H&F Council-owned Housing Fabric Retrofit Strategy

22/04/2025

V.2.2

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Fabric Retrofit strategy, *in brief*

Vision

H&F's Fabric Retrofit Strategy sets out our approach to making our homes affordable, healthy, and in line with the council's climate and ecological emergency targets.

Its goal is to provide H&F's residents with comfortable, affordably-heated and well-adapted homes. These homes will reduce fuel poverty, be cost efficient and have net zero carbon impact.

Reduce bills and tackle climate change by:	**Upgrading the fabric**	**Decarbonising heat**	**Adapting buildings to a changing climate**
Deliver this via:	**Capital Delivery**	**Mechanical and Electrical**	**Repairs and Voids**
Enable and support this through:	**Finance and policy**	**Engagement and collaboration**	**Planning**
	Data Management	**The business case**	**Archetypes and programmes**

The need for retrofit

We need to fix our homes to use less and cleaner energy. Doing this helps our residents and environment by solving three major challenges we face:

- The climate crisis
- The cost-of-living crisis
- Healthy homes

This retrofit strategy sets out the need and context for upgrading our homes with energy efficiency measures and renewable energy, as well as the challenges and considerations for doing so. It then outlines the key approaches we will take to delivering retrofit, considering elements such as different archetypes of home, retrofit interventions, tenures, works programmes, and financing approaches.

The strategy takes a 'fabric first' approach to retrofitting its housing stock, focusing first on reducing energy use with cost-effective interventions that insulate our homes and stop them losing heat as quickly. A fabric first approach to retrofitting social housing is needed to reduce energy demand, lower running costs for residents, and enhance indoor comfort. Installing cost-effective fabric measures supports homes to ultimately move to lower carbon heating sources such as heat pumps.

Tackling the climate crisis

The world is in a climate emergency and urgent action is needed by everyone. H&F Council declared an emergency in 2019, pledging to reduce its carbon emissions and meet net zero carbon by 2030. Since then global temperatures continue to rise, with 2023 the hottest year ever recorded, and 2024 on track to top this.[1][2] With rising temperatures have come increasingly frequent and severe impacts, globally and locally.

The largest source of greenhouse gas emissions in the borough is from our buildings, with 40% of the borough's local carbon footprint coming from its homes.[3] As the largest landlord in the borough, H&F Council has a key role to play in tackling this. Besides procurement, the council's housing also represents the largest proportion of the council's own organisational carbon emissions, as seen in Figure 1. A key pathway to achieving net zero will be upgrading these homes to be more energy-efficient, with low-carbon heating and hot water.

[1] 2023 was the warmest year in the modern temperature record | NOAA Climate.gov
[2] State of the climate: 2024 off to a record-warm start - Carbon Brief
[3] London Energy and Greenhouse Gas Inventory (LEGGI) - London Datastore

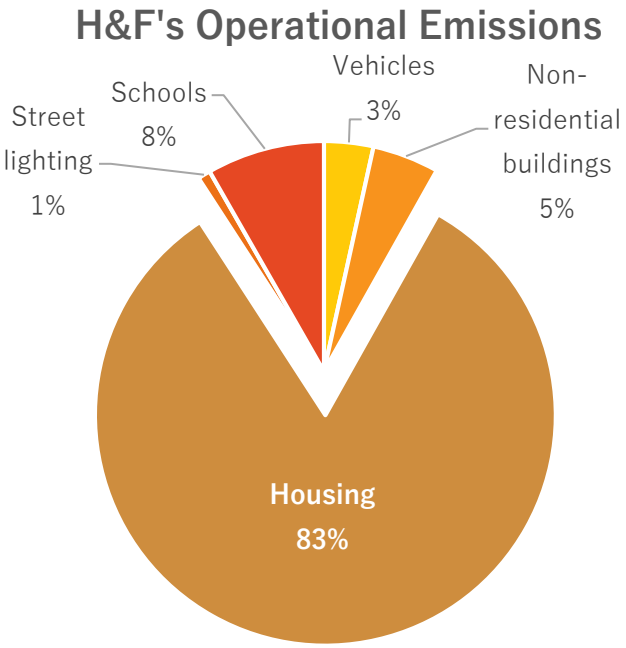


Figure 1. Split of H&F Council's operational carbon emissions[4]

In addition to reducing carbon emissions, we need to act to protect ourselves from increasingly frequent severe weather.

Due to our densely built urban setting our residents and buildings experience higher levels of risk. Most of H&F lies within flood risk zones due to the high levels of paved surfaces and lack of natural spaces for water to drain into. A forthcoming Climate Risk Assessment for the borough identifies extreme heat in housing as one of the most severe climate-related risks, with the density of buildings and dark surfaces meaning heatwaves are more intense and dangerous than in surrounding rural and suburban areas. Adapting H&F properties to be resilient in a changing climate is of growing importance. For example, heat related deaths hit their highest level in 2022 with over 4,500 people dying due to high temperatures.[5]

Tackling the cost-of-living crisis

The cost-of-living crisis has been acute, with inflation peaking at 11% in 2022, higher prices in London than beyond, and energy prices rising threefold between 2020 and 2023. Energy bills are a major outgoing and concern for residents. The cost of fuel increased sharply in the wake of the war in Ukraine, exposing the vulnerability of the UK to energy price shocks. Residents should be able to live in warm homes that they can heat affordably. Energy prices are unpredictable; using less energy puts money back in people's pockets and improves our resilience to any future crises. Retrofitting our homes with measures like insulation will help us achieve this.

[4] Including the council's scope 1 and 2 emissions from its use of energy in buildings and vehicles it operates, plus emissions from housing where the council controls the building's fabric and heat source.

[5] Heat-related deaths in 2022 hit highest level on record in England | Extreme weather | The Guardian

Healthy homes

We want our residents to be able to rely on their homes keeping them in the best of health. Cold homes, damp and mould, and poor ventilation combined with pollutants from cooking and other activities, can all take a toll on health. There is a strong relationship between cold temperatures and illness, including cardiovascular disease, respiratory illness, colds and flu, rheumatism and arthritis, and mental health.

With each 1C drop in temperature below 5C, GP consultations for respiratory illness in older people increase by 19%, and hospital admissions for Chronic Obstructive Pulmonary Disease (COPD), commonly linked with fuel poverty, are four times more likely to happen over winter.[6] Countries with more energy efficient housing have lower excess winter deaths, which are almost three times higher in the coldest quarter of housing than in the warmest quarter.[7]

Retrofitting homes can address these issues, ensuring they can be kept warm affordably and are well ventilated, preventing cold and damp. Replacing our gas cooking and heating systems with low-carbon systems means residents breathe cleaner air inside and outside the home.

A challenging context for delivery

The context in which the council is delivering retrofit is challenging:

- Council budgets are not sufficient to fully decarbonise social homes unaided
- Inflation has hit construction hard, with costs at an all-time high
- Central government funding schemes have so far offered only a fraction of the funding required across the country's social housing and cover only a small portion of the true costs per home
- The funding has restrictive eligibility criteria that leave many homes in need
- A history of stop-start funding schemes has not given the retrofit market the certainty needed to invest in skills, leaving it under-resourced to meet the scale of delivery required
- There are cost implications and legal considerations for the majority of our buildings that include owner-occupying residents
- Delivering retrofit can be disruptive and the benefits for residents are not always widely understood

Retrofitting our housing requires innovative solutions to be brought forward by landlords, the market, and government. Challenges to be overcome include alternative funding models, solutions for hard-to-treat homes, planning restrictions, and approaches to leasehold properties.

[6] National Energy Action, Under One Roof: NEA-Under-One-Roof-FULL-REPORT-FINAL-Feb-19-1.pdf

[7] The Health Impacts of Cold Homes and Fuel Poverty: Excess winter deaths and illness and the health risks associated with cold homes (nice.org.uk)

What is retrofit and how will it help?

Preventing homes from losing heat

Retrofitting means adding new components to an existing building. In the context of energy efficiency and net zero carbon this means adding components that make the buildings more energy efficient, generate or provide renewable energy, and make them well-adapted to our future climate.

H&F will take a 'fabric first' approach to retrofitting its housing stock. This means focusing first on reducing energy use with cost-effective interventions that insulate our homes and stop them losing heat as quickly. Focusing first on reducing heat demand reduces energy bills for residents, helps heat pumps operate more efficiently by smoothing peaks and troughs in demand, and supports national decarbonisation by reducing the additional demand placed on the electricity grid as a result of switching heating sources from gas to electricity.

Typical fabric energy efficiency measures include:

- Double glazing
- Loft insulation
- Floor insulation
- Cavity or solid wall insulation
- Draughtproofing

Every home is different, and the interventions for each will vary according to what's cost-effective and right for the property and resident.

Transitioning H&Fs heating source from gas to electricity is also needed to achieve net zero carbon. The UK's electricity is rapidly decarbonising, and heat pumps are suitable for most homes and offer a highly energy efficient source of heating by extracting renewable heat from the environment[8]. However further work is needed for the council to develop a viable strategic approach. Key actions are referenced in this document along with a decision tree to ensure any opportunities to upgrade buildings to low-carbon heat are not missed in the short term.

This approach allows us to reduce emissions, reduce residents' energy bills, and ready our homes for the transition to low-carbon heating. The benefits of this approach are:

1. Reducing carbon emissions from Hammersmith and Fulham's homes by reducing the amount of gas needed to heat them.
2. Reducing residents' energy bills.
3. Includes lower cost and cost-efficient interventions.

[8] UK Parliament POSTnote 699: Heat pumps

4. Prepares buildings for low-carbon heat, which operates more efficiently when buildings are well-insulated.
5. Spreading the costs of decarbonisation.

Benefits of retrofit

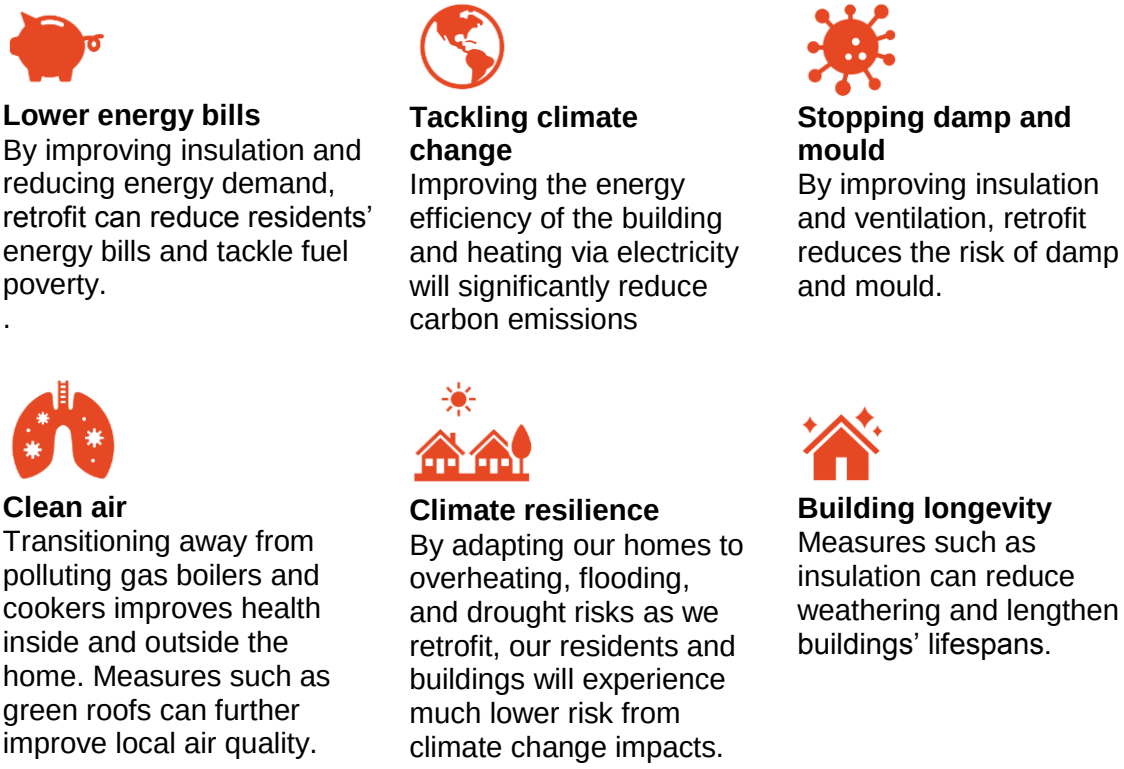


Figure 2. Benefits of retrofit

The benefits of retrofitting the council's stock are not only confined to reducing carbon emissions; it can also increase the standard of H&Fs housing, making them warmer, healthier and cheaper to run. H&F buildings also need to be adapted for a changing climate, such as rising summer temperatures. Retrofit measures can also make buildings more attractive, increase biodiversity, and provide more green space for people to enjoy. Three core benefits are outlined below.

Cost of living

Improving the energy efficiency of our homes is the most reliable and durable way to reduce residents' energy bills, ensuring that they are resilient to any future price volatility. Carrying out the interventions modelled for this strategy is projected to reduce the average heating bill from £433 to £291 per year.

Health

Retrofitting can help to tackle the strong links between cold, poorly ventilated homes, damp and mould, and poor health. Homes that are affordable to heat are less likely to present such issues. Studies have found that countries with more energy efficient

housing have lower excess winter deaths, and that these are almost three times lower in the warmest quarter of homes than the coldest quarter.[9]

Climate change

Retrofitting our council homes takes positive action on the borough's largest source of greenhouse gas emissions. Installing fabric energy efficiency measures will reduce our emissions by 6,971 tonnes CO2e per year, with low-carbon heating and grid decarbonisation providing the remaining route to net zero carbon.

Our homes

Where we're starting from

H&F's 17,089 tenanted and leasehold properties are varied but can be separated into four main 'archetypes': houses, converted street properties, low- and mid-rise blocks, and high-rise blocks. These broad archetypes will be broken down into further typologies and analysed to guide a retrofit programme, a key next step in the action plan.

				
Archetype:	**Houses**	**Converted street properties**	**Low and medium rise flats**	**High rise flats**
Number of homes:	1,396	1,788	7,999	1,191
Average EPC score:	65	68	72	74

Our heating systems are less varied; the majority are individual gas boilers, while the rest are mostly communal heating systems, which are large gas boilers that serve a group of flats within a block or across multiple blocks.

Our homes have been built in different ways and vary in how energy efficient they are. Purpose-built flats in blocks are typically more energy efficient because they are more modern constructions that often have filled cavity walls and double-glazed windows, and share their walls with neighbouring properties, reducing heat loss. Older houses and converted street properties are the lease energy efficient, because they often have uninsulated single-brick walls and single-glazed windows which lose a lot of heat in the winter.

The standard way of measuring energy efficiency is with SAP, the Standard Assessment Procedure: a government-approved method of determining the energy

[9] The Health Impacts of Cold Homes and Fuel Poverty: Excess winter deaths and illness and the health risks associated with cold homes (nice.org.uk)

efficiency and environmental index of a building. It is based on a 100 point scale, with higher scores performing better. The outputs of SAP assessments are captured in Energy Performance Certificates (EPC) for individual homes. Across our whole stock our homes average a modelled EPC of grade C, SAP point 71.25.

A more specific measure for how quickly homes lose heat is space heating demand (SHD). It describes the amount of heat required to maintain the internal temperature at a comfortable level and is measured in kilowatt hours per meter squared per year (kwh/m2/y). The average across our stock is 76 kWh/m2/y.

These averages mask a variation in how energy efficient our homes are, and how much heating they require:

H&F building archetype	Heat demand (kWh/m2/year)	Annual heating bill	Tonnes of CO2e per year
Example Victorian house, single glazed	159	£755 (£8.07/m2)	4.3
Example flat in 1970s tower block, double glazed	50	£288 (£4.05/m2)	1.9

Table 1. Example homes owned by H&F and energy use

There are 3,500 H&F homes that are pre-1929 and 1,760 of these are in conservation areas. Pre-1929 homes are likely to be subject to restrictions by planners, and all homes in conservation areas will be subject to restrictions on what retrofit measures will be possible.

More information on our existing stock is in Appendix 3.

Making our homes warmer and more affordable to heat is not a new agenda to H&F. The council is already delivering energy efficiency schemes to its homes and is currently delivering a capital programme replacing old and leaky windows, doors and roofs. Recent pilot retrofit projects include:

- Innovative ‘deep retrofit’ of non-traditional houses on the West Kensington Estate
- Large scale insulation to blocks on the West Kensington estate
- Incorporating energy efficiency measures into our wider capital programme, with 3,214 measures including new windows, doors, roofs, wall insulation and loft insulation installed in 1,546 homes in the past 2 years
- Hybrid heat pumps for 10 sheltered housing schemes.
- Domestic air-source heat pumps for flats
- Feasibility studies for large scale heat networks in our estates

Where we want to get to

Fabric energy efficiency

We will take a ‘fabric first’ approach to retrofitting our homes, installing cost-effective measures that reduce heat demand before installing low-carbon heating.

Based on modelling of energy efficiency measures for our homes and guidance including the Retrofit London action plan, we aim to insulate properties to achieve a space heating demand of **64 kWh/m²**. This is considered a 'sweet spot' balancing ambition and deliverability, and is suitable for heat pump installation. Some homes already meet this, and the target may be higher or lower in practice for some homes depending on the constraints of each home. Applying energy efficiency measures to achieve this target across our stock is estimated to achieve the following benefits:

	Average heat demand (kWh/m2/year)	Average annual heating bill	Average tonnes of CO2e per year
Our homes now	76	£433.39	1.79
Our homes after retrofit	49	£291.44	0.07*

*after installing low-carbon heating

Table 2. Energy use improvements from retrofit in H&F homes

Some measures are more cost effective than others. Loft insulation, for instance, is cheaper and has a faster pay-back through bill savings. Some other measures such as solid wall insulation have a higher upfront cost. We aim to reach net zero in the most cost-effective way that is also right for our residents, installing fabric measures where these are the least cost approach to decarbonisation, but prioritising investment in decarbonising heat where the cost per tonne of carbon saved is significantly lower than installing further fabric energy efficiency measures. This will take into account both the cost to H&F and the energy bill implications for residents, and fabric measures will be installed before or at the same time as new heating systems so the systems are not oversized in future.

Low-carbon heating

Upgrading to low-carbon heating is needed across our stock to meet net zero, with electrification of heat being the most evidenced and efficient solution. Heat pumps are expected to be the preferred technology as they use energy highly efficiently. District heat networks, in which heat is shared between buildings in densely populated areas, are likely to play a significant role in the medium term; more information on this can be found in our Cross-Borough Energy Masterplan[10].

Transitioning homes to low-carbon heating at scale across the council's stock is extremely challenging. Low-carbon heating faces high capital costs with limited grant funding currently available. Installation can be limited by electrical grid capacity. The current high ratio of electricity-to-gas prices means that, although heat pumps are much more efficient than gas boilers, homes must be sufficiently insulated to avoid higher energy bills. A low-carbon heat strategy will be developed as part of the action plan attached to this strategy (see separate document).

Although this strategy focuses on fabric, we will pursue opportunities to install low-carbon heat immediately where possible. A decision tree for properties with domestic (individual) boilers has been developed that will be followed to ensure these projects

[10] Cross-borough energy masterplan | London Borough of Hammersmith & Fulham (lbhf.gov.uk)

are captured (Appendix 6). Communal boilers, due to their size and the typically lower space heating demand of blocks, can be suitable for replacement with low-carbon heating now. Opportunities to upgrade these boilers to low-carbon heat are being explored and progressed, with the budget to replace these currently covered within the Climate Emergency fund (see finance section below).

Renewable Energy

Installing solar panels and battery storage has the potential to reduce carbon emissions, residents' bills, and reliance on the grid. The technology is complementary to electrification of heat and electric vehicle charging and offers a good return on investment. Opportunities to install solar panels will be considered on a case-by-case basis, taking account of the level of opportunity provided by the roof space, the electricity demand of the site, and any planning constraints. Opportunities for alternative financing models that provide energy bill savings to residents and payback to the council's investment will be explored for this technology.

Adapting to a changing climate

We need to adapt our homes to protect both the council's residents and the rest of the borough from flooding, overheating, and drought. Retrofit offers an ideal opportunity to install climate adaptation measures. These include nature-based solutions like green roofs, and non-nature based solutions like external shutters and window tinting to reduce impacts of overheating. Reducing leaks and water consumption in homes supports the resilience of our residents and London more widely to drought.

As part of our capital programme we will conduct overheating assessments (TM52 Thermal Comfort Survey) on each property. We will incorporate recommendations into project design as appropriate, and consider opportunities to:

- Disconnect downpipes and reroute stormwater to nearby green spaces.
- Install green roofs
- Install cool roofs where green roofs aren't structurally feasible.
- Install rainwater harvesting systems in gardens.
- Install solar shading (e.g. brise soleil)

Embodied carbon and the circular economy

This strategy focuses mainly on reducing the 'operational' greenhouse gas emissions of our homes, which means those occurring because of our residents' energy use. 'Embodied' emissions look beyond this at the emissions associated with physical products, in this case those associated with retrofit such as insulation boards and new windows. This includes emissions from extraction of materials, manufacturing, transport to site, and energy used to install them.

The high embodied carbon of construction is one reason why retrofitting rather than rebuilding homes is a positive move for climate change. However, H&F acknowledges the impact of embodied carbon even in these projects and will

develop a plan to reduce embodied carbon emissions in retrofit and other capital projects.

The ‘circular economy’ describes a range of approaches to reducing embodied carbon and wasteful use of materials. These include repairing what we already have, reusing and recycling existing materials, and sharing rather than individually owning resources (such as a car-sharing scheme).

H&F has a low-carbon procurement policy and sustainable supplier charter, which requires all H&F contractors to make reasonable efforts to improve the sustainability of their practices, including through minimising waste and promoting the circular economy. H&F also has schemes such as the reuse of furniture scheme when properties are void. The Asset Management team will continue to commit to circular economy principles in line with H&F’s climate and ecology strategy, and embed these with contractors.

For example, solar panels are typically guaranteed for 20-25 years, with a shelf life of more than 30 years, and contain rare metals. Opportunities to reuse panels removed from H&F assets before their end-of-life will be followed to ensure they are not recycled or otherwise disposed of by default. Where financial circumstances challenge this, the Asset Management team will consult with the Climate and Ecology team before any decision on disposal.

<u>The journey to retrofit each home</u>

The overarching steps from now to completed retrofits to each home are:

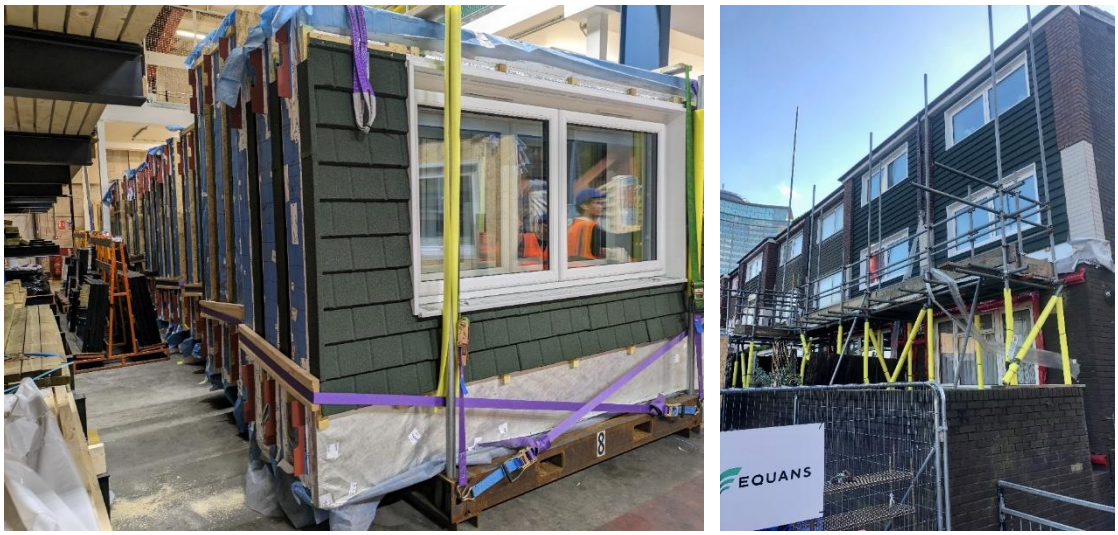
1. This retrofit strategy sets out our guiding approach
2. Stock condition surveys and our asset management strategy define which properties and works will be prioritised in each 5-year capital programme
3. In collaboration with residents, each property is surveyed to assess the right retrofit measures to install
4. Necessary ventilation and fabric energy efficiency measures are installed first
5. Low-carbon heating and renewable energy measures are installed alongside or after necessary ventilation and fabric measures
6. On completion residents are supported to get the most out of their newly upgraded, energy-efficient home

<u>Pilot projects</u>

H&F has completed early and pilot projects across various aspects of retrofit, as well as incorporating energy efficiency measures into its wider capital programme.

The Energiesprong ‘deep retrofit’ pilot in the West Kensington estate involved designing and off-site manufacturing bespoke external wall panels for 11 of our homes, which were then craned into place (see picture). These provide a warm envelope to the home, significantly reducing the need for heating, and are supplemented with loft insulation, solar panels and heat pumps to provide efficient, low-carbon heating. This was an innovative project part-funded by central government and undertaken as a partnership with the GLA and other boroughs. The result is warm, sustainable homes, and the project has provided the council with

valuable learning around delivering challenging retrofit projects, which will be carried into our future projects.



Bespoke insulated external wall panels with integrated windows for the West Kensington Energiesprong pilot, off-site in the factory and being installed.

Energy efficiency measures have also been incorporated into our mainstream housing capital programme. In the previous 2 years of the programme 1,546 homes received energy efficiency measures of various kinds, resulting in an estimated 390 tonnes of CO2e being saved per year. An example is the West Kensington estate towers, which will benefit from a new energy efficient roof, cavity and external wall insulation, windows and enhanced ventilation to ensure good air quality and avoid damp.

Heat pumps have been installed in 9 communally heated blocks, currently operating alongside back-up gas boilers. As fabric energy efficiency measures to these blocks progress these can be moved over to be fully served by heat pumps.

Heat pumps in place in communally-heated blocks

<u>The business case for retrofit</u>

Retrofit can be complex and expensive, however there are multiple benefits and co-benefits. Many of these are touched on in the strategy, however quantifying them is not always straightforward. Areas such as impact on health and wellbeing are

priorities for the council and exploring ways to measure the impact and embedding them into the retrofit business will be important to justify ongoing investment.

Delivering retrofit

Having reviewed different approaches, H&F will focus most of its resources on methods that can deliver retrofit at a larger scale.

Services

The following services are involved in delivery:

Capital Delivery:

H&F's capital delivery function delivers various large scale capital projects according to the strategic needs of the community, council and housing stock. Retrofit projects are already being progressed through our capital programme, and retrofit will become a core function of the capital delivery team in order to deliver the first stage of upgrading the fabric. All capital projects will identify and progress retrofit opportunities, and the capital programme will be developed to support this strategic aim of the council.

Mechanical and Electrical team

The Mechanical and Electrical team (M+E) are responsible for managing the primary heating source in H&Fs housing. The Asset Management team will work closely with M+E to analyse heating needs on a case-by-case basis, using the decision tree reference in annex 2, and ensure that sites that are due for heating upgrades are prioritised for fabric retrofit.

Voids and Repairs

Retrofitting a vacant property presents an opportunity to carry out measures that would be disruptive while occupied. While purpose-built flats will generally need to be treated in a planned programme block-by-block, the voids process presents an opportunity for upgrading street properties, which need to be treated individually. Voids can also facilitate the move towards decarbonisation by updating the 'lettable standard', for instance to encourage moves towards electric cookers.

Whilst the repairs' function will not be a primary vehicle for upgrading the stock it can support decarbonisation through minor measures such as insulation to pipework, and energy efficient fittings such as low flow taps. The new repairs contract is due to be procured in 2025, and the asset management and climate teams will work with the repairs and procurement teams to understand what can be included.

Retrofit programme

Retrofit will be a core objective of our asset management strategy and capital programme. Two main approaches to delivering retrofit at scale are likely to be considered:

1. **Area-based approach**. Buildings will be prioritised in the capital programme based on a range of investment needs and retrofit will then be incorporated and applied to homes in this geographical area. This ensures investment is focused on buildings with the greatest need, helps with engaging residents, offers efficiencies from being based on one site, and can be aligned to local area energy planning along with other strategic priorities.
2. **Archetype-based approach**. This would focus delivery in sequence on different building archetypes such as pre-1919 solid wall houses or cavity wall blocks of flats. This allows less challenging archetypes to be addressed first, common solutions to be procured and rolled out at scale, and learnings from early projects to feed into subsequent ones.

Both approaches hold open the option to explore offering retrofit to local residents in other tenures. When the council is delivering a retrofit scheme for a particular archetype of neighbourhood, private homeowners in the area and in similar archetypes could be offered retrofit at cost. The benefits of this would include economies of scale, the possibility for it to be community led and more opportunities for joint funding.

Enabling Retrofit

Retrofit can be complex. As well as a clear approach and delivery mechanism several areas will be key to ensuring that it can be delivered to the time and scale required.

Finance

Retrofitting often involves substantial initial investment but can lead to cost reductions over time, as well as long-term durability of the stock and meeting the organisation's strategic objectives.

We are delivering retrofit in a challenging financial environment. Out of an estimated £100bn needed for social housing decarbonisation nationally, only £3.8bn has been committed to date by central government.

At the time of writing this strategy the council had made a strategic financial commitment of about £197 million up until 2032 that could contribute toward decarbonisation.[11] The current estimated cost of fabric retrofit, plus converting existing communal heating systems to heat pumps, and installing solar panels is £132,160,561. Further funding will be needed for the remaining conversion of gas boilers to low-carbon heating.

[11] In 2021 a strategic 'Capital Ask' paper was approved by Cabinet that lasted until 2032. This included £106.5 million for climate works, £70million for windows, £10milllion for communal boilers and £50million for White City, of which £11million was estimated for climate upgrades.

A breakdown of cost assumptions in the strategy is included in Appendix 5.

Given the current shortfall of funding when full heat decarbonisation is considered as well as fabric retrofit, it is necessary to keep exploring new financial models. As well as using the council's capital budget and bidding for grant funding, we will evaluate opportunities from public-private partnerships, competitive financing sources such as loans and bonds, and income from installing renewable energy.

Leaseholders

Leaseholders make up about 28% of H&Fs housing stock. Given the high costs of retrofit it is critical that costs are distributed fairly and leaseholders understand why they are being charged. Undertaking extensive resident engagement, communicating the overall goal of the strategy and its benefits will be crucial to achieving this goal.

The average cost per home for fabric upgrades is £6,488 based on modelling of our stock with software. It is important to note that this is an average, including some properties where minimal fabric retrofit is needed and some harder to treat properties where costs will be higher. These costs may change as there is high inflation in construction costs at present, with some quotes for projects coming back higher than estimated.

H&F recognise that charging leaseholders these amounts may place a financial burden on the leaseholders, and that leaseholders renting their property out could transfer these costs through increased rent. The council will ensure leaseholder costs for energy efficiency measures are reasonable, with these being approached on a case-by-case basis.

Resident engagement

Early, clear, and continuous engagement with residents will be a key part of delivering the strategy. Retrofit has a wide range of benefits and communicating these to residents will be essential to gaining the buy-in needed for successful delivery. Works can be disruptive, so we will engage with residents transparently to be clear on what they can expect and when.
This will involve general communication to all residents to promote the benefits, and project-specific communication.

Planning

Collaboration with the H&F Planning Team will be an integral part of the successful delivery of this strategy. Many homes are likely to be subject to restrictions on what interventions are possible, including historically and aesthetically important building types and all homes in conservation areas.

H&F has published a Climate Change Supplementary Planning Document (SPD). The SPD offers guidance to developers, planning officers, landowners and homeowners when preparing, assessing and reviewing planning applications, including for retrofit.

Further work will include:

1. **Develop a retrofit planning guide:** Aligned closely to the archetype approach, guidance will be developed around the types of windows, insulation, ventilation, and low-carbon heat and energy can be installed on chosen buildings.
2. **External Wall Insulation (EWI) case studies:** EWI can play a key role in reducing heat demand across our blocks, but poses challenges in terms of conservation. Work will continue with the Planning Team to find EWI solutions that meet planning requirements and allow wide-spread adoption of EWI systems.

Data management and smart technology

Good quality data is paramount in retrofit projects, enabling well-informed decision-making on which areas and buildings to prioritise, which measures to apply, what challenges and considerations must be taken into account, and ongoing maintenance needs.

H&F currently have an ongoing programme of stock condition surveys that collect key information on the condition of each building's components. We use an energy assessment tool to identify retrofit works needed and track progress on emissions reductions.

Energy efficiency retrofits can suffer from a 'performance gap' between expected and realised energy savings. Ongoing performance monitoring will allow evaluation of energy efficiency, environmental benefits, and the overall effectiveness of the retrofit measures. We will explore smart technology tools to support this work and help us understand the needs of our homes and residents in general.

Metrics for the performance of our homes can be found in Appendix 4.

Procurement and the supply chain

The council will be a significant purchaser, enabler and provider of housing decarbonisation work. This gives an opportunity to use procurement strategically in shaping the market, building supply chains for the future and working with partners to build the local skills base. Additionally, this can support supplier confidence through a 'pipeline' of work that give medium-term certainty for private sector investment decisions, supporting the consumer-oriented market that is needed.

Industrial strategy

This retrofit strategy aligns with the goals of H&F's Upstream Industrial Strategy by fostering economic growth, innovation, and sustainability within the borough. Investing in upgrading our housing stock stimulates local economic activity and creates jobs in high-growth and high-innovation sectors including low-carbon construction and renewable energy. These are areas of new development and

research by anchor institutions such as Imperial College and start-ups in the borough, and the council will develop opportunities for collaboration.

PAS 2035 Retrofit Specification

PAS 2035 is an approach and specification for retrofit that considers the requirements of the whole building, from the perspectives of technical requirements and occupants' health and comfort. It aims to avoid unintended consequences of poorly designed or installed retrofit. The PAS 2035 approach has been shown to reduce the risk of unintended consequences in retrofit projects.

H&F will embed PAS 2035 into its retrofit operations, to be decided on a case-by-case basis according to the complexity and combination of measures involved. For instance:

- Simple project not requiring PAS 2035 – solely upgrading the windows on a block.
- Complex project requiring PAS 2035 – the exterior of the block is insulated, along with new windows and loft insulation.

Action plan

An action plan has been co-developed between the relevant delivery teams within H&F, outlining the projects and actions needed to meet the targets and agreements outlined in the strategy- see Appendix 2. The actions are assigned to one or multiple teams within H&F. The action plan will be updated quarterly to track progress and highlight risk areas. The plan remains live and can be amended with approval of Asset Management and affected teams.

Key workstreams

With the development of this strategy and action plan, various priority workstreams have been identified in the short term that will be integral to the delivery and success of the strategy and its goals. The workstreams are as follows:

1. **Develop low-carbon heating strategy.** Further work is needed around developing an approach to transition H&Fs properties away from fossil fuels.

2. **Determine which communal boiler sites can be upgraded to low-carbon heat immediately.** Feasibility studies will need to be undertaken as soon as possible to identify the sites that can be upgraded.

3. **Continue to undertake low-carbon heat pilot projects.** Continuing to develop the organisation's knowledge and understanding of different technologies and solutions for low-carbon heat will be important in the lead up to 2028. A clear, scalable solution will be needed for each archetype that can be rolled out at pace.

4. **Develop archetype approach and agree retrofit programme.** Work to further investigate the array of archetypes found in H&F's housing stock must be completed, assigning the range of retrofit works most likely to be applied to each archetype, allowing a full programme of works to be developed, costed and delivered.

5. **Develop a climate adaptation plan for the councils housing.** Overheating assessments, flood risk assessments, and adaptation measures are all relatively new to H&F's delivery process. Thus, it will be integral to develop a more detail action plan and costed action plan that can be delivered.

6. **Review planning policies and procedures.** Planning constraints pose a large barrier to wide-spread retrofit. It will be key to collaborate with the Planning Team to develop a set of guidelines and amend policies to enable retrofit while also respecting and maintaining the aesthetics and heritage elements of our housing.

7. **Develop in-depth resident engagement plan for retrofit works.** Residents are at the heart of this strategy and will be most impacted by retrofit works. Developing an in-depth resident engagement strategy will be key in ensuring residents are brought along the retrofit journey from the beginning.

8. **Continue to develop the business case around retrofit.** Retrofit can be expensive and complex. However, when it is done correctly there are many benefits, some that are challenging to quantify such as impact on health. Continuing to develop this understanding will be key in unlocking more resources.

Governance

Governance for the strategy plays a pivotal role in orchestrating its success. Key aspects of governance in this context include ensuring key objectives and metrics are followed as well as, allocating resources effectively, engaging stakeholders, and ensuring compliance. Furthermore, an inclusive and transparent approach fosters collaboration among various stakeholders to ensure that retrofit projects align with broader organisation goals. With that in mind a Retrofit Board will be set up to govern the progress of the strategy.

Appendix 1: Values and principles

Council Values

The development of this strategy has been guided by the councils core values and will continue to be guided by them.

Creating a compassionate council. Improving the safety, wellbeing and comfort of our residents is at the heart of this strategy. Improving the quality of our housing and its ability to protect our residents, especially considering our most vulnerable residents, is what drives this work.
Building shared prosperity. Retrofit projects will grow the economy with more jobs and training in green fields such as insulation and solar panel installation, as well as increasing the lifespan of our existing assets, making the most of the Council's budgets and doing so with our people and planet in mind.
Doing things with residents, not to them. Tenants and leaseholders have both inputted into the strategy and will continue to be involved as it progresses. Retrofit projects will involve residents from the start and a thorough engagement strategy is identified as a key action succeeding this work.
Taking pride in Hammersmith & Fulham. Retrofit not only improves energy efficiency and resilience in our homes, but also improves the look and feel. These projects will bring buildings up to a higher standard, giving all residents of H&F a nicer place to live and take pride in.
Rising to the challenge of the climate and ecological emergency. This strategy outlines how H&F will deliver on reducing emissions from the councils housing stock which accounts for over 85% of the council's operational emissions.
Being ruthlessly financially efficient. Financing retrofit poses a great challenge, and the programme will be built around value for money and maximizing grant funding availability. The strategy also priorities an approach that is financially sustainable for the organisation given the high cost of decarbonising the stock.

Strategy Principles

The strategy will also follow a set of principles that will guide decision.

Just transition. The impacts of climate change and inadequate housing often fall disproportionately on the vulnerable. This strategy aims to ensure that action taken is equitable, taking action to protect the most vulnerable first, and bringing all residents to a comfortable standard of living.
Wider environmental benefit. While this strategy's actions focus on reaching net zero carbon by reducing carbon emissions, they also aim to increase biodiversity by increasing green spaces, improve air quality by removing polluting heating systems, and reduce the impacts of climate change through adaptation measures.

Ambition. H&F must remain ambitious when it comes to decarbonising and adapting the stock. Whilst the organisation can only work within the confines of its resources, continuing to push for new, more effective ways of achieving net zero will be critical to achieving the goal.

Innovation. The climate change retrofit industry is still in its infancy. Continuing to innovate not only with technology but the strategic approach will be critical to ensure the stock is decarbonised in the most effective way for everyone.

Partnership. Collaboration within the council and with our external partners, residents and wider communities will be integral to the successful delivery of this strategy.

Resilience. Retrofit is complex and there will be ongoing challenges at strategic level but also on the ground. Remaining resilient to these challenges may be the most important principle of the strategy.

Appendix 2: Context for the strategy

Strategy development

Industry consultants Turner & Townsend were appointed in 2022 to undertake an assessment of the stock and give recommendations on the best strategic approach, along with high-level cost estimates. This was using a housing stock assessment tool, which can model the impacts of different retrofit measures on our buildings' energy use and carbon emissions. The results of the analysis were then brought into a series of workshops with departments across the Council. Following this a strategic pathway was agreed by senior council leaders which forms the foundation of this document. It should be noted that given the changeable landscape in relation to retrofit including finance, technology, and government policy it has been decided to keep this strategy a live document. Remaining agile is likely to be critical to achieving net zero emissions in the most efficient way.

National policy context

The development of this strategy is aligned with various national policies, global agreements and UK legislation. The key drivers are listed below:

- **The UNFCCC Paris Agreement** Its central aim is to keep global temperature rise this century to well below 2˚C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5˚C.
- **Climate Change Act 2008** Requires the Secretary of State to ensure that the net UK carbon account for the year 2050 is at least 100% lower than the 1990 baseline.
- **Government's Industrial Strategy** With clean growth at its heart, one of the 'Grand Challenges' driving it is to halve the energy use of new buildings by half by 2030.
- **Heat and Buildings Strategy** Launched in October 2021, it drives to make buildings more energy efficient, perform better, be healthier and more comfortable to occupy and live in. It calls for a systemic change in the way building performance is improved, leaning on the "no- and low-regrets" pathways mentioned in the retrofit quality standard PAS2035, which lead to a fabric-first retrofit approach.
- **Net Zero Strategy: Build Back Greener**, sets out policies and proposals for decarbonising all sectors of the UK economy to net zero by 2050. Section 3iv focuses on the way we heat and power our buildings and their decarbonisation plan.
- **The UK Environment Bill** Published in 2020, this bill inspired an ambitious package of measures to address the urgent need for greater natural preservation and recovery to adapt and mitigate climate risk.
- **Energy Act 2023** sets out a framework for urban areas to develop heat networks, and for the country to move to low-carbon heat sources.

Aligning with current H&F and local policies

H&F Council have already produced various strategies that address the wide range of issues presented. Additionally, there are various local London policies that guide retrofit action. This work is linked to these existing strategies and will further strengthen the Council's. The Asset Management Strategy is also being updated of which this strategy will also form a critical part. The latest version of this is now being updated following completion of the council's recent 'compliance' strategy.

- **H&F Climate and Ecology Strategy** Outlines an objective for Council-housing: *"Put in place and implement whole house retrofit plans for all council homes to achieve net zero, that include adaptation measures".*
- **Fuel Poverty Strategy** - In 2023, the Council published the H&F Fuel Poverty Strategy, aiming to tackle the cost-of-living crisis and increasing energy prices while also making progress on the climate emergency and net zero carbon goals. Retrofit is identified as a key solution to support achieve the strategic aims.
- **H&F Housing Strategy** Specific objective surrounding sustainability in housing: *"All homes should satisfy London Plan policy on sustainability design and construction and make the fullest contribution to the mitigation and adaptation to climate change".*
- **H&F Air Quality Action Plan** Aims to *"reduce emissions at source – through […] controlling emissions from building and construction sites"*.
- **The London Plan** Notes that London's existing domestic buildings contribute 36% of the region's CO_2e emissions and mandates that borough *"develop policies and proposals regarding the sustainable retrofitting of existing buildings"*.
- **Retrofit London Action Plan** Launched in 2021, providing a detailed, cross-tenure approach to retrofitting London's 3.7 million homes to EPC B or equivalent by 2030. It sets out actions that can be taken forward, along with proposed metrics – including overall carbon emissions, space heating demand and energy use.
- **Clean Heat Masterplan**– This piece of work identifies potential 'heat networks' around the Hammersmith and Fulham. Heat networks will be a key approach to decarbonising heat around the borough.
- **H&F Corporate Plan** - This Corporate Plan for 2023-26 describes how we will work with our residents, businesses, voluntary and community sector and partners to rise to the challenges of our time. Net zero by 2030 is a key goal and retrofitting housing is a key action within this.

Appendix 3: Further stock analysis

As an inner London borough, the council has a varied housing stock and therefore there is no 'one-size fits all' solution. There is also a high amount of conservation areas where strict planning rules apply. Some buildings due to their age will require deeper retrofits, whereas the more modern buildings may only require a lighter touch. Understanding H&Fs stock, its environmental performance, and the required finance to upgrade it is therefore critical in developing a strategic approach.

Archetypes and approaches to retrofit

There are 17,089 properties within H&F's council-housing stock. Of these, 12,375 are social housing properties and 4,723 are leasehold properties. Leasehold properties make up about 28% of H&Fs housing stock and are predominantly in converted street properties and low/medium rise blocks.

The split of properties across four main archetypes is depicted in Table 3. These will be broken down further to guide a retrofit programme.

				
Archetype:	**Houses**	**Converted street properties**	**Low and medium rise flats**	**High rise flats**
Number of homes:	1,396	1,788	7,999	1,191
Average EPC score:	65	68	72	74

Table 3. Archetype split across council-owned housing stock (not inc. leaseholders), current EPC scores

There are 3,500 H&F homes that are pre-1929 and 1,760 of these are in conservation areas. Pre-1929 homes are likely to be subject to restrictions by planners, and all homes in conservation areas will be subject to strict restrictions, reducing the level of retrofit that will be possible.

As can be seen in Figure 3 and Figure 4, the energy efficiency and emissions associated with each archetype vary.

The total annual emissions from H&F's stock are 30,159 tonnes of carbon dioxide equivalent (tCO2e), of which our tenanted properties make up 72%. The majority (62%) of emissions are from low and medium rise flats, followed by converted street properties (19%), houses (14%) and high-rise flats (5%). The highest average emissions are from houses at 2.94 tCO2e per home, compared to high rise flats with the lowest average emissions of 1.20 tCO2e per home.

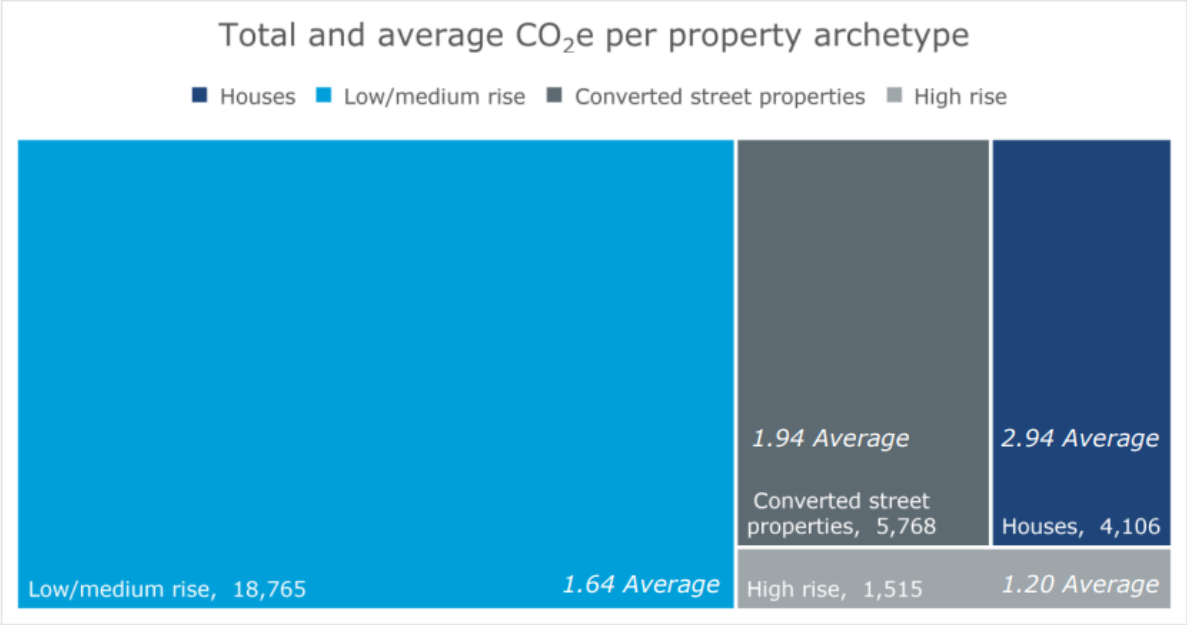


Figure 3. Tonnes of Co2e per property archetype

The houses and converted street properties are the worst-performing properties in our stock. This is because they have single-brick walls that are uninsulated, as well as many of them having single-glazed windows, which cause the building envelope to be very leaky, losing a significant amount of heat in the winter. Our block properties (low-, medium-, and high-rise flats) are better performing in terms of energy efficiency because they are more modern constructions that often have cavity walls and double-glazed windows. Also, since flats in blocks share most of their walls with neighbouring properties, there is less heat loss.

Figure 4 shows that the average EPC across our stock is 71.25, which is a low C and the average space heating is 76kwh/m2/y, but that this differs significantly by archetype.

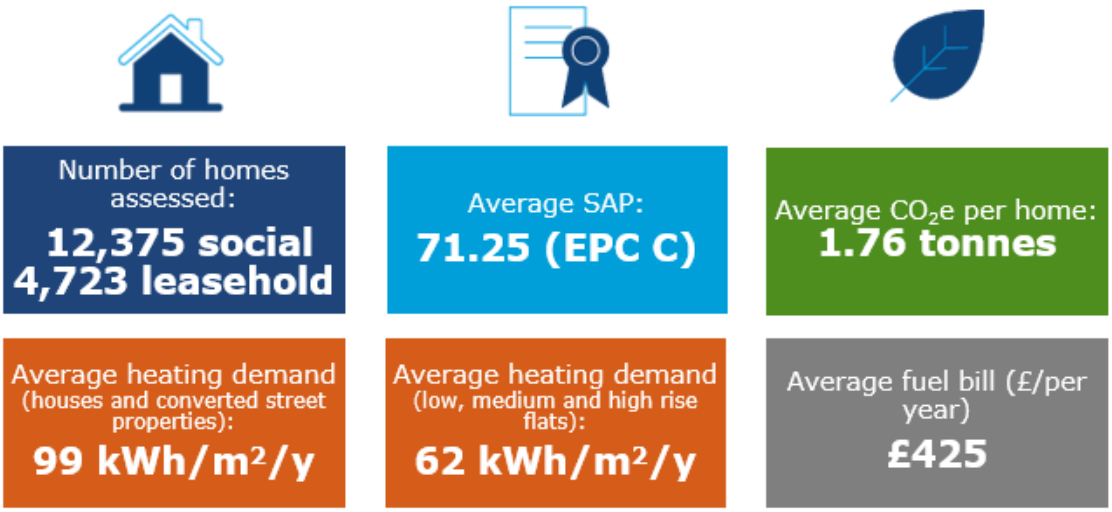


Figure 4. Summary of modelling results across H&F housing stock

With several types of buildings in our housing stock that have varying constraints, a range of energy efficiency targets is required. An archetype approach will be developed further, breaking our stock into common construction types, and identifying what retrofit measures and space heating targets may be applicable for each. This will support the development of a long-term capital works programme. An example of the different approaches to retrofit is outlined in Table 4; the final archetype approach will be more detailed.

	Deep retrofit	Good practice retrofit	Constrained retrofit
Space heating demand target (kWh/m^2/y)	**20-25** (EnerPHit standard).	**64** (London Retrofit Action Plan 'sweet spot').	**90-120** (see commentary below).
Overview	Exemplar level of retrofit. High attention to detail on air tightness, removal of thermal bridges, and low U-value insulation. The benefits of this approach are that it reduces the need for a larger heat pump and in smaller homes direct electric maybe feasible. However, it is more costly and more disruptive whilst works are underway.	The recommended sweet spot between deep retrofit and constrained. This should be the default position for projects. This comes at a reduced cost, whilst being effective for heat pump installation.	Lower ambition of heat demand reduction. Should only be pursued where there are several constraints, e.g. conservation area heritage properties with limited internal space. Focus on air tightness, new windows, floor and loft/roof insulation. This will maintain the character of the heritage building and does not limit space internally.

Table 4. Approaches to retrofit

Heating and hot water systems

Figure 5 shows that the majority of heating systems are individual gas boilers. The rest are mostly communal heating systems, which are large gas boilers that serve a group of flats within a block or across multiple blocks.

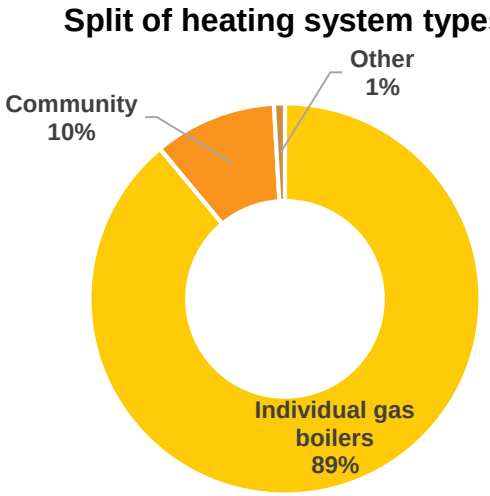


Figure 5. Split of heating system types across H&F housing stock

Climate vulnerability

Within the stock analysis, the level of climate risk our residents and council homes face currently and in the future was assessed. These risks involved overheating risk, flood risk, and drought risk.

Around 90% of existing homes in the UK are predicted to overheat in a 2C global-warming scenario[12]. Overheating poses a great health and comfort risk to all residents, increasing instances of heat-related illnesses and deaths, but especially for our more vulnerable residents. Overheating in homes can be mitigated through two main areas: property-specific works that increase controllable ventilation and minimise unwanted solar gains, and borough-wide works that increase green-spaces and thus minimise the Urban Heat Island (UHI) effect. All homes, when developing the retrofit plan, will be assessed for thermal comfort and overheating mitigation measures that can be applied.

As mentioned, most of H&F is under some level of surface water flooding risk. Surface water flooding is caused when rainfall water cannot be absorbed by the ground or by drainage infrastructure. Among our Council-owned homes, there are 422 properties at high risk of surface water flooding, and 1,048 properties at medium risk of surface water flooding. These properties, when developing the retrofit plan, will be assessed for flood risk mitigation measures that can be applied. These measures range include disconnecting downpipes and re-routing flow to nearby green spaces or sustainable drainage solutions (SuDS), green roofs and blue roofs.

Drought is projected to be a growing problem, with summer rainfall projected to decrease by 12.4%-17.7% by the 2050s compared to the 1981-2010 average, which may lead to drought conditions. Actions may be required to reduce the impact of drought such as hosepipe bans within public residences and possible supply disruptions which can have an impact on sanitation. Low water pressure brough about by drought is likely to have worse impacts on supply to residents on higher

[12] Addressing overheating risk in existing UK homes ARUP report (theccc.org.uk)

floors of tall buildings. Drought conditions can also result in subsidence, especially in the clay-rich soil common across London. Currently, in England, 142 litres of water per person are used every day[13]. Given this, the Royal Institute of British Architects (RIBA) recommend that water consumption is reduced to 95 litres per person per day by 2025 and to 75 litres per person per day by 2030. H&F will aim to reach these targets through the water efficiency strand of the Retrofit Strategy Action Plan.

[13] https://www.waterwise.org.uk/save-water/

Appendix 4: Measurement

Key metrics are essential for evaluating the success and effectiveness of a retrofit strategy. These metrics help measure progress and ensure that objectives are met.

Stock level metrics

Metric	
Average space heating of the stock (KWh/m2 per year)	Main council metric for tracking progress against efficiency of stock and ability to install low-carbon heating. Also supports with fuel poverty.
Average EPC (SAP) rating of the stock	Key government metric used for grant funding.
% reduction carbon emissions of stock	Used to track environmental progress against timeline.
% of the stock retrofitted with fabric measures	Used to track progress against timeline
% of stock retrofitted with adaptation measures*	Basic metric to track progress on adaptation*

**Whilst adaptation will be monitored it is expected more detailed metrics will be introduced once an action plan is developed.*

Table 5. Stock-level metrics

Individual building metrics

To deliver at a stock level, metrics are also needed at a building level. These will be further refined as the archetype solutions are more clearly understood. Table 6 shows a breakdown of the metrics.

Target area	Unit/KPI	Description
Space heating demand (SHD)	kWh/m^2/year	**H&F's space heating target which was modelled in Portfolio is 64 kWh/m^2/y.** This can go up and down depending on constraints and challenges of different archetypes. This is aligned to the London Retrofit Action Plan target, which is a recommended target for London's housing stock. It provides a balance between ambition and deliverability and is the 'sweet spot' for fabric retrofit as a way of balancing risks and costs. 28 previous studies have demonstrated that heat pumps perform best with a low SHD; below 85 kWh/m2/year is suitable for heat pump installation.
Energy performance Certificate (EPC)	A-F	Target of average EPC B across the stock.
Hot water demand (HWD)	kWh/m^2/year	HWD is the amount of energy needed for hot water over a year. Insulation of hot water tanks and pipes, and reduction of flow rates from taps can reduce this.

		The LETI benchmark for good practice HWD is 20 kWh/m^2/y. If HWD cannot be modelled, LETI suggest setting a litres per person per day target to specify for low flow devices on showers and taps. Hot water tanks and pipework should also be insulated.
Switch to low-carbon heating	Yes/No	Removal of fossil fuel burning boilers to heat pumps, low-carbon heat networks, or direct electrical heating.
Switch to appropriate ventilation system	Yes/No	A low energy whole house ventilation system is required to maintain indoor air quality when fabric measures are delivered.
Switch to low energy lighting	Yes/No	Lighting is included within the regulated electrical energy load which can be influenced by H&F.
Onsite PV maximised	% roof area maximised	The percentage achievable will vary by archetype. Solar Thermal should also be considered in some cases.

Table 6. Building-level metrics

Using smart technology

Homes that receive insulation, ventilation, and air tightness works should track:

- Indoor air temperature,
- Humidity levels,
- Carbon dioxide levels, and
- Comfort levels.

Appendix 5: Retrofit Measures and costs

This appendix provides details associated with the fabric element of retrofit. Costs are based on a price set developed by the housing assessment tool from data collected across Local Councils and other open sources. These costs only cover capital costs of measures so a 20% uplift is applied to cover contract management, prelims and other enabling costs required, based on benchmarks provided by several housing providers.

Costs provided are high-level figures that are designed to give an understanding of the expected investment required. These prices will be further validated when installers are engaged and provide quotes for specific works. Additionally, inflation has not been accounted for due to its unpredictable nature.

	Retrofit measure	No. of homes with measure	Cost	Tonnes CO_2e saved per year	Cost per tonne CO_2e saved per year
Fabric measures	Any conservatory is separate and not heated	2	£5,040	0.7	£7,474
	Cavity filled and internally insulated main walls	64	£903,251	18.2	£49,597
	Cavity filled alternate wall	114	£92,078	7.1	£13,034
	Cavity filled main walls	1,859	£2,257,035	595.9	£3,788
	Cavity filled party walls	527	£849,884	18.0	£47,220
	Exposed or semi exposed floors retrofitted	65	£828,919	18.8	£44,026
	Externally insulated alternate walls	47	£417,625	15.2	£27,495
	Externally insulated main walls	2,533	£20,052,653	1,341.7	£14,945
	Flat roof retrofitted	509	£1,371,939	224.1	£6,123
	Fully draughtproofed fenestrations	1,695	£501,694	62.7	£7,997
	Glazing (double)	819	£6,168,035	131.9	£46,760
	Glazing (triple)	236	£1,705,572	21.7	£78,471
	Loft insulation 300mm	2,285	£3,399,719	1,326.1	£2,564
	Blocking open chimneys	29	£9,500	2.3	£4,051
	Part L doors	1,285	£3,256,668	89.9	£36,235
	Rafters retrofitted	3	£8,317	0.3	£26,330
	Secondary glazing throughout	1,887	£5,424,951	306.8	£17,681
	Solid floors retrofitted	648	£2,631,317	69.0	£38,135
	Suspended floors retrofitted	1,400	£5,841,427	166.5	£35,091

Appendix 6: Domestic boiler replacement decision tree

This is an indicative decision tree for the replacement of domestic boilers for individual properties which are approaching end of life. As referenced above in the strategy, communal boilers serving multiple properties will be upgraded proactively rather than reactively, with work starting on this right away.

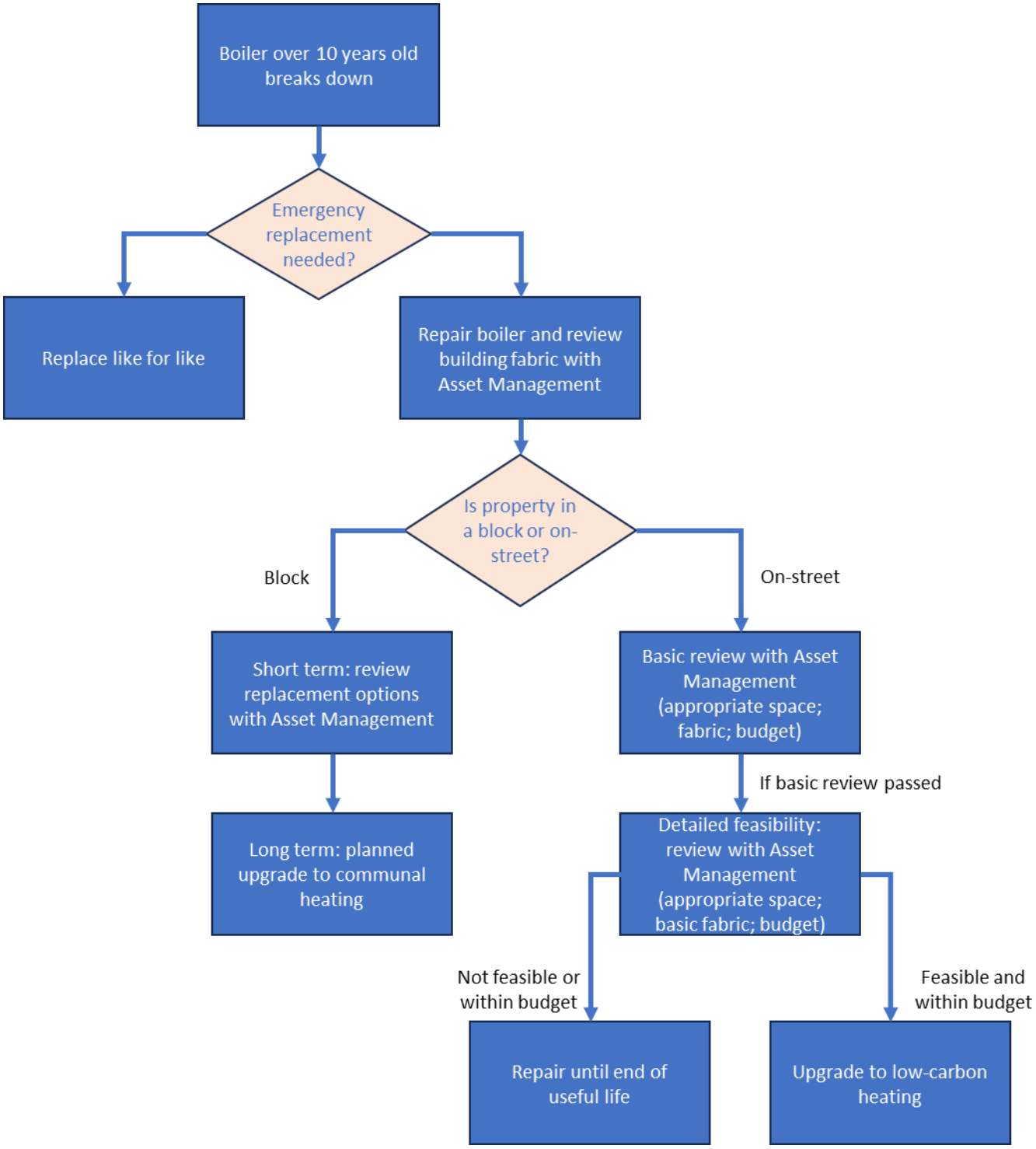


Figure 6: Domestic boiler replacement decision tree

Glossary

Archetype: A recurring form or design of building, used to categorize housing stock for retrofit analysis.

Carbon Emissions: The release of carbon dioxide (CO2) into the atmosphere, primarily from burning fossil fuels, which contributes to climate change.

Circular Economy: An economic system aimed at eliminating waste and the continual use of resources through reducing disposal, recycling, reusing, and repairing.

Climate Resilience and Adaptation: The ability of a system or community to withstand and recover from climate-related impacts such as extreme weather events.

Decarbonisation: The process of reducing carbon dioxide emissions through the use of low-carbon technologies and practices.

Embodied Carbon: The total carbon emissions associated with the production, transport, and installation of building materials. This is as opposed to the 'operational' or 'in-use' emissions of a building, which relate to energy used to heat and power the finished building.

Energy Efficiency Measures: Interventions aimed at reducing energy consumption, such as insulation, double glazing, and draughtproofing.

Energy Performance Certificate (EPC): A certificate that rates the energy efficiency of a building on a scale from A (most efficient) to G (least efficient).

'Fabric First' Approach: A strategy that prioritises improving the building envelope (walls, roof, windows) to reduce energy demand before installing low-carbon heating systems.

Fuel Poverty: A situation where households are unable to afford to keep their homes adequately heated, often due to high energy costs and low incomes.

Green Roofs: Roofs covered with vegetation that provide insulation, reduce stormwater runoff, and improve air quality.

Heat Networks: Systems that distribute heat generated from a central source to multiple buildings, often used in densely populated urban areas.

Heat Pumps: Heating systems that efficiently transfer heat from the surrounding environment (often the air, ground or water) into a building using electricity. These are expected to be one of the main heating systems to replace gas boilers in order to decarbonise our homes.

Low-Carbon Heating: Heating systems that produce fewer carbon emissions compared to traditional fossil fuel-based systems, such as heat pumps or district heating networks.

Net Zero Carbon: Achieving a balance between the amount of greenhouse gas emissions produced and the amount removed from the atmosphere.

Operational Carbon Emissions: Emissions resulting from the day-to-day energy use of a building, such as heating, cooling, and electricity consumption.

PAS 2035: A specification for the retrofit of domestic buildings that considers the whole building approach, ensuring technical requirements and occupant health and comfort are met.

Performance Gap: The difference between expected and actual energy savings achieved through retrofit measures.

Renewable Energy: Energy generated from natural resources that are replenished naturally, such as solar, wind, and hydro power.

Retrofit: The addition of new technology or features to older systems or buildings to improve energy efficiency and reduce carbon emissions.

SAP (Standard Assessment Procedure): A government-approved method for assessing the energy performance of buildings, used to produce EPCs.

Smart Technology: Advanced technology used to monitor and manage building performance, such as sensors for tracking indoor air quality and energy use.

Space Heating Demand (SHD): The amount of heat required to maintain a comfortable indoor temperature, measured in kilowatt-hours per square meter per year (kWh/m²/y).

Sustainable Drainage Solutions (SuDS): Systems designed to manage surface water runoff sustainably, reducing flood risk and improving water quality.

Urban Heat Island (UHI) Effect: The phenomenon where urban areas experience higher temperatures than surrounding rural areas due to human activities and infrastructure.

Ventilation: Providing sufficient exchange of air between the home and outdoors to ensure good air quality and minimise the risk of damp and mould.

Voids: Vacant properties that present an opportunity for retrofit measures that would be disruptive if the property were occupied.