Ventilation Impact: Medium

Cost: Professional – Medium-low

Disruption: Low

DIY: No

Planning permission: (Retrofit) is not required, but when retrofitting vents, these should be carefully designed and located to minimise their visual impact.
(New windows) permission is not required for single household homes outside of Conservation Areas that are not Listed Buildings. Vents on new windows should be incorporated within the design of the framing.

Trickle vents are a popular strategy to deliver the ventilation requirements of updated Building Regulations (Part F).

Listed Building Consent: Visible trickle vents should be avoided in Conservation Areas and for Listed Buildings.

How do they work?

Trickle vents are small vents that allow a constant flow of fresh air to enter the building, allowing moisture to escape.

When open, they allow a flow of fresh air into a building, which can help with:

- Air quality: Reduces airborne toxins
- Condensation: Helps reduce condensation on windows and walls
- Temperature: Regulates indoor temperature
- Energy efficiency: Helps support energy efficiency
- Security: Allows you to ventilate a room without leaving the window open.

Trickle vents can be retrofitted to existing windows, and they might be appropriate if your room suffers from condensation.

They can be

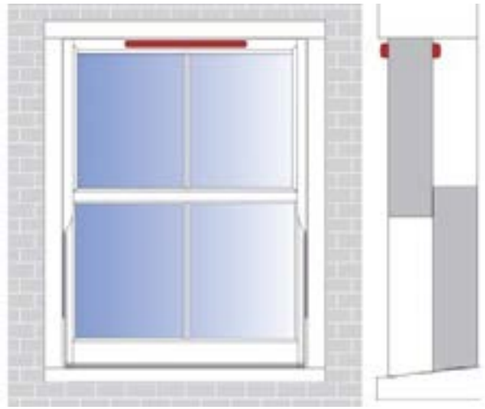
- fitted through the window frame itself or the opening sash;
- located on a separate frame attached to the top of the window;
- mounted at the top of glass units;

Considerations

Trickle vents only provide effective ventilation when they are kept open.

New models are available that:

- sense when the amount of humidity requires the system to open. These systems are called demand controlled systems, or hygro-controlled systems.
- come with soundproofing as standard. Models reduce noise from entering your home more effectively than previous designs.



Window shutters

At a glance

Energy Impact: Medium-low

Cost: Medium-low per window

Disruption: Medium

DIY: No

Planning permission: is not required

Listed Building Consent: Listed Building Consent is required.

This measure is likely to be acceptable if its design is sensitive to significant elements of the building's listing.

See Islington's Guide to Repairing and Upgrading Windows in Listed Buildings and Conservation Areas for detailed information about window repair and replacement.

How does it work?

Using or reinstating shutters in homes where they have been removed will improve energy efficiency and acoustic attenuation. When the shutter panels are closed, they can reduce heat loss through a window by more than 50%.

Considerations

Releasing existing shutters may require the services of a suitably experienced and qualified professional depending on their condition and the ease of releasing them.

Shutters can conflict with secondary glazing. Some secondary glazing products can be mounted on the interior of the staff bead and are therefore compatible with traditional shutters.

Embodied Carbon should be considered when selecting what type of material your shutters will be made from. Wooden shutters will always have a lower embodied carbon than plastic.

External shading and window awnings

At a glance

Energy Impact: Low

Cost: Medium-low per awning

Disruption: Low

DIY: No

Permitted Development: for single household properties that have not been converted to flats **and** are outside of a Conservation Area **and** not on front elevations.

Planning Permission: is required on front elevations, for flats, for houses of multiple occupation and properties within a Conservation Area.

This measure will usually be acceptable if designed in accordance with the guidance below.

Listed Building Consent: Listed Building Consent is required.

We recommend seeking advice via the Council's free pre-application advice service for retrofit proposals.

See Islington's Guide to Repairing and Upgrading Windows in Listed Buildings and Conservation Areas for detailed information about window repair and replacement.

How does it work?

External canvas awnings can be installed on windows to provide shade if overheating is a problem. They reduce the need for active cooling, creating energy savings and result in greater thermal comfort during hot weather.

Considerations

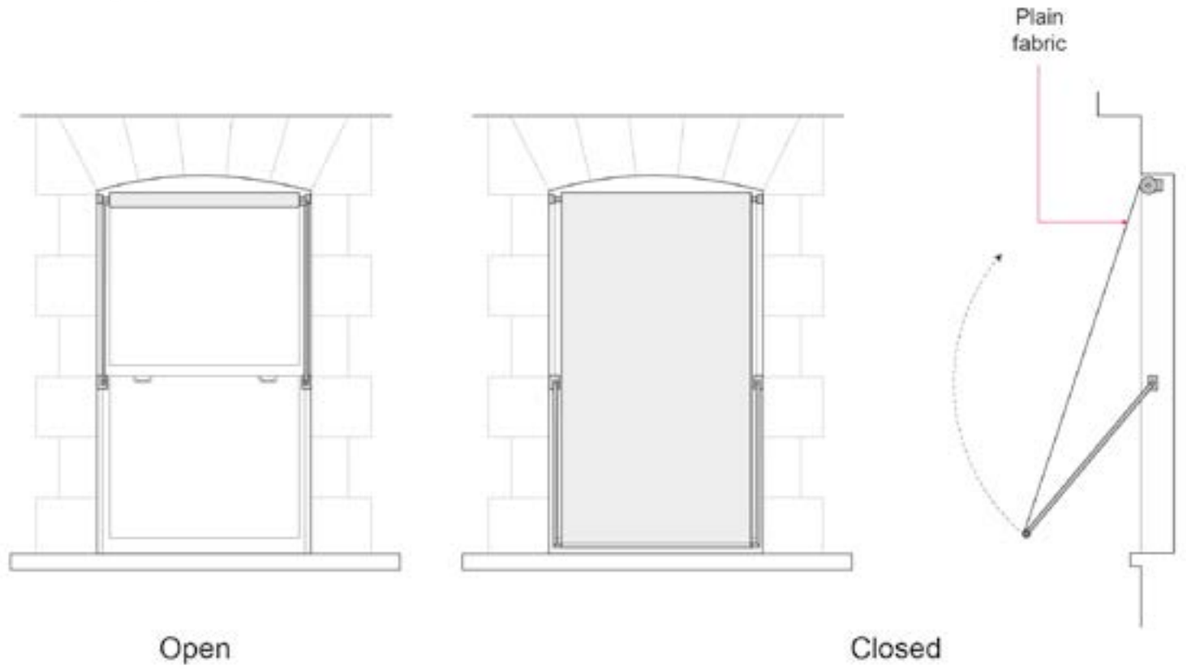
Shading should be prioritised on south or west facing windows. It should be angled when in use so that it doesn't prevent airflow when the window is open.

Lighter colours of material will reflect the heat of the sun away from property more effectively.

A broad variety of shading is available to suit different building types.

Design Guidance for Conservation Areas

1. Awnings should be fully retractable and should fit inside the window reveal. Any cables or boxes for automated mechanisms should not be visible.
2. The fabric should be plain and should be a light neutral colour. Metal elements should have a paint or powder coated finish to match.
3. The awning should be angled when in the 'down' position so that it doesn't prevent airflow when the window is open.



Window replacement

At a glance

Energy Impact: Medium-high

Cost: Under £25,000

Disruption: Medium

DIY: No

Planning Permission: required for flats, houses of multiple occupation and properties in Conservation Areas. Please refer to the draft Climate Action SPD for guidance on acceptability of replacing windows in conservation areas.

Permitted Development:
Planning permission is not required for single household houses, provided materials are similar in appearance in terms of shape, colour, size and type to the existing. An application for certificate of lawfulness is encouraged for homes located within Conservation Areas.

Planning Permission Is required for flats, houses of multiple occupation and properties in Conservation Areas.

Listed Building Consent: Listed Building Consent is required. Windows which make a contribution to the significance of listed buildings should be retained. Where replacement is proposed Listed Building Consent is required and we recommend seeking advice via the Council's free pre-application advice service for retrofit proposals.

See Islington's Guide to Repairing and Upgrading Windows in Listed Buildings and Conservation Areas for detailed information about window repair and replacement.

How do they work?

Single glazed windows and older double-glazed units and surrounds contribute to significant air leakage in the home. New window installations are a key step in improving the overall air tightness of a home to reduce heat-loss and will improve thermal comfort and acoustic performance.

Ventilation

New windows will affect the air-tightness of your home. Ensure air-pathways remain open by installing and maintaining trickle vents and air-bricks.

Considerations

If a building has pre-1990 double-glazing, single glazing, or metal framed windows then replacement should be a priority.

It is very common to have reasonably well performing double glazing. This can be improved by checking and repairing existing double-glazing units.

An upgrade to triple glazing is only recommended as and when windows are due to be replaced, the cost is not dissimilar to new double glazing.

Embodied Carbon is important when deciding what material frames you will select. Find out the service-life of the replacement windows will be and aim to choose the option with lower embodied carbon. Ensure contractors will properly recycle old windows. See Appendix XX for further detail.

Secondary Glazing

At a glance

Energy Impact: Medium-high

Cost: Medium for both facades

Disruption: Medium

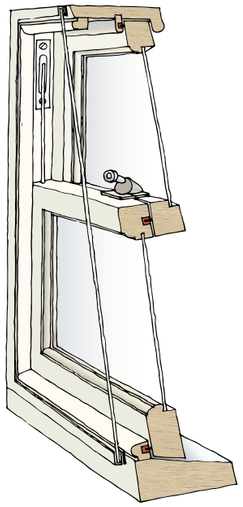
DIY: No

Planning Permission: is not required

Listed Building Consent: Listed Building Consent is required.

This measure is likely to be acceptable if its design is sensitive to significant elements of the building's listing.

See Islington's Guide to Repairing and Upgrading Windows in Listed Buildings and Conservation Areas for detailed information about window repair and replacement.



Photograph of secondary discreet glazing on metal frame window. Credit (Bath Preservation Trust)

How does it work?

Secondary glazing can reduce heat loss from heritage windows by at least 70% - but often the benefits are greater due to the leakiness of traditional windows. If measured and fitted correctly, and when combined with timber shutters and heavy curtains, the energy saved in cold weather can be as good as double glazing.

Ventilation

Some ventilation between the exterior and the air gap will limit the risk of condensation forming on the inner face of the primary window. It is often recommended that the primary window is not sealed or draught proofed and the secondary glazing is well sealed to prevent moisture entering the air gap. Secondary glazing will affect the air-tightness of your home. Ensure air-pathways remain open by installing and maintaining trickle vents and air-bricks. Contracting a suitably qualified professional to install it is critical.

Considerations

Lightweight metal frames are often the most suitable and least noticeable.

Some products can be mounted on the interior of the staff bead and are therefore compatible with traditional shutters.

Embodied Carbon

Secondary glazing is a less carbon intensive method of improving the performance of windows than replacement.

Door replacement

At a glance

Energy Impact: Medium

Cost: Medium

Disruption: Medium-low

DIY: No

Permitted Development: for single household properties that have not been converted to flats and are outside of a Conservation Area.

Planning Permission: is required for flats, houses of multiple occupation and properties within a Conservation Area where an Article 4 Direction is in place .

This measure will usually be acceptable if the proposal is designed to be a like for like replacement of the building's existing door.

Listed Building Consent: Listed Building Consent is required. Doors which make a contribution to the significance of listed buildings should be retained. Where replacement is proposed Listed Building Consent is required and we recommend seeking advice via the Council's free pre-application advice service for retrofit proposals.

How does it work?

Traditional doors often have large gaps around the cil and letter box entry, as well as being poorly insulated. Replacing doors to a higher standard will improve thermal performance of the home.

Ventilation

This measure should be considered alongside other façade measures to reduce air leakage pathways.

The installation of smart air-bricks may be suitable at the same time as door replacement as ventilation grilles are often located under door cills of older properties.

Considerations

If the door cannot be repaired, aim for triple glazing for transparent elements and two layers of draught and weather proofing. A Passivhaus-certified door will achieve the highest of standards.

Roof and Loft Insulation

At a glance

Energy Impact: High

Cost: Loft insulation Medium-low, Flat roof Medium-high

DIY: No

Disruption: Low for Loft, Medium for Flat Roof

Planning permission: not required

Listed Building Consent: not normally required for pitched or butterfly roofs but required for flat roofs. This measure is likely to be acceptable if its design is sensitive to significant elements of the building's listing.

See Historic England Advice Note 18 and Guidance on insulating flat roofs online.

How does it work?

A considerable proportion (35%) of heat is lost through the roof of an uninsulated home. Insulating the roof or loft minimises this heat loss.

Ventilation

There is a condensation risk so any work should be specified by a competent person, ideally with PAS 2035 accreditation. Care must be taken at the eaves to avoid weak spots in the insulation where heat can escape. A breathable insulation is preferable to prevent potential condensation issues.

Considerations

Flat roofs are insulated from above the structure (typically timber joists with a plywood deck), but this is only possible if the roof covering is removed. Therefore, a condition survey is a critical first step before deciding on an approach. Insulating from below and between is possible as a maintenance approach.

Pitched roofs usually have an insulation layer in the loft floor between and over the joists. If the pitched roof is also the ceiling of a warm room below like a room-in-the loft, then this element needs insulation. The roof construction should be assessed before deciding on an approach. Regardless of roofing material a ventilation space is required behind the covering. The roofing membrane must be vapour permeable.

Down-lighting to be insulated around the fixtures, otherwise can lead to significant heat-loss.

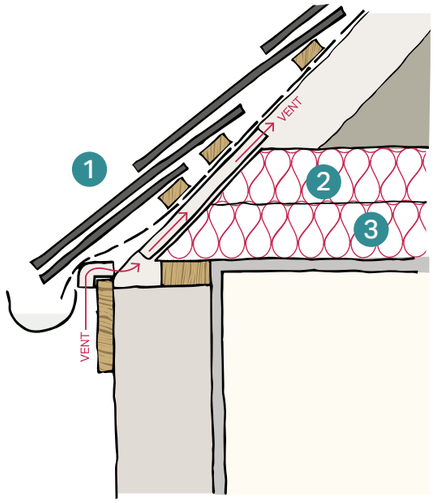
Ecology: Insulation can have an environmental impact on bats. Consider a bat safe insulation if you have seen bats nearby.

Embodied Carbon: Some synthetic insulation materials are very carbon intensive. Selecting naturally derived materials will reduce the impacts.

Loft insulation with insulated downlighter fittings

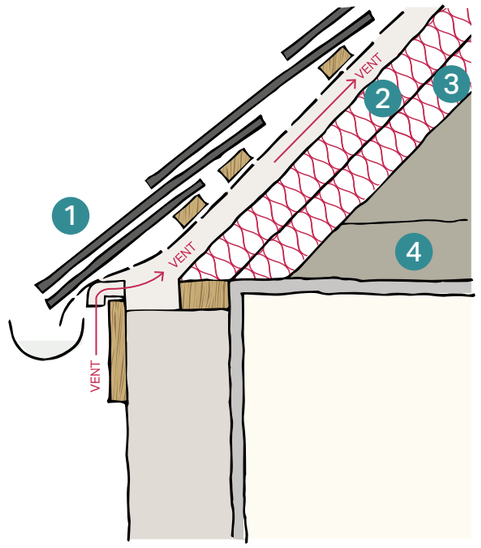
Technical considerations: Roof insultation at ceiling level

1. Some adjustments may be required to improve ventilation in the roof space above loft insulation.
2. Typically 270mm of insulation is required as a minimum at ceiling level and should be laid in alternate layers across and between the ceiling joists to avoid cold spots.
3. You should ensure your existing loft insulation is well fitted, to eliminate cold spots through which heat can pass. Care should be taken to adequately insulate tanks, pipes and other services in the roof. Also ensure that the loft access door is draught stripped and insulated.



Technical considerations: Roof insulation at rafter level

1. Some adjustments may be required to improve ventilation of the roof above the insulation. Vents, counter-battens and breathable underlays are basic measures which a builder or roofing contractor could fit.
2. Insulation is laid in alternate directions to eliminate heat loss through joints.
3. Typically, rigid insulation boards are laid between and beneath the rafters to achieve the required level of insulation. Compressible insulation types can be held in place with a net or breathable building membrane. With insulation at rafter level, the roof can remain useable and tanks, pipes may not need separate insulation.
4. Retaining existing insulation at ceiling level will reduce the heat from the home spent warming the roof space. This measure may require you to remove existing finishes.



Solid and timber floor insulation

At a glance

Energy Impact: Medium

Cost: Medium-high- not including consequential costs such as redecorating.

Disruption: High

DIY: No

Planning Permission: is not required.

Listed Building Consent: Listed Building Consent is required.

This measure is likely to be acceptable if its design is sensitive to significant elements of the building's listing.

See for Historic England Guidance

How does it work?

Homes could be losing approximately 10-20% of their heat through uninsulated suspended timber floors. Solid floors generally lose less heat than suspended floors, but there are still potential significant energy gains from insulating them.

Ventilation

There is a risk of creating condensation between layers of the building fabric or 'interstitial condensation'. This will occur if the solid floor insulation interferes with adequate building ventilation. Ensure the risk is assessed in advance and installation is undertaken by a suitably qualified professional who may advise using "vapour open" insulation in some cases.

This measure should be considered alongside sealing service penetrations to avoid thermal bridges.

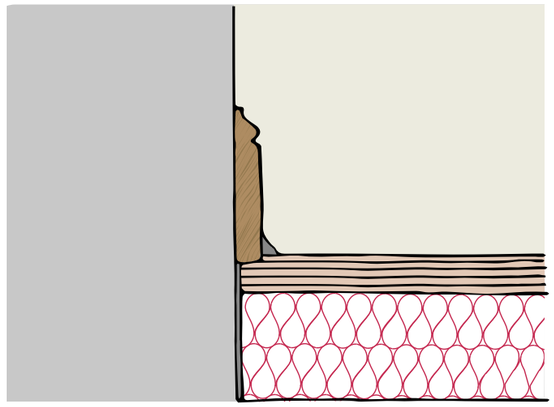
Considerations

Insulation is vital when underfloor heating is to be installed to ensure heat-loss doesn't occur.

If there is a small gap below the floor and work would cause excessive disturbance, then an alternative is for a remote-controlled robot to apply insulation from beneath

Embodied Carbon

Insulation materials can vary greatly in how much energy is required for their production. Natural materials like hemp, cellulose or wood-fibre board are suitable for insulating suspended timber floors. See Appendix 2. Further information on Embodied Carbon of... insulation for further details.



Internal wall insulation

At a glance

Energy Impact: High

Cost: High

Disruption: High

DIY: No

Planning Permission: is not required

Listed Building Consent: Listed Building Consent is required.

This measure is likely to be acceptable if design is sensitive to significant elements of the building's listing. See Historic England guidance for further details.

How does it work?

Internal wall insulation is a good choice for solid wall buildings where, for aesthetic or heritage reasons, it is not appropriate to insulate the outside walls. It is appropriate for incremental retrofits, doing one room at a time before redecorating. For most buildings, thermal performance of walls will be improved by around 35%.

Ventilation

Adequate ventilation is required, otherwise insulation is likely to cause condensation between the internal wall surface and the internal surface of the wall insulation and thermal bridging, especially at junctions between walls and floors. Appointing a suitably qualified expert is advised, (ideally PAS 2035 accredited).

Breathable paints and decorative treatments (including wallpaper) must also be used to ensure that moisture can continue to dissipate through the insultation. Cement-based insulating products are discouraged

Considerations

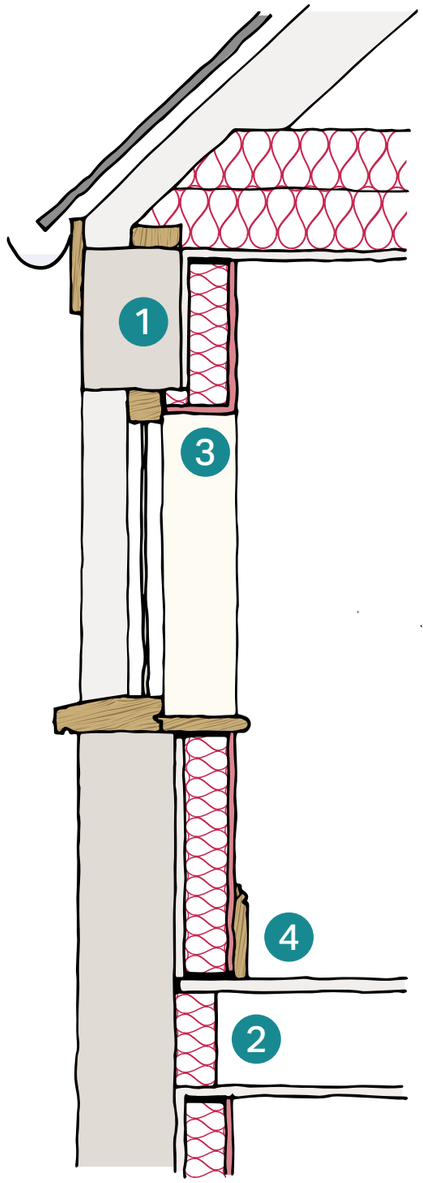
It is worth carrying out internal insulation when considering redecorating to minimise future disruption.

Insulation may require adjustment of skirting boards and redecoration

Embodied Carbon: Natural breathable insulants, such as hemp fibre, wool and cellulose are recommended.

Technical considerations:

1. Insulation should be carried over lintels and arranged to be contiguous with insulation at ground and roof level.
2. On terraced buildings insulation may be carried partly across the party walls to reduce the thermal bridging at the edges of the building.
3. Insulation should be carried into the floor voids to ensure continuity.
4. Decorative ceiling roses and plasterwork may need to be removed. This can be reinstated if desired unless your building is listed, when acceptability would need to be considered on a case-by-case basis.
5. Insulation should be carried into the reveals of windows and doors to ensure there are not cold spots where the wall is thinnest.



External wall insulation

At a glance

Energy Impact: High

Disruption: Medium

Cost: Medium-high

DIY: No

Permitted Development: for single household properties that have not been converted to flats and are outside of a Conservation Area, provided the materials used are of a similar appearance to the existing exterior. It is unlikely that an external insulation system will adequately match existing brick buildings. In this case, Planning Permission will be required.

Planning Permission: is required for flats, houses of multiple occupation, properties within a Conservation Area and buildings where the proposed external insulation system can't achieve a similar appearance to the existing exterior of the building (such as if it is proposed on brick).

- **Planning Applications are likely to be found acceptable if** they can demonstrate that the proposed system provides successful detailing around edges, window and door reveals, eaves, and rainwater goods and that the material and finish would be good quality and contextually appropriate
- **Planning Applications in Conservation Areas are likely to** be found acceptable if they can demonstrate, in addition to the above, that the existing building or façade does not make a positive contribution to the Conservation Area. Walls that already have a rendered finish such as those for rear extensions or new garden buildings may be suitable for this measure.

Listed Building Consent: Listed Building Consent is required. This measure is less likely to be acceptable. See Historic England guidance for further details

How does it work?

External wall insulation provides an opportunity for much improved thermal performance. For most buildings, an improvement of around 35% is possible. It is thicker than other kinds of wall insulation, and there is less risk from moisture. Insulating external walls will save energy and reduce heating bills considerably.

Ventilation

Adequate ventilation is still required, otherwise there is a condensation risk. Check existing air-flows and consider installing trickle vents, smart air-bricks and extract or ventilation systems. There is a risk of thermal bridging and cold spots, especially for window reveals, eaves and party walls if they haven't also been insulated.

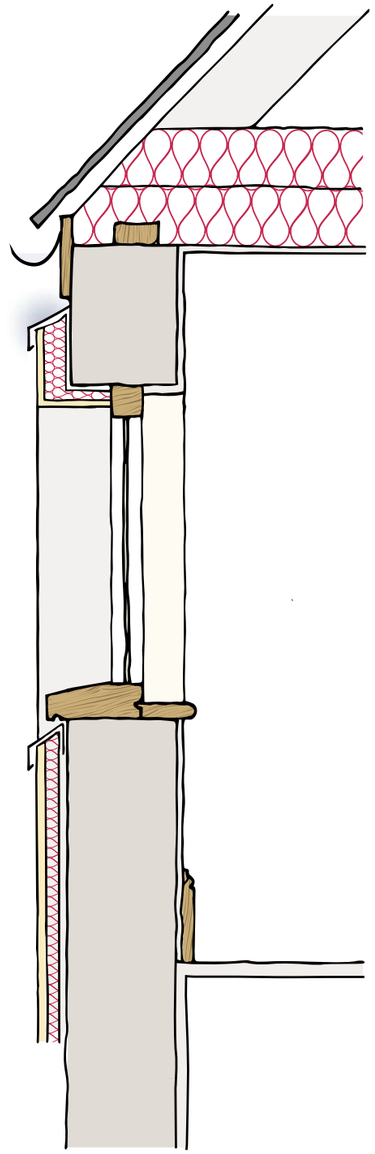
Appointing a suitably qualified expert is strongly encouraged, ideally, they should be PAS 2035 accredited.

Considerations

Changes to the fabric will be needed in order to accommodate the insulation such as roof extending, insulation capping and gutter and downpipe refitting

Embodied Carbon

Some insulation materials have a high embodied carbon value. Select lower intensity materials. See "Appendix 2. Further information on Embodied Carbon of..." for more on carbon impacts of insulation



Cavity wall insulation

At a glance

Energy Impact: Medium-high

Cost: Medium-high

Disruption: High

DIY: No

Planning Permission: is not required

Listed Building Consent: Listed Building Consent is required.

This measure is likely to be acceptable in cases where design does not harm significant elements of the building's listing. See Historic England Advice Note 18 for further details.

How does it work?

Homes built in between 1935-1970 may have featured cavity walls which were designed to avoid moisture penetration from the outside.

Cavity wall insulation utilises flowing insulation products, which are injected into the cavity between the inner and outer masonry layers of the wall. It is injected through a series of holes drilled outside the property and is a low disruption low-cost measure.

The effectiveness of the insulation will vary with the type of insulation chosen, size of cavity and proportion of wall to windows, roof. For most, an improvement in wall performance of around 35% will be possible.

Ventilation

Adequate ventilation is required, otherwise there is a condensation risk.

Appointing a suitably qualified expert is advised, (ideally PAS 2035 accredited).

Considerations

The success of cavity wall insulation can be hard to assess. Only thermal imaging can show areas where the filling material has settled. Ensure installers can provide a guarantee from CIGA (Cavity Insulation Guarantee Agency). If they are unable to do so, they should be avoided.

Highly exposed walls may not be suitable for cavity wall insulation.

In some homes the cavity may already be partially filled with an insulation board and top-up insulation can be difficult as the void can be narrow.

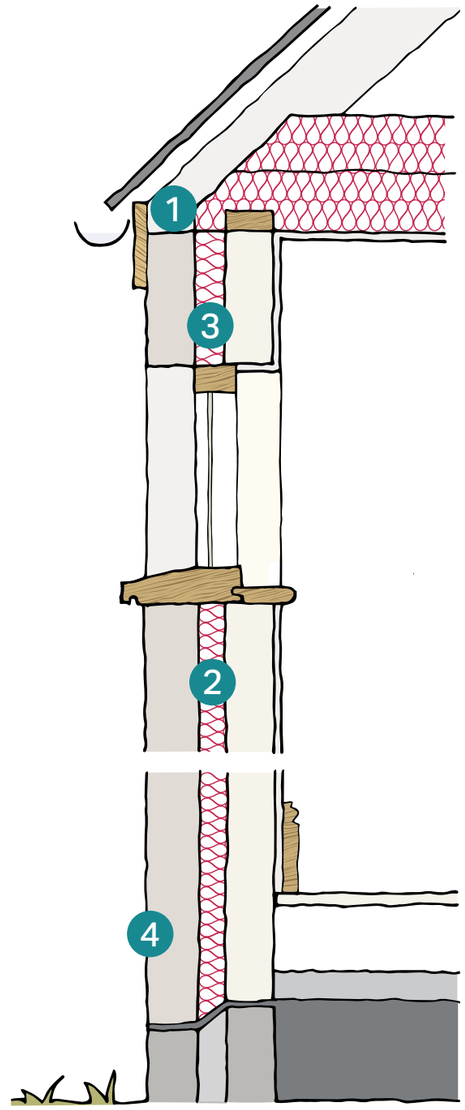
This insulation can be fitted without disruption, making it a suitable choice for many.

Embodied Carbon

Specify for low embodied carbon options where possible. See Appendix X for more on carbon impacts of insulation

Technical considerations

1. The edges of cavities at the roof and openings may need physical closers installed to ensure the insulation does not escape. The insulation should be weatherproof and water-repellent. Make sure to avoid sagging and slumping
2. Typically, fibre insulation or expanded polystyrene spheres are injected into the cavity through a series of entry holes drilled in the facade. The cavity is fully filled.
3. Some additional insulation measures may be needed around lintels, vents and other features which bridge the cavity.
4. Cavity wall insulation should be carried over the joints with other insulation measures at the head and foot of the wall, to ensure there are no cold spots on the exterior at the floor and roof.



Thermostatic radiator valves (TRVs), Smart thermostats and flow controls

At a glance

Energy Impact: Medium

Cost: Medium-low

Disruption: Low

DIY: Yes

Planning Permission: is not required

Listed Building Consent: Listed Building Consent not usually required. This measure is likely to be acceptable in cases where design does not harm significant elements of the building's listing.

How does it work?

TRV installation allows individual room to room radiator temperature control for more efficient temperature modulation, reducing unnecessary heating of vacant spaces.

SMART thermostats allow you to control your target temperatures and when your home heats to provide comfort when you need, and allow lower temperatures automatically when you are not home. They have been shown to save 10 - 20% on energy bills on average. In addition, boiler flow controllers are a relatively cheap and effective way of improving boiler efficiency.

Considerations

There is a large contrast in CO2 emissions between the high levels emitted by gas boilers and the very low levels from renewable sources, such as heat pumps.

Any upgrade to the boiler system should also have the circulating pipework insulated to reduce heat loss.

Homes often have a radically different heat loss rates in different rooms of the home. This means some rooms may require more heating from their radiator, for a longer time than other rooms in the home.

LED lighting

At a glance

Energy Impact: Medium-high

Cost: Medium-low

Disruption: Low

DIY: Yes

Planning Permission: is not required

Listed Building Consent: is not required

How does it work?

LED lighting uses 80% less energy than traditional bulbs, and 50% less than Halogen lighting. Significant energy savings can be achieved when applied to a whole home. Under current electricity prices payback can be less than 1 year.

Considerations

Costs account for modifications to enable dimming to the lighting system.

Solar panels

At a glance

Energy Impact: High

Cost: Medium-high

Disruption: Medium

DIY: No

How do they work?

Solar panels convert sunlight into electricity or heat. They have an immediate impact of supplying renewable energy and reducing energy bills.

Considerations

Solar panels work best when installed on south facing slopes but also work on west and east facing roofs, ideally at an angle of 30 degrees. Shallower angles and orientations away from south will reduce the efficiency of the array.

Solar panels generate peak power during the day when homeowners are not always consuming much electricity. Solar diverters offer a way to utilise this solar energy for hot water heating by redirecting it to an immersion heater in the hot water cylinder.

The roof of your building may require strengthening in places to accommodate panels.

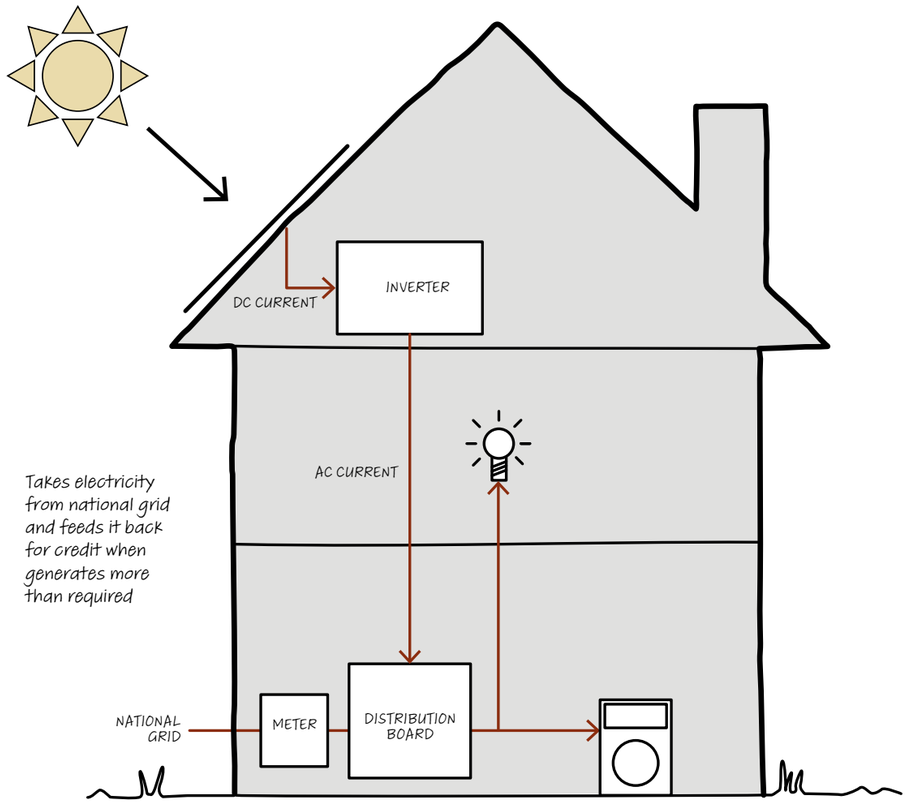
If panels are mounted at more than a 15 degree angle, they are mostly self-cleaning. They need to be inspected for cracks—we suggest doing this every other year.

Embodied Carbon

The lifetime of solar panels is 25-30 years. Their effectiveness reduces gradually. It is important to recycle spent panels, and various schemes exist that can recycle up to 95% of each panel.

Batteries can store power generated by solar panels locally when the energy supply is not needed offering additional resilience to the system. Batteries do have a significant embodied carbon value and this should be investigated before pursuing this option.

Solar tiles are an alternative option if solar panels are not possible to mount. However, they have a considerably shorter life than traditional materials such as slate. It is therefore usually best to add solar roof tiles when replacing elements of the existing roof that have come to the end of their natural life rather than removing sound roof coverings to accommodate them



Permitted Development, Planning Permission and Listed Building Requirements: Mounted Solar Panels

Permitted Development

Planning permission will not be required, except for Listed Buildings. Permitted Development is subject to the following conditions:

- The panel's effect on external appearance of the building and the amenity of the area must be minimised,
- Panels must be removed as soon as possible when no longer needed,
- The equipment must not exceed the limits described and illustrated in the GDPO limit section on this page.

This will usually mean installing solar panels to the rear of the property.

If panels must be installed on the front roof slope due to performance, their effect on external appearance and amenity of the area can be minimised using the following strategies, also illustrated in the "minimising solar panel's effect" diagram.

- Arrange panels regularly,
- Choose material and colour sympathetic to existing roof tiling,
- Install the conduit panel and servicing internally or to the rear so that it is not publicly visible.

Permitted Development: Houses and flats in Conservation Areas

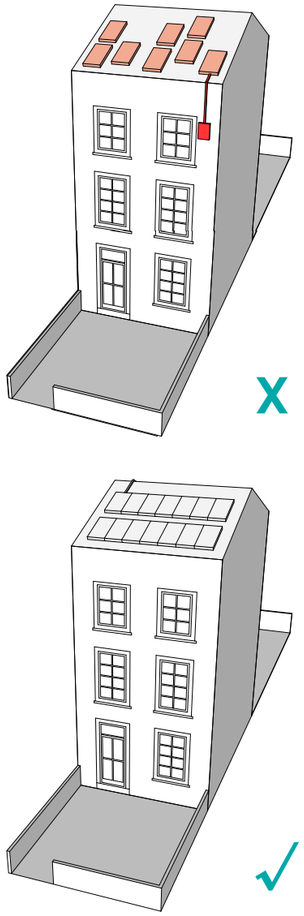
Where proposed panels would be visible in public views, Islington encourages an application for a "Certificate of Lawfulness" before installation to provide technical evidence that:

- no other location could support solar equipment due to the buildings' structural integrity and/or lack of adequate sunlight,
- the details and material of the solar equipment is sympathetic to the host building and its surrounding area,
- the impact of solar glare on neighbouring properties has been considered.

Planning Permission: Required for Listed Buildings

Listed Building Consent and Planning permission is required. This measure is likely to be acceptable if design does not harm significant elements of the building's listing. See Historic England guidance.

Minimising solar panel's effect on the building and the area



Permitted Development Limits

Butterfly Roof Slope

- The highest part of the equipment must not be more than 0.6m higher than the highest part of the roof (excluding any chimney),
- Solar equipment taller than 0.6m from the existing roof should be avoided.

Pitched Roof Slope

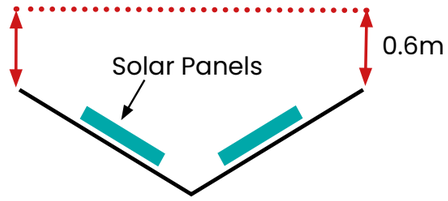
- Equipment must protrude no more than 0.2 metres beyond the plane of the roof slope (when measured from the perpendicular with the roof slope),
- The highest part of the equipment would not be higher than the highest part of the roof (excluding any chimney).

Flat Roof

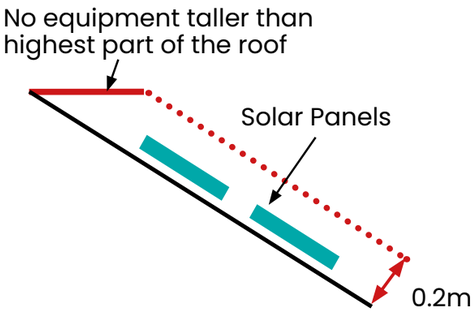
- The highest part of the equipment must not be more than 0.6m higher than the highest part of the roof (excluding any chimney).

More information is provided in the Islington Permitted Development Guide for Net Zero Works and the Climate Action SPD.

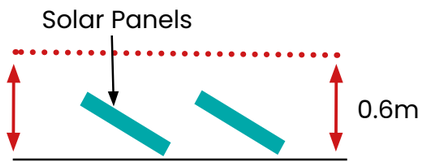
Butterfly Roof Slope



Pitched Roof Slope



Flat Roof



Air source heat pumps

At a glance

Energy Impact: High

Cost: Medium-high

Disruption: Medium

DIY: No

Planning Permission: is not required

Listed Building Consent: Listed Building Consent is required.

This measure is likely to be acceptable in cases where design does not harm significant elements of the building's listing. See Historic England Advice Note 18 for further details.

How does it work?

A heat pump works like a fridge in reverse; instead of cooling it is used for heating. Heat is produced by squeezing heat out of the air using refrigerants and a compressor. It uses some electricity, for each unit used it is possible to produce two-to-five units of useful heat.

Considerations

Fabric improvements made in parallel to heat pump specification can reduce your homes heat demand to ensure the most efficient heat pump operation to reduce energy bills.

You may need to increase the size of existing radiators because the temperature of a heat pump is lower than a gas boiler. An easy way to test if upgraded radiators are needed is to reduce your radiators to their lowest settings and leave them on for a long time. If you still feel warm on a cold day then your radiators are the correct size.

Internally, hot water cylinders are typically required. These are the size of a tall fridge freezer. Externally, an ASHP is the size of a large suitcase.

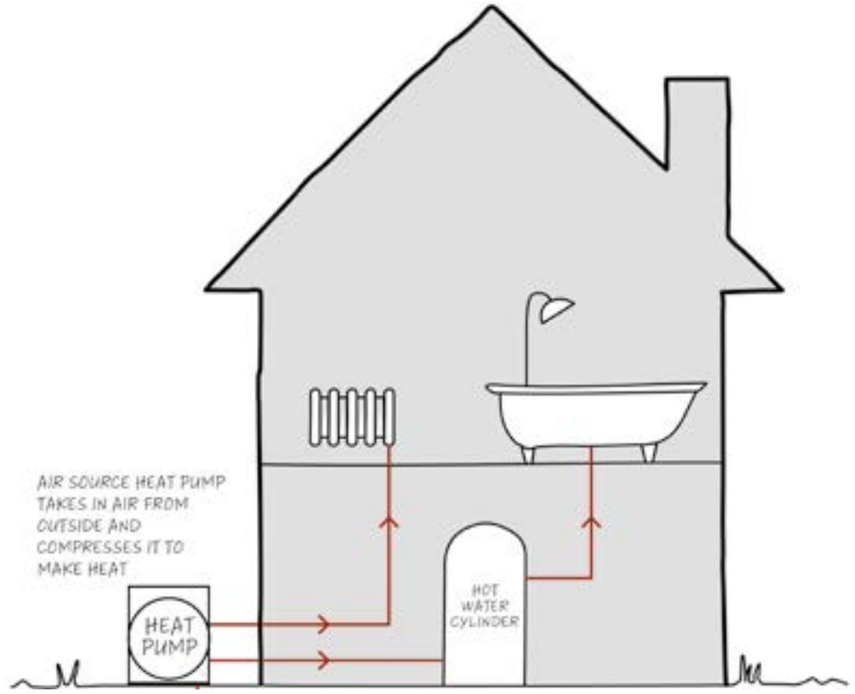
Well designed and installed ASHPs should not make much noise. They should not be installed under bedroom windows.

There are three types of air source heat pump; low-temperature air-water systems; high-temperature air-water systems; and air-conditioning (air-air) systems. These systems offer different benefits and their suitability will depend on your building's context.

A guide on installing air source heat pumps is included in the appendices.

Embodied Carbon

Air source heat pumps use refrigerants to capture heat from the air. Refrigerants are greenhouse gases that contribute to global warming. Choose heat pumps with lower Global Warming Potential refrigerants, maintain heat pumps carefully and dispose of them responsibly using refrigerant recycling schemes.



Air Source Heat Pumps: Permitted Development, Planning Permission and Listed Building Requirements:

Permitted Development outside of Conservation Areas

Planning permission will not be required, except for Listed Buildings. Permitted Development is subject to the following:

Criteria:

- The system must comply with MCS Planning Standards
- The development does not result in more than one ASHP on the building/block of flats or within building/block's curtilage.
- A wind turbine must not be installed on the property on the building/block of flats or within its curtilage.
- The volume of the external unit including housing is under 0.6m^3
- The unit is not to be installed:
  - within 1m of the property boundary
  - on a pitched roof
  - within 1m of the external edge of a flat roof
  - on a site designated as a scheduled monument or a Listed Building
  - on the wall of a building that fronts a highway
  - on any part of a wall fronting the highway above the ground floor storey.

Conditions:

- So far as practicable, the unit is sited to minimise effect on external appearance and amenity of area
- It must be for heating only
- It must be removed as soon as it is not needed
- The panel's effect on external appearance of the building and the amenity of the area must be minimised.
- Panels must be removed as soon as possible when no longer needed;
- The equipment must not exceed the limits described in the GDPO and illustrated below.

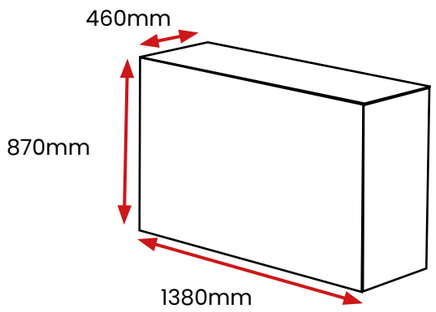


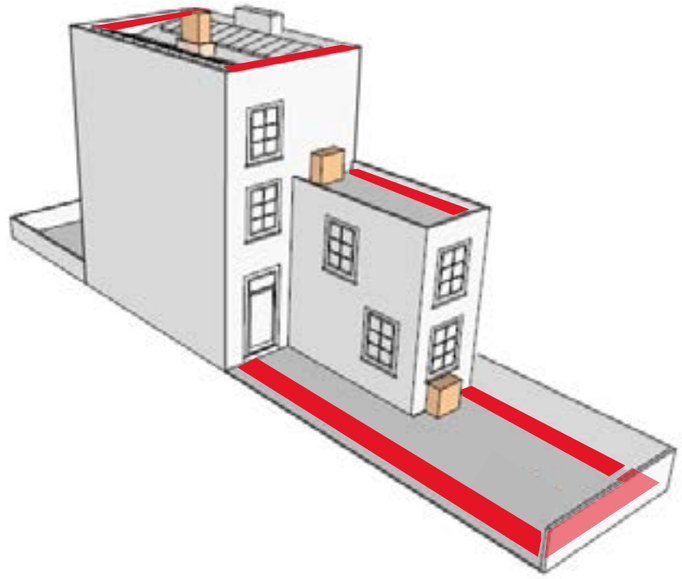
Illustration of a standard Air Source Heat Pump of no more than 0.6m3 that qualifies for permitted development.

Permitted Development inside of Conservation Areas

Air source heat pumps located in Conservation Areas must meet the following additional criteria. They must not be installed:

- on a wall or roof that front a highway, or
- so that the unit is closer to highway than the building, measured from the part of the building that is closest to the highway.

This means that in most cases air source heat pumps on the front of buildings in Conservation Areas will require Planning Permission.



Air Source Heat Pumps Planning Permission Guidance

If your proposal does not fulfil the criteria and conditions for Permitted Development, you will need to submit a planning application.

Planning applications for air source heat pumps will usually be acceptable if:

- the energy benefits to replace existing heating and hot water system are clearly set out within the application. Replacing the heating system on your home with an air source heat pump is the biggest contribution you can make to reducing carbon emissions short of being connected to a district heat network. See the Retrofit and Energy Chapters of the Climate Action SPD for more details.
- external units are located to the rear of a property or on a flat roof demonstrating that the unit(s) are not visible to the public
- if rear locations are not feasible, evidence should be presented to demonstrate this.
- Installation of units should avoid adverse impact to the amenity of nearby windows.
- The front garden might offer a suitable alternative location, but the unit and housing must be as discrete as possible in size and appearance and should relate sensitively to its context. Screening with planting should be explored for amenity and biodiversity benefits.
- Submit a noise and vibration assessment to comply with the requirements of Local Plan policy DH5 Part D (i and ii). See Retrofit Chapter of Climate Action SPD for more details.

Listed Buildings

Listed Building Consent and Planning permission is required. This measure is likely to be acceptable if design does not harm significant elements of the building's listing. This will need to be assessed on a case-by case basis. See Historic England guidance.

Technical Design Guidance

Some technical design guidance is provided below to support you to explore the most suitable locations for your air source heat pump.

- ensure it is not exposed to direct sunlight or other sources of heat
- the space around the unit must allow sufficient air circulation, and no obstructions should exist around the air intake and exhaust. There should be;
  - a minimum of 15cm rear clearance on wall mounted units
  - a minimum of 30cm rear clearance for ground mounted units
  - over 60cm from the front and sides of any obstruction
- minimise wind entering the air outlet
  - orientate the air outlet towards the nearest available wall, at a distance of 50cm
  - consider the installation of an air guide to prevent direct air flow into the outlet
  - position the unit so that the outlet air can blow at right angles to the seasonal wind direction, if possible.
  - Ensure snow does not block air intake

Ground source heat pumps

At a glance

Energy Impact: High

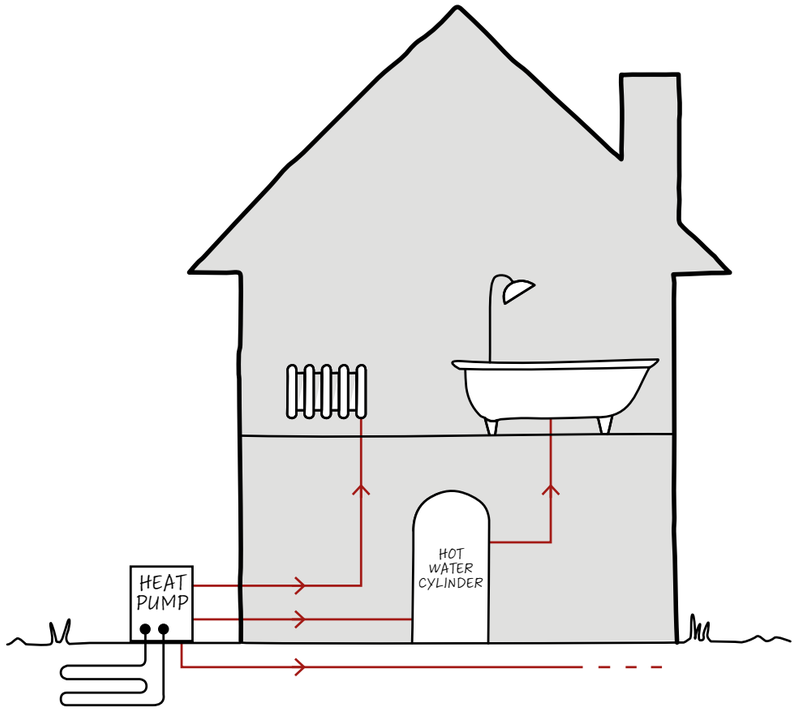
Cost: High

Disruption: Medium

DIY: No

Permitted Development: Yes, there are no conditions attached to this right.

Listed Building Consent: Listed Building Consent and Planning Permission is required. This measure is likely to be acceptable if design does not harm significant elements of the building's listing. This will need to be assessed on a case-by-case basis.



How do they work?

A ground source heat pump works like a fridge in reverse; instead of cooling it is used for heating, squeezing heat from the ground using refrigerants and a compressor. It uses some electricity.

Considerations

They are an alternative to conventional boilers, but operate at lower temperatures, so note that they can be unfeasible without insulation improvements or changes to heat emitters. They are not a direct alternative to combination boilers, as hot water storage must also be introduced.

Compared to Air Source Heat Pumps, Ground Source Heat Pumps potentially have lower maintenance and replacement costs, although the upfront cost tends to be higher.

There are two types of system, a ground loop system or a borehole. The ground loop system will require 30-40m long trenches or a borehole or 20cm wide and 75-200m deep which will require machinery access.

Ecology issues such as tree roots and any effect on the temperature of the soil should be checked by a professional prior to work commencing.

Embodied Carbon

Ground source heat pumps use refrigerants to capture heat from the ground. Refrigerants are greenhouse gases that contribute to global warming. Choose heat pumps with lower Global Warming Potential. Maintain ground source heat pumps carefully and dispose of them responsibly using refrigerant recycling schemes.

Extract and mechanical ventilation and heat recovery systems

Consents

Planning Permission: If external equipment is very small and is not visible from the surrounding streets it will not require Planning Permission, but if it is visible and will materially change the external appearance of the building Planning Permission will be required.

This measure is likely to be acceptable if the impact on the external appearance of the building is minimised. This means vents and extracts should be located on rear elevations.

Listed Building Consent: Listed Building Consent and Planning Permission will be required. This measure is likely to be acceptable if design does not harm significant elements of the building's listing. This will need to be assessed on a case-by case basis.

How do they work?

Ventilation plays a critical role within retrofit, especially where measures involve improvements to the air-tightness of the building like draught-proofing and insulation. As a minimum, homes need a ventilation system for kitchens and bathrooms due to moisture resulting from normal use. Installing systems in these rooms and across the house will maintain an internal environment that will benefit both occupants and building health.

Continuous extract systems

Energy Impact: Low

Cost: Low

Disruption: Medium

DIY: No

Continuous extract systems are usually located in kitchens and bathrooms. They do not have controls so are likely to use more energy than demand control systems with a less targeted approach.

Intermittent demand controlled extract systems

Energy Impact: Low

Cost: Low

Disruption: Medium

DIY: No

An intermittent demand controlled extract system is only engaged when required, typically via a humidity sensor, therefore reducing unnecessary energy consumption.

There are a variety of types of Intermittent extract system to choose from:

- Humidity sensor-based extract control from wet rooms.
- Kitchen extract adjusted for direct to outside extract.
- Demand controlled ventilation with trickle vents.

Considerations

- Carrying out redecoration of bathroom and kitchen spaces presents a good opportunity to upgrade existing extract systems.
- Minimise the appearance of external extractors by prioritising a location to the rear of the property and using grills that best match the appearance of the wall.
- These measures can be accompanied by trickle vents and air-bricks.

Mechanical ventilation and heat recovery (MVHR)

Energy Impact: Medium
Cost: Medium
Disruption: High
DIY: No

Energy efficiency

A whole house MVHR can recover approximately 90% of the wasted heat in a room, reducing a home's heating requirements by up to 25%.

MVHR provides automatic ventilation and recovers heat before exhaust air is released. Systems are designed to reduce moisture build up and ensure good air quality.

MVHR installation takes place via the loft space of the property so work should be coordinated with other fabric measures associated with this area of the home, such as specification of new loft insulation and general roof repairs

1. Extract is taken through 2 outlets: intake and exhaust. They can be discreetly located on the building, as close as possible to the fan unit to avoid heat loss.
2. Ductwork will be required to connect the various extract outlet and supply inlet locations to the MVHR plant. Some slimline systems are available which can fit inside partition and ceiling voids.
3. The MVHR plant can be installed in a concealed location such as a cupboard or roof space.

Cycle Storage

At a glance

Cost: Medium-low

Disruption: Low

DIY: Yes

Planning Permission: is required. Any structure used by vehicles over 1m in height next to a highway is not permitted development.

This measure is likely to be acceptable if it observes the design guidance below.

Listed Building Consent: may not be required. This measure is likely to be acceptable if its design does not harm significant elements of the building's listing. This will need to be assessed on a case-by case basis.

Why it's supported

Cycling is an important carbon-free mode of active travel. Providing convenient storage for cycles in the front garden is encouraged if it can encourage more cycling. Cycle storage in the front garden can avoid cycles from being stored inside the home or being taken through the home to the back garden.

Design guidance

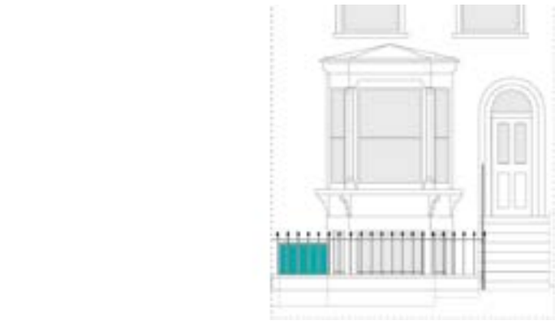
When not located in Conservation Areas, cycle storage:

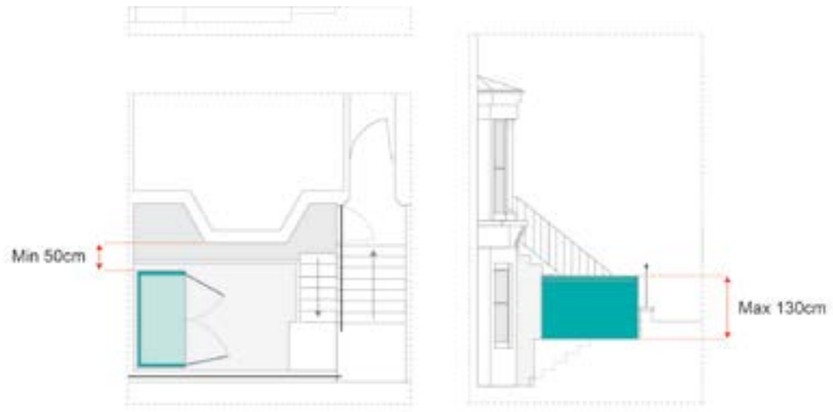
- can be installed in front gardens providing it is designed to be discrete in size and material (painted or treated timber or painted or powder-coated metal). Containers of 2-3 cycles are likely to be acceptable.
- can be up to about 140cm in height, or 150cm inclusive of a green or sedum roof.
- Where possible, be positioned against the side boundary on the opposite side of the front door. If this is demonstrated to not be possible, a container can be in line with the front boundary.
- Space between the front façade and the cycle storage should be maintained when possible. About 50cm is likely to be sufficient.
- Where there is not enough space to store all bikes, additional storage can be provided in rear gardens or residents can make use of shared cycle hangers located in the street. Request space in a hangar here.

Cycle Storage in Conservation Areas

When located in Conservation Areas cycle storage should be designed according to the guidance above with the following differences:

- Can be up to about 130cm in height or 140cm if it has a green/ sedum roof
- Containers in line with the front boundary should maintain a gap between the container and the front wall (About 1 metre is usually sufficient).





Off-street electric vehicle charging points

At a glance

Energy impact: High

Cost: Medium-low

Disruption: Low

DIY: No

Permitted Development: Yes, only for areas of off-street parking. The General Permitted Development Order (GDPO) it allows electric vehicle charging points to be installed, altered or replaced in areas of off-street parking if:

- they are not within 2 metres of the highway;
- 'upstands' (i.e. bollards) do not exceed 2.3 metres in height,9 or 0.2 cubic metres if wall-mounted;
- they are not within a site designated such as a scheduled monument, or within the curtilage of a Listed Building;
- there is not more than one upstand for each parking space.

Planning Permission: is required in situations not covered by the GDPO described above. This measure is likely to be acceptable if it is located and designed discretely.

In Conservation Areas: off-street electric vehicle charging points are likely to be acceptable if they preserve or enhance the character and appearance of the Conservation Area.

Listed Building Consent is required if the setting of the Listed Building is impacted. This measure is likely to be acceptable if its design does not harm significant elements of the building's listing. This will need to be assessed on a case-by case basis.

While Islington's Local Plan prioritises car-free development, in situations where off-street parking already exists, or when parking is considered acceptable, electric vehicle charging points should be provided to reduce carbon emissions associated with vehicles powered by fossil fuels.

Rainwater harvesting system

At a glance

Cost: Medium

Disruption: Medium

DIY: No

Planning Permission: is not required.

Listed Building Consent is not usually required. This measure is likely to be acceptable if its design does not harm significant elements of the building's listing. This will need to be assessed on a case-by case basis.

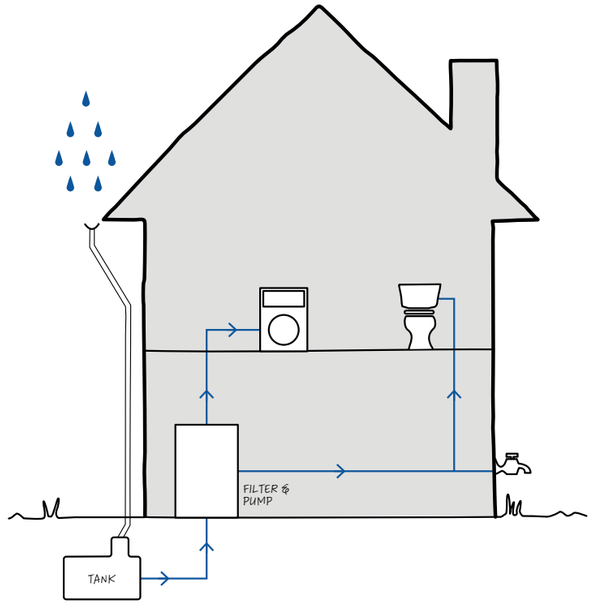
How does it work?

Rainwater harvesting is the collection of rainwater from roofs or hard-standings for use for toilet flushing, laundry water supply or irrigation. Household rainwater systems reduce demand on drinking water supplies and decrease pressure on storm-water drains and sewers.

Consideration

Rainwater harvesting systems are easier to fit when you are doing significant renovation as it will require changes to the plumbing system and potentially digging for a water tank if stored underground.

Rainwater collected can be stored and used for garden use, car washing, WC flushing and washing machine use. Industrial pollution, contamination from bird droppings and other dirt means that rainwater is rarely used for other uses.



Water butts

At a glance

Cost: Low

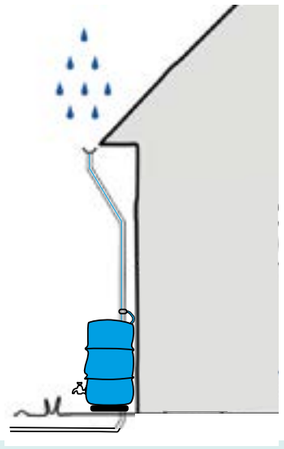
Disruption: Low

DIY: Yes

Planning Permission and Listed Building Consent are not required

How do they work?

Water butts are a simple, cheaper DIY option to capture and collect rainwater. Rain from the gutters is diverted to the water butt and can be used for garden irrigation. They reduce demand on drinking water and decrease pressure on storm-water drains and sewers.



Greywater recycling system

At a glance

Cost: Medium-low

Disruption: Medium

DIY: No

Planning Permission: is not required.

Listed Building Consent is not usually required. This measure is likely to be acceptable if its design does not harm significant elements of the building's listing. This will need to be assessed on a case-by case basis.

How does it work?

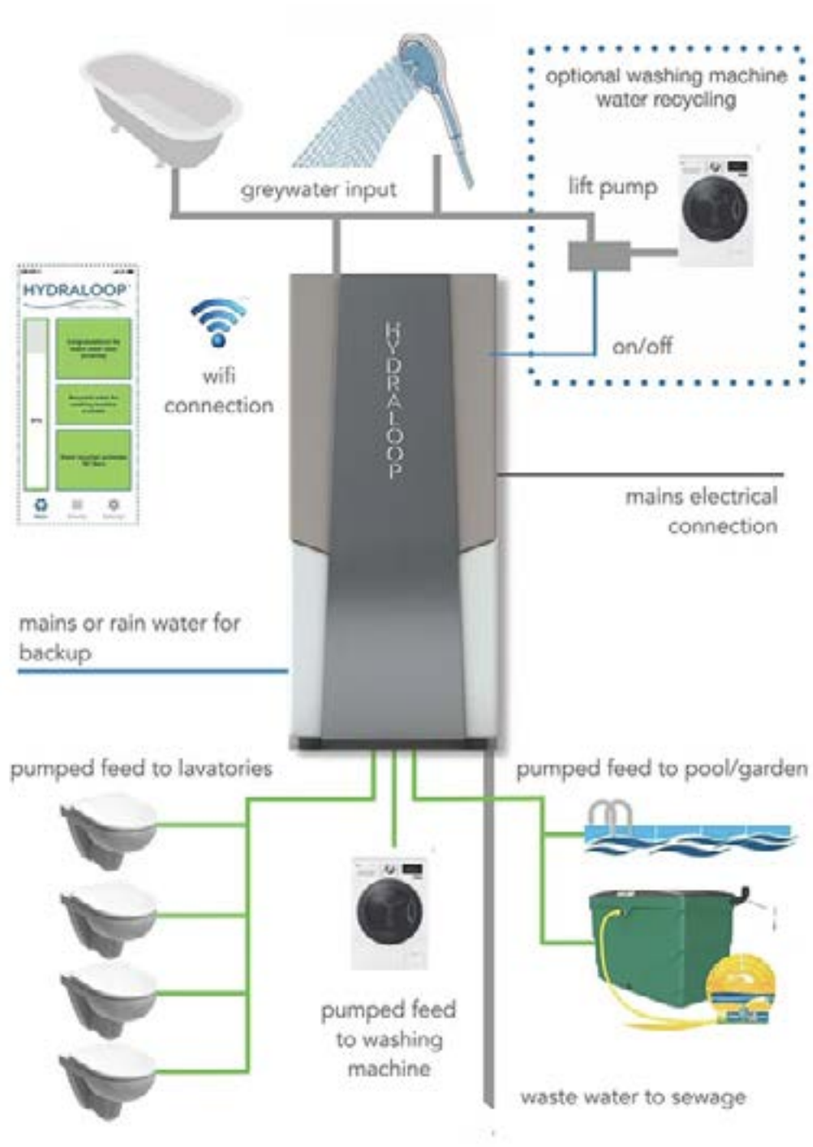
Greywater is water that originated from the mains but has been used for bathing or laundry. About two thirds of domestic waste water is greywater. This water can be diverted to a tank to be treated and then reused for irrigating plants. This saves mains water and reduces pressure on drains and sewers.

Consideration

Water quality and contamination should be properly considered. Tanks are available that include settlement tanks and filtration. Tanks will need maintenance to ensure filtration methods are working well.

Greywater should not be applied to crops that will be eaten uncooked.

More guidance is available from the Freeflush Water Management, Water Regulation Advisory Scheme and Building Regulations Part H.



Green roofs

At a glance

Cost: DIY Medium-low; Professional Medium-high

Disruption: Low Medium

DIY: Yes

Planning Permission: not required on sheds, bin stores and cycle storage. Planning Permission is required on residential buildings and extensions. Local Plan Policy G5 requires proposals involving the extension of existing buildings to seek to retrofit extensive green roofs on existing roof areas where feasible, in addition to providing green roofs on the extension. Part B (i-iv) requires specific design features of the green roof to be delivered

Listed Building Consent is required. This measure is likely to be acceptable if its design does not harm significant elements of the building's listing. This will need to be assessed on a case-by case basis

How do they work?

Green roofs provide cooling, biodiversity and drainage benefits and are well worth considering within retrofit projects.

An impermeable layer is laid on a roof, followed by a layer of growing medium and then species of low-maintenance, drought resistant plants are planted on the layers (see SPD for a green roof species list).

Consideration

Green roofs work best on flat roofs but can handle slight gradients.

If you are installing solar panels, investigate whether you can introduce a green roof at the same time; a "bio-solar roof" (Local Plan Policy G5 Part D).

A key consideration is to ensure that the existing roof structurally capable of supporting the increased weight of a green roof, which are much heavier than standard roofs.

If your property's main structure cannot handle a green roof, consider one for a bin or cycle store.

Image credit: @MelissaJolly

Design Guidance for Conservation Areas

When planning a green roof on an extension on a Listed Building or in a conservation area, ensure the design respects the historical and architectural significance, uses sympathetic materials, and maintains structural integrity. Consider the visual impact and compatibility with the surrounding environment, emphasising sustainability benefits like improved insulation and biodiversity. By considering these factors, a green roof on an extension can respect and enhance the heritage value of both Listed Buildings and buildings in conservation areas.

Bird and bat boxes

At a glance

Cost: Low

Disruption: Low

DIY: Yes

Planning Permission: not required. There is a planning permission requirement for works to buildings on the first storey and above, or where trees are located on site, should include bird and bat bricks or boxes.

Listed Building Consent: may not be required. This measure is likely to be acceptable if its design does not harm significant elements of the building's listing. This will need to be assessed on a case-by case basis.

How do they work?

Bird and bat boxes are great ways to provide habitats for birds and bats to roost and nest. Islington is home to many types of birds and bats, including some endangered species. Nest boxes placed in gardens can make a difference to the success or failure of a breeding species in an area.

DIY or Buy?

You can purchase bird and bat boxes, or you can have a go at making them.

Make a swift box

Explore buying or making a bat box

Make a bird box

Swift using integrated swift brick, Image credit: Wienerberger and Ecosurv Ltd | Ecological Consultant),

Bird Boxes/Bricks

There are a variety of different types of bird boxes or bricks available.

Islington especially recommends integrated swift bricks and boxes to install on buildings, as they can accommodate swifts, starlings and sparrows.

Bricks or boxes should always be provided in multiples as swifts (and sparrows) nest in colonies.

Bricks or boxes should be provided with a drop in height immediately below them.

The Universal Swift Nest Brick model is favoured, Integrated bricks are the preferred approach for buildings for thermal stability

For more information on swifts, visit the Swift Conservation's website.

If there is a tree in your garden, hole nesting boxes are also a great option to hang as they accommodate blue tits and great tits.

Bat Boxes/Bricks

Bat boxes provide crevices for bats to roost.

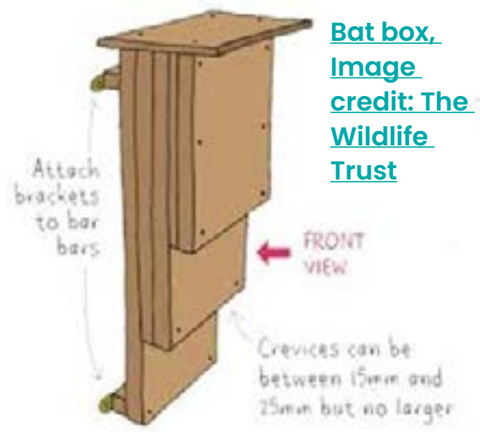
Bat boxes should be placed close together but facing different aspects so bats can move around according to environmental conditions.

They should be located where they will receive full or partial sunlight.

They should be located a minimum of 2m above ground although 5-7m is better.

Bat bricks/boxes should be located well away from artificial light sources.

See The London Bat Group website for more details on bats in London



Bat box, Image credit: The Wildlife Trust

Wildlife ponds

At a glance

Cost: Low

Disruption: Low Medium

DIY: Yes

Planning Permission: is not required

Listed Building Consent may not be required. This measure is likely to be acceptable if its design does not harm significant elements of the building's listing. This will need to be assessed on a case-by case basis.

What are the benefits?

Providing a body of water, even a tiny pond, within your garden is one of the best things you can to do to encourage biodiversity locally. You might be surprised how quickly species will arrive.

Consideration

In order to install a successful pond;

- locate it in a spot with some sunlight and avoid areas with leaf fall;
- fill it with rain water (tap water is chemically treated which is less welcoming to organisms which will affect its biodiversity value).
- it should have sloping slides to welcome amphibians.
- It should support plant life, preferably native plants.
- installation must prioritise safety within proposals especially if you have children or they visit your garden.

See Fresh Water Habitats website and the Wildlife Trusts' "How to build a pond" for more details.

Image Credit: IDVERDE Bromley

Compost heaps

At a glance

Cost: Low

Disruption: Low

DIY: Yes

Planning Permission: is not required

Listed Building Consent may not be required. This measure is likely to be acceptable if its design does not harm significant elements of the building's listing. This will need to be assessed on a case-by case basis.

What are the benefits?

Compost heaps make habitats for woodlice, worms, toads and grass snakes. compost heaps and wildflower meadows help you to turn food waste from kitchen into compost that will enrich your garden soil. This will in turn support biodiversity and soil structure to help it to retain carbon and water, and to help you to grow healthy plants.

Consideration

In order to establish a healthy compost heap you should:

Locate it in a spot that receives some sun (but not too much)

Add a mix of 1 part green to 2 parts brown materials.

- Green materials include grass clippings, weeds and uncooked vegetable peelings
- Brown includes sticks, dried grass, wood chippings, shredded paper and cardboard. This is generally drier.

If you shred material up finely, it will compost more quickly.

Including cooked food on your compost heap might attract unwanted rodent visitors. If you avoid including bread, rice and leftovers the risk is reduced.

For more details

Visit Wrap's website on home composting.

Octopus Community Network developed a useful video about composting and the development of three Composting Hubs in Islington as part of their Urban Soil Food project.

Photographs of composting
Credit: Octopus Community Network

Mini wildflower meadow or wildlife patch

At a glance

Cost: Low

Disruption: Low

DIY: Yes

Planning Permission: is not required

Listed Building Consent is not required.

What are the benefits?

Wildflowers provide pollen and habitats that are important for insects. Growing wildflowers in small garden areas or even letting your grass grow taller still makes a difference!

Consideration

If you already have grass in your garden, leaving parts of it to grow long is an easy first step.

If you'd like to establish a meadow;

- wait until Autumn or Spring,
- pick a patch of garden that hasn't been cultivated recently,
- choose and buy some seeds that are suitable for your soil type and how much sun the patch will receive;
- dig and rotate the topsoil to 15-20cm to bury vegetation
- sow the seed evenly, rake it in and water thoroughly.

For more details

Visit The Wildlife Trusts website on How to grow a wild patch or mini meadow.

4. Common Home Types

The objective of this chapter is to set out the different ways that residents can go about their retrofit journey in differing types of buildings in Islington.

This information is derived from a study conducted by Bioregional which used PAS 2035 and Passivhaus certified professionals and expert cost modellers, to provide an accurate appraisal of the costs, risks and technical challenges of retrofitting the diverse housing within Islington. Cost modelling was conducted in Autumn 2023 and has not been adjusted for inflation. Further technical information is available in the appendices.

Model Homes

An initial survey of the borough identified four types of model home across the borough:

Georgian Home

Early 20th century Home

Victorian Home

Mid-20th century Home

Information on each typology is organised and presented according to the following :

Within the Handbook

1. Description of key features of each model home and how it performs before any retrofit,
2. Retrofit goals (summarising the model home's performance against the Evaluation Framework),
3. Summary of three Retrofit Journeys suited to the model homes at various budgets.

Within the Appendices

- The Evaluation Framework that informed the study and selection of measures
- The application of the Evaluation Framework for each model home
- Retrofit Journeys in detail
- Measures summaries?

Key to costs and emissions scales

The cost and performance of each retrofit journey has been simplified into comparative scales. For more detail, please see the Summary of the Bioregional report.

Key for costs and emissions	**Upfront costs**	**Running costs**	**Emissions generated**
Low	£0 - £1,500	£750 - £1,000	0 – 500
Medium-low	£1,501 - £5,000	£1,001- £1,250	501 – 1,800
Medium	£5,001 - £30,000	£1,250 - £1,499	1,801 – 4,400
Medium-high	£30,001 - £65,000	£1,500 - £1,749	4,401 - 5,700
High	£65,000 - £150,000	£1,750 - £2,000	5,701 - 7,000

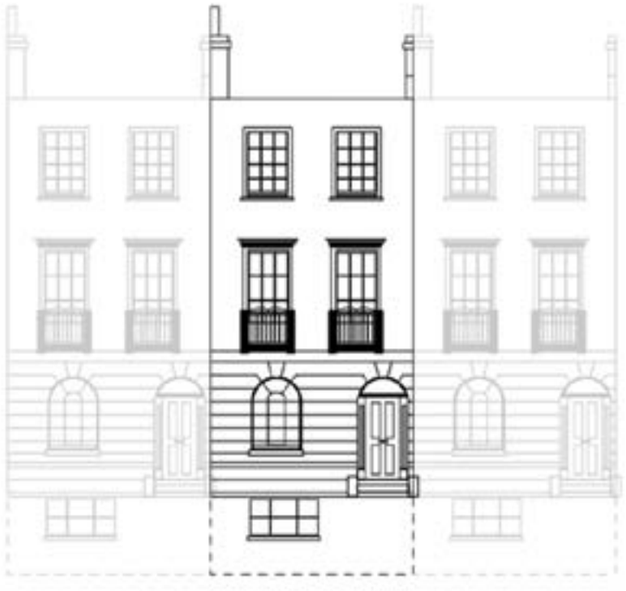
These models aim to demonstrate the variety of options that are available for different types of home. The retrofit journeys provide a starting point to support your future retrofit journey. Every building is different so these journeys should not be used as the sole basis of your retrofitting plan.

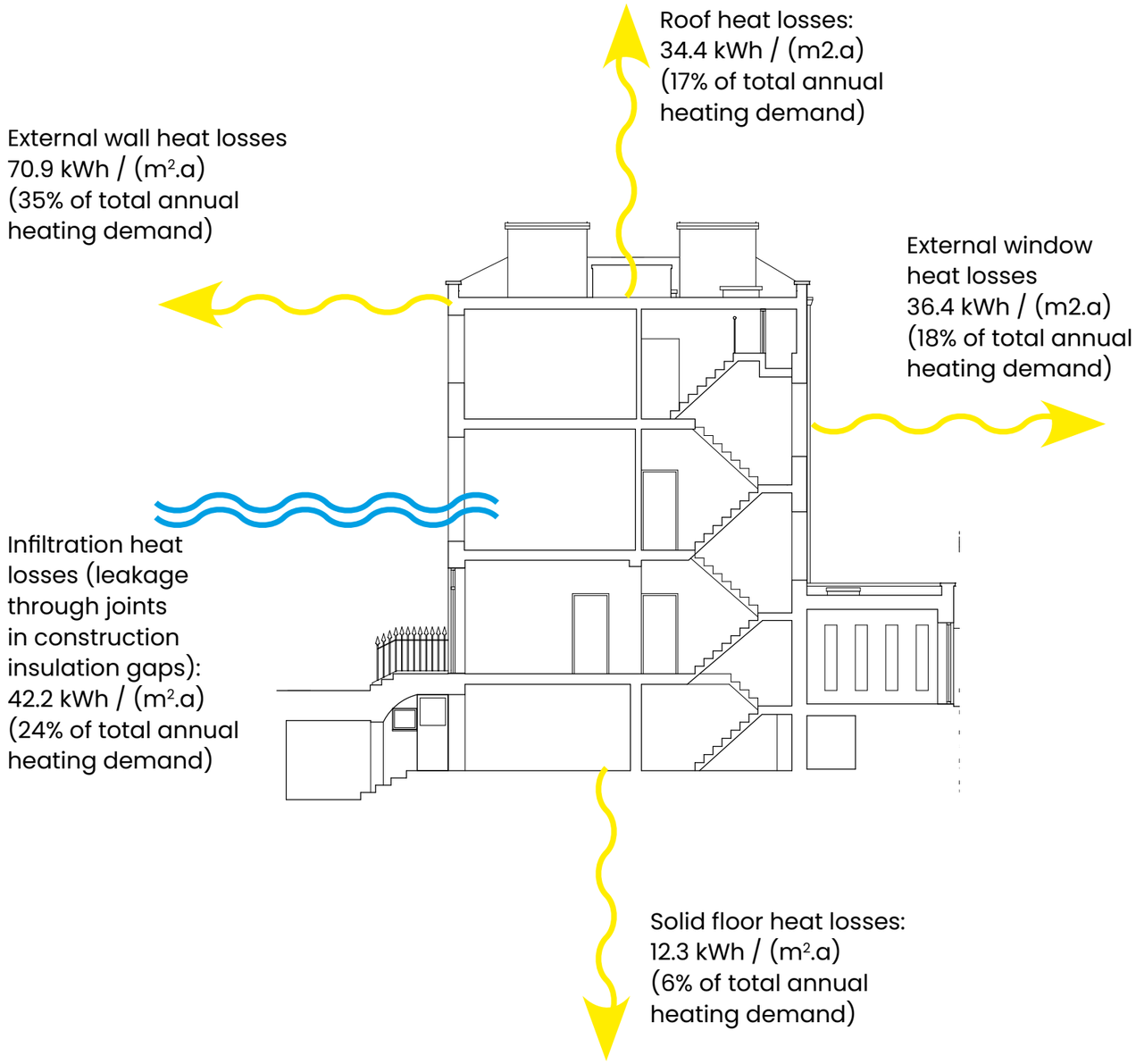
Georgian terraced home

Key features

Typically formed of terraced and semi-detached properties, Georgian homes were built from the early 1700 - 1840. Georgian properties are characterised by large rooms and large windows, providing good daylight. Homes were mostly arranged over three or four storeys, often with small dormer style windows at the top floor. Timber sash windows are common on these homes. In the case of properties in Islington, Georgian homes are often Listed and located in Conservation areas.

	Estimated Annual Running Costs	Emissions generated: Rate KgCO2/annum
Existing Building Baseline	£2,325 / Very High	6,983 / High





Cross section showing heat loss in a Georgian House.

Retrofit Goals for Georgian Homes

Below is a summary of key retrofit measures for this typology. The evaluation matrix and detailed measures summaries for each of the retrofit journeys are provided in Appendix 4. Islington Housing types in focus.

Windows and measures to avoid heat-loss

The most impactful measures are those which address the major sources of heat loss - loft insulation, internal wall insulation and glazing upgrades. External wall insulation has not been considered due to the heritage constraints on this typology. Loft-insulation provides the greatest value to homeowners, followed by secondary glazing. With both measures, it is essential that there is adequate ventilation.

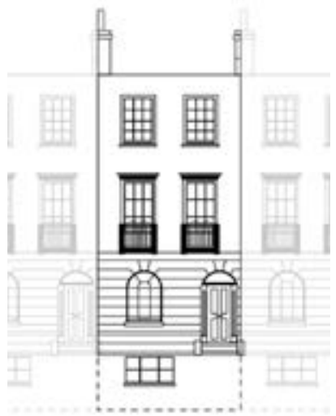
Heating and energy supply measures

Heat pumps provide the best value in terms of decarbonising Georgian properties. Air-water heat pumps are the most attractive option in terms of cost. Air-air heat pumps, can provide both heating and cooling, which may benefit Georgian homes in the Summer. If this option is pursued, Local Plan Policy S5 requires that the heating hierarchy is applied to maximise passive cooling measures.

Ventilation measures

In the short term, upgrading bathroom and kitchen extraction fans and ensuring internal ventilation pathways through door undercuts may be sufficient. However, in the long term, a continuous mechanical ventilation and heat recovery system provides the greatest benefit - ensuring fresh air provision while also reducing any heat losses. Installing one within a heritage property will however be a disruptive and expensive process.

Summary table: Retrofit Journeys for a Georgian House



Retrofit Journey Type	DIY	Medium	Comprehensive
Upfront cost	Under £5,000/ Medium-low	Under £30,000 / Medium	Under £150,000 / High
Approximate Annual Running Cost	£1,900 / High	£1,820 / High	£1,340 / Medium
Total emissions generated after retrofit works	6,537 KgCO2/ annum / High	1,149 KgCO2/ annum / Medium-low	746 KgCO2/ annum / Medium-low

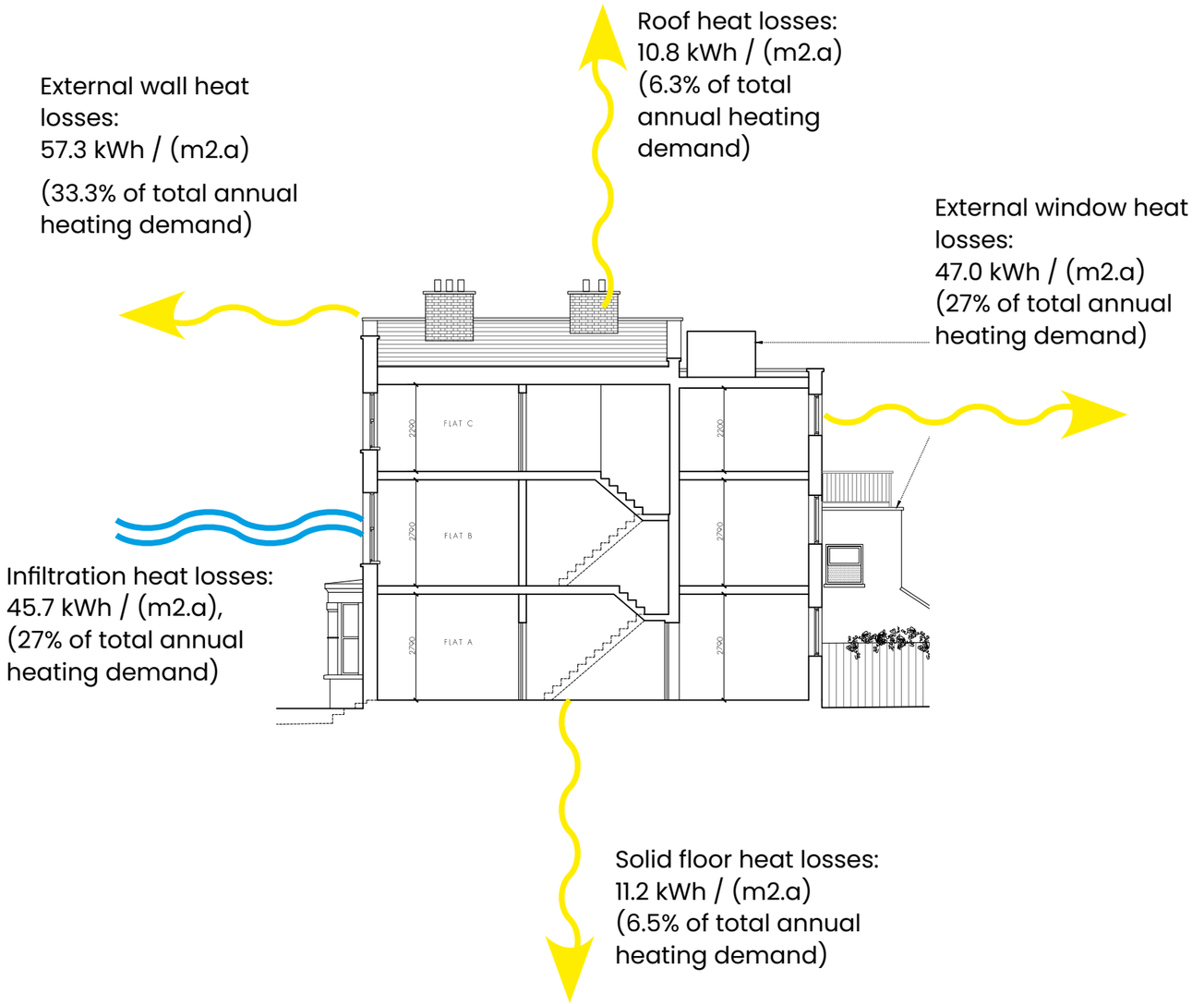
Measure Category	Recommended DIY Measures	Recommended Medium Measures	Recommended Comprehensive Measures
Windows	Draught-proofing to front and rear doors and windows	Secondary Glazing	Double glazed sash windows (front) Triple glazed windows (rear)
Avoiding heat loss through insulation and air-tightness	Insulated loft hatch and surround draught-proofing	All measures from DIY Journey Loft Insulation	Insulated Loft Hatch and surround draught-proofing Door replacement Internal wall insulation
Efficient supply of energy	LED Lighting Heating system controls and internal monitoring		LED Lighting
Renewable Energy generation		Air Source Heat Pump with new hot water cylinder and radiator replacement Solar PV (4kW array)	Air source heat pump with new hot water cylinder with future solar thermal integration Solar PV (8kW array)
Ventilation			Mechanical ventilation and heat recovery

Victorian House

Key Features

Typically formed of terraced properties, Victorian homes were built from around 1840 - 1900. As urbanisation in the Victorian era continued, density of housing was a key concern which saw the increased popularity of the terraced house. Built of solid brick walls, Victorian houses were often roofed with slate and seen with terracotta ridge tiles. This period also saw the introduction of plate glass and introduction of bay and sash window. Victorian properties re-introduced high pitched roofs, with top floor rooms in the eaves. Many of these homes are now located within Conservation areas.

	Estimated Annual Running Costs	Emissions generated: Rate KgCO2/annum
Existing Building Baseline	£1,752 / High	5,590 / Medium-high



Cross section showing heat loss in a Victorian House.

Retrofit Goals for Victorian Homes

Below is a summary of key retrofit measures for this typology. The evaluation matrix and detailed measures summaries for each of the retrofit journeys are provided in Appendix 4. Islington Housing types in focus.

Windows and measures to avoid heat-loss

The most impactful measures are those which address the major sources of heat loss - internal and external wall insulation and glazing upgrades. External wall insulation has only been considered for the rear facade. This is due to heritage considerations on the front facade. The second most effective measure is secondary glazing to single glazed windows, which can reduce heat loss from heritage windows by at least 70%. When installing secondary glazing, it is important to ensure any affected rooms have adequate ventilation.

Heating and energy supply measures

Heat pumps provide the best value in terms of decarbonising Victorian properties. Air-water heat pumps are the most attractive option in terms of cost. Air-air heat pumps, can provide both heating and cooling, which may benefit Victorian homes in the summer. If this option is pursued, Local Plan Policy S5 requires that the heating hierarchy is applied to maximise passive cooling measures.

Ventilation measures

It is likely that many Victorian properties are relying on significant background infiltration to provide fresh air. In the short term, upgrading the kitchen and bathroom extraction fans and ensuring internal ventilation pathways through door undercuts may be sufficient. However, in the long term, a continuous mechanical ventilation system with heat recovery provides the greatest benefit - ensuring fresh air provision while also reducing any heat losses. Installing one within a heritage property will however be a disruptive and expensive process.

Summary table of Retrofit Journeys for a Victorian House

Retrofit Journey Type	DIY	Medium	Comprehensive
Upfront cost	Under £4,000/ Medium-low	Under £30,000 / Medium	Under £110,000 / High
Approximate Annual Running Cost	£1,675 / Medium-high	£1,820 / Medium	£1,150 / Medium
Total emissions generated after retrofit works	5,280 KgCO2/ annum / Medium-high	1,078 KgCO2/ annum / Medium-low	636.2 KgCO2/ annum / Medium-low

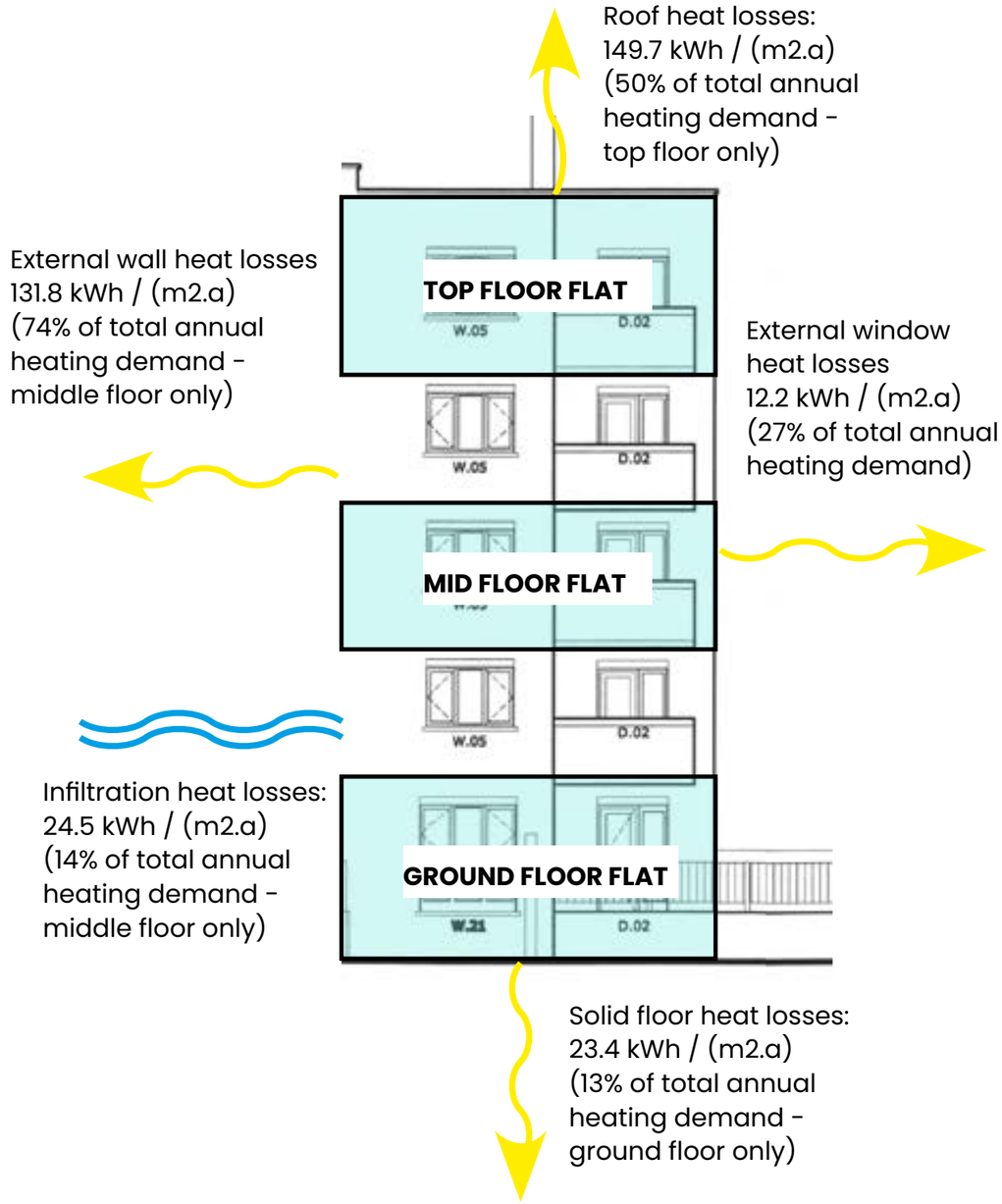
Measure Category	Recommended DIY Measures	Recommended Medium Measures	Recommended Comprehensive Measures
Windows	Draught-proofing to front and rear doors and windows	Secondary Glazing	Double glazed sash windows (front) Triple glazed windows (rear)
Avoiding heat loss through insulation and air-tightness	Insulated loft hatch and surround draught-proofing	All measures from DIY Journey Loft Insulation	Insulated Loft Hatch and surround Door replacement Internal wall insulation (front) External wall insulation (rear) Robot underfloor insulation
Efficient supply of energy	LED Lighting Heating system controls and internal monitoring		LED Lighting
Renewable Energy generation		Air Source Heat Pump with new hot water cylinder and radiator replacement Solar PV (4kW array)	Air source heat pump with new hot water cylinder with future solar thermal integration Solar PV (8kW array)
Ventilation		AirEx SMART air-bricks	Mechanical ventilation and heat recovery

Early 20th Century Flat

Key Features

Built of solid brick walls, early 20th century homes were originally specified with single glazed windows, but often retrofit with double glazing in recent years. In some cases flats may have crittal or metal casement windows. There is likely to be a proportion of the flats owned under leasehold terms within these blocks. Different floors of the block will have different priorities. Notably the ground and top floor flats will have significant heat loss impacts through the ground and roof. The summary results provided within each scenario are provided for the mid-floor flats only.

Existing Building Baseline	Estimated Annual Running Costs	Emissions generated: Rate KgCO2/annum
Ground Floor	£1,284 / Medium	3,940 / Medium
Middle Floor	£1,262 / Medium	3,837 / Medium
Top Floor	£1,710 / Medium-high	5,840 / High



Front elevation showing heat loss in an Early 20th Century block of flats.

Retrofit Goals for Early 20th Century Homes

Below is a summary of key retrofit measures for this typology. The evaluation matrix and detailed measures summaries for each of the retrofit journeys are provided in "Appendix 4. Islington Housing types in focus"

Windows and measures to avoid heat-loss

The most impactful measures are internal wall insulation, roof insulation for top floor flats and glazing upgrades. External wall insulation has not been considered as it would need to be undertaken by the freeholder. Internal wall insulation provides the greatest cost benefit, however it can be disruptive and impact on the size of the room. However, for the top floor flats, ensuring the roof is adequately insulated is the highest priority. The second most effective measure is modern double glazing. Replacement double glazing is likely to be a freeholder measure, depending on the legal structure - but sometimes the glazing systems themselves are the leaseholder's responsibility. Planning permission would be needed and would require glazing systems on blocks to deliver a uniform design across all windows.

System measures

Heat pump decarbonisation can be challenging in flats, due to lack of access to external space for the condensing unit. The air-air systems proposed are "packaged terminal air-conditioning" units which can be fitted through the wall under an external window. Some blocks may have existing communal heating systems, or there may be scope for them to connect to a heat network. If you proceed with installing a packaged terminal unit, you might consider the need to enable connection to a heat network.

Ventilation measures

In the short term, upgrading kitchen and bathroom extraction fans and ensuring internal ventilation pathways through trickle vents/ air-bricks may be sufficient. In the long term, a continuous heat recovery ventilation system provides the greatest benefit - ensuring fresh air provision whilst also reducing any heat losses. Space constraints may make this option a challenge, unless installed in a packaged system with an exhaust air heat pump.

Summary tables of Retrofit Journeys for an Early 20th Century Flat

Retrofit Journey Type	DIY	Medium	Comprehensive
Upfront cost	Under £1,500/ Low	Under £26,000 / Medium	Under £60,000 / Medium high
Approximate Annual Running Cost	£1,209 / Medium-low	£1,287 / Medium	£1,150 / Medium
Total emissions generated after retrofit works	2,890 KgCO2/ annum / Medium	1,031 KgCO2/ annum / Medium-low	601.3 KgCO2/ annum / Medium-low

Measure Category	Recommended DIY Measures	Recommended Medium Measures	Recommended Comprehensive Measures
Windows and doors	Draught-proofing to front and rear doors and windows	All measures from DIY Journey	Double glazed windows
Avoiding heat loss through insulation and air-tightness		Insulated roof (top floor flat only)	Internal wall insulation (front)
Efficient supply of energy	LED Lighting Heating system controls and internal monitoring		LED Lighting
Renewable Energy generation		Air-to-air heat pump (packaged terminal) and radiant panels with high efficiency hot water cylinder	Packaged cabinet with exhaust air heat pump, mechanical ventilation and heat recovery and high efficiency hot water cylinder
Ventilation		AirEx SMART air-bricks and upgraded extract fans	Mechanical ventilation and heat recovery included above

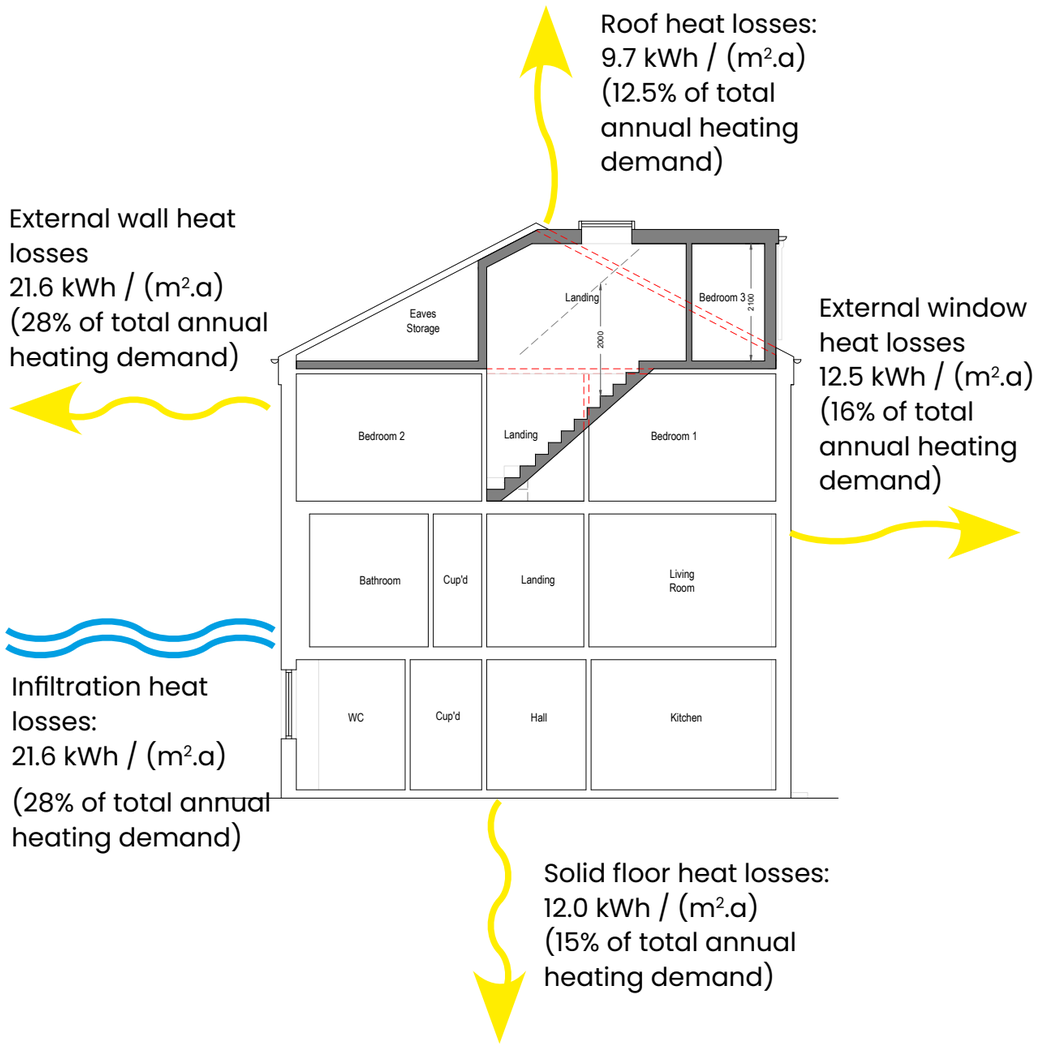
Mid 20th Century House

Key Features

This home type is a low-rise Mid 20th Century dwelling, typically consisting of maisonettes and semi-detached type homes, and small flatted developments.

These developments saw the introduction of cavity walls with a brick inner and outer leaf. The relatively long span of construction of this type of home, (from the 1940s through to 1960) means that the quality of insulation can vary significantly which will affect the building's energy performance. This typology has more limitations than the previous three due to the architectural experimentation and variety in construction systems found in buildings constructed during this period. This analysis is indicative of a type of Mid-20th Century dwelling commonly found in Islington, but is not broadly applicable to all mid-century homes.

	Estimated Annual Running Costs	Emissions generated: Rate KgCO2/annum
Existing Building Baseline	£1,194 / Medium-low	2,429.8 / Medium



Retrofit Goals for Mid 20th Century Homes

Below is a summary of key retrofit measures for this typology. The evaluation matrix and detailed measures summaries for each of the retrofit journeys are provided in Appendix 4. Islington Housing types in focus.

Windows and measures to avoid heat-loss

The most impactful measures are those which address the major sources of heat loss - external walls and sources of infiltration. The relative cost benefits show that cavity wall insulation provides the greatest benefit. If unfilled, cavities are still present on a property, these should be filled if there aren't fundamental technical barriers. The second most effective measure is upgrading existing loft insulation. Many homes will have existing loft insulation, but often only 100mm depth. Increasing this to 270-300mm depth will have significant benefits.

Heating and energy supply measures

Air-water heat pumps and air-air heat-pumps offer the best value options for decarbonising mid-20th century properties. Air-water systems are best installed through the use of a monoblock external unit, which would be placed in the rear garden of the home. They are the most attractive option from a cost perspective compared to air-air heat pumps.

Ventilation measures

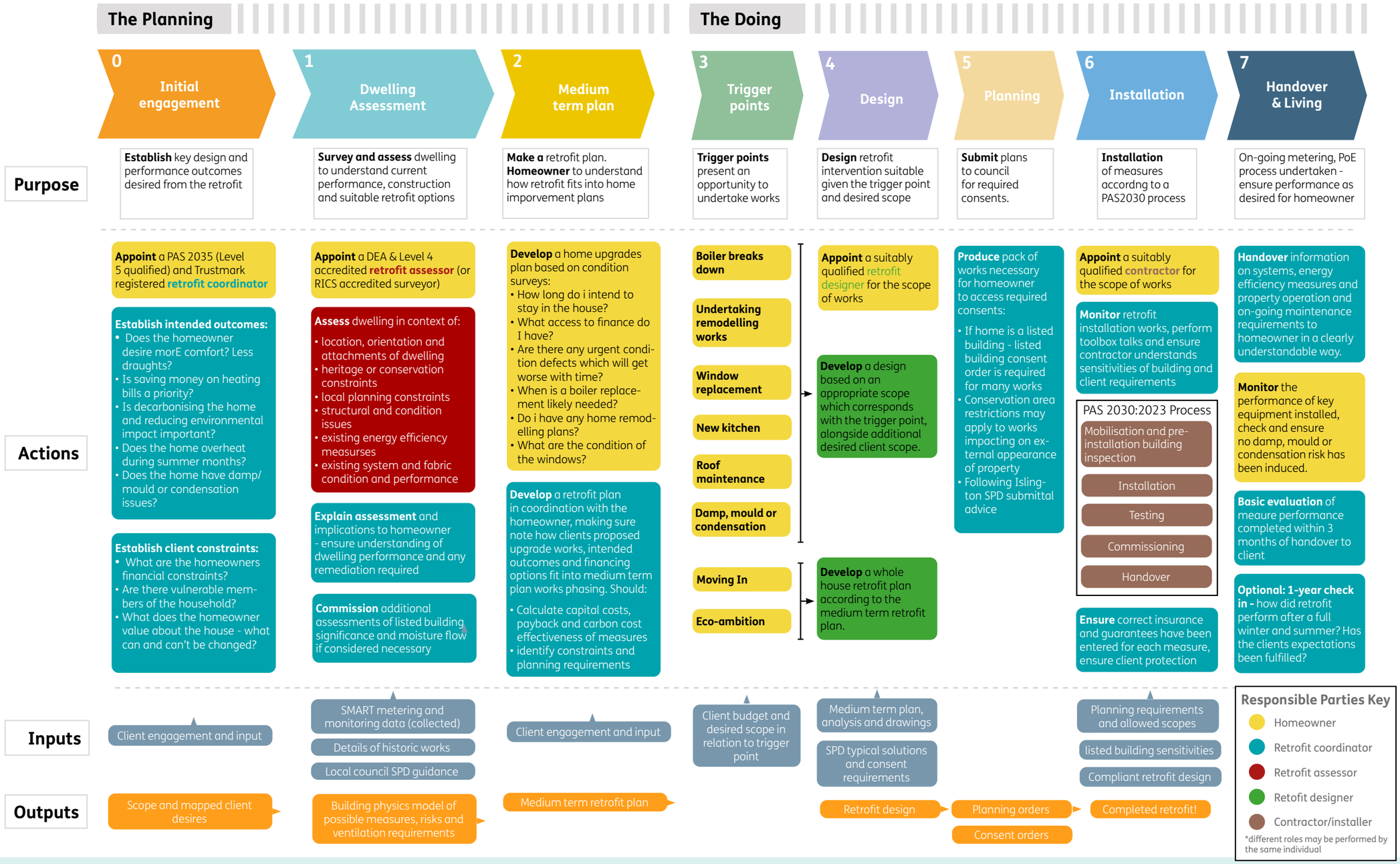
In the short term, upgrading the wet room extraction fans and ensuring internal ventilation pathways through trickle vents/air-bricks may be sufficient. However, in the long term, a continuous mechanical ventilation system with heat recovery provides the greatest benefit - ensuring fresh air provision while also reducing any heat losses. Space constraints may make this option a challenge, unless installed in a packaged system with an exhaust air heat pump.

Summary tables of Retrofit Journey for an Mid 20th Century House

Retrofit Journey Type	DIY	Medium	Comprehensive
Upfront cost	Under £3,500 / Medium-low	Under £30,000/ Medium	Under £60,000 / Medium-high
Approximate Annual Running Cost	£1,158 Medium-low	£1,054 Medium-low	£1,150 / Medium
Total emissions generated after retrofit works	2,422 KgCO2/ annum / Medium	806.3 KgCO2/ annum / Medium-low	601.3 KgCO2/ annum / Medium-low

Measure Category	Recommended DIY Measures	Recommended Medium Measures	Recommended Comprehensive Measures
Windows and Doors	Draught-proofing to front and rear doors and windows	All measures from DIY Journey	Triple glazed windows, Door replacement
Avoiding heat loss through insulation and air-tightness	Insulate loft hatch and surround	Top Up Loft Insulation Cavity Wall Insulation	Upgrade Loft Insulation and hatch surrounds Cavity Wall Insulation
Efficient supply of energy	LED Lighting Heating system controls and internal monitoring		LED Lighting
Renewable Energy generation	Door replacement	Air Source Heat Pump with new hot water cylinder and radiator replacement Solar PV (4kW array)	Air source heat pump with new hot water cylinder with future solar thermal integration Solar PV (8kW array)
Ventilation			Mechanical ventilation and heat recovery

Appendix 1. Comprehensive guide to the Retrofit Journey



Appendix 2. Further information on Embodied Carbon of...

... Insulation

There are a large variety of insulation materials and installation processes available for retrofitting energy efficiency measures. When deciding on the appropriate material to use for a project there are several factors to consider:

Installation practicality

This often influences the material used, as installing materials in hard-to-reach places may require different technologies, such as spray foam insulation, than would be necessary in other circumstances.

Heat transmission

Higher performing insulation materials require a smaller thickness to achieve the same heat transmission reduction. Materials should be compared based on their thermal performance and not their volume.

Moisture transmission

The flow of moisture through the building is key. If insulation materials don't complement the building's moisture flow it can lead to condensation and damp. The use of 'vapour open' materials which allow moisture to transmit through them may be required.

Cost

Different materials have different costs, although these are often low when compared to the cost of installation or finishes.

Environmental impact

Some insulation materials are manufactured through energy intensive processes. For example, at over 150kgCO2e per m2 of wall, the embodied carbon of both expanded and un-faced polyurethane is significantly higher than many other insulation materials including cork slab and board, glass fibre quilt and slab, and flax (all of which have embodied carbon well below 50kgCO2e per m2 of wall).

... Window Frames

Modern window frames have significantly improved thermal efficiency compared to units manufactured prior to 2002, meaning that replacing windows is a practical way to improve home energy efficiency. The choice of window frame material will have a significant influence on the embodied carbon associated with window replacement:

Wood

There is a price premium associated with good quality timber framed windows but they have the lowest embodied carbon, are a renewable resource and can store carbon. They are also fairly thermally efficient and more in keeping with heritage window frames, particularly on Georgian and Victorian homes.

Aluminium

Aluminium has high embodied carbon but is durable and has high recycling rates which can reduce its overall environmental impact.

Aluminium-clad FSC temperate softwood

This is a high-performing product with a long life, but it does have higher embodied energy than wood window frames.

Polyvinyl Chloride (PVC)

PVC window frames tend to be the cheapest option and offer relatively good thermal efficiency as well as lower embodied carbon than aluminium. However, they have a relatively short lifespan compared to timber and aluminium frames, are not recycled in most circumstances and have significant wider environmental impacts.

...Refrigerants used in heat pumps

Heat pumps use refrigerants to capture heat from the air (or ground depending on the system) and then release it through the home. Refrigerants are powerful greenhouse gases that contribute significantly to global warming and are therefore subject to increasingly stringent international and national regulations. It is important to consider the global warming potential (GWP) of refrigerants in selecting a heat pump, and it may be possible to have a heat pump installed that contains refrigerants with lower GWP, such as carbon dioxide, ammonia and hydrocarbons such as propane.

The embodied carbon in refrigerants is derived in three ways: the production process and the chemical processes involved in refrigerant manufacturing; the material composition, as the type of chemicals used and their sourcing can affect the overall carbon footprint; and the distance travelled by the refrigerants from the manufacturing plant to the point of use.

As well as seeking a heat pump with lower GWP, there are some other ways to reduce the overall environmental impact of heat pumps:

Optimising system design – efficient design can minimise refrigerant charge, thereby reducing the amount of refrigerant required.

Proper maintenance – regular maintenance and leak detection can prevent refrigerant loss and extend the system's lifespan. The lifespan of heat pumps is expanding as technology advances which helps to minimise embodied carbon costs.

End-of-life management – responsible disposal and recovery of refrigerants at the end of the system's life are crucial. Producers and suppliers increasingly offer a recycling programme as part of replacement, allowing parts to be refurbished and refrigerants recovered.

Appendix 3. Advice on installing air source heat pumps

Can all homes, even Georgian and Victorian properties, have a heat pump?

All homes can have a heat pump. There are great examples of heat pumps operating at extremely high performance levels in Victorian terraces. However, home insulation levels do have an impact on heat pump operation, and it may be that making relatively low-cost fabric changes to a property first – such as loft insulation, cavity wall insulation or secondary glazing – will reduce the cost of heat pump installation and significantly lower its running costs.

What does the heat pump installation process look like?

At the start of the process an installer will visit the property to conduct a technical survey. This will consider four main things:

1. **Heat loss and radiator output for each room**
   Heat pumps like to run at lower temperatures than gas boilers. If radiator temperatures can be kept below 45C the property will be suitable for a low temperature heat pump and will see bill savings following installation.
2. **Assess radiators for need to upgrade**
   If the entire radiator system is undersized the home will only be suitable for a high-temperature heat pump, unless heat loss can be reduced through fabric changes such as loft or wall insulation.
3. **Check the heating system pipe sizes**
   These will connect the future heat pump to the radiators. Heat pumps pump water at a higher flow rate than gas boilers so the pipework needs to be larger. If it's too narrow replacement pipework may be needed.
4. **Check the existing electrical system**
   A heat pump adds additional load onto the existing electrical system. Additional circuits may be needed on consumer unit, or an upgrade to the main fuse or entire connection may be needed. An upgrade to the 80 Amp connection on single phase is sufficient and usually free.

Following the survey the installer may provide a quote requiring a certain specification of heat pump or certain upgrades or changes to the existing heating system. The installation of a heat pump will deliver deep carbon emissions reductions but there are some things to consider:

If the quote is for a high temperature heat pump the running costs may be up to 25% higher than for a low temperature option. It may be worth considering if fabric changes to the home could be delivered that would enable the installation of a low temperature heat pump which will be cheaper to run and possibly cheaper to install.

If the quote requires significant radiator replacement this will require extensive internal works which may be expensive and disruptive. It may be more cost effective to install an insulation measure first which will reduce the need for radiator replacements.

Energy Efficiency

Heat-pumps move heat from one location to another efficiently, delivering more heat to the home than energy input.

Carbon Emission Reductions

Carbon emission reductions are at least 65% when compared to a gas boiler baseline but can be up to 78% for an efficient low temperature system.

Upfront Costs

The government is providing a grant of £7,500 to support the installation of air-water systems (at the time of writing). The average total cost of installation is £12,000, and this is likely to be higher in complex older buildings.

Operational Costs

Low-temperature heat pumps will achieve price parity with gas boilers under a standard tariff. On a SMART tariff, such as Octopus Cosy, savings of over 20% can be achieved. Higher temperature heat pumps tend to cost marginally more to run than gas boilers, even on a SMART tariff.

Disruption

Heat pump units will be installed outside the property in a suitable location. Internal disruption will centre around radiator replacement and hot water cylinder installation if needed.

Acoustic impact

Heat pumps are now quieter than older models. If not eligible for Permitted Development as above, see Climate Action SPD for information on Noise Assessment requirements.

Appendix 4. Islington Housing types in focus

Evaluation framework

An evaluation framework has been developed to guide residents through the prioritisation of retrofit measures within their home, and to provide typology-specific guidance on the expected benefits. Each measure has been evaluated against the following framework criteria:

i. Overall energy demand and carbon emission reductions - The most common heating fuel across Islington is gas (66.5% of properties), utilised within gas boilers, which have been used as the baseline within all the typologies analysed. The two approaches to reducing energy demand and carbon emissions are reducing the heating and hot water demands (commonly termed "energy efficiency") and switching to higher efficiency heating systems which run off a cleaner fuel, such as electrically powered heat pumps ("low carbon technologies,").

ii. Installation cost - Low-cost measures are under £1,000 to install and are considered potentially affordable to many tenants and homeowners. Medium cost measures are between £1,000 and £15,000, reflecting a mid-range expenditure for moderate renovations. High-cost measures over £15,000 will likely only be spent for significant renovation works.

iii. Cost benefit - The cost benefit of retrofit measures has been evaluated based on the economic payback to the home occupant. The energy demand reductions have been valued based on current standard utility prices, and straight payback periods calculated based on the installation costs. The cost benefits have been categorised in three bands: short payback measures (<2 years); medium payback (2-10 years); long payback (10+ years).

iv. Health and well-being impact – There are severe health impacts deriving from excess cold and damp in properties, which are closely related to fuel poverty and home energy efficiency. The installation and running costs of measures was balanced with cost savings where possible, noting that for many fuel poor homes, grant funding is available to mitigate installation costs to the occupant.

v. Acoustic impacts - The acoustic impacts of measures have been evaluated on a neutral or positive comparative basis. For example, improved window performance will decrease exposure to noise pollution – improving occupant wellbeing. The ultimate acoustic impact of a modern heat pump is small, and hence these measures are not ranked as causing additional acoustic pollution providing they are correctly installed.

vi. Heritage and visual impacts - Retrofit measures installed within historic buildings should be designed to complement and enhance their character, in a way which is sensitive to occupant needs. Measures are ranked based on their impact on external heritage visual impact. The evaluation bands are: low-no impact -no visual impact on the conservation area e.g. loft insulation; medium impacts -e.g. double glazing and heat pumps; high impact – e.g. external wall glazing on street facing façade, triple glazing, solar panels on street facing roof. As Listed Buildings must be considered on a case-by-case basis, the study did not make assumptions relating to the building's listing.

vii. Disruption of measure - The evaluation of the disruption of measure installation is based on a qualitative assessment of the impact on occupants' normal daily life. The evaluation scale consists of: Low disruption – less than a day disruption to standard occupation; Medium disruption – requires moderate change to living practices for a small number of days; Major disruption – significant change to living practices for several days.

Links to

In Focus: Georgian House

In Focus: Victorian House

In Focus: Early 20th Century Flat

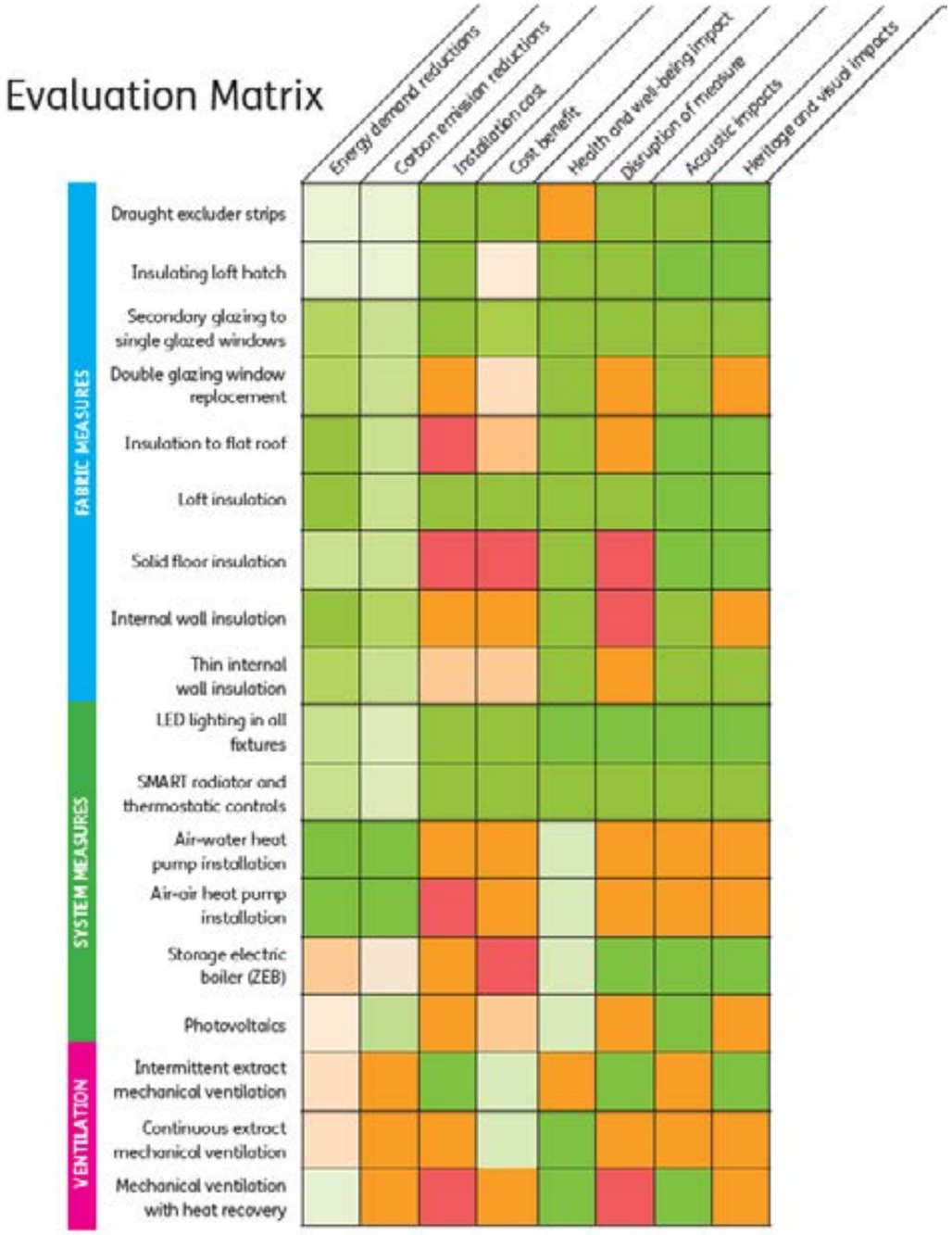
In Focus: Mid-20th Century House

In Focus: Georgian House

This section includes detail relating to the retrofit journeys for the Georgian house.

It includes:

- Evaluation Matrix: A summary of how measures scored against the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- A more detailed discussion of the retrofit journey measures.



In focus: Georgian House, DIY Journey

- A summary of measures and how they scored against the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- An in depth discussion of the chosen measures.

DIY Retrofit Journey: Georgian House

Measure	Energy Demand Reduction % against building baseline	Carbon Emission Reduction % against building baseline	Upfront Cost (incl. installation)	Estimated Annual running cost
LED lighting	5% electricity	~2%	~£200- £1500	
Insulated loft hatch	3% gas	~2%	~£300- £500	
Draught proofing windows and doors	5.5% gas	~2%	~£300- £800	
Heating system controls and monitoring	8% gas	~3%	~£400- £1,k	
Total	**11.7% gas , 5% electricity**	**~6%**	**~£1,200 - £3,800**	**£1,900**

In focus: Georgian House, Medium Journey

- A summary of measures and how they scored against the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- An in depth discussion of the chosen measures.

Medium Retrofit Journey: Georgian House

Measure	Energy Demand Reduction % against building baseline	Carbon Emission Reduction % against building baseline	Upfront Cost (incl. installation)	Estimated Annual running cost
Step 1				
All "DIY" Measures Above	11.7% gas , 5% electricity	~6%	~£1,200 - £3,800	
Loft insulation	20% gas	~15%	~£1k- £3k	
Secondary glazing	25% gas	~18%	~£3k - £5k	
Total	49% gas , 5% electricity	~30%	~£4k-£8k	
Step 2				
Installation of an ASHP including new hot water cylinder and radiator replacement	100% gas +190% electricity	~75%	~£8k - £12k (inclusive of government boiler replacement grant)	
Roof-mounted PV (4kW array)	5% electricity	~5%	~£10k- £16k	
Total				
Total	**100% gas +190% electricity**	**~84%**	**~£18k -£28k**	**£1,820**

In focus: Georgian House, Comprehensive Journey

- A summary of measures and how they scored aganst the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- An in depth discussion of the chosen measures.

Comprehensive Retrofit Journey: Georgian House

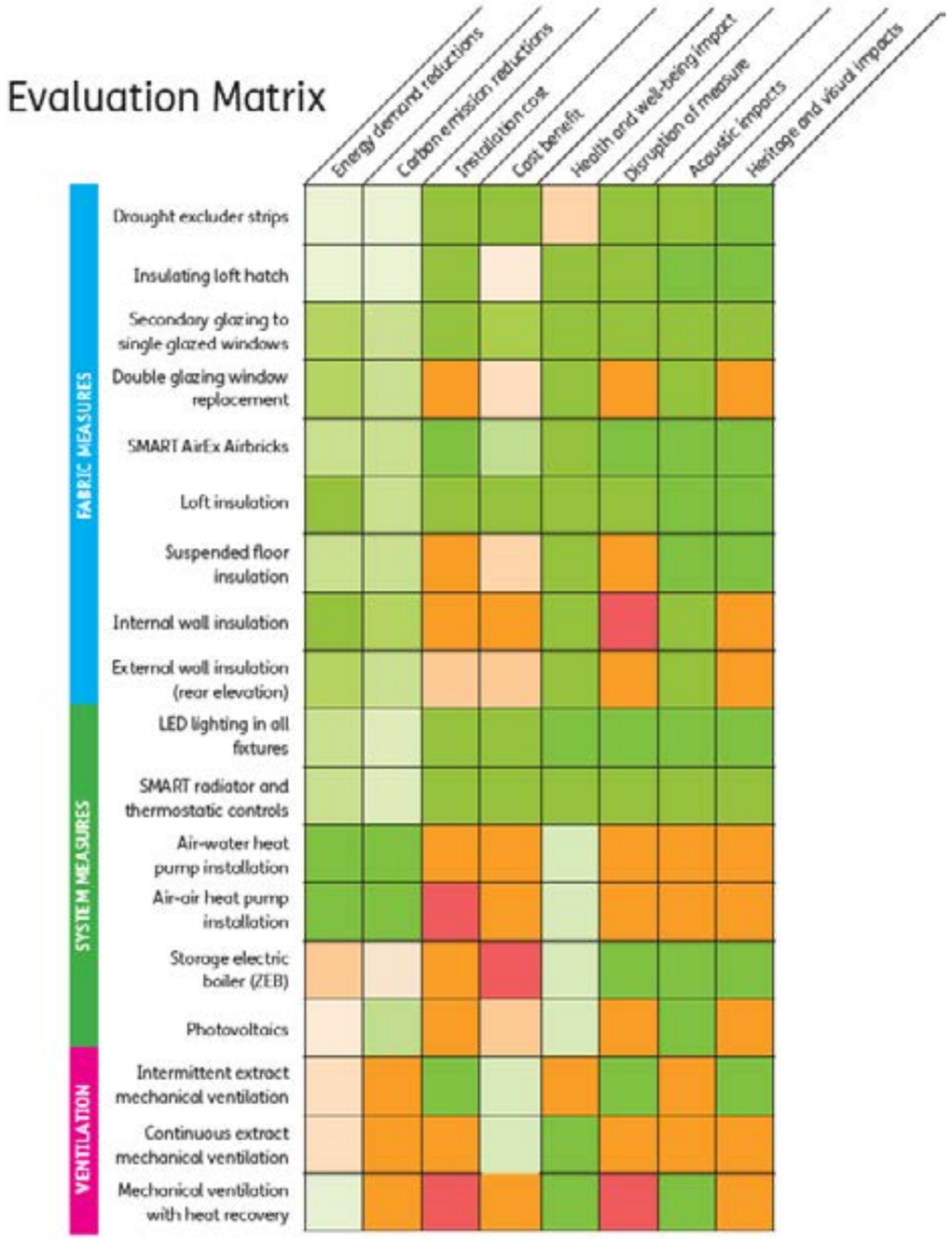
Measure	Energy Demand Reduction % against building baseline	Carbon Emission Reduction % against building baseline	Upfront Cost (incl. installation)	Estimated Annual running cost
LED lighting	5% electricity	~2%	£~200-£1,500	
Upgrade Loft insulation + hatch and surrounds	22% gas	~2%	£1.5k-£3.5k	
Double glazed sash windows (front façade)	30% gas	~5%	£40k- £60k	
Triple glazed windows (rear façade), Door replacement, Internal wall Insulation	25% gas	~5%	£20k-£40k	
MVHR Installation	5% gas	~5%	£5k-£7k	
New air-to-water ASHP including Hot Water Cylinder with future solar integration	100% gas, +120% electricity	~80%	£6k-£10k	
Roof-mounted PV (8kW array)	5% electricity	~5%	£14k- £19k	
Total	**100% gas +110% electricity**	**~89%**	**£86-£140k**	**£1,340**

In Focus: Victorian House

This section includes detail relating to the retrofit journeys for the Victorian house.

It includes:

- Evaluation Matrix: A summary of how measures scored aganst the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- A more detailed discussion of the retrofit journey measures.



In focus: Victorian House, DIY Journey

It includes:

- A summary of measures and how they scored aganst the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- An in depth discussion of the chosen measures.

DIY Retrofit Journey: Victorian House

Measure	Energy Demand Reduction % against building baseline	Carbon Emission Reduction % against building baseline	Upfront Cost (incl. installation)	Estimated Annual running cost
LED lighting	4% electricity	~2%	~£150/£1,000	
Insulated loft hatch	2% gas	~2%	~£300- £500	
Draught proofing windows and doors	4% gas	~2%	~£250- £600	
Heating system controls and monitoring	4% gas	~3%	~£400- £1,000	
Total	**7% gas , 4% electricity**	**~5%**	**~£1,100 - £3,100**	**£1,675**

In focus: Victorian House, Medium Journey

It includes:

- A summary of measures and how they scored aganst the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- An in depth discussion of the chosen measures.

Medium Retrofit Journey: Victorian House

Measure	Energy Demand Reduction % against building baseline	Carbon Emission Reduction % against building baseline	Upfront Cost (incl. installation)	Estimated Annual running cost
Step 1				
All "DIY" Measures Above	7% gas 4% electricity	~5%	~£1,100 - £3,100	
Upgraded loft insulation	8% gas	~15%	~£1k- £3k	
Secondary glazing	31% gas	~18%	~£1,500- £2,600	
AirEx SMART air-bricks	12%	~18%	~£1k -£2k	
Total	49% gas , 5% electricity	~30%	~£4,600-£10k	
Step 2				
Installation of an ASHP including new hot water cylinder and radiator replacement	100% gas +132% electricity	~75%	~£7k - £10k (inclusive of government boiler replacement grant)	
Roof-mounted PV (4kW array)	7% electricity	~5%	~£10k- £16k	
Total	100% gas +190% electricity	~84%	~£18k -£28k	£1,820

In focus: Victorian House, Comprehensive Journey

- A summary of measures and how they scored aganst the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- An in depth discussion of the chosen measures.

Comprehensive Retrofit Journey: Victorian House

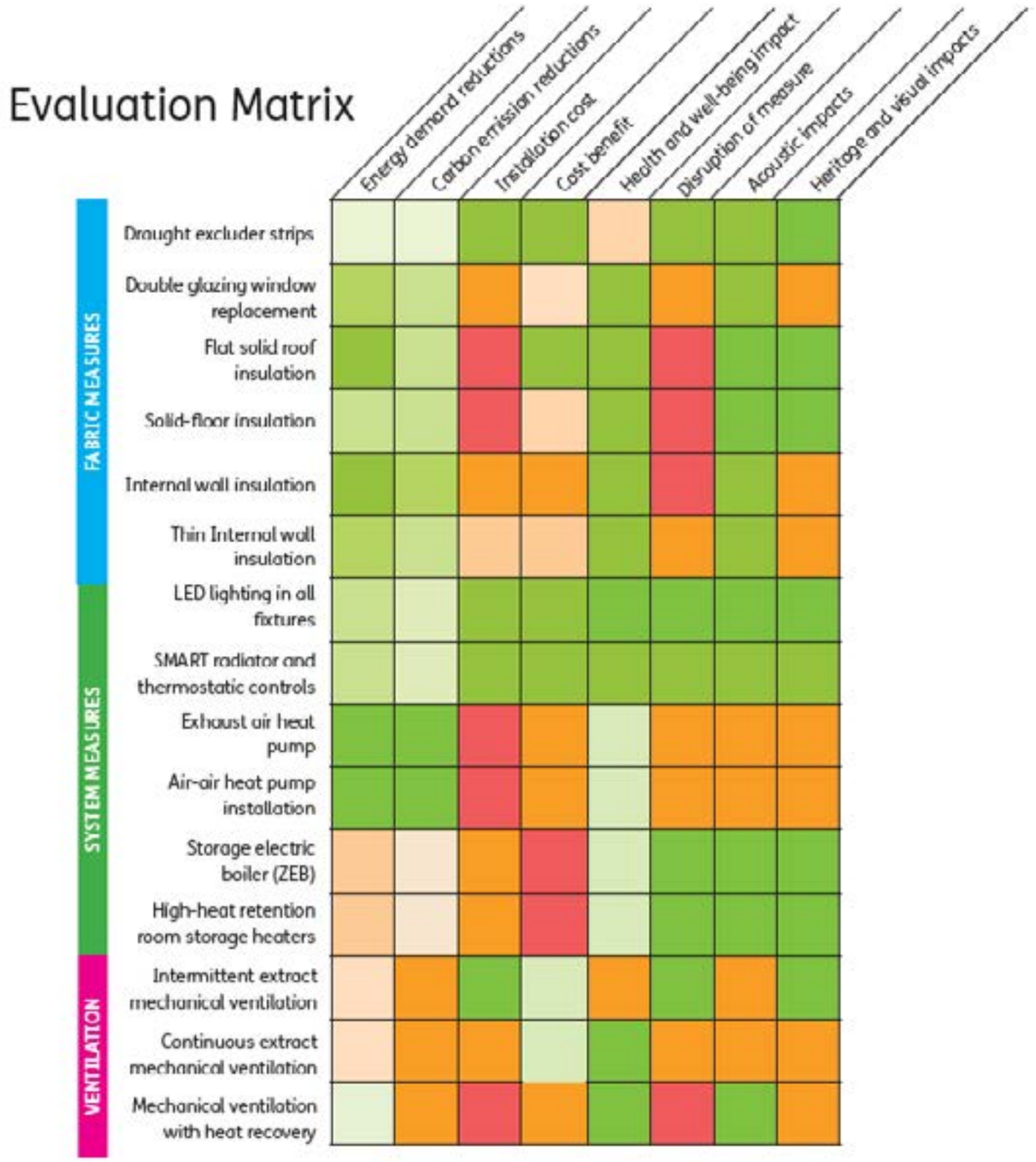
Measure	Energy Demand Reduction % against building baseline	Carbon Emission Reduction % against building baseline	Upfront Cost (incl. installation)	Estimated Annual running cost
LED lighting	4% electricity	~2%	~£150/£1k	
Upgrade Loft insulation + hatch and surrounds	10% gas	~8%	~£1.5k-£3.5k	
Double glazed sash windows (front façade)	20 % gas	16%	~£25k-£35k	
Triple glazed windows (rear façade)				
Door replacement				
Internal wall insulation + External wall insulation	25% gas	~20%	~£14k-£26k	
Robot underfloor insulation	6% gas	~4%	~£6k-£8k	
MVHR installation	5% gas	~5%	~£5k-£7k	
New air-to-water ASHP including Hot Water Cylinder with future solar integration	83% electricity, 100% gas	~80%	~£5k-£8K	
Roof-mounted PV (8kW array)	7% electricity	~5%	~£14-£19k	
Total	**76% electricity , 100% gas**	**~89%**	**~£70k-£107k**	**£1,150**

In Focus: Early 20th Century Flat

This section includes detail relating to the retrofit journeys for the Early 20th Century Flat.

It includes:

- Evaluation Matrix: A summary of how measures scored aganst the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- A more detailed discussion of the retrofit journey measures.



In focus: Early 20th Century Flat, DIY Journey

- A summary of measures and how they scored aganst the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- An in depth discussion of the chosen measures.

DIY Retrofit Journey: Early 20th Century Flat

Measure	Energy Demand Reduction % against building baseline	Carbon Emission Reduction % against building baseline	Upfront Cost (incl. installation)	Estimated Annual running cost
LED lighting	4% electricity	~2%	£80-£200	
Draught proofing windows and doors	3% gas	~2%	£50- £200	
Heating system controls and monitoring	4% gas	~3%	£400- £1000	
Total reductions and overall cost	**2% electricity, 6% gas**	**~5%**	**£530-£1,400**	**£1,209**

In focus: Early 20th Century Flat, Medium Journey

- A summary of measures and how they scored aganst the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- An in depth discussion of the chosen measures.

This era of property had passive ventilation provided through air-bricks, and later, through trickle vents on double glazed windows. However, due to localised discomfort from cold draughts, often these vents are blocked or closed, leading to damp risk. Aereco make a type of trickle vent which can modulate depending on internal humidity. Providing fresh air only when needed. Coupled with humidity controlled upgraded bathroom and kitchen extract fans, these measures should significantly improve home ventilation and air quality.

Through the wall" packaged terminal air conditioning (PTAC) units, provide high efficiency heat generation compared to any direct systems, and the capacity to provide some comfort cooling to occupants. However, as PTAC systems can have issues operating at sub freezing temperatures, supplementary local radiant panels are recommended which can be utilised on the coldest days to provide immediate warmth. The net impact of these measures is a significant carbon saving, but a likely small increase on heating bills. In practice this could likely be mitigated with good tariff selection.

Medium Retrofit Journey: Early 20th Century Flat

Measure	Energy Demand Reduction % against building baseline	Carbon Emission Reduction % against building baseline	Upfront Cost (incl. installation)	Estimated Annual running cost
Step 1				
All "DIY" Measures Above	6% gas , 2% electricity	~5%	~£1,100 - £3,100	
Insulated roof (top floor only)	40% gas	~35%	£3,000- £7,000	
AirEx SMART air-bricks/ Aereco DCV trickle vents/ Upgraded extract fans	8% (both)	~8%	£1,000-£3,000	
Total	**13% gas , 2% electricity**	**~15%**	**~£4,530-£11,400**	
Step 2				
Packaged terminal HP + radiant panels and new high-efficiency hot water cylinder	100% gas , +240% electricity	~60%	£8,000 - £14,000	
Total	**100% gas , +240% electricity**	**~60%**	**~£12,530-£25,400**	**£1,287**

In focus: Early 20th Century Flat, Comprehensive Journey

- A summary of measures and how they scored aganst the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- An in depth discussion of the chosen measures.

The core difference to the medium journey is the alternative system option employed here - which will only be suitable in well insulated properties. The packaged cabinet inside the home will require a suitable space, but can contain the MVHR, exhaust air heat pump and the DHW cylinder in a single assembly. The exhaust air heat pump will be relatively low powered, and run continuously, charging the DHW cylinder. Distribution for the space heating circuit runs off the cylinder, as per Groundsun heat pump units. Additional local radiant panels may be required to deliver sufficient heating during coldest periods.

Comprehensive Retrofit Journey: Early 20th Century Flat

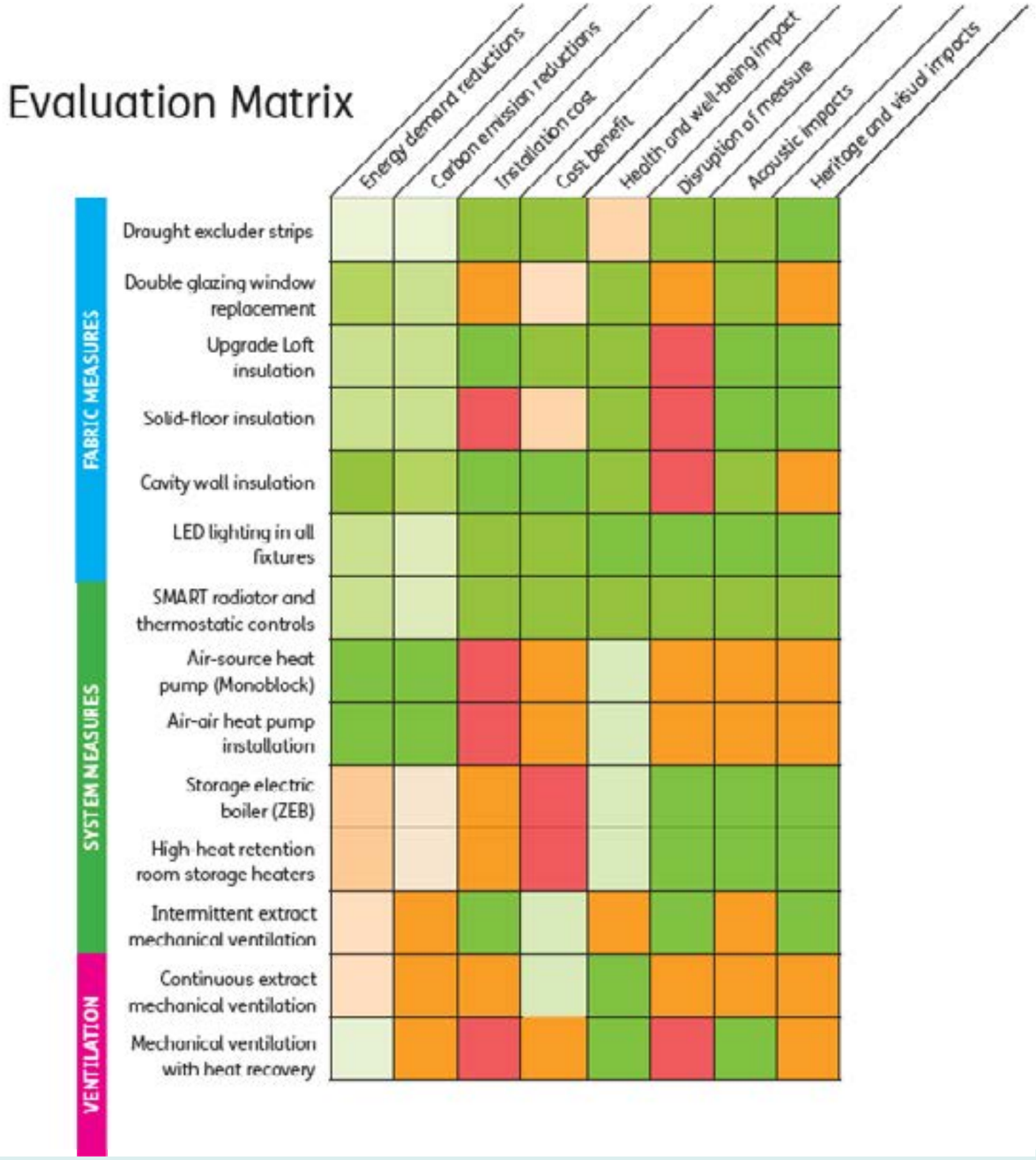
Measure	Energy Demand Reduction % against building baseline	Carbon Emission Reduction % against building baseline	Upfront Cost (incl. installation)	Estimated Annual running cost
LED lighting	4% electricity	~2%	£80- £200	
Double glazed windows	10% gas	~8%	£8,000-£12,000	
Internal wall insulation	41% gas	~35%	£12,000- £24,000	
Door replacement	5% gas	~4%	£2,000- £4,000	
Packaged cabinet MVHR installation + Exhaust air HP + New high-efficiency DHW cylinder	100% gas, 83% electricity	~80%	£12,000-£20,0006	
Total	100% gas, 95% electricity	~81%	£34,000-£60,000	£841.9

In Focus: Mid-20th Century House

This section includes detail relating to the retrofit journeys for the Mid-20th Century House.

It includes:

- Evaluation Matrix: A summary of how measures scored aganst the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- A more detailed discussion of the retrofit journey measures.



In focus: Mid-20th Century House, DIY Journey

- A summary of measures and how they scored aganst the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- An in depth discussion of the chosen measures.

DIY Retrofit Journey: Mid- 20th Century House

Measure	Energy Demand Reduction % against building baseline	Carbon Emission Reduction % against building baseline	Upfront Cost (incl. installation)	Estimated Annual running cost
LED lighting	6% electricity	~4%	£150-£1000	
Insulated loft hatch	2% gas	~2%	£300- £500	
Draught proofing windows and doors	1% gas	~2%	£250- £600	
Heating system controls and monitoring	3% gas	~3%	£400- £1000	
Total reductions and overall cost	**3% gas , 6% electricity**	**~5%**	**~1,100-£3,100**	**£1,158**

In focus: Mid-20th Century House, Medium Journey

- A summary of measures and how they scored aganst the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- An in depth discussion of the chosen measures.

Medium Retrofit Journey: Mid- 20th Century House

Measure	Energy Demand Reduction % against building baseline	Carbon Emission Reduction % against building baseline	Upfront Cost (incl. installation)	Estimated Annual running cost
Step 1				
DIY measures	3% gas, 6% electricity	~5%	£1,100- £3,100	
Top-up loft insulation	7% gas	~5%	£1,000- £3,000	
Cavity wall insultation	20% gas	~14%	£3,000- £5,000	
Total reductions and overall cost	**28% gas, 6% electricity**	**~15%**	**~£5,100-£11,100**	
Step 2				
Installation of ASHP with new cylinder, Radiator replacement, resized for ASHP installation	100% gas , 132% electricity	~75%	£3,000 - £6,0007	
Roof-mounted PV (4kW array)	7% electricity	~5%	£8,000- £10,000	
Total reductions and overall cost	**100% gas, 58% electricity**	**~70%**	**~£11,000-£16,000**	**£1,158**

In focus: Mid-20th Century House, Comprehensive Journey

- A summary of measures and how they scored aganst the evaluation framework
- A summary of each retrofit journey, including costs of measures (modelled in 2023 and not inclusive of inflation)
- An in depth discussion of the chosen measures.

Comprehensive Retrofit Journey: Mid-20th Century House

Measure	Energy Demand Reduction % against building baseline	Carbon Emission Reduction % against building baseline	Upfront Cost (incl. installation)	Estimated Annual running cost
LED lighting	6% electricity	~4%	£150- £1000	
Upgraded insulated loft hatch	9% gas	~5%	£1,300-£3,500	
Triple glazed windows and door replacements	12% gas	~7%	£16,000- £24,000	
Cavity wall insulation	20% gas	~14%	£3,000- £5,000	
MVHR installation	5% gas	~5%	£3,000- £5,000	
New air-to-water ASHP, new hot water cylinder with future solar integration	100% gas , 57% electricity	~65%	£3,000-£5,0008	
Roof-mounted PV (8kW array)	7% electricity	~5%	£14,000-£19,000	
Total reductions and overall cost	**47% electricity , 100% gas**	**~70%**	**£40,000-£61,000**	**£994**