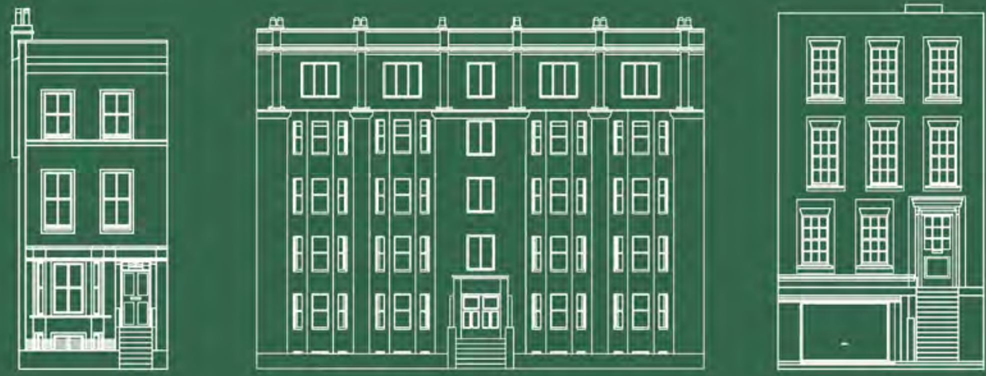


Part 1

Enabling Net Zero in the Conservation Area

A retrofit appraisal and guide

September 2024 I Rev R

ESSA your conservation association

Edwardes Square, Scarsdale and Abingdon Association (ESSA)

THE ROYAL BOROUGH OF KENSINGTON AND CHELSEA

Funded by RBKC NCIL

Levitt Bernstein People.Design

prewett bizley architects

Etude

Retrofit guidance developed for the ESSA Conservation Area

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

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

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

This document

Executive summary (1/4)

A joint effort between residents and the Council

Climate change is one of the main challenges of our time and it cannot be solved by Government alone. It requires coordinated action from residents and the Council, and every level of society.

Taking the ESSA Conservation Area to Net Zero

The Royal Borough of Kensington and Chelsea is targeting Net Zero by 2040 for the whole borough, leading by example with its own estate.

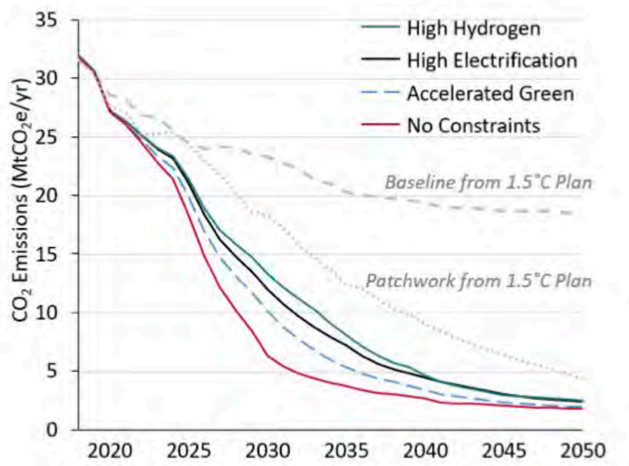
This means that conservation areas, which cover approximately 73% of the borough, need to achieve Net Zero by 2040 too. This retrofit appraisal and its associated guides for residents focus on the Edwardes Square Scarsdale and Abingdon (ESSA) Conservation Area but they will largely be relevant to other conservation areas in the borough.

This work has been commissioned by ESSA, with support and funding via RBKC Neighbourhood Community Infrastructure Levy (NCIL), in order to articulate how residents can put their homes on track to Net Zero and which retrofit measures should be generally supported in order to respond to both conservation and climate change responsibilities.

Conservation of our heritage and our climate

This study seeks to inform residents and show that it is possible for them to reduce their home's carbon emissions ambitiously whilst maintaining the character of the Conservation Area.

The Edwardes Square, Scarsdale and Abingdon (ESSA) Conservation Area Appraisal describes the historic and architectural character and appearance of the area.



The blue dotted line shows the carbon pathway adopted by the Mayor of London. It shows how decisive action is required over the next 10 years.

Executive summary (2/4)

Respecting the past and the future

The ESSA Conservation Area is an important Conservation Area in the Royal Borough of Kensington and Chelsea. The historic environment of the ESSA Conservation Area is a shared asset and a rich and diverse part of London's cultural heritage. We have a duty to preserve this heritage.

In parallel, we also have a duty to address climate change. All buildings have a role to play in that. Key objectives in this respect are to enable buildings to use less energy, to stop burning gas and other fossil fuels, and to contribute towards the generation of renewable energy. This can be achieved through planned and whole house retrofit programmes for individual or groups of properties.

ESSA's history and characteristics should inform the selection of suitable retrofit measures available to residents to decarbonise the their homes while making them more comfortable and sustainable.

The key challenge of implementing domestic retrofit at scale within conservation areas is balancing conservation objectives with management of sustainability-led change.

The importance of a 'whole house approach'

A 'whole house approach' to successful retrofit is championed by organisations ranging from Historic England to the Sustainable Traditional Building Alliance. Benefits can be maximised and risks minimised if the undertaking is premised on a thorough understanding of the asset including significance and context, building fabric condition and occupant needs.

The domestic architecture of the ESSA Conservation Area is distinctive and well loved.

Executive summary (3/4)

Simplifying the challenge and providing guidance to residents

There are many different types of buildings and construction types within the ESSA Conservation Area. Appropriate retrofit measures may differ depending on the building, but are broadly similar. In order to provide clear, actionable advice that is relevant to most buildings in the area, three 'Retrofit archetypes' were identified, and three distinct Resident Retrofit Guides prepared.

'Retrofit archetypes' are groups of buildings that share similar features and are likely to require similar interventions to make them low energy and compliant with Net Zero. Retrofit archetypes might be easily identifiable as belonging to the same group of buildings, but in some instances, they may also look different yet still require the same retrofit strategy.

Low carbon retrofit measures can be successfully integrated into traditional buildings

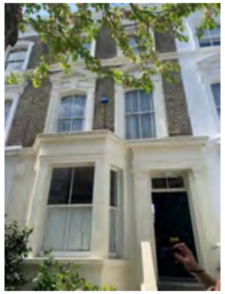
Retrofit measures are explored in Section 5 and grouped by:

- windows;
- insulation;
- air-tightness and ventilation;
- heating systems;
- renewable energy.

Consideration is given to each measure in the context of the Conservation Area, Listed Building status and characteristics of traditional buildings.

Replacement windows represents the biggest opportunity for energy savings. Wall insulation (internal or external) can deliver good energy savings but consideration should be given to the options, their effectiveness, moisture risks and level of disruption to occupants.

The transition to low carbon heat away from gas is a critical step for all buildings and generating renewable energy with roof-mounted PVs represent a significant opportunity.



Retrofit archetype 1

Victorian house

Retrofit archetype 2

Mansion blocks

Retrofit archetype 3

Modern house

Non-domestic

Three retrofit archetypes were chosen for which to develop detailed retrofit guides for residents (separate documents). These capture most housing types in the ESSA Conservation Area.

Executive summary (4/4)

The third perspective: the residents'

In addition to issues of conservation and climate change, building owners and occupants (the residents) are absolutely key to ensuring low carbon retrofit happens and is done in an appropriate and sensitive manner for the homes they live in. It is therefore important to provide high quality advice, clarity, and address as far as possible barriers that might discourage intervention.

Delivering these measures in practice

Disruption, cleaning and maintenance, cost and the ability to remain in the home while works are carried out are all considerations that residents will make when deciding which retrofit measures to do.

Take windows as an example - their improvement is crucial for energy efficiency. If choice is reduced, on all elevations, to evacuated glazing in similar frames or advanced secondary glazing, it may be restrictive to the extent that they may be discouraged by cost or the practicality of secondary glazing (e.g. cleaning, ventilation). Opening up the choice to a wider range of high performance high quality windows, particularly for the back elevations, is important and could help to enable more low carbon retrofits.

Clarity and appropriate advice

Developing a common understanding of what is likely to be acceptable from a conservation and planning point of view in the majority of cases is important for residents and officers alike.

The resident retrofit guides will help building owners and residents develop low carbon retrofit plans that achieve a successful balance between conservation and climate change.

These measures should be supported at a borough level

Conservation	Justifiable benefits outweigh conservation concerns		Conservation challenges
Residents	More challenging to residents due to disruption	Less challenging/ disruptive to residents	Less challenging/ disruptive to residents
Windows		• Triple-glazed single casement windows on back elevations • Evacuated glass sash windows on front elevations • Advanced secondary glazing on front elevations	• Triple-glazed sash windows on front elevations (mainly due to casement opening mechanism) • Triple-glazed single casement windows on front elevations (unless justified)
Airtightness & Ventilation	• Heat recovery ventilation	• Improvements to airtightness	
		• Continuous mechanical extract ventilation	
Insulation	• Internal wall insulation on front elevations and sensitive flank walls • Solid floor and suspended floor insulation	• External insulation on back and end of terrace elevations (depending on location) • Loft insulation	• External insulation on street elevations (unless rendered already and/or justified)
Low carbon heat		• Heat pump external unit on roof • Heat pump external unit in back garden (away from neighbours' windows) • Heat pump external unit between buildings	
		• Direct electric heating • Compact heat pump unit	• Heat pump external units in front garden (unless justified)
Solar PVs		• All solar PV installations	

Finding the right balance between conservation, disruption to residents and impact on energy use/carbon emissions climate change will be different for each property. Although all measures above help and should be considered positively, some of them have been highlighted in orange when there are more efficient alternatives.

Contents

1.0

The Edwardes Square, Scarsdale and Abingdon (ESSA) Conservation Area

The ESSA Conservation Area is an important conservation area in the Royal Borough of Kensington and Chelsea. Its history and characteristics should inform the selection of suitable retrofit measures available to residents to decarbonise the local housing stock and make it more comfortable and sustainable.

Summary of brief from the ESSA Conservation Area Association

The ESSA Conservation Area Association

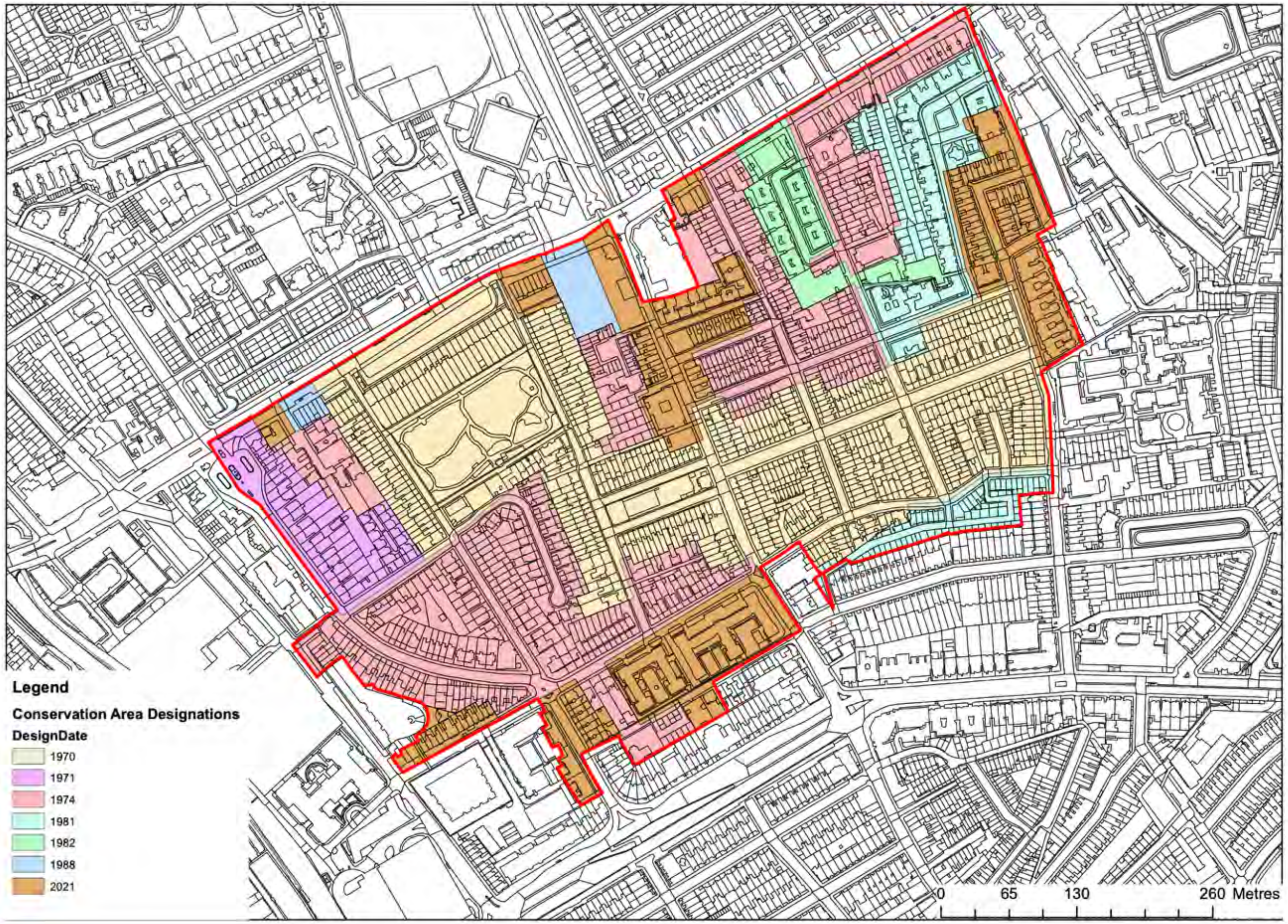
ESSA is a conservation association founded in 1970 to encourage high standards of architecture and town planning within and adjacent to the Edwardes Square, Scarsdale and Abingdon Conservation Area. Its committee of trustees includes members who are professionally qualified as well as interested local residents.

The ESSA Conservation Area and climate change

ESSA acknowledges that climate change is a complex and wide ranging issue and that tackling it is not something that Government can do alone. A comprehensive and collective effort is needed in which residents, local businesses, building professionals, RBKC and the Government should all play a role.

ESSA are also keen to address the concern that the pressure to achieve the borough's net zero carbon targets may lead to interventions that are not sensitive to the character and/appearance of the conservation areas, and therefore wishes to provide adequate advice to residents within these areas.

ESSA have obtained Neighbourhood Community Infrastructure Levy (NCIL) from the Council to develop retrofit templates for three housing archetypes in Abingdon Ward to showcase to homeowners and landlords the energy efficiency and low carbon improvements that can be achieved utilising the latest building refurbishment methods, materials, and technologies. This will enable a more consistent approach to conservation constraints and provide residents a helpful (and free) resource to identify the environmentally efficient retrofit solutions most likely to be suitable for their home.



The Edwardes Square, Scarsdale and Abingdon (ESSA) Conservation Area Appraisal Map. The different colours indicate the year when the different areas have been added to the conservation area from 1970 (yellow) to 2021 (orange)

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Why is retrofit so important?

Decarbonising existing housing is key to Net Zero

England currently has some 25 million homes. All of those will have to have some form of retrofit by 2050 while, in that time, we will have only built another six million homes. This means that 80% of the homes that will be present in 2050 have already been built. If we are to successfully decarbonise housing, retrofitting is where the real challenge lies: we need to increase our homes' energy efficiency, change their gas or oil heating system for a low carbon heat system (e.g. heat pump) and generate more renewable energy on their roofs.

Reducing fuel bills alongside carbon emissions

Whilst decarbonising homes is important to mitigate climate change, it is not the only reason to retrofit. Much lower energy bills are possible, helping to minimise the impact of higher energy prices.

Health and wellbeing

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

Better homes

Poorly maintained windows, brickwork and roofs all represent weak points, and more generally all homes need regular maintenance. However, well-planned retrofit can help with this by incorporating maintenance and repair, and offering a new lease of life to buildings. It reduces significantly the risk of under-heating by occupants worried about energy bills, and associated risks of fabric degradation. By being more comfortable, buildings are also more likely to remain valuable and well looked after in the future.

The United Kingdom is legally committed to achieve Net Zero by 2050. The Climate Change Committee provides supporting information on how this should be achieved in its Future of Housing report (2019), along with other documents (e.g. Construction Leadership Council's Greening our existing homes publication).

Low carbon

Low energy bills

Better comfort in winter

Better comfort in summer

Less noise from outside

Better indoor air quality

Better buildings for the future

The multiple benefits of retrofit

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

An important part of the borough

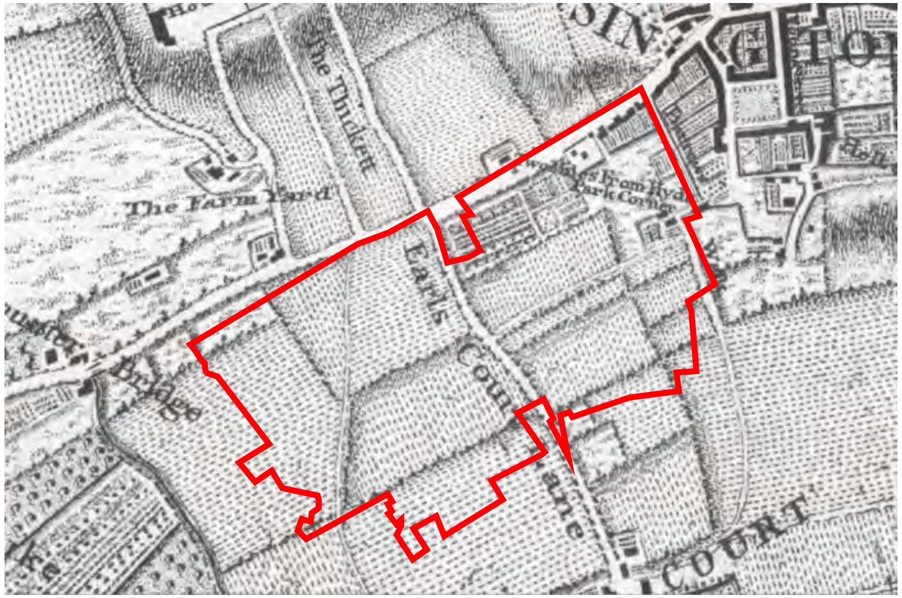
More than 70% of the borough is protected by 38 separate conservation areas and ESSA's development patterns are a microcosm of much of the borough including how pressures for change affect an area.

The ESSA Conservation Area epitomises the early nineteenth century urbanisation of the flat rich open fielded market garden countryside beyond Georgian London. It is rich in character and architecture with a history that supports an understanding of how variances in ownership patterns, evolving circumstance and aspiration can be read in the street layouts and the buildings.

There is also evidence of social change. The stabling facilities housed in the mews became redundant with the expansion of the railways and were converted into workshops and subsequently houses. The 1867 construction of High Street Kensington station increased housing demand precipitating intensification of the station surrounds.

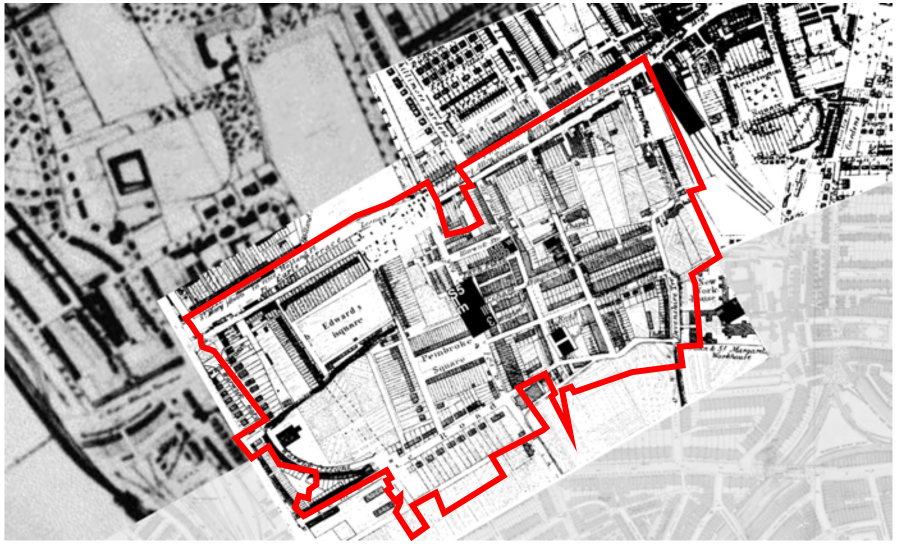
Many of the Abingdon villas were demolished and replaced by denser mansion blocks and even the station itself was redeveloped in 1906 to incorporate a shopping arcade.

The ESSA Conservation Area within the context of the borough's Conservation Areas and the Royal Borough of Kensington and Chelsea in the context of Greater London.



The ESSA Conservation Area superimposed on detail of Rocque's 1746 map around London

https://www.british-history.ac.uk/survey-london/vol42/plate-2



The ESSA Conservation Area superimposed on Edmund Daw's 1879 map prior to development of mansion flats

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The local housing stock in the ESSA Conservation Area

The ESSA Conservation Area today

Only 10% of the area's buildings are statutorily listed[1] but over 90% of the remainder are deemed to make a positive contribution to the historic and architectural character of the area.

The earliest western Regency square developments derive their character from the quirks of piecemeal development which contrasts with the cohesive regimented formal layout of the eastern half.

The changes in character between the area's squares and villas, its central grid and the small scale backstreets are unified by authentic high quality materials with hand finishes and imperfections that patinate with time. Most buildings have solid wall construction.

Small scale back-streets of introspective mews and studio enclaves contrast with the major terraces. The mews properties appear to have suffered the most from alteration having lost original barn doors, hay lofts and cornices but the major streetscapes remain unified despite the widespread removal of front boundary walls and the replacement of front gardens with forecourt parking spaces.

Typical houses

Many of the houses are variants of either basic terrace house or villas detailed with Italianate trimmings that are quite standard in Kensington terraces. The combination of stucco and brick is calibrated by ruled and rusticated plaster that gave the impression of masonry. The stucco was confined to basement and ground floors initially although in later areas it was applied to the whole frontage.

Typical mansion blocks

Archetypal London Edwardian red brick mansion blocks replaced earlier Italianate villas in the densely developed north east area just behind the high street. The predominant southern 1920's mansions are hybrid Deco English 'moderne' with flourishes of green pantiles.

[1] These buildings are all Grade II Listed except for the Grade II* listed church

Houses and mansion blocks form the majority of buildings in the ESSA Conservation Area

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2.0

The ESSA Conservation Area and the climate emergency: the objective of Net Zero

Achieving Net Zero is both about a **destination** (i.e. Net Zero greenhouse gas emissions by 2050 or earlier) and a **trajectory** (we need to start decarbonising now to stay within our remaining carbon budget). For existing homes, the scale, ambition and delivery of retrofit need to increase now if they are to be put on the right track to Net Zero in line with our Net Zero Carbon pathway.

Net Zero objectives

The UK must achieve Net Zero by 2050

In 2019, the UK government committed to achieving net zero carbon emissions by 2050. This is a legally binding target and is referred to in this report as the absolute backstop date. In 2021, the government set additional interim targets, including reducing emissions by 78% by 2035, which will require most homes in the UK to be on track towards Net Zero well in advance of the 2050 'backstop' date.

The Royal Borough of Kensington and Chelsea Net Zero objectives

Like many other local authorities across the UK, RBKC are aiming for the whole Borough to achieve Net Zero by 2040, ahead of the legal national objective. The Council has also set a Net Zero objective for their own operations (including controlled properties) by 2030.

Taking the ESSA Conservation Area to Net Zero

For the Royal Borough of Kensington and Chelsea to achieve its objective of net zero by 2040, its different areas all need to achieve net zero. This includes conservation areas, which cover approximately 73% of the borough. This strategic retrofit appraisal focuses on the Edwardes Square Scarsdale and Abingdon (ESSA) Conservation Area.

The crucial role of retrofit

Around 80% of the homes that will exist nationally in 2050 have already been built. Carbon was emitted when the ESSA homes were built, by the production, transport and assembly of bricks, metals, timber, stone and concrete, and we cannot afford to waste that material. Even aside from the aesthetic and historic value, there is a carbon value in existing buildings which means we must find ways to adapt, refurbish and reuse what we have, making it fit for the future, low carbon world that we have to create. The term 'retrofit' is used to describe this decarbonisation of the operation of existing buildings.


STATUTORY INSTRUMENTS

2019 No. 1056

CLIMATE CHANGE

The Climate Change Act 2008 (2050 Target Amendment) Order 2019

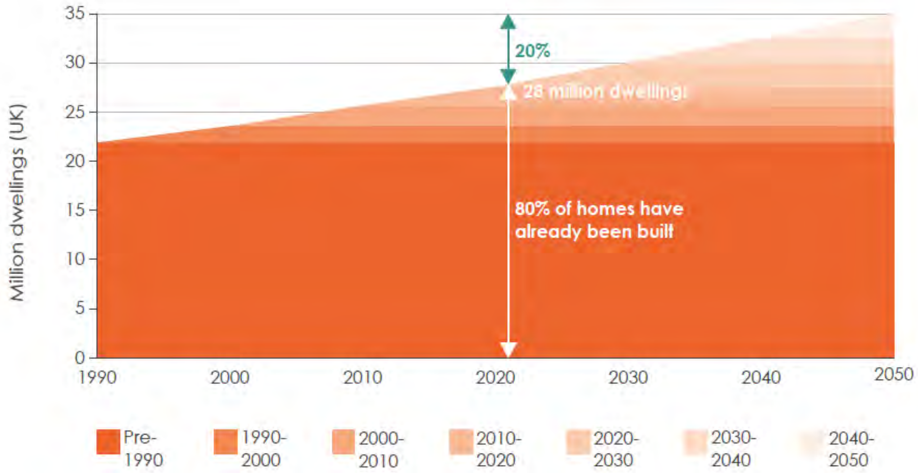
Made 26th June 2019

Coming into force in accordance with article 1

Net zero emissions targets have been set by national and local government policy.

Net Zero by 2050 is a national legal requirement set in the Climate Change Act (2008 with 2019 amendment) above.

RBKC has developed a Climate Emergency Action Plan in order to achieve Net Zero by 2040 as a borough (right).



Millions of dwellings built in the UK from pre-1990 to 2050. Note: demolition has been ignored in this table as the relatively small amount of domestic demolition is usually followed with replacement.

Source: LETI retrofit guide

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Low carbon retrofit needs to happen, and start now

Carbon budgets

The Tyndall Centre at the University of Manchester has developed carbon budgets. They represent recommended climate change commitments for UK local authority areas that are aligned with the commitments in the UN Paris Agreement and the maximum 2°C global temperature rise target.

Each local authority, including RBKC, is being given a maximum total amount of greenhouse gas emissions they can emit by 2050. If carbon emissions within RBKC remained at the current level, the entire RBKC carbon budget would be used **by 2028**.

Although a carbon budget has not been identified for the ESSA Conservation Area, if the same approach had been taken, the carbon budget for the ESSA Conservation Area would be in proportion to that for the wider RBKC area and the timescale for substantive action to be taken is the same. This highlights the urgency and scale of carbon reduction required withing the ESSA Conservation Area.

Start now, learn and share

As a large proportion of the ESSA Conservation Area greenhouse gas emissions comes from its housing stock, the Net Zero ambition needs to be translated into retrofit, with a rapid switch away from gas for heating a key objective. The task may seem overwhelming, and there are real or perceived barriers to retrofit including cost, disruption, conservation and planning. However, making a meaningful start now will help to focus efforts and address these barriers. There can then be a rapid acceleration once the process begins and residents can see exactly what they need to do and how to do it.

Social media will allow the dissemination of knowledge on retrofit amongst residents. This would include experience (good and bad), information and recommendations on suitable products and techniques, as well as on good tradespeople (e.g. window replacement and heat pump installation).

6.3 $MtCO_2$

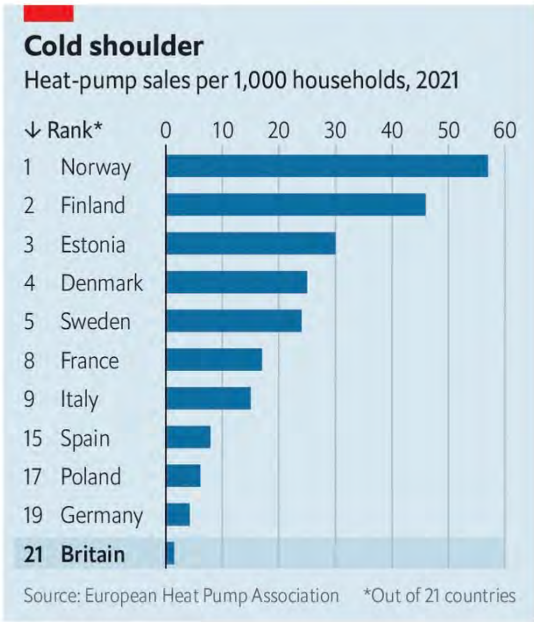
Estimation of RBKC's portion of the **remaining carbon budget** for staying well below 2°C global temperature rise.

5 years

The number of years it would take RBKC to **consume its entire carbon budget** at current emissions rates

Tyndall Centre carbon budget report for RBKC in numbers.

Figures relate to CO_2 from energy only and cover energy used by buildings and transport. Decarbonisation of existing housing stock is a crucial action area.



The Economist

Heat Pumps are critical to delivering net zero

The UK is falling well behind other European nations in the roll out of heat pumps to householders.

It can also be seen that heat pumps are popular in both colder and warmer climates.

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Getting our homes on track to Net Zero: what does it mean?

An ambitious objective, delivered in steps

The objective of a retrofit project should be to achieve Net Zero Carbon by 2050 (or earlier) and although getting our existing homes on track towards Net Zero is a challenge, it can be done.

Practically, it means that:

- The home's energy efficiency is improved.
- A low carbon heating system is installed.
- Renewable energy is installed on-site.
- The home is made smart ready.

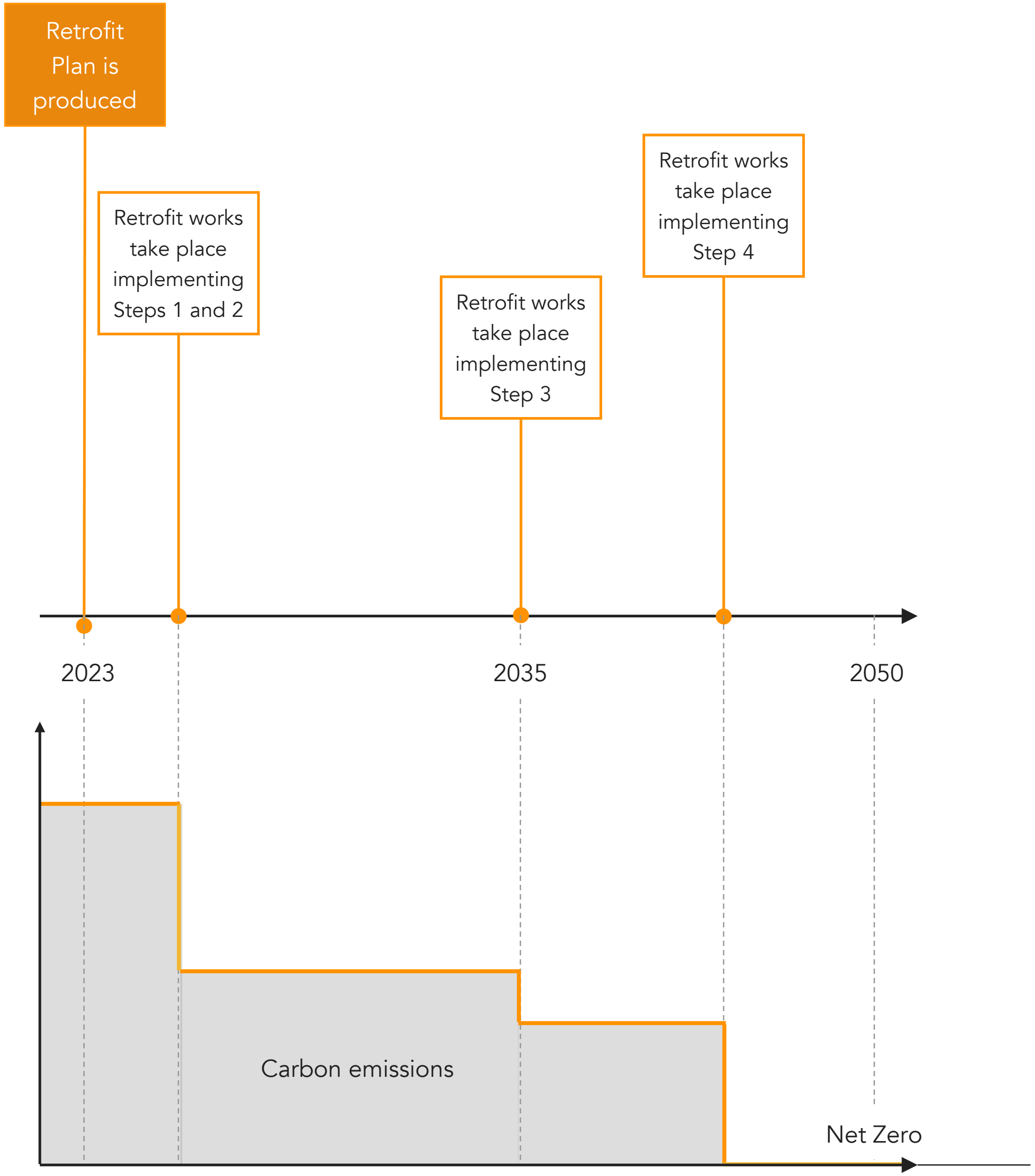
A whole house retrofit plan that breaks down this ambitious target into manageable steps is a useful strategy as it provides a pragmatic and coherent way to deliver the works over a long period of time.

Phasing improvements as part of coherent whole house plan

It may not be possible to implement all retrofit measures at once, but it is important to plan ahead so that packages of work are coherent and complementary. The preparation of a whole house retrofit plan is recommended to help in that planning.

A bespoke sequence of work

Each home is different, and each homeowner is unique, so the individual whole house plans will all be bespoke to that property. The steps needed may be similar, but the choices about what to do when may be influenced by financial, practical or maintenance considerations. For instance, a busy family may want to do as much as possible at one time to avoid long term work ongoing, but a couple on a fixed income may need to space the work out over a longer period to make it affordable. If the boiler is very old and likely to fail, the heat pump work may be done earlier than where the boiler is fairly new.



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

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What is space heating demand and why is it an important indicator?

The root of the problem

The vast majority of carbon emissions in an existing home is due to gas, a fossil fuel, being used by the boiler to heat the home. Worse, most homes are not energy efficient, leaking and losing heat through the building envelope, which often creates connected issues such as poor comfort or fuel poverty, when heating their home becomes an excessive part of someone's budget.

Reducing the need for heating therefore helps to reduce energy use and bills and also to improve comfort, but there is another crucial reason to do it: enable a move away from gas boilers and 'electrify' heat. This is why most retrofit will focus on reducing the need for heat, which professionals refer to as the 'space heating demand'.

The importance of a space heating demand threshold

Although heat pumps can work in any home, they may need extra radiators compared to a standard gas boiler and can cost more to run too. If space heating demand is reduced sufficiently, they may be able to work with the current radiators and the energy bills are likely to go down. Reducing space heating demand to a threshold level of 80-100 kWh/m^2.yr (or less) is therefore a recommended objective.

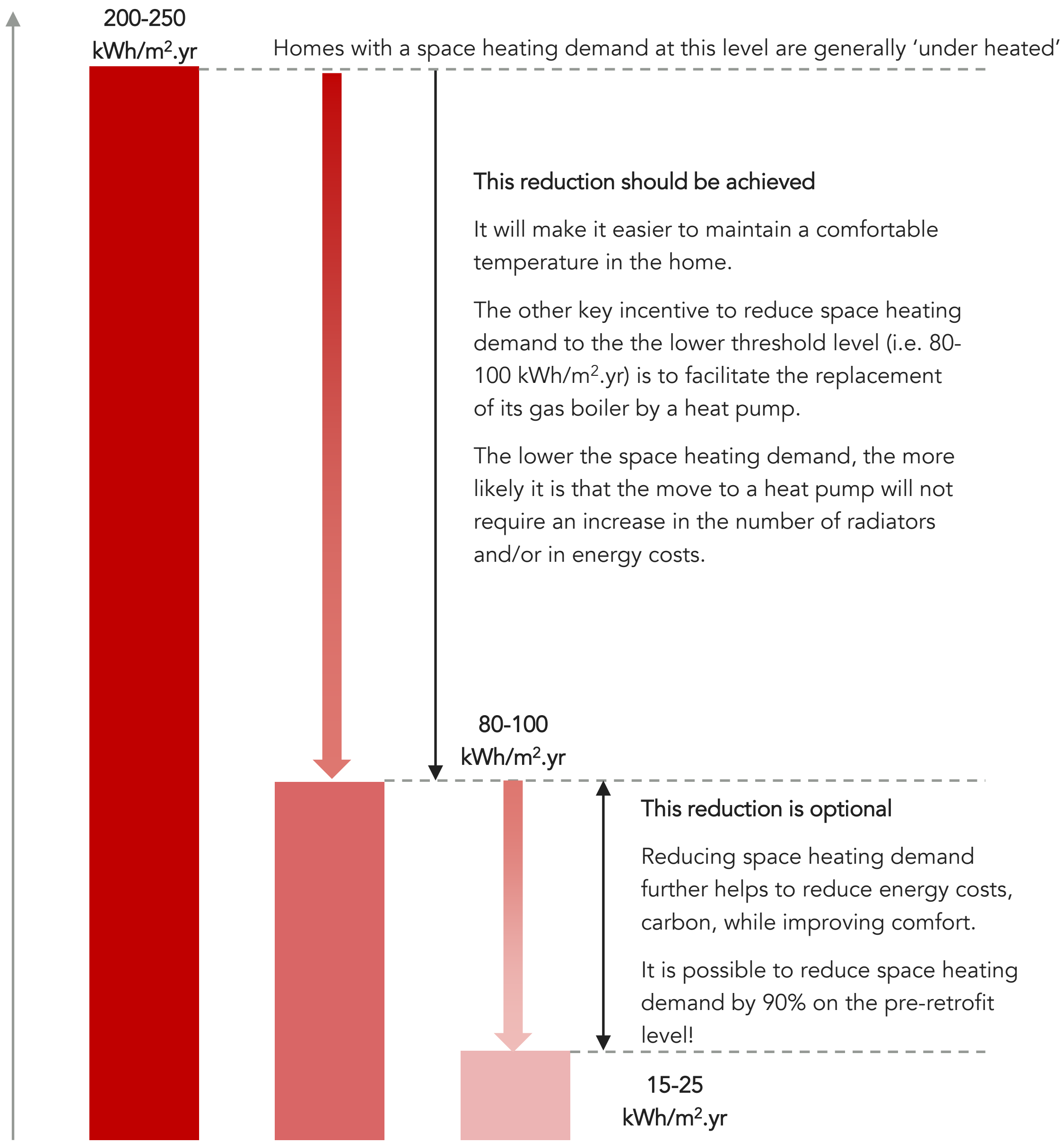
The transformative impact of a heat pump

A heat pump is critical as, coupled with a move to induction cooking, it will enable to disconnect the building from the gas grid. And heat pumps have other benefits: they do not create local air pollution or represent a health & safety risk as gas boilers do. When designed, installed and commissioned properly, they are also efficient at using electricity to generate heat: a ratio of 1:3 is readily possible. Finally, their capital costs is reducing.

Each home is different, each home will be different

Beyond this threshold we anticipate that some homeowners/landlords will want to reduce their space heating demand to continue to save energy, costs and carbon, while others may not go further.

Space heating demand in a typical home



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3.0

Conservation and Net Zero: a clear framework is required

The key challenge of implementing domestic retrofit at scale within conservation areas is balancing conservation objectives with management of sustainability-led change.

By fostering an understanding of what contributes to the area's uniqueness, it should be possible to address the drivers for change, whilst minimising changes that threaten or diminish the place.

What are the key issues in terms of conservation?

Retrofit must happen, and be respectful of conservation

The historic environment of the ESSA Conservation Area is a shared asset and a rich and diverse part of London's cultural heritage. We have a duty to preserve this heritage.

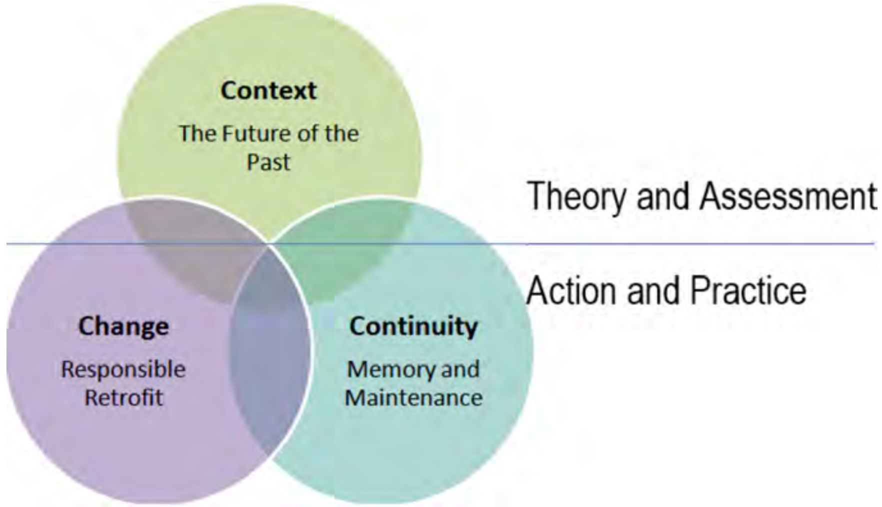
However, it is also very important to acknowledge that retrofit plays a key role in supporting the Government's wider environmental, economic and social objectives.

Many perceive conservation and retrofit coming from opposite ends of the spectrum, one resisting change and the other promoting change but they both share the common objectives of sustainable management of change. Homeowners, landlords and the Council's drive to retrofit homes towards Net Zero will therefore need to reconcile with the sensitivities of the area's listed buildings and of the conservation area's character.

Whole house retrofit plans to manage change successfully

A 'whole house approach' to successful retrofit is championed by organisations ranging from Historic England to the Sustainable Traditional Building Alliance. Benefits can be maximised and risks minimised if the undertaking is premised on a thorough understanding of the asset including significance and context, building fabric condition and occupant needs combined with changed usage and improvements to operational system controls.

Reduced carbon emissions, energy bill reductions and increased occupant comfort works can all be incrementally phased through holistic planning that ensures that the character of a building is maintained. Successful heritage management is achieved by respecting and understanding historic significance whilst accepting the need for change and improvement.



Historic England's Heritage Cycle is similar to the Sustainable Traditional Building Alliance's Whole Building Approach. A balance should be found between a building's context (its history, setting and future), its potential for change, and demands for continuity (including maintenance).

Retrofit has been delivered successfully in a growing number of conservation areas

(Credits for images above: Studio PDP, Prewett Bizley, bere:architects, Arboreal)

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Key conservation concepts: heritage values, levels of significance and potential for change

Assessing change in relation to conservation

Historic England's Conservation Principles state that: '*Change is only harmful if (and to the extent that) significance is eroded*'. They define significance as 'a *collective term for the sum of all the heritage values attached to a place*'.

The level of listing, its significance and potential impact of change on the character of a place or building are determinants of what type of consent is required. By understanding what is important about a place and the degrees of significance, rational decisions can be made about how to conserve it.

Listings apply to entire buildings and conservation area designations cover all structures and landscape features within that area but not everything is of equal value, so the relative significance of contributing elements is assessed according to a hierarchy ranging from exceptional/highest to low significance in relation to the four main heritage values explained opposite.

Potential for change within the ESSA Conservation Area

There is a time honoured tradition of adapting buildings to meet evolving needs. By changing as much as necessary but as little as possible, sensitive retrofit can continue this tradition of performance upgrades and respectful improvements.

The significance of buildings, spaces, places or elements is an amalgam of different heritage values

Heritage values

- **Evidential value:** what evidence does it reveal about the past and what potential for new knowledge is there in the fabric of the asset?
- **Historical value:** how does the asset or its features support a narrative of the past and what are its associations?
- **Aesthetic value:** how do people engage with the asset emotionally both in respect of the original design and the way that the place has evolved?
- **Communal value:** how does the asset bring people together as a community and how is it valued for its social role?

Levels of significance

- **Exceptional significance:** Assets or elements that are essential to the significance of the place and play a crucial role in supporting this significance that are important at the highest national or international levels.
- **High significance:** Buildings or features which make an important contribution to the architectural and historic interest and character of the site. through age, rarity, architectural merit or historical association or group value
- **Moderate significance:** Elements making a lesser contribution, which are considered worthy of preservation or enhancement although there is usually scope for adaptation.
- **Low significance:** Elements or buildings making only a limited contribution to the site overall that may have been compromised by later changes
- **Detracts:** Structure or feature that harms the value of a heritage asset. Removal of negative features should be considered, taking account setting and enhancement opportunities

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Heritage value and significance in the ESSA Conservation Area

Key considerations for the ESSA Conservation Area

Streetscapes of stuccoed villas are one of the defining characteristics of Kensington but one of the most significant aspects of the ESSA Conservation Area is how it exemplifies the evolution of the city.

The restrained Georgian Edwardes Square brick terraces echo Bloomsbury, later squares such as Abingdon are closer in character to Chelsea's half rendered facades but the fully rendered Italianate villas are archetypal Kensingtonian. Its range and characteristics suggest a robustness that can maintain its special interest whilst continuing to evolve. 10% of the area's buildings are listed.

The street frontages constitute the most significant fabric. The rear elevations could be more tolerant in some specific locations, although they can be visible from the adjacent streets and care need to be taken to conserve consistent materials and fenestration.

Key opportunities within the ESSA Conservation Area

Routine maintenance and end of life cycle replacement works can provide opportunities for the reversal of harm with sympathetic replacement of elements which detract.

Combining these works with the implementation of environmental upgrade works has the added benefit of reducing overheads and operational disruption:

- **Insensitive UPVC windows or decayed / under-performing timber windows can be replaced** with high performance timber windows, ranging from high performance replica vacuum glazed windows to triple-glazed windows.
- **External rear walls altered or in need of repair could be insulated and improved.** The Conservation Area Appraisal places as much emphasis on the rhythms and voids of the rear elevation projecting closet wings as it does on the materiality of rear elevations. Rendered rear walls could therefore be insulated externally as could rear brick walls in specific locations.

Buildings audit map from the ESSA Conservation Area Appraisal showing the contribution made by buildings to the historic and architectural character of the area

Examples of poor quality window replacements that invite high performance window upgrades that can enhance the character of the conservation area.

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Permitted development, planning permission and listed building consent

Permitted Development Rights

For **houses**, some key retrofit works fall under Permitted Development (PD) rights. These include window replacement, heat pumps and solar PV installation. In each case, there are limits applied and relevant guidance (see adjacent text box) , but the presumption is that they are, or should be, permitted. For **flats**, Permitted Development (PD) rights unfortunately do not apply (except in some cases to solar PV installations).

ESSA Conservation Area Article 4 directions, which negate specific PD rights in the area, generally are not concerned with these issues. However, a small number of properties are affected by limits on 'minor alterations'. These generally refer to hardstanding for vehicles or boundary fences, so are not relevant. One, for Inkerman Terrace, relates to any alterations to the rear elevations, which could be more problematic for those houses. Over-cladding is not generally Permitted Development (e.g. on brick elevations).

Planning permission

Planning permission will therefore be required for External Wall Insulation and any measures which do not fall within the PD limits (e.g. triple-glazed casement windows at the back).

Listed building consent

PDs do not apply to listed buildings (which represent around 10% of the buildings in the ESSA Conservation Area).

Clarity where there are no Permitted Development Rights is required

The absence of PD rights for flats and the houses in Inkerman Terrace means that those residents will have to apply for planning permission for the same retrofit works as those which benefit from PD rights for most houses in the area. In order to help them, RBKC could clarify whether those works are likely to be considered positively, provided they demonstrate compliance with the requirements and limitations associated with PD rights.

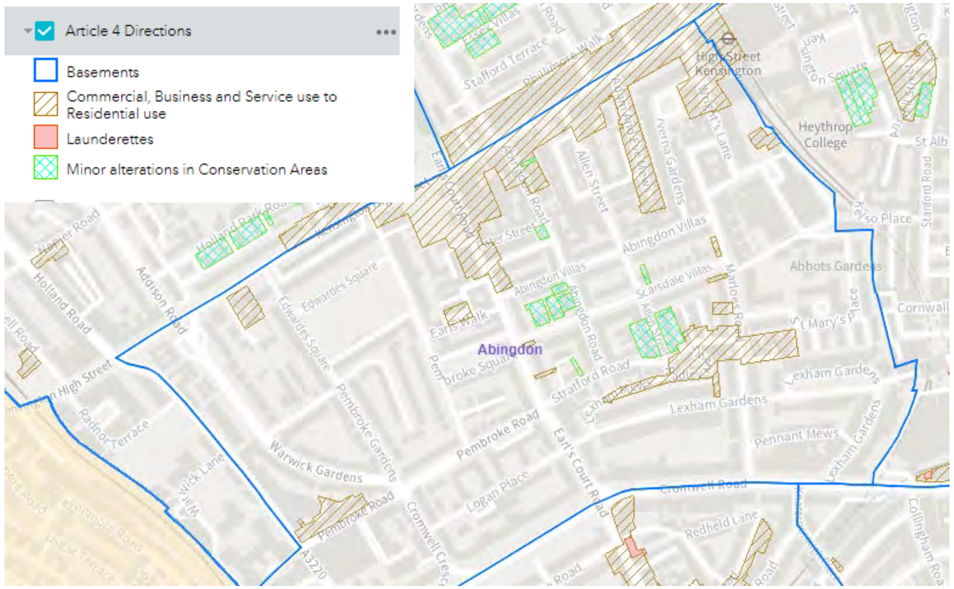
Permitted development (from the Planning Portal)

Windows replacement: "*You do not usually need to apply for planning permission for [inter alia] insertion of new windows and doors that are of a similar appearance to those used in the construction of the house or installation of internal secondary glazing.*"

Heat pumps: "*The installation of air or ground source heat pumps or a water source heat pump on domestic premises is usually considered to be permitted development, not needing an application for planning permission.*" Please note that the installation has to comply with specific requirements though, e.g. location.

Solar panels: "*The installation of solar panels and equipment on residential buildings and land may be 'permitted development' with no need to apply to the Local Planning Authority for planning permission [subject to limits and conditions].*"

Please refer to the Planning Portal for more details and qualifications.



Map of Article 4 Directions in ESSA (Source: RBKC website). A small number of properties (in green) do not have Permitted Development Rights for 'Minor Alterations'.

4.0

Retrofit archetypes and retrofit templates for the ESSA Conservation Area

This section explains the concepts of retrofit archetypes and whole house retrofit templates.

It introduces the three retrofit archetypes selected for the ESSA Conservation Area and their associated whole house retrofit template.

Developing a specific retrofit plan for your home

What is a whole house retrofit plan?

Understanding which retrofit measures are likely to be required for your home will help you develop a specific retrofit plan.

The term 'whole house retrofit' has emerged over recent years as a fundamental concept underpinning successful retrofit projects. It defines an end point and helps to make sure that the type of works, their sequence and interaction are considered as a whole.

It may be implemented over a long period of time but ensures the coherence of the works and the quality of the end result.

ECOFURB
The Low Carbon Home Service

Ecofurb Plan

8. Phasing your improvements (continued)

The measures recommended below aim to significantly reduce your energy use, annual energy costs and CO_2 emissions. This demonstrates a good range of the possibilities available. We can of course limit recommendations to your more immediate needs to fit within your current budget.

Phase 1 Measures	Estimated Costs	Energy Rating	Fuel Bill	tCO_2
Where you are now	**Per Measure**	**58 D**	**£1,320**	**5.73**
Low energy lighting	£80	60 D	£1,260	5.66
Block open chimneys	£480	61 D	£1,230	5.55
Install PV system where potential has been identified	£4,170	69 C	£920	5.02
External insulation to pre 1900 solid walls	£16,890	79 C	£580	3.25
Part L insulated doors	£1,560	79 C	£570	3.20
Triple glazing from partial single	£7,240	81 B	£520	2.95
After Phase 1 Measures		**81 B**	**£520**	**2.95**
Package Cost & % Improvements	**£30,420**		**61%**	**49%**

Phase 2 Measures	Estimated Costs	Energy Rating	Fuel Bill	tCO_2
After Phase 1	**Per Measure**	**81 B**	**£520**	**2.95**
ASHP (55 degree emitters) with existing radiator central heating and hot water, from C rated gas boiler	£12,000	81 B	£540	0.95
After Phase 2 Measures		**81 B**	**£540**	**0.95**
Package Cost & % Improvements	**£12,000**		**-4%**	**68%**
Cumulative Cost & % Improvements	**£42,420**		**59%**	**83%**

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Whole house retrofit plans have been used by retrofit professionals for a number of years to assess a building pre-retrofit and recommend retrofit measures as part of a coherent plan, either in a single phase or over a long time. The image above is an example of a whole house retrofit plan (Image source: Ecofurb - Please note that the cost estimated above are also from Ecofurb)

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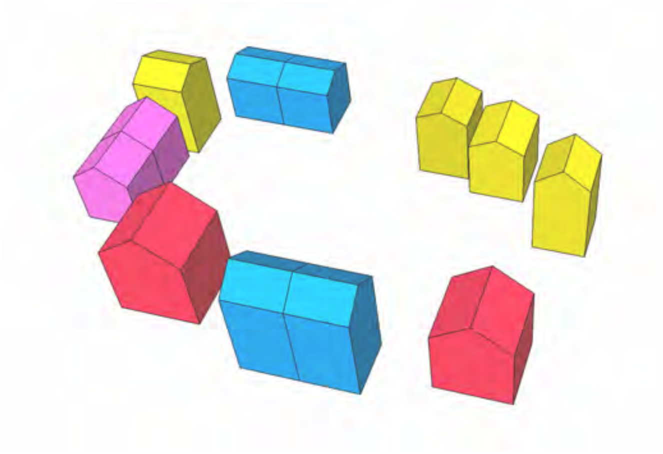
How retrofit archetypes help simplify the retrofit challenge

What are retrofit archetypes?

‘Retrofit archetypes’ are groups of buildings that share similar features and are likely to require similar interventions to make them low energy and compliant with Net Zero. Retrofit archetypes might be easily identifiable as belonging to the same group of buildings, but in some instances, they may also look different yet still require the same retrofit strategy.

Three retrofit archetypes have been identified by ESSA. Once retrofits start to get delivered, knowledge can develop on an archetype by archetype basis, helping residents in the ESSA Conservation Area to share lessons learnt on retrofit measures and supply chain.

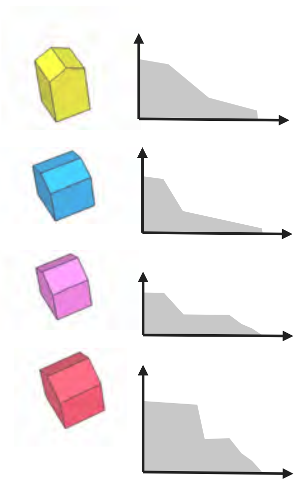


Identifying retrofit archetypes through the definition of a set of retrofit measures, helps to identify homes which are likely to share similar interventions. Each home is different obviously so the retrofit plan for each archetype will have to be made specific. However, it provides residents with a very useful ‘template’.

Retrofit is a complex, multi-faceted, and ‘personal’ challenge

Each house and block of flats in the ESSA Conservation Area is different. Their levels of insulation, their heating systems, their current condition are all different. What can/should be done to improve them will also vary and may be constrained by heritage, architectural or technical considerations. Equally importantly, the individual circumstances of each resident will vary: their age, their financial means, their attachment to their property and how likely they are to stay or move out in the future. Some residents may also be more motivated than others by reducing their energy bills and. Very importantly, some may able to pay for retrofit in one single phase while others will have to plan it over the next 20 years.

The concept of ‘retrofit archetypes’ seeks to simplify the retrofit challenge by creating whole house retrofit templates. They will provide an advanced starting point for residents interested in starting their low carbon retrofit journey.



Each retrofit archetype will significantly reduce their carbon emissions despite having different starting points, retrofit measures and carbon pathway.

Some homes may be able to improve energy efficiency more than others or some will find it easier to install a heat pump. There is a solution for each home to improve it, put in on track to Net Zero and deliver high levels of comfort.

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Introducing the three home retrofit archetypes for the ESSA Conservation Area

A specific retrofit guide has been prepared for each archetype.

It has been informed by building surveys and three different energy models. The adjacent diagram summarises the following indicators for each archetype:

- Current estimated level of energy use intensity (in kWh/m^2.yr).
- Proportion of this energy use generated by renewable energy on-site.
- Whether it is using fossil fuel on site for heating, hot water and/or cooking.
- Its level of greenhouse gas emissions in 2035 if no retrofit takes place.

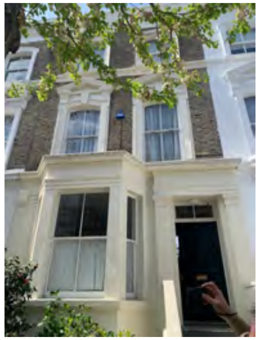
Although our work is based on visits to and inspections to specific dwellings where homeowners kindly opened their doors to us, it is important to note these building archetypes should be considered as 'typical'.

Retrofit archetype 1

Victorian house

4 stories including lower ground floor

Mid terrace



210 kWh/m^2.yr energy use

0% renewable energy generation

Gas used for cooking, heating and hot water

6.25 Tonnes CO_2 (2035)

Retrofit archetype 2

Mansion block

Typical intermediate floor flat
Top floor flat
Lower ground floor flat

280 kWh/m^2.yr energy use

0% renewable energy generation

Gas used for cooking, heating and hot water

6.30 Tonnes CO_2 (2035)

Retrofit archetype 3

Modern house

3 stories including lower ground floor

Mid terrace

179 kWh/m^2.yr energy use

0% renewable energy generation

Gas used for cooking, heating and hot water

6.83 Tonnes CO_2 (2035)

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

The adjacent retrofit archetype map identifies which retrofit archetype is likely to be the closest match to houses and blocks of flats in the ESSA Conservation Area.

Retrofit archetype 1

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

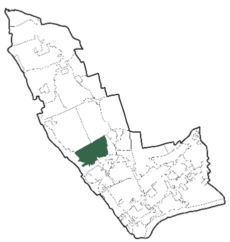
Retrofit archetype 2

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

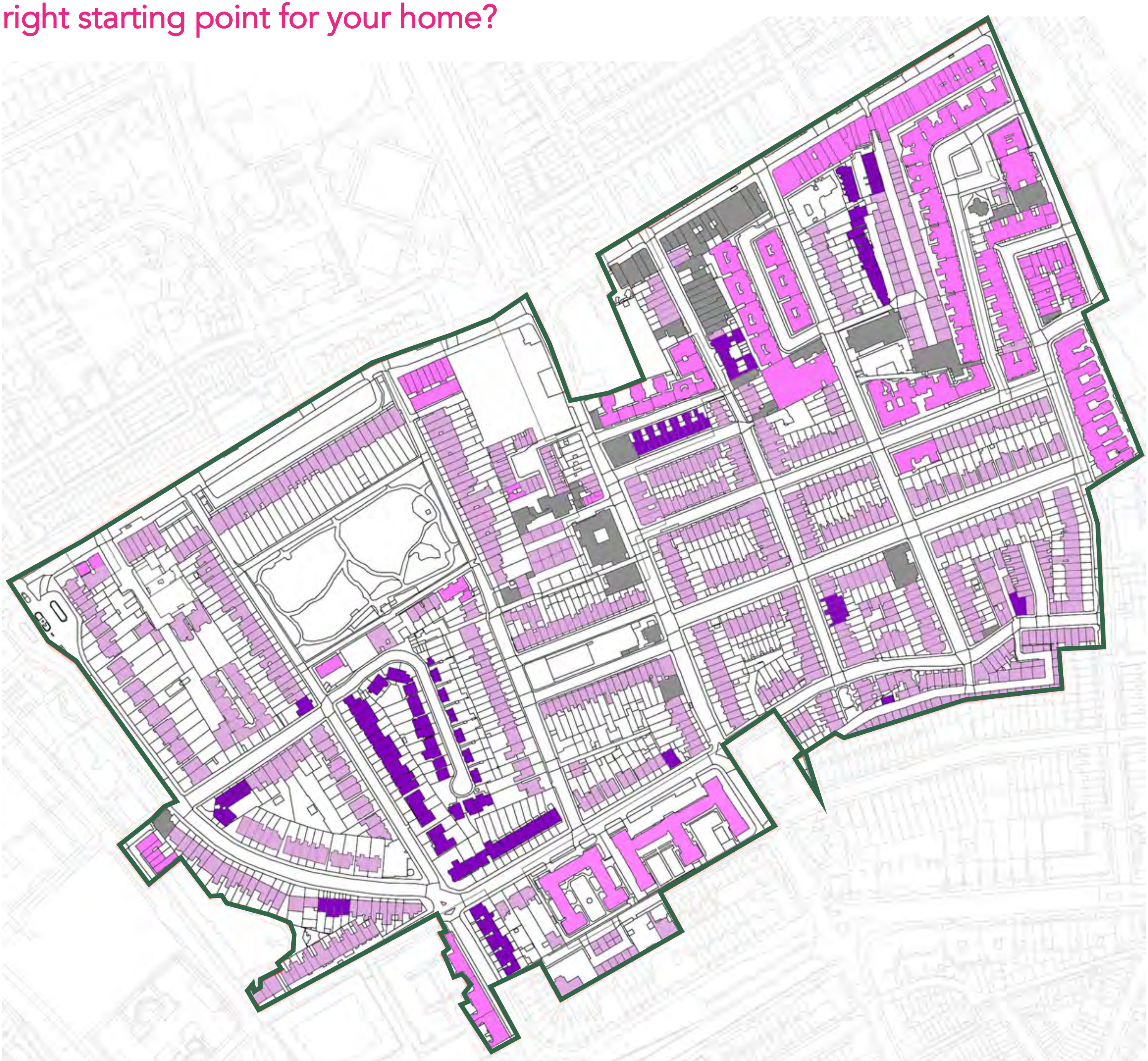
Retrofit archetype 3

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

Non-residential



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



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

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Archetype 1 | Victorian house

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

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

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

Lexham Mews

Pembroke Road

Warwick Gardens

Warwick Gardens - rear

Stratford Road

Earls Court Road - rear

Pembroke Mews

Pembroke Road

Abingdon Villas

Abingdon Road

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Archetype 2 | Mansion blocks

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

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

Pembroke Road

Pembroke Road

Pembroke Square

Pater Street

Wrights Lane

Wrights Lane

Cromwell Crescent

Abingdon Villas

Cheniston Gardens

Kensington High Street

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Archetype 3 | Modern house

A variety of characteristics and constraints are common to houses which form Archetype 3, which covers a wide range of different types of houses which may not look similar. Some of them may look like they should be in Archetype 1 but as they actually share similar retrofit solutions to Archetype 3, they have been incorporated into this archetype.

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

Cromwell Crescent

Pembroke Gardens

Warwick Gardens

Pembroke Gardens

Pembroke Road

Warwick Gardens

Cope Lane

Cope Lane - rear

Abingdon Road

Abingdon Road

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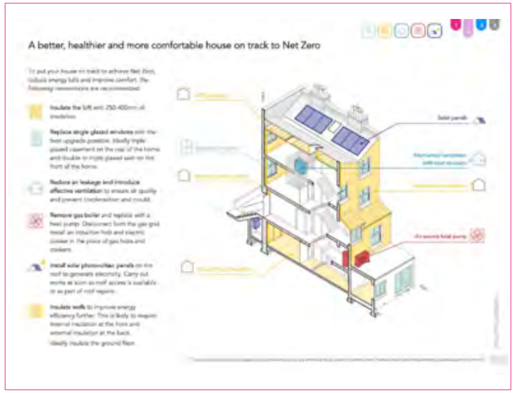
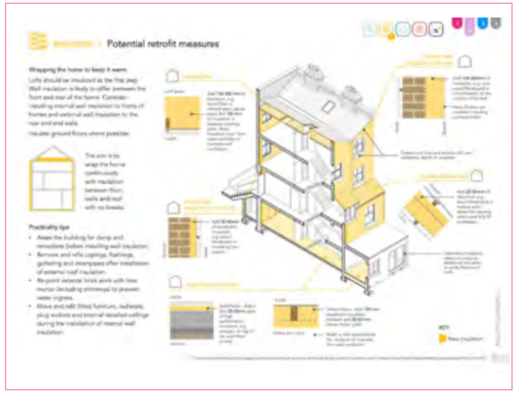
Introducing the ESSA retrofit guides for residents

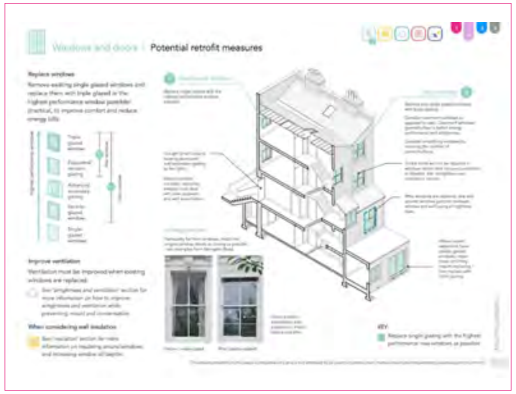
We have developed three retrofit guides for residents, one for each retrofit archetype, illustrating which retrofit measures are likely to be suitable.

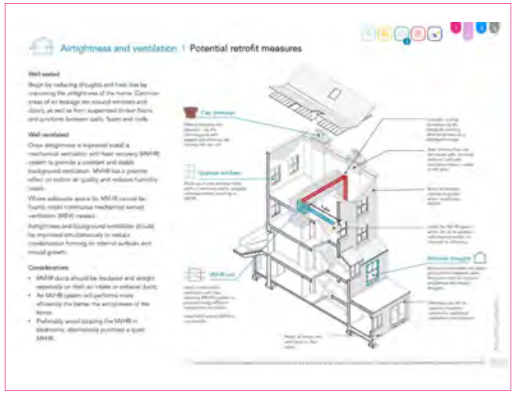
These guide are available as separate documents.

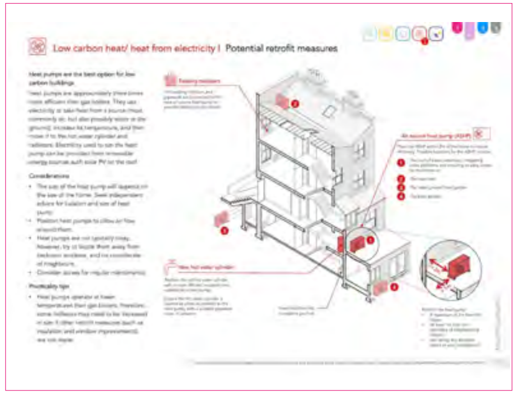
The adjacent images provide a snapshot of these guides and the efforts made by ESSA and the team to make them as clear and graphical as possible.

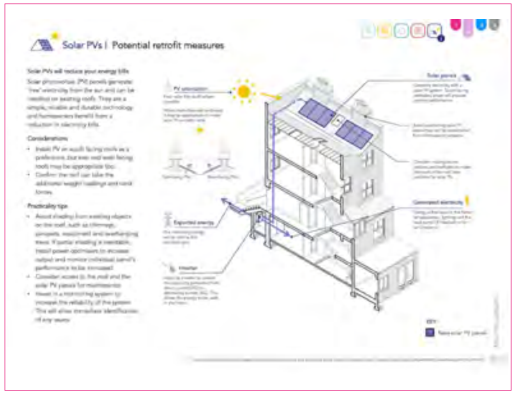


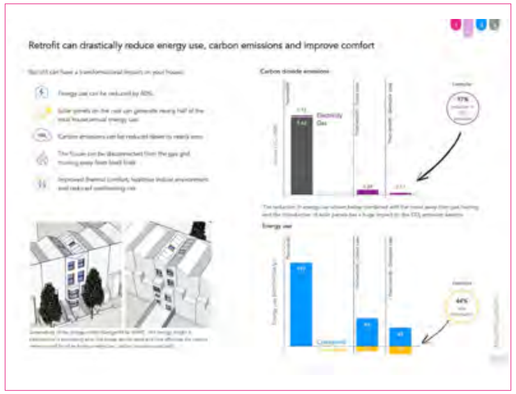












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5.0

Key retrofit measures

This section summarises the different types of measures which generally form part of a low carbon retrofit. They are grouped into two different categories:

- **Building fabric and ventilation:** windows, insulation, airtightness and ventilation
- **Bolt-on technologies:** low carbon heating systems (e.g. heat pumps) and solar PVs

Conservation, net zero and the residents' perspective: developing a common understanding

All measures will, to a greater or lesser extent, be disruptive. Some residents will want or need to remain in their homes during the work. More major renovations might require owners to move out. In summary:

- **Wall insulation:** Internal wall insulation can be more challenging for residents than external wall insulation (e.g. disruption, loss of floor space, introduction of retrofit risks, potential ceiling details).
- **Windows:** advanced secondary glazing may introduce issues in terms of cleaning and ventilation. Evacuated glazing may appear too expensive to some residents.
- **Ventilation:** Mechanical Ventilation with Heat Recovery may be challenging to install if internal works are minimal.

An integrated hierarchy of retrofit measures which takes into account the residents' perspective alongside conservation should be developed:

1. **Loft insulation** needs to be done with care but ticks all boxes: it is not a concern in terms of conservation, will improve energy efficiency and is beneficial to residents without being disruptive.
2. **Windows** are likely to be the most important energy efficiency move. Residents should have the choice between a range of high quality high performance window, especially for rear elevations.
3. **Airtightness and ventilation** need to be considered alongside window improvements and should not represent a conservation concern.
4. Moving away from gas to incorporate a **heat pump** system is the most crucial move to radically reduce carbon emissions.
5. Incorporating **solar panels (PVs)** on the roof would tick all boxes and should be done when the opportunity arises. (e.g. roof repair).
6. **Wall insulation** is more complex: internal wall insulation is favoured for conservation but it is more disruptive. Allowing external insulation in specific locations would be very positive.
7. **Ground/basement floor insulation** is ideal but can be challenging, particularly for solid floors for which the options are to dig up the floor slabs or to affect the floor level, which has implications.

Retrofit measures are more likely to be implemented by residents if they are less challenging/disruptive

	More challenging/ disruptive for residents during installation or operation		Less challenging/ disruptive for residents during installation or operation
Windows		• Secondary glazing	• Evacuated glass sash single glazed windows on front elevations • Double or triple-glazed sash windows
Airtightness & Ventilation	• Heat recovery ventilation (supply and extract)	• Continuous extract ventilation	• Improvements to airtightness
Insulation	• Internal wall insulation • Ground/basement floor insulation	• External insulation on all back elevations and plain flank elevations	• Loft insulation
Low carbon heat		• Heat pump in difficult to access location (e.g. roof)	• Heat pump in easy to access location (e.g. back garden) • Direct electric
Solar PVs			• All solar PV installations

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5.1

Building fabric and ventilation

Windows

Between 30 and 50% of heat loss is due to windows.
This can be reduced significantly and represents the most significant energy efficiency opportunity.
That is why a ‘best window alternative’ possible approach is proposed.

Windows in the ESSA Conservation Area

Windows in the ESSA Conservation Area

Window arrangements across the area are as varied as the housing types with the most prevalent feature being the slenderness of the glazing bars. Single glazing in white painted timber frames dominate, some with glazing bars and some without. Many of the original fenestration patterns remains in place although many of the steel windows have been replaced by UPVC frames, and many of the timber windows will already have been altered/repaired.

Balancing conservation with retrofit

Authentic materials (e.g. timber) combined with modern glazing technology can deliver very significant gains in energy performance whilst maintaining very similar appearance and sightlines.

Window upgrades are critical

The figure on page 37 highlights the tremendous reductions in heat loss that windows can provide, higher than all other fabric measures. They should be a fundamental part of all retrofit plans and an early step.

Single paned casements or sashes could be replaced with high performance triple glazing

Multipaned sashes might suit advanced secondary glazing or might be re-glazed/replaced with slimline double/triple glazed units set in modified astragals, or evacuated glazed sashes with plant on glazing bars.

Intricate windows or leaded lights can be upgraded with high performance secondary glazing

Windows in the ESSA Conservation Area

Windows and heat loss

The architectural styles of the house and blocks gives rise to generally large scale single glazed window openings, which in turn predicates very high heat loss (due to simple conduction as well as high levels of infiltration due to old frames that fit poorly). **Almost half of the heat loss for the townhouse typology is directly associated with original single glazed windows.**

Window patterns and solutions

There is a variety of casement windows, single pane sash windows, and different types of multi pane sash patterns.

There appears to be a roughly equal distribution of sash windows that are: 1-over-1, 2-over-2, 3-over-3, and 4-over-4; there are also some that have 6-over-2 panes, for example.

Depending on the window type and pattern different approaches are likely to be more or less appropriate. Any intervention should seek to be both sympathetic and to maximise the energy efficiency outcome.

Some of the best performing options that are also in keeping with the context are shown on the following pages.

Other benefits

As well as reducing heat loss and condensation, window upgrades can greatly enhance the acoustic separation between inside and outside, a matter of high importance in a dense urban environment.

Single glazing tends to give rise to much higher amounts of surface condensation than modern insulating glass, due to the lower surface temperatures is tends to reach during winter.

Staining, moulid and decay are commonly found on single glazed windows with regular large amounts of condensation.

Example of an Edwardian casement window with poor attempt to fit a draft seal.

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Window solutions | The most crucial energy efficiency measure

Why are windows so important?

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

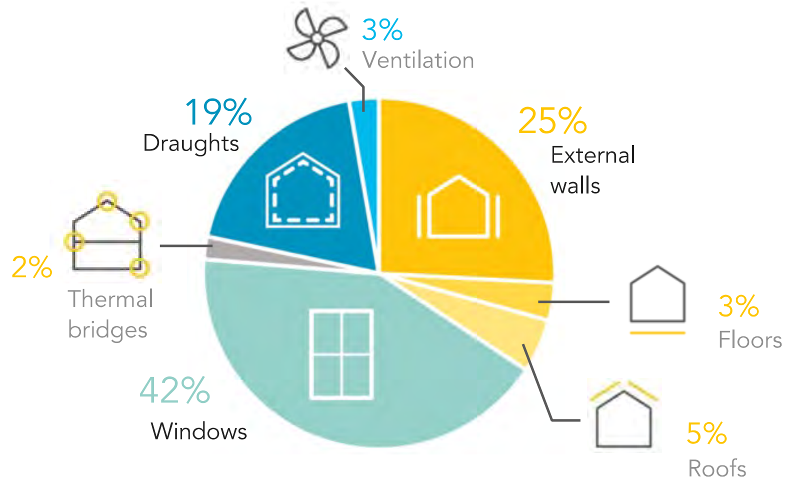
Improving the windows will also deliver significant additional benefits to the residents such as better thermal comfort (the window pane will be warmer), less cold draughts and better acoustic insulation, making it a more attractive and likely proposition than other retrofit measures.

And another co-benefit of significantly improving windows is that wall insulation and moisture risks can be reduced a little in ambition, which may help save internal features such as cornices.

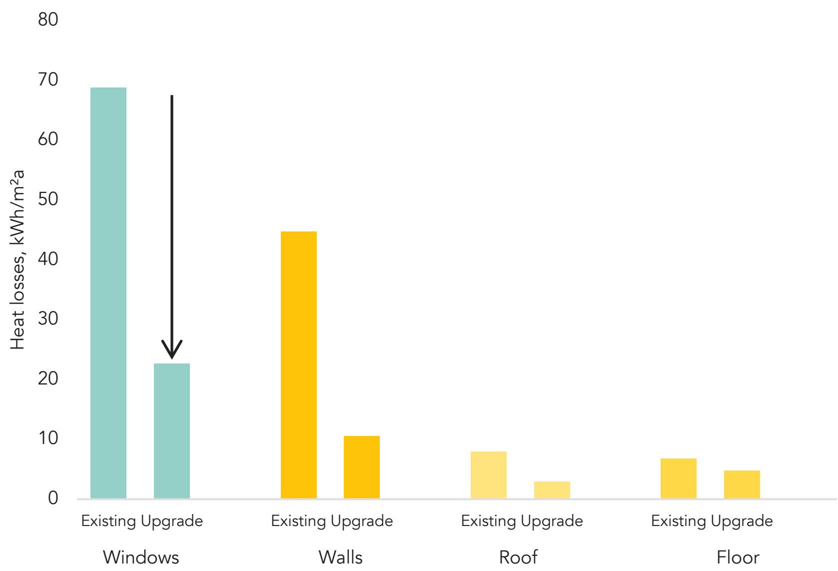
Finally, it is very important to note that for many homes in the ESSA conservation area, an appropriate window upgrade can provide such a significant reduction in space heating demand that it will unlock the ability for a successful replacement of the existing gas boiler by a heat pump, leading to a move away from fossil fuel heating and radical carbon emission reduction of more than 80%, with wall insulation and floor insulation taking place in future steps.

'Best possible' window – what does this mean?

Altering windows is expensive and likely to only occur once every few decades, especially if embodied carbon is being considered, so it is crucial that changes are made with a view to optimising performance while complying with conservation requirements. A targeted energy performance with a U-value of 1.0 W/m².K is proposed which the following available solutions can deliver: **triple glazing, best quality evacuated glazing, advanced secondary glazing.** These solutions will be capable of dealing with most of the windows within the borough without substantial harm to character and significance.



Windows represent the most significant opportunity to reduce heat losses (42% in the case of the Victorian house)



Coincidentally, windows often represent the biggest opportunity for improvement (see above comparison of heat loss improvements from existing to ideal upgrade). The amount of improvement for windows is greater per square metre than any other measure.

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Secondary glazing

The latest contemporary secondary glazing can incorporate double glazing or evacuated units, yielding a whole window U-value as low as 1.0 W/m^{2}K (almost as good as a new triple glazed unit, and far superior to early simple single pane secondary glazing).

This is a good solution for where existing window is still serviceable and where retaining that fabric is especially important, for instance if it is listed. The quality of solution is very dependent on appropriate selection of system and detailed integration with surrounding fabric.

Systems exist for hinged casement or sliding sash style operation. Careful consideration is required regarding competing demands of cleaning (casement operation can be best) and furniture location (sash operation is more flexible), as well as how to integrate with any other features such as shutter boxes. The secondary unit should also seal much tighter than the 'primary' to guard against 'fogging' and instead allow any moisture trapped in the cavity to escape. Good sealing of secondary can help with general draught proofing of

Installed casement advanced secondary system using double glazing, with original sashes overhauled. The system allow for night vent with tilt inwards (left) as well as fully open (middle) for cleaning and purge venting. Unit fully shut (right).

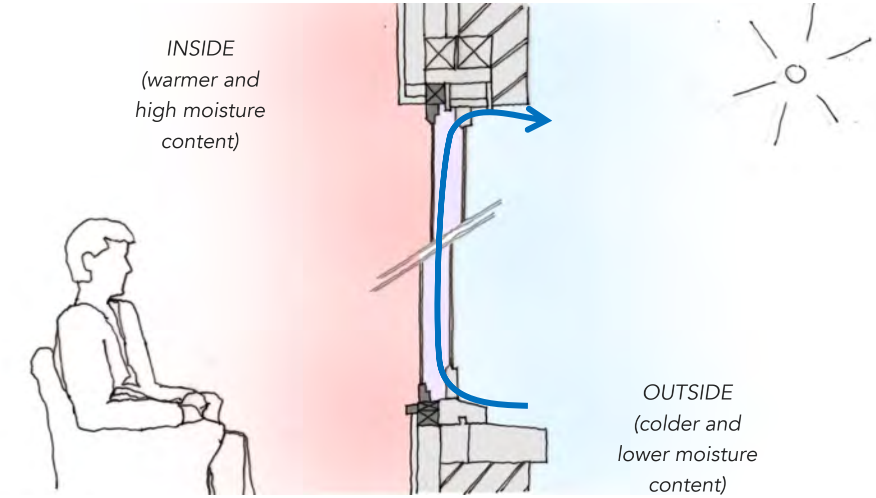
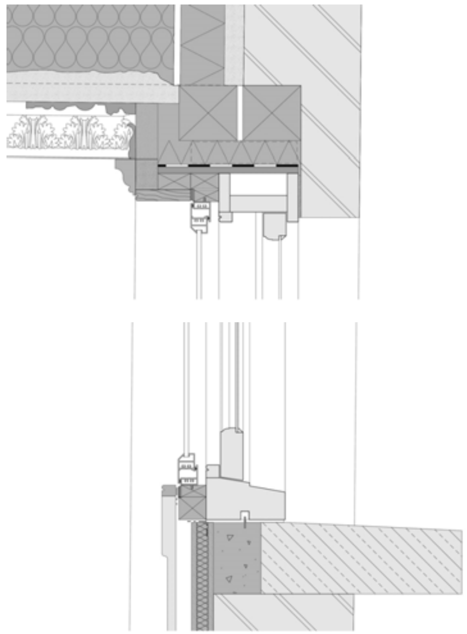


Diagram illustrating the 'primary' function of secondary glazing



Left - Secondary glazing system installed to a listed building in South London (source: Arboreal Architects). Please note the low impact from outside.

Right - Installed secondary glazing section detail (right)

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New evacuated glazing sash windows

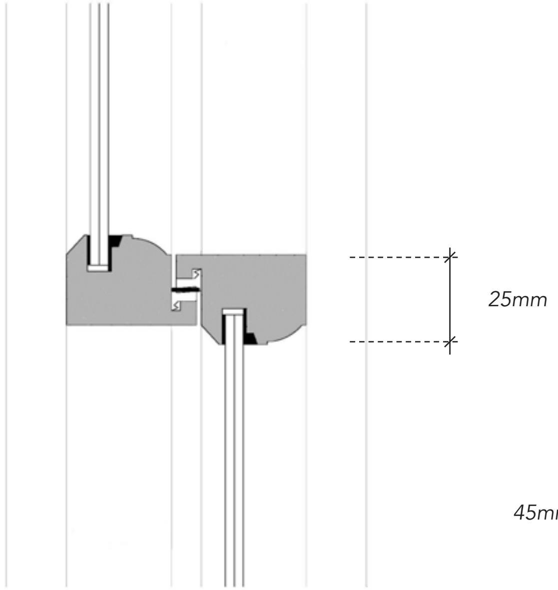
Where there is the need to match an existing multi-pane sash/casement window, new evacuated glass can be the right solution. Its appearance is very similar to single glazing due to this thinness (only 6mm thick) and the lack of the metal spacer bars that double/triple glazing normally comes with.

The latest generation of evacuated glass can achieve a U-value almost comparable with triple glazing: A whole window U-value of close to 1.0 W/m^{2}K is achievable.

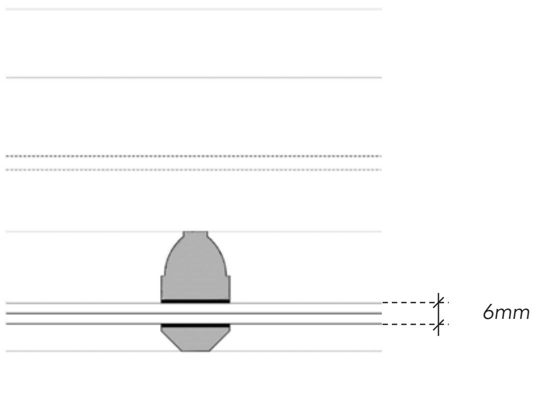
The slenderness of the glass can help keep the frame section size low so that new sashes can be fitted into historic boxes and in some case glass can even be fitted to existing frames.

This sort of approach can replicate fenestrations patterns very closely while providing a window with a performance close to contemporary triple glazing.

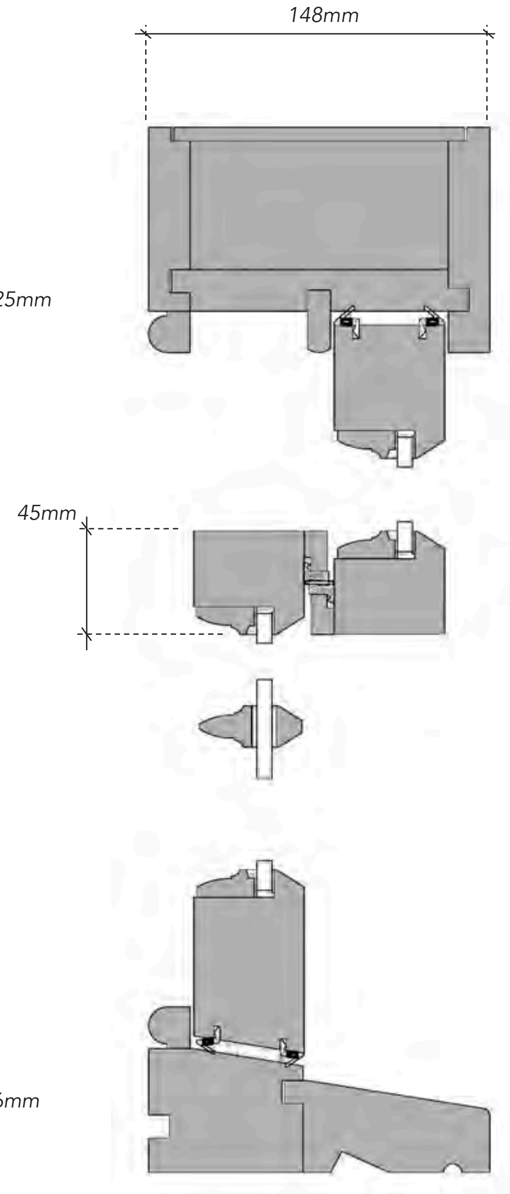
Installed proprietary sash window with evacuated glass (right) and close-up of glass/frame junction (left), in a conservation area in west London.



Single glazed sash window. Mid-rail detail.



Proposed, bespoke new sliding sashes in existing boxes to a listed building in City of London. Astragal detail.



Whole section detail (head, mid-rail, and cill) of factory made evacuated glazing.

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Window solutions | Double glazed sash windows

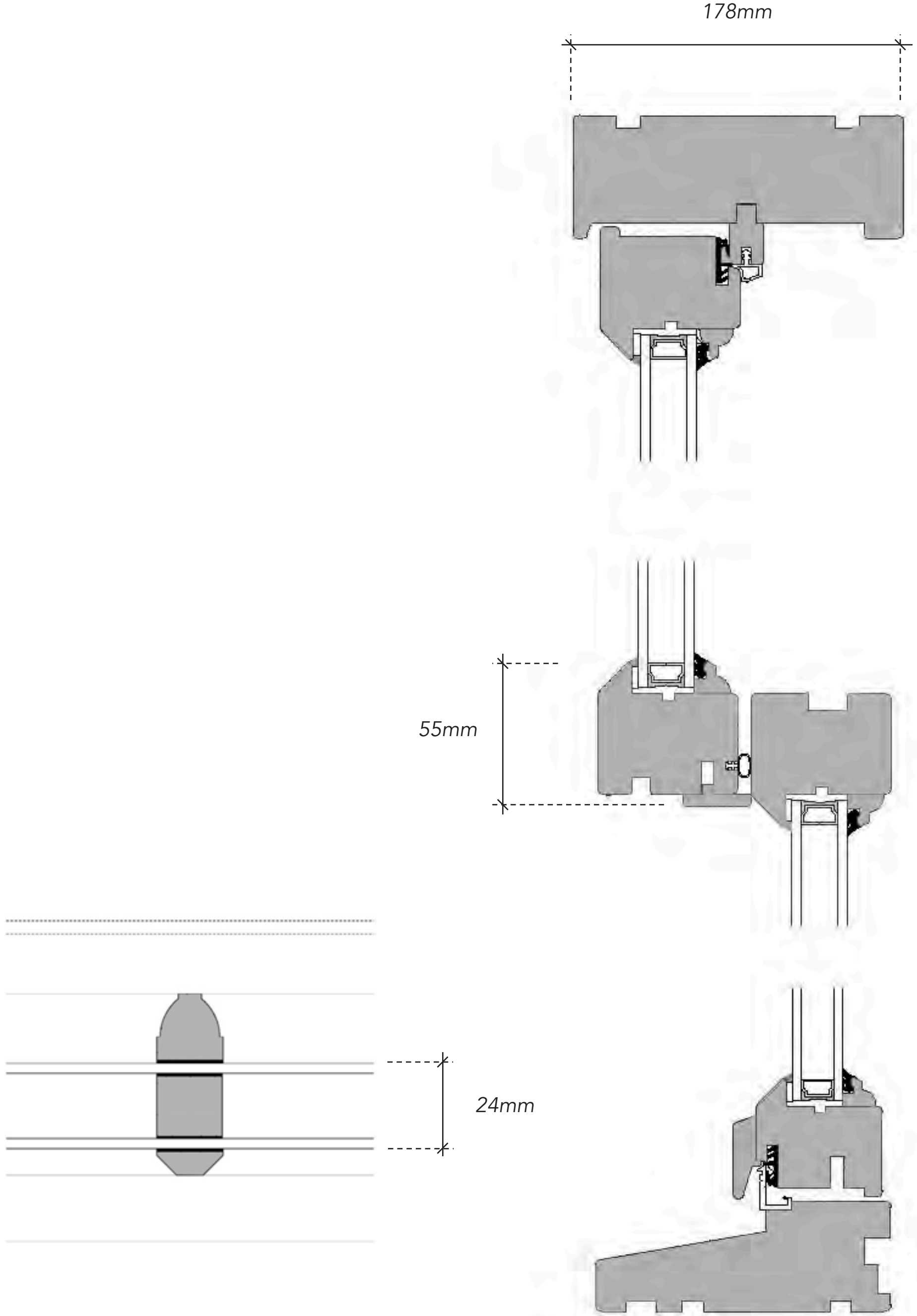
Double glazed sash window

High performance double glazing with 24mm glazing units can work well for simple sash windows. While the metal separating bars and plant-on astragals are visible, the effect is likely to be acceptable on large format windows with simple 2-over-2 arrangement.

The system shown here also has a special closing mechanism that shuts the sash tight to the surrounding frame making for excellent air tightness.

It is probably the least expensive, providing a robust but sympathetic solution. As it is factory made, the quality and durability are good too.

Double glazed sash window (left) and close-up of glass/frame junction (right), residential project for local authority in a South London conservation area. The brick faced dwelling was locally listed.



Double glazed sash window. Astragal detail (left). Head-midrail-cill detail (right).

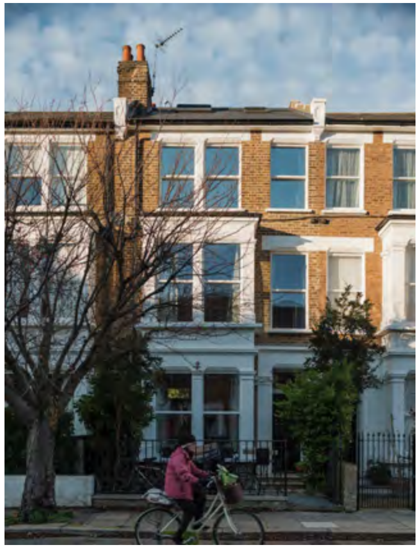
'Mock' sash triple glazed casement

Triple glazing is the most robust and high performance glazing option. Casement opening units have been developed to allow a similar appearance to a sash window while providing all the technical performance of a contemporary window.

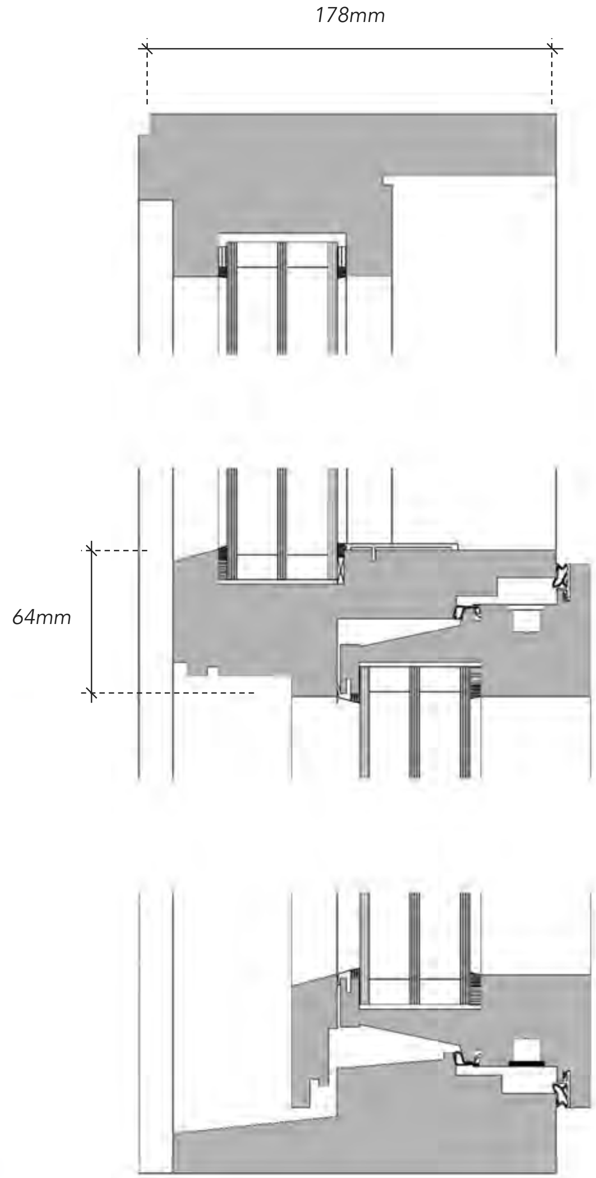
However, their opening mechanism is often different from sash windows in order to be more airtight. Typically these have lower sashes that open as tilt or turn. Other versions use a top hung sash. This is likely to be a consideration from a conservation point of view, particularly for front elevations.

U-values for such windows are as low as of 0.8 $W/m^2 \cdot K$. The casement operation also ensures a very good seal, using compression gasket all way around the opening.

This approach can be especially successful for large sashes without multipane separating glazing bars.



Installed mock sash windows as part of a deep retrofit project (left) and at a Bere:architects project (right).



Triple glazed window (left). Head-midrail-cill detail (right).

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Triple glazed casement

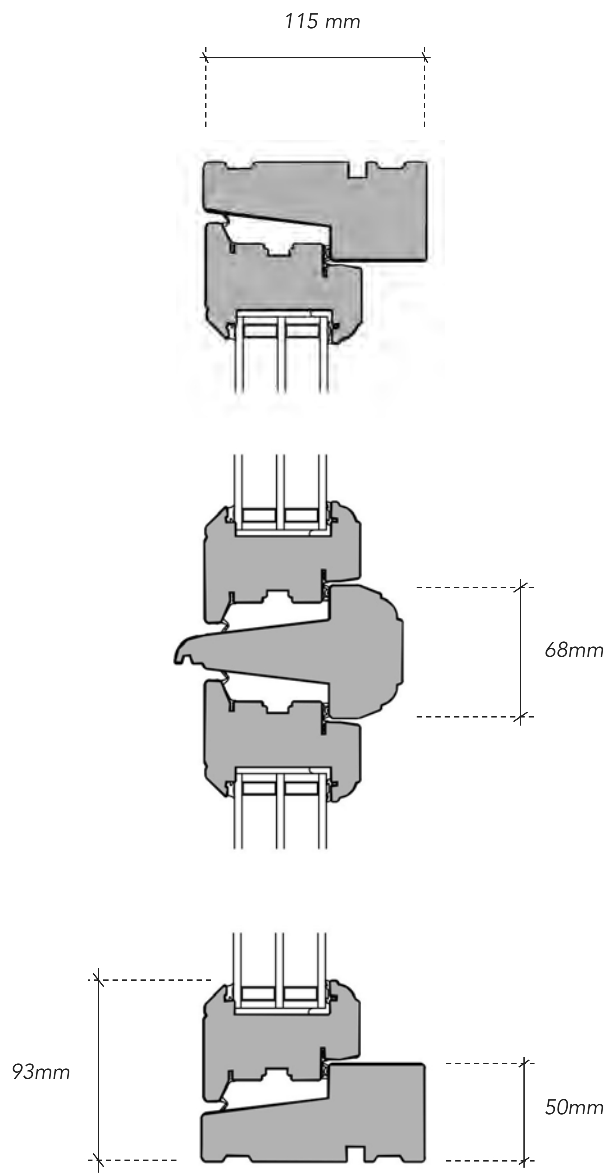
Standard triple glazed windows may appear too plain for most front elevations but can often fit in well at the rear where modern additions have often changed the character of the elevation too.

Larger openings tend to work better with this approach as the glazing to frame areas is more in balance.

Standard triple glazing is more cost effective than most of the alternatives suggested here.

Plain triple glazed casement window within an externally insulated wall at the back of a Victorian terrace.

Triple glazed casement windows installed within a Victorian façade of a residential project.



Triple glazed casement window. Head-midrail-cill detail.

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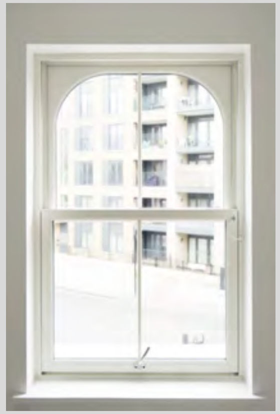
Window solutions | 'A comparative overview'

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

Windows | Conservation requirements

Windows in the ESSA Conservation Area

The group value of terraced streetscape windows is highly significant. Maintaining consistency with windows in the same terrace group is important however variance in sensitivity of differing locations could support varying outcomes.

It is very important to note that street facades and rear elevations would generally enable different solutions: a conservative approach to street facades could be countered by radical interventions on rear elevations.

What appears significant in terms of conservation?

Glazing upgrades that respect the simplicity of the original detailing by matching historic glazing bar profiles and pane proportions can be sensitively absorbed with minimal harm to the special character and historic interest of the listed facades.

- Windows are vulnerable and susceptible to wear and tear so maintenance or replacement projects provide a good opportunity for thermal upgrade.
- Windows have high potential for improved weather-sealing and operation. Retention of obsolete technology or inadequate weathering components can exacerbate decay if unchecked.
- Double glazed outer panes can be faced with restoration glass (instead of of mechanically flat float glass) to replicate the imperfections and rippled reflections of cylinder glass.

Upgrade or treatment recommendations

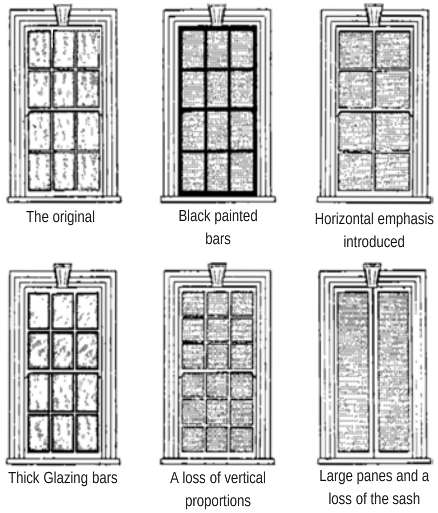
- Advanced secondary glazing (double or evacuated glazing)
- Evacuated glazing in existing frames
- New windows (evacuated glazing, double- or triple-glazing)

Where a window that diminishes the significance of the building is to be replaced the new window should be designed to be in keeping with the period and architectural style of the building.

Windows

There are too many examples of unsympathetic glazing patterns to list, but the diagram opposite will give some idea just how much a window's proportions change with different glazing patterns. When restoring glazing bars it is important to use the correct cross-section which may be so slender as to require hardwood and not one of today's, rather heavier, softwood sections. In this context a restoration of absolute originality may sometimes be sacrificed in favour of conformity with the neighbouring properties, although it may be worth checking that neighbours are not contemplating conforming with your own house. Having completed the restoration, paint should match the other painted detailing of the property and should be of a light colour. Painting glazing bars black makes them less obvious in the facade. Although the Victorians sometimes did have large single panes of glass in important rooms and painted other bars in the house to disguise the use of cheaper multiple panels of glass, it is indisputable that the proportions of the windows with white glazing bars look better to the modern eye.

A comparison of original and unacceptable glazing patterns



Guidance on unacceptable glazing patterns from original ESSA Conservation Area Proposal. The document has been revoked but the advice is still useful.

<table>
<tr><th>Element</th><th>Green</th><th>Amber</th><th>Red</th></tr>
<tr><td>Windows</td><td>Permitted development</td><td>Requires listed building consent but should be acceptable</td><td>Requires planning permission and unlikely to be acceptable</td></tr>
<tr><td colspan="4">Window framing can be repaired or redecorated, ironmongery eased, or broken glass replaced on a like for like basis (listed and non listed buildings)</td></tr>
<tr><td colspan="4">High performance replacement windows and secondary glazing to non listed buildings</td></tr>
<tr><td colspan="4">Listed buildings (depending on context):
• Like for like replacement frames, alterations to ironmongery or changes to historic glazing that alter the surface texture of the glass.
• Upgrading glazing with slimline or vacuum double glazed units
• Draught proofing that modifies the frames but retains the original sightlines
• Replacement of steel frames with thermally broken slimline frames</td></tr>
<tr><td colspan="4">Listed buildings: changes of frame type, alterations to fenestration patterns, installation of trickle vents</td></tr>
</table>

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Windows | Examples of a variety of window upgrades

Secondary glazing in front of historic stained glass

Evacuated glass sash windows within a conservation area

Triple mock sash window (Bere:architects)

Casement advanced secondary system

Double glazed sash window within a conservation area

Triple glazed mock sash windows (PDP architects)

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

Triple glazed mock sash window

Triple glazed casement windows

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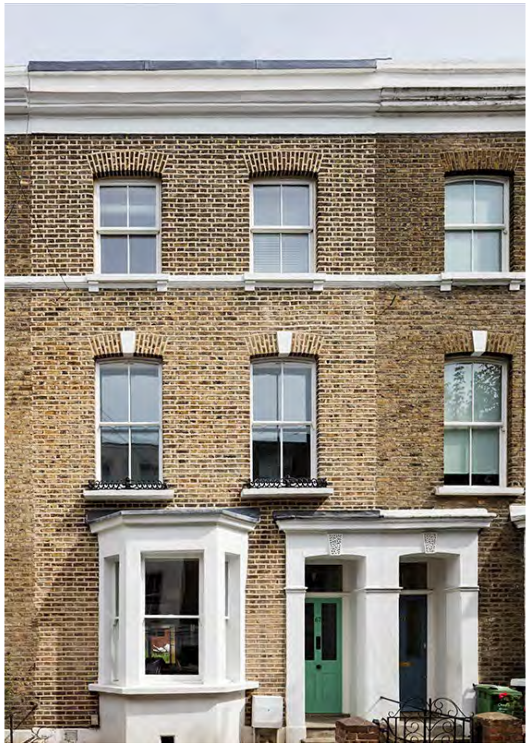
Windows | Improving window performance on sensitive street elevations is possible

The examples below demonstrate that significantly better windows can be installed without affecting negatively the character of a building or conservation area. These windows will significantly improve energy efficiency and comfort for residents.

Double glazed replica sashes.



Mix of secondary, double glazing into old frames and new double glazing.

Advanced secondary using evacuated glazing on a listed Georgian townhouse.

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Windows | Shading to avoid overheating

Shading strategies

The architecture in the conservation area tends to have quite large windows, which create a feeling of generosity and provide good internal daylight. However, the window size also tends to increase heat loss in winter and heat gain in summer from the sun.

South and west elevations are likely to be at most risk of extensive solar gain. East facing windows would also experience similar issues especially as midday sun approaches.

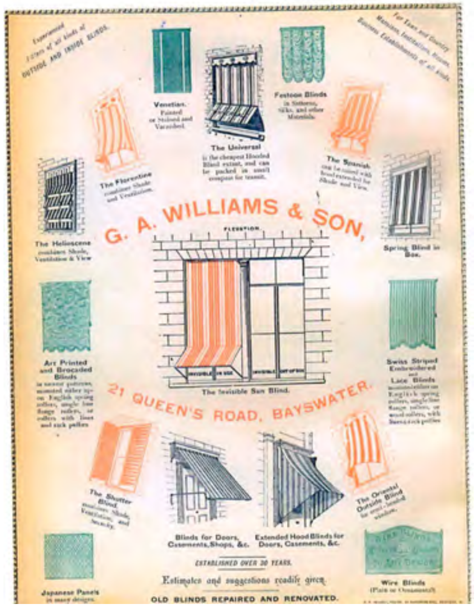
Therefore, and in order to minimise the need for mechanical cooling, retrofit projects should consider how effective shading strategies may help to minimise the extent and severity of periods of overheating. Historically, awnings were a very popular solar shading. Forms of external shading are more efficient at reducing overheating. But, if historic internal shutters already exist, these can be brought back into use and will contribute to reduced solar gain, though not to the same extent.

Victorian style awnings

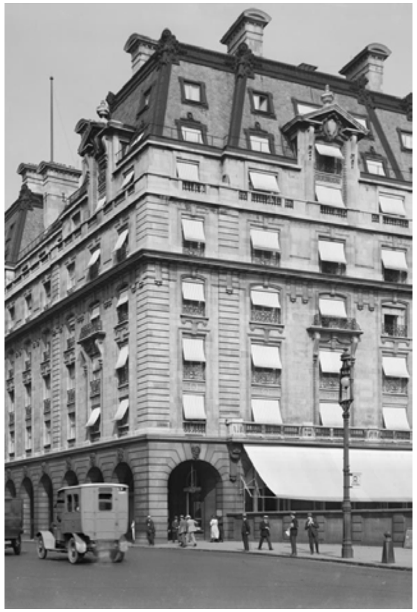
- Reducing the amount of sun reaching the window externally is more effective than shading from the inside.
- The awning would be bespoke to fit the opening.
- The awning would obstruct the view out from internal spaces but not obstruct opening the sash window.
- The projecting form was deliberate to allow ventilation.

Shutters

- The original windows to some of the buildings in the ESSA Conservation Area are likely to have had folding or sliding shutters.
- Internal shutters are less effective at reducing solar gain.
- These would obstruct views out and the ability to open the window for ventilation



Page from a Victorian awnings catalogue (Source English Heritage.



Historic picture of the Ritz, resplendent with awnings.

Disused awning boxes are still commonly found on historic buildings and remind us how our forbearers managed overheating

Less effective but still useful are internal shutters but if in place worth bringing back into service.

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5.2

Building fabric and ventilation

Airtightness and ventilation

Reducing air leakage through the building fabric (i.e. making the building more 'airtight') improves energy efficiency significantly and is an important part of a successful retrofit.

However, it is very important to remember that it should be coupled with the integration of controlled ventilation, i.e. small fans running constantly. Heat recovery ventilation also also improves indoor air quality as is filters the incoming air.

Airtightness and ventilation

A road map to airtightness

Improving airtightness significantly reduces heat loss through the building fabric and makes homes more comfortable – an airtightness strategy should therefore form part of the whole house retrofit plan. This should include a clear road map detailing the airtightness measures to install at each stage, how key junctions and interfaces will be made more airtight, and when and how the airtightness target will be verified.

Airtightness baseline target

Most pre-retrofit homes have an airtightness of 7-15m^3/m^{2}hr (when the house is pressurised at 50Pa). At these levels, the heat loss due to infiltration will very high. It is typically possible to achieve between 3-5 m^3/m^{2}hr by ensuring visible gaps are filled and using well fitted windows and doors.

Taking airtightness further

An airtightness of 1m^3/m^{2}hr at 50 Pa is possible for retrofit, but depends on specialist air tightness tapes and windows that have especially good seals. Achieving this best practice level of performance is generally only possible with a 'deep retrofit, as it is likely to be necessary to strip back to the basic structure and perform basic repair work before methodically applying airtightness products and principles. Applying airtightness tape to joist ends is a common measure required to achieve good airtightness, and large gaps may need filling with mortar (with a suitable primer).

Improve ventilation together with airtightness

For airtightness levels of 5 m^3/m^{2}hr or below some form of continuous extract ventilation is necessary to ensure good air quality. Demand controlled systems can automatically adjust the ventilation rate and so reduce unneeded heat loss. Ventilation with heat recovery goes further, recovering up to approximately 90% of the heat from the extracted air and using filters to provide more reliable air quality.

Replacing windows represents a significant opportunity to improve airtightness.

Ducts moving air across the house in order to ensure it is properly ventilated

Stripping back to the structure (Source: Eightpans) and applying airtightness tape to joist ends (Source: Ecomerchant) will deliver best practice levels of airtightness.

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5.3

Building fabric and ventilation

Insulation

30-40% of heat of our homes is lost through the the roof, walls and ground/lower ground floors.

Reducing these heat losses requires a variety of solutions, some of them more disruptive than others.

Generally, **insulating the loft and adding external wall insulation** is much less challenging and disruptive for residents than **insulating the floor and adding internal wall insulation**.

Insulation | External walls

Insulating externally or internally?

When possible, it is generally best to insulate walls externally than internally. Allowing the insulation to wrap around the building continuously, keeping it warm and dry, while avoiding the need to address weak points and junctions e.g. around floor joists, is preferable. However, the choice will come down to what is practical and acceptable from a planning perspective. This section highlights the key approaches to wall insulation and how they differ in terms of space, aesthetics preferences and disruption to occupants.

Cavity wall insulation

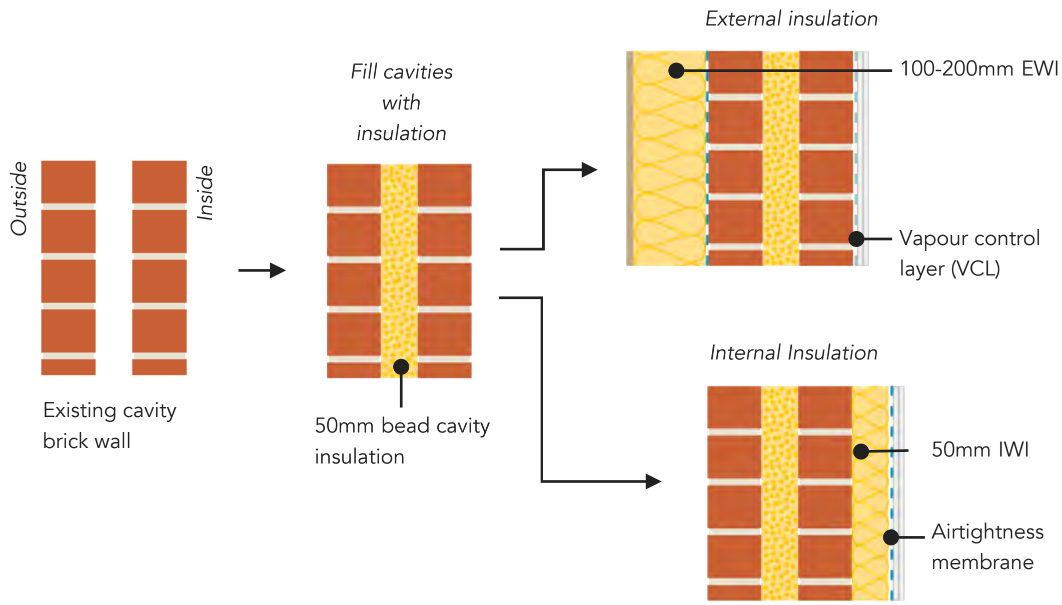
It has no visual impact and improves energy efficiency, but not as much as external or internal insulation. It is however generally the first step to adopt. Cavities should be cleaned to the base and filled with a non-hygroscopic, non-capillary active bead insulation to minimise the risk of moisture problems. Existing brickwork should be repointed to keep the wall dry and the rain out of the cavity.

External insulation (EWI)

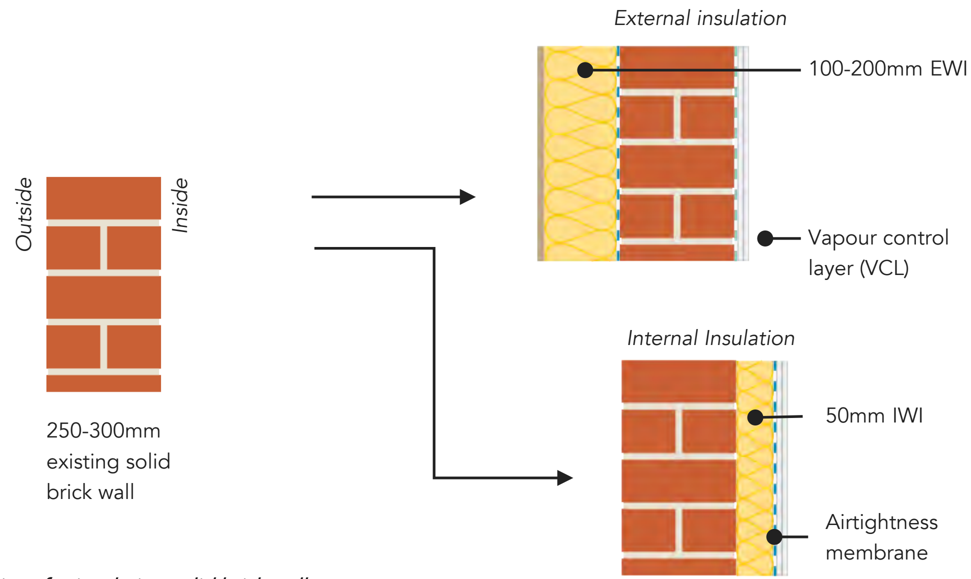
It is effective thermally, maintains the internally exposed thermal mass, does not reduce internal space and creates less disruption during fitting. However, it will require planning permission as it will affect the external visual appearance will be affected. Finally, roof eaves may require extending or parapets wrapping. Insulation is generally finished in render, brick slips and pebbledash cladding.

Internal insulation (IWI)

Breathable materials should be used when insulating internally e.g. wood fibre insulation or plastered insulation. Non-breathable materials e.g. rigid foam insulation, can achieve a good thermal performance and are often cheaper, but they can also trap moisture and are more challenging to install well, for example around junctions. Natural products are likely to be combustible but can be used safely in the right application. Where internal space is limited consider using thin products such as aerogel insulation.



Options for insulating cavity walls. For step 1 ensure measures have been made to prevent condensation.



Options for insulating solid brick walls.

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Loft / roof insulation approach

For unheated attic spaces the simplest approach is to insulate the joists in the loft. It is important to consider the eave-loft junction carefully in order to prevent air leakage and properly ventilate the unheated loft space to avoid the condensation risk.

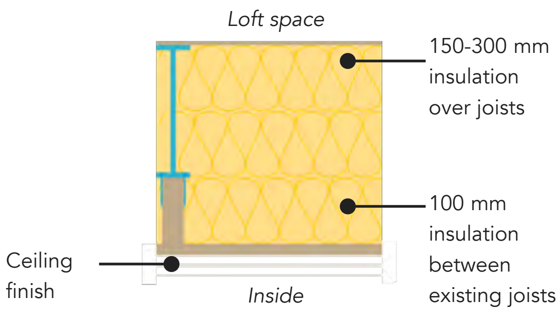
Loft space can also become a 'warm space' room by insulating the roof. Insulation can be added in between the rafters and an insulated sheathing board over the rafters as shown in the rafter detail to the right. Pay attention to flashing, sealing and roof penetrations such as chimneys, skylights and roof vents, in order to prevent air and water leaks.

Continuous external insulation approach

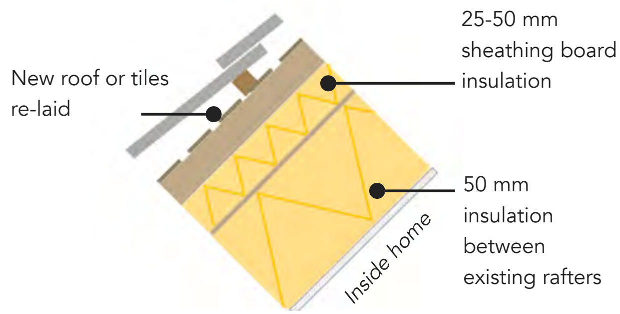
When wall insulation extends up the roof, you should consider extending eaves to cover the additional wall thickness, ensuring a continuous thermal barrier. It is important to maintain or provide ventilation at the eaves and apply flashing and sealing to prevent water ingress. External roof finishes such as tiles and rainwater goods like gutters will need to temporarily move during the installation of external roof insulation.

Ground floor insulation

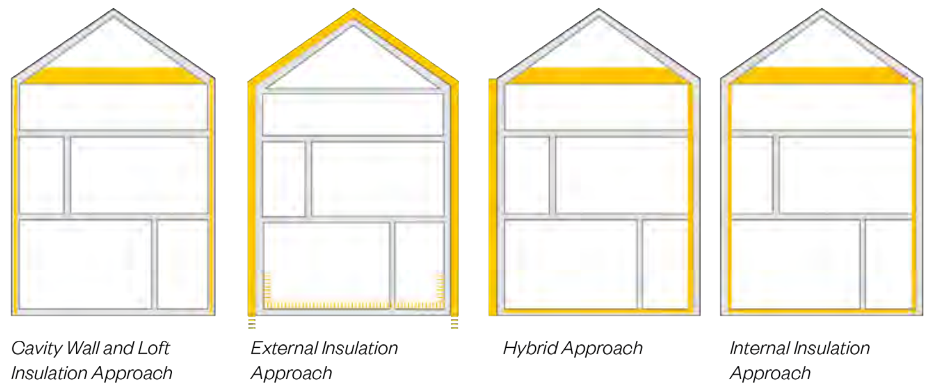
Insulating concrete floors may require raising the floor-level, therefore special consideration should be given on the impact on steps at the entrance, door heights and consistent staircases levels. In the case of raised timber floors, weatherproof insulation can be added between the floor and the ground, protecting the structure from moisture rising from the ground, as well as insulation in between timber joists to enhance the thermal performance of the floor.



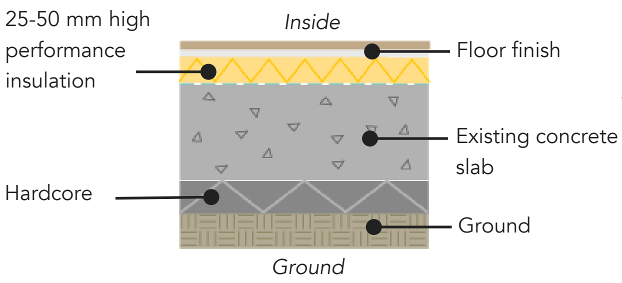
Roof insulation at joist level



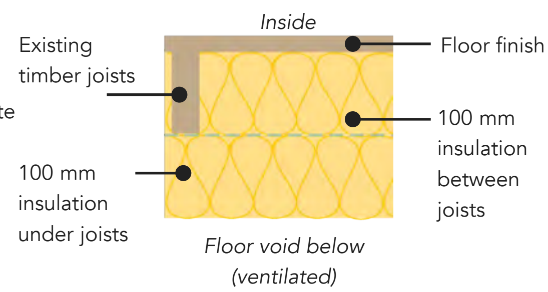
Roof insulation at rafter level



Ensuring continuous insulation



Solid floor



Timber floor

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External walls in the ESSA Conservation Area

The formal ornamental front elevations express status when compared with the utilitarian sides or rears. Where the rear elevation is part of a group of rear elevations which have experienced a high degree of alteration in the past, it is the consultant team's opinion that external insulation could be applied.

What appears significant in terms of conservation?

Significant features must not be damaged. Walls must be stabilised prior to insulating and care must be taken to maintain their equilibrium. Historic building fabric is watertight but vapour permeable, so it is critical that fabric changes do not inhibit moisture dissipation in a solid wall building.

Watch points and actions affecting the element or impact on significance

- Moisture concentrations such as rising damp, or water wicking from failed drainage must be identified and fully remediated before insulation is installed.
- Original pointing and mortar would have been lime putty based without cement. Modern cementitious pointing is impermeable and harder than soft brick so it cracks and erodes the interface.
- Modern materials can harm the function of a building leading to deterioration so incompatible materials should be removed such as cement renders and non-breathable paints that trap moisture.
- Internal insulation reduces external wall temperatures inhibiting their drying out, affecting their equilibrium. This can be partially mitigated by using breathable insulation and reducing insulation targets but it also requires careful consideration.


Feature brickwork on flank walls such as blind windows (left) should not be insulated although plain rear walls or closet wings on the same building could be, as could flank and rear walls of the villas shown right.

Element	Green	Amber	Red
External and internal wall insulation	Permitted development	Requires planning permission but should be acceptable	Requires planning permission and unlikely to be acceptable
Loft insulation for all buildings			
Internal wall insulation and insulating plasters in non-listed buildings			
Basement or ground floor insulations below slab or below suspended floors in non-listed buildings			
External rear wall insulation (and flank wall insulation in most instances) insulating plasters and basement below slab or below suspended floor insulations for non-listed buildings			
Internal wall insulation and basement/ground floor insulation in listed buildings			
External wall insulation to brick street facades or feature brickwork to flank elevations			
Removal or subsuming of cornices, brackets and other decorative features.			
Loss of ancillary components such as cast iron railings, pot guards or balcony rails			

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Insulation | The case for external insulated render on rear elevations

Many of the backs of terraces within the ESSA Conservation Area have been much altered and rendered. This ad hoc informality may mean that in some cases external wall insulation is possible, although the decision will be taken on a case-by-case basis.

Abingdon Rd

Scarsdale villas

Abingdon Rd

Abingdon Rd

Scarsdale villas

Cope Pl

Pembroke square

Earls Ct Rd

Stratford Rd

Abingdon villas

Earls Ct Rd

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Insulation | Examples

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

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

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

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

House façade after external wall installation

Cork granules visible in lime/cork plaster internal plaster insulation

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

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5.4

Technologies

Moving away from fossil fuel heating

It is crucial for the decarbonisation of homes in the ESSA Conservation Area to stop using systems using fossil fuels (for heating, hot water, but also cooking) and replace them with systems using electricity: heat pumps (or alternative electric systems) and induction hobs.

This section focuses on heating and hot water.

Heating systems in homes have always evolved

Central heating – that is a heating system with a single source of heat and heat emitters in every principal room in a house – was available to well-to-do Romans in their villas 2,000 years ago. As gas and electricity became available in big cities like London in the Victorian era they affected our homes, mainly lighting initially. And in the 20th century the recognisable forms of central heating that we know today with a gas boiler (usually) and hot water pipes to radiators in each room were installed in the majority of homes in the ESSA area.

Homes reflect the wider changes around them, and as we need to move away from fossil fuels while the electricity grid is decarbonising, it is normal to see new heating sources (e.g. heat pumps) replace old ones (i.e. gas boilers).

Managing change

Before gas central heating, homes were heated by open fires, stoves and ranges, often with only one room, usually the kitchen or 'parlour' heated and all the other rooms, including bedrooms, being much colder or entirely unheated. The hearth as the centre of the home was a traditional idea that was relinquished reluctantly. As late as the 1940s and 1950s there were objectors to the widespread introduction of central heating on the grounds that it would undermine the fabric of society. Resistance to change is normal.

Homes in the ESSA Conservation Area need to manage change

Most of the houses in the ESSA Conservation Area date from a time before central heating was commonplace and have multiple chimneys to serve fireplaces and hearths in every principal room. The fireplaces have often been closed or removed entirely, but the chimneys are still in place. Some of those are now repurposed to take the flues from new gas boilers. Gas boiler flues also started to appear on the elevations of many houses. It is normal for our heating systems to lead to a visual change. It is not a reason to resist change, but instead to manage it carefully.

A 'Rumford' fireplace from a 19th Century home(Source: 'OldHouse')

Fireplaces for many of the homes in the ESSA area would follow this model, with shallow fireboxes to reflect more heat into the room and reduce draughts.

Boiler flues spread across the façade of a building in the ESSA Conservation Area

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Heat pumps are the best option

The electricity grid is decarbonising and consequently, the most readily available low carbon heat source is electricity. This is used most efficiently and has lower running costs when using heat pumps.

There are various types of heat pump systems available to suit different homes and space constraints. Most of them require an external unit. As it will create a low level of noise, it is important for its location and its acoustic impact on the neighbours to be carefully considered. Some heat pumps are only internal and can be combined with the ventilation system. They are called 'compact heat pump units' and although they are generally less powerful and efficient than standard heat pumps, they can be well suited to flats.

Hot water storage should, if possible, always be part of all low carbon heating systems, to provide low cost, effective energy storage

What other options are available?

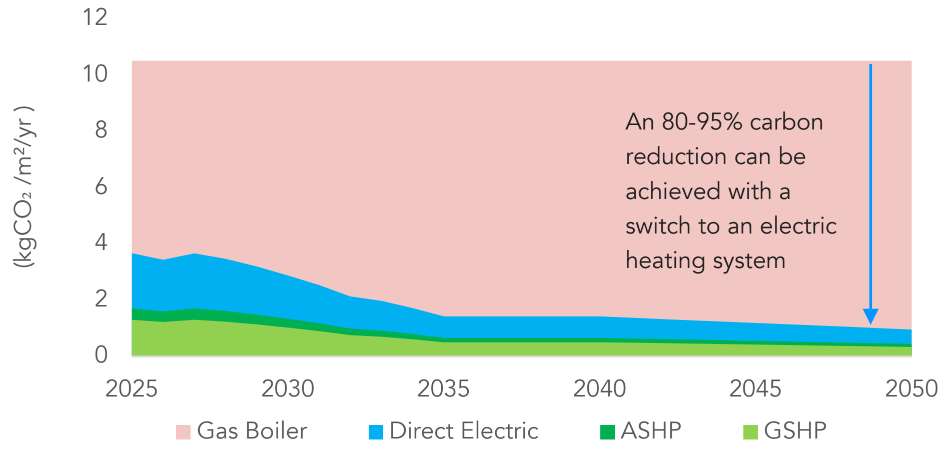
Direct electric heating will become low carbon in the future, as the grid continues to decarbonise. However it can lead to high heating bills, especially in homes where fabric performance is poor.

Hydrogen is very unlikely to be a solution for heating homes due to the constraints and costs of production of green hydrogen and of the costs of converting the existing gas grid to a different type of gas.

Enabling low carbon heat – lowering space heating demand

Simply swapping an existing gas boiler for a heat pump is generally seen as problematic for both economic and practical reasons:

- Heat pumps operate most efficiently at lower heating water temperatures than gas boilers. In order to enable the switch to heat pumps, ideally with the same radiators, reductions in space heating demand are likely to be required.
- Electricity is,more expensive than gas so a like for like replacement may lead to higher fuel bills. Energy efficiency improvements can enable the home to switch without incurring significant additional annual heating costs for the residents.



Use of fossil fuels
Not compatible with Net Zero. The heating system must be changed.

Comparison of carbon emissions associated with different heating systems for a typical home over the next 25 years.

Emissions from a gas boiler stay constant, whereas emissions from direct electric systems and heat pumps reduce over time due to the electricity grid decarbonisation. Heat pumps have lower emissions than direct electric systems purely because they are more efficient.

A typical domestic-type monobloc ASHP (Mitsubishi)

A typical compact heat pump (Nilan)

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Heating systems in the ESSA Conservation Area

The majority of homes in the ESSA Conservation Area currently have gas boilers. For houses, most appear to have reused existing chimneys for the flues, but in apartment blocks and houses divided into flats, multiple balanced flues are evident on facades.

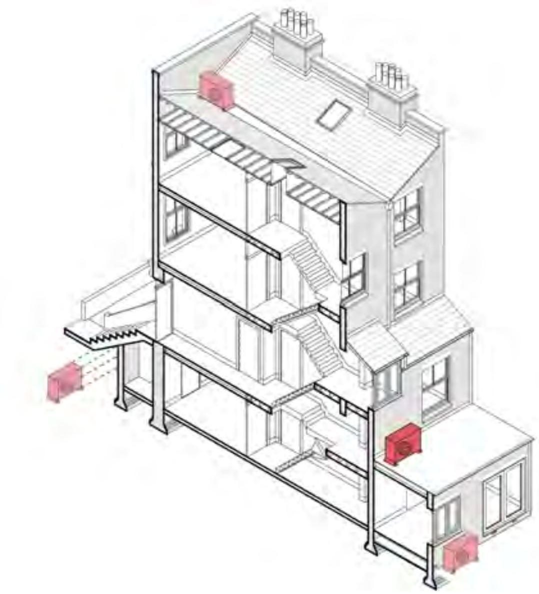
What appears significant in terms of conservation?

Most heat pumps are external and of the order of 1–1.5m tall. They can therefore be visually quite intrusive, and should therefore not be located on brackets on external walls facing the street or on terraces, roofs or balconies that are visible from street level. There are however many other locations possible as external heat pumps only need to have a pair of pipes connecting the unit into the home it serves: back gardens, terraces and roofs can be suitable alternatives to consider (see adjacent diagram). Having an external heat pump in these locations should be considered acceptable, subject to compliance with acoustic requirements and avoiding the air from the heat pump blowing directly windows.

There are some heat pumps that are located internally, with ducts connecting to outside. These units are less efficient than the more common external ones but can be the best option where external space is very limited, such as tall blocks with flats. The location and appearance of the grilles for the vents, which are larger than standard ventilation grilles, would need to be carefully considered.

Comment on Permitted Development (PD) rights and heat pumps

Most heat pump installations for houses will not require planning permission, subject to some limits and conditions on size and siting. There are no PD rights in blocks of flats so any external installation of heat pumps will require planning permission.



Air source heat pumps can be located in different locations, as indicated in red on the adjacent drawing.

It is important for the selected location to also consider the potential acoustic impact on neighbouring properties.

Element	Green	Amber	Red
External Air Source Heat Pump	Permitted development	Requires planning permission but should be acceptable	Requires planning permission and unlikely to be acceptable
The heat pump is sited, so far as is practicable, to minimise its effect on the external appearance of the building and its effect on the amenity of the area (non-listed buildings).			
The volume of the heat pump’s outdoor compressor unit (including housing) not exceeding 0.6 cubic metres (non-listed buildings).			
All parts of the heat pump are at least one metre from the property boundary (non-listed buildings).			
The heat pump is installed on a flat roof and all parts of the unit are at least one metre from the external edge of that roof (non-listed buildings).			
Multiple heat pumps are installed to serve several flats in one building and all units comply with the PD criteria (non-listed buildings).			
The heat pump meets all PD criteria and is located on a Listed Building			
Heat pump is installed on a pitched roof.			
The heat pump is mounted on a wall above the ground floor level, facing the street.			

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Low carbon heat | Examples of heat pump installations

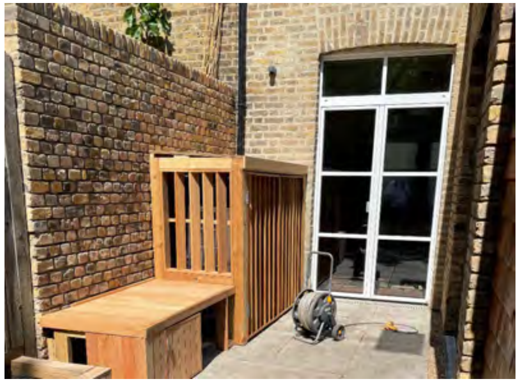

Deck mounted


Rear garden – ground mounted


Rear garden – ground mounted


Roof mounted


Bracket mounted

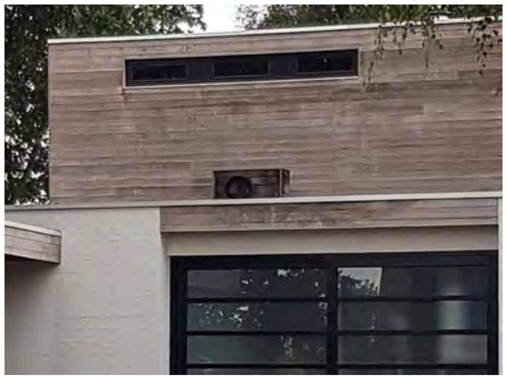

Boxed enclosure


Rear garden – ground mounted

Rear garden – ground mounted


Front garden – ground mounted


Wall mounted – wired enclosure


Wall mounted


Heat pump under a window and behind enclosure

Sources: @heatpumpchic and other homeowners' installations

5.5

Technologies

Solar PVs

In order to achieve Net Zero we do not only need to use less energy and to move to low carbon sources of energy: we need to generate more renewable energy.

The roofs of our buildings represent a significant opportunity to generate more renewable energy locally, and as it can be used directly by residents, it will help to reduce their energy bills too.

Solar PV panels | Potential retrofit measures and their impact

Roofs are an asset for Net Zero

Ideally, for ESSA's housing stock to be Net Zero carbon in operation, a balance between the energy (electricity) used by all dwellings and the renewable energy (electricity) they generate over the course of a year is needed. And for homes in the ESSA Conservation Area, solar photovoltaic panels (PVs) is the key suitable solution to generate renewable energy.

Whilst it is often not possible for every individual home to have enough solar PV panels to match their energy consumption, especially in blocks of flats, the aim should be to maximise the PV capacity in order to get as close to the targeted energy balance as possible, and hopefully achieve it for the ESSA area as a whole.

Predictive energy modelling carried out as part of this study demonstrate that a decent PV system could generate the equivalent of nearly half of the annual energy use of a retrofitted Victorian house.

PVs can also help significantly with energy costs

Solar PVs can provide 'free' electricity (after purchase and installation costs have been recouped) which can significantly reduce the residents' energy bills. This used to be considered as a 'side benefit' but is now becoming a stronger benefit with energy prices rising as it displaces high-cost power from the grid. For houses, it is a simple matter to connect the PV system on the roof to the home electrical system.

For flats, it is not straightforward. There are different electrical system configurations possible, including proprietary electricity sharing systems, 'private wire', 'sleeved' and 'microgrid' systems. Distribution of energy is possible through the use of a 'microgrid'. However, this requires an energy supply company to be established. The UKGBC recommend using a system called 'Solshare', a promising technology that would allow residents to share the benefits of a building level PV system.

Good	Exemplar
18% solar contribution	45% solar contribution

Energy modelling results for the Victorian House showing the potential contribution of on-site solar energy generation compared to annual energy use. Please note that this will not translate as a direct reduction of energy use for residents as a proportion of renewable electricity generated by the solar PV panels will be exported to the local electricity grid.

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

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Solar PV panels | Conservation requirements

Roofscape in the ESSA Conservation Area

The cohesion of the roofscape is a significant feature within the area with much of the roofing concealed behind parapets. The skyline of party wall blades and uniform covering materials is largely unbroken apart from the silhouettes of chimney stacks and pots.

What appears significant in terms of conservation?

Sustainability benefits must be weighed against the impact on heritage settings but PV equipment is becoming commonplace within the townscape and with shifts in acceptance they are increasingly considered as necessary service equipment providing they are located with sensitivity. Photovoltaic panels can be installed behind parapets or on rear slopes wherever possible to minimise potentially harmful effects on the appearance of the building and the wider townscape. Setting out can be important - they should be neatly grouped, and dark grey or black colours minimise the visual impacts.

- Advances in technology are ever-changing so installations should be fully reversible.
- Original roof coverings are fragile so the minimum number of slates or tiles should be carefully removed for fixing and operatives must minimise collateral damage.
- Routing of cables and location of converters needs careful consideration as does access for maintenance and cleaning.

Most of the butterfly roofs within ESSA have hatches or rooflights for service access. PV panels on visible slopes can be neatly arrayed in short wide panels just above eaves to minimise impact .

Comment on permitted development rights, LLBCO and solar PVs

Installation of PV arrays is permissible under permitted development rights subject to limits and conditions on size and siting for non-listed buildings and permitted under Local Listed Building Consent Order (LLBCO) for listed buildings providing installation details are submitted to and approved in writing by the Council before works commence.

Butterfly inverted V-shaped roof slopes behind parapets are suitable locations for PV arrays

Element	Green	Amber	Red
Solar PV panels	Permitted development	Requires planning permission but should be acceptable	Requires planning permission and unlikely to be acceptable
Solar panels sited, so far as is practicable, to minimise their effect on the external appearance of the building and their effect on the amenity of the area			
Panels not installed above the highest part of the roof (excluding the chimney) and not projecting any more than 200mm from the roof slope or wall surface			
Integrated roof slate style PVs for non-listed buildings			
PV panels on grade II and II* Listed Building where these meet the PD criteria, subject to the requirements of the Council's Local Listed Building Consent Order (LLBCO) for the Installation of Solar Panels. This includes the need for the details of the position, size, fixing, colour and finish, associated equipment, and any minor strengthening works to the roof to be submitted to and approved in writing by the Local Planning Authority before works commence.			
PV panels installed on a street facing pitched roof or fitted to a wall which fronts a highway for a property within a conservation area or a listed building.			
NOTE: Equipment no longer needed for microgeneration should be removed as soon as reasonably practical			

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Solar PV panels | Examples of installations

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

PV installation on a roof (house) as tile replacement

PV installation on a roof (house) over the tiles

PV installation on several roofs (*RBKC/Solar Together*)

PV installation on a roof (house) as tile replacement

PV installation on a roof (block of flats)

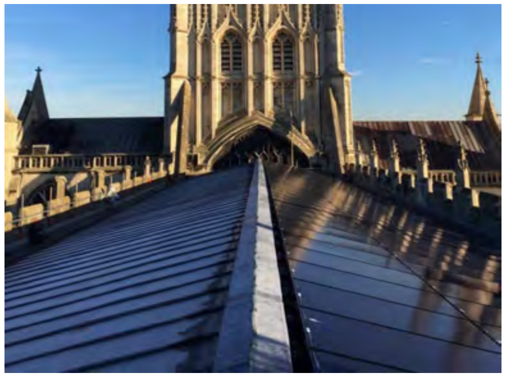
PV installation (rear elevation) over the tiles

PV installation on a roof (block of flats) - concertina

PV installation on a roof (house) over the tiles

PV installation on a roof (house) over the tiles

PV installation on a roof (house) over the tiles



PV installation at King's College, Cambridge

PV installation on a roof (house) – PV slates

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