Green Finance Institute

BROKER'S HANDBOOK ON GREEN HOME RETROFIT AND TECHNOLOGIES

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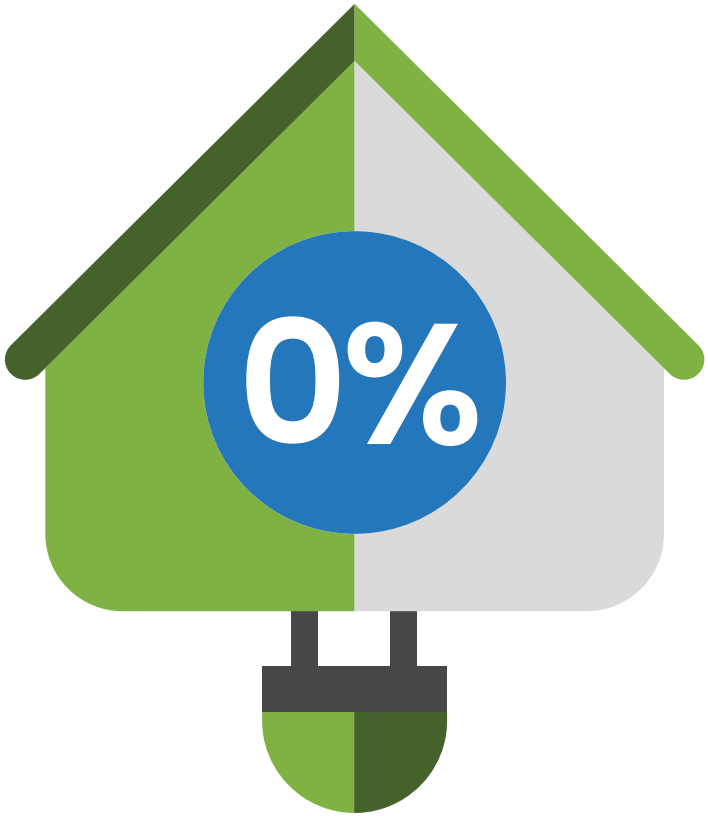
INTRODUCTION AND MARKET OVERVIEW

In the UK, buildings are responsible for around 23% of total greenhouse gas emissions.[1] Decarbonising the built environment is essential for meeting the UK's legally-binding climate target of net-zero emissions by 2050.

Making the UK's housing stock net-zero ready will also unlock substantial economic benefits. Energy bill savings will increase consumer spending power. More efficient and higher quality homes will reduce the burden that the negative health impacts of poor housing put on the NHS. The creation of new skilled jobs in the retrofit and low-carbon technology supply chains will help stimulate and sustain economic growth. Energy efficiency measures and green home retrofit technologies are crucial to the transition to net-zero ready homes, as are the financial products and services which will facilitate their roll-out.

The need to upgrade the UK's building stock to meet the country's climate targets presents a major investment opportunity in green infrastructure. The Climate Change Committee (CCC), the government's independent advisory body on climate change, estimates a total investment need of £360bn by 2050.[2]

In the face of the energy and cost-of-living crisis of 2022, upgrading the energy efficiency of our homes is one of the most important ways of increasing the UK's energy security.



[1] https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Buildings.pdf
[2] https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Buildings.pdf

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INTRODUCTION AND MARKET OVERVIEW

Net zero, energy security and the cost of living crises are colliding in an 'energy trilemma' perfect storm. The price of energy has dramatically increased in recent months, both in the UK and globally. Rising prices are causing widespread and severe affordability concerns for both domestic and commercial energy consumers[3] with reports that the number of households struggling with energy bills is set to triple in 2022.[4]

Better insulated homes have less demand for energy and cost less to heat. An upgraded, energy efficient housing stock would be futureproofed both against future consumer crises from energy shocks, but also for a net zero future.

Mortgage intermediaries have wide-ranging, long-standing and trusted relationships with homebuyers, therefore have an important role to play in supporting consumers on their net-zero journey – in particular, in relation to upgrading the energy efficiency of their property.

This handbook seeks to educate and inform mortgage intermediaries about different green home retrofit solutions and technologies including their opportunities and risks, quality assurance standards, benefits across the housing value chain, and the policy landscape for home energy efficiency. For the avoidance of doubt, this handbook does not provide guidance or best practice on recommendations of financial solutions to their clients.

[3] https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Buildings.pdf
[4] Resolution Foundation, Higher and higher, Averting a looming energy bill crisis, 17 January 2022

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INTRODUCTION AND MARKET OVERVIEW

The handbook has been drafted by a consortium of organisations and bodies, including:

- **Association of Mortgage Intermediaries (AMI):** A representative body for the mortgage and protection advice profession. AMI's mission is to deliver a better business environment to their members, who make up over 80% of all brokers.
- **Building Societies Association (BSA):** BSA is the voice for all 43 UK building societies as well as 7 credit unions, and aims to support and champion its members. Together these organisations serve around 25 million customers up and down the length of the UK.
- **Energy Saving Trust:** A respected and trusted voice on energy efficiency and clean energy solutions, the Energy Saving Trust works towards a smart, decarbonised, decentralised energy system by supporting households and businesses to make better energy choices and delivering energy programmes alongside governments and policy-makers.
- **Equity Release Council:** The Equity Release Council represents the equity release sector. It exists to promote high standards of conduct and practice, in the provision of and advice on equity release, which have consumer safeguards at its heart.
- **Green Finance Institute's Built Environment Programme:** Established by the Green Finance Institute and supported by E3G, the Built Environment Programme aims to catalyse new markets for financing the decarbonisation of existing buildings and the construction of net-zero new builds, promote the enabling conditions for market growth, and deliver scalable models for stimulating financial innovation.
- **L&G Mortgage Club:** Legal & General Mortgage Club is the largest and longest running mortgage club in the UK, involved in nearly 1 in 5 of all mortgages and 1 in 3 of all intermediated mortgages, completing over £97 billion of lending in 2021 alone. Now in its 27th year, L&G Mortgage Club has completed £765bn of mortgages since 1995.
- **Mortgage Climate Action Group:** The Mortgage Climate Action Group (MCAG), launched in April 2022, acts as a source of support for intermediaries, helping them to understand and address green issues when dealing with mortgage applications, and ensuring advisers' interests are represented among lenders, regulators, trade bodies and government institutions.
- **The Intermediary Mortgage Lenders Association (IMLA):** IMLA represents the views and interests of UK mortgage lenders involved in the generation of mortgage business via professional financial intermediaries.
- **UK Finance:** The collective voice for the banking and finance industry. Representing around 300 firms across the industry, UK Finance act to enhance competitiveness, support customers and facilitate innovation.

The handbook has been adapted from the Green Finance Institute's 'Lenders' Handbook on Green Technologies and Retrofit'[5] that was developed by a consortium of organisations and bodies, including: the Energy Saving Trust, MCS, Solar Energy UK, Renewable Energy Consumer Code (RECC), and the Association for Decentralised Energy.

[5] https://www.greenfinanceinstitute.co.uk/programmes/ceeb/lenders-handbook/

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UNDERSTANDING CUSTOMER DRIVERS AND MOTIVATIONS

There are many reasons why people choose to retrofit their homes to improve energy efficiency and reduce carbon emissions. This section briefly overviews these.[6]

Drivers of action

Some common and cross-cutting behavioural drivers and motivations that apply across the different housing tenures include: a desire to lower energy bills and protect against future energy crises, environmental consciousness, aesthetic considerations, as well as comfort and health considerations – such as eliminating cold spots and draughts to create a consistent temperature throughout the home.

Households may see retrofitting as a long-term investment, or as a way of potentially increasing the value of their asset. With rising energy prices, the payback periods for installing green technologies is expected to decrease rapidly, making energy efficiency measures increasingly attractive (see 'Section 3, Benefits to households: cost of energy' for more information).

For landlords and social housing providers, the need to meet regulatory standards and targets can also drive action (see 'Private Rented Sector' box).

Landlords may also see retrofitting as a way of improving their relationship with long-term tenants, or as a means of attracting new ones. Local Authorities and social housing providers are also driven by the need to address fuel poverty, and increasingly by the need to meet local targets to reach net-zero earlier than the national target date of 2050.

Trigger points for energy efficiency upgrades

'Trigger points' describe moments where property owners are more likely to make changes to homes. Common examples include soon after moving into a property, when families grow or children leave home, and when having other work done to a property (such as the installation of a new kitchen or an extension).

Landlords may choose to make energy efficiency upgrades during void periods, following a change in tenancies, or when replacing a faulty system or upgrading the property. The availability of new Government grants and incentives can also spur action across different housing tenures.

[6] For more information, please see page 25 Financing energy efficient buildings: the path to retrofit at scale

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UNDERSTANDING CUSTOMER DRIVERS AND MOTIVATIONS

Private Rented Sector

The greatest barrier to energy efficiency upgrades in the private rented sector is the 'split incentive' between landlords and tenants. Landlords typically fund energy efficiency improvements in their properties, however they do not benefit economically from the retrofit as landlords are rarely responsible for paying the energy bills. As a result, landlords have little incentive to make their portfolios more energy efficient – especially beyond incoming regulations – which results in higher carbon emissions and less comfortable homes for tenants.

Since April 2020, under the UK Government's Minimum Energy Efficiency Standards (MEES), landlords can incur a fine if they lease (be it a new or existing lease) any properties with an EPC rating of F or G (subject to a limited number of temporary exemptions in certain circumstances). If the rental property has an EPC rating of F or G, landlords will need to take steps immediately to ensure it complies with the minimum standard requirements.[7]

In 2019, the UK Government consulted on a proposed update to MEES, of which the results were expected in 2022, that suggests that a number of fast-approaching deadlines are on the horizon for the Private-Rented Sector.[8] The consultation proposed that new tenancies will require an EPC rating of C or higher by 2025, and existing tenancies will have to be EPC rated C or higher by 2028. The minimum spending cap is likely to increase from £3,500 to £10,000 per property to make energy efficiency upgrades. Landlords who fail to make these changes will face a potential fine up to £30,000. These changes to regulation are set to act as a trigger point for landlords.

With the strengthening of requirements on the EPC rating of properties in the private rented sector (currently proposed for 2025/2028), landlords will need to plan to make any necessary changes to properties to meet the new requirements. This may involve the need for additional funding and should form part of intermediaries' conversations with landlords who are looking to mortgage or remortgage buy to let properties. These changes will also support landlords to keep their properties highly rentable through responding to the market demands (e.g. lowering energy bills where possible will become more attractive and more important for tenants seeking to rent new properties). It can be expected that energy bills will have to become more transparent as tenants sign onto new properties, as they will consider the affordability of a new property and the energy bills that come with heating the property more closely.

[7] https://www.gov.uk/guidance/domestic-private-rented-property-minimum-energy-efficiency-standard-landlord-guidance
[8] https://www.gov.uk/government/consultations/improving-the-energy-performance-of-privately-rented-homes

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OPPORTUNITIES AND BENEFITS

This section overviews the cost, comfort and environmental benefits of green home retrofits and low carbon technology for lenders, mortgage intermediaries, and households. It signposts some of the ways these benefits can be quantified. However, it is important to note that in many incidences quantification methodologies are still emerging.

Benefits to financial institutions

There are reputational benefits for banks, lenders and funders shown to be taking the lead on climate change, particularly given growing public awareness of and concern about the climate emergency. Publicly listed financial institutions are coming under increased investor scrutiny on actions and disclosures related to net zero. The UK Government has also proposed disclosure requirements on lenders in the 'Improving home energy performance through lenders' consultation (see Section 8).

Those banks, lenders and funders with expertise in green home retrofits can support 'early adopter' households and customers, which will ensure they are well positioned to benefit as the market grows. Rapid market growth is particularly likely to follow new regulations, such as tighter Minimum Energy Efficiency Standards (MEES) for private landlords, as well as legislation to phase out fossil fuel boilers, coming into force.[10]

Benefits to mortgage intermediaries

- Energy security has become a major focus for UK customers, therefore it is important for mortgage intermediaries to know the benefits and opportunities that energy efficiency upgrades can bring to their customers, as well as the risks of not taking early action.
- Advisers with knowledge of retrofit experts can unlock opportunities for their customers as demand increases.
- Intermediaries with expertise in the financial products that can support customers on their home decarbonisation journey can demonstrate credibility.
- Awareness of incoming regulations and legislation can allow intermediaries to have informed discussions with customers, address scamming concerns and signal the importance of using accredited installers for works.

[10] For more information: https://www.legalandgeneral.com/adviser/mortgage-club/green-hub/useful-dates-timeline/

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OPPORTUNITIES AND BENEFITS

Benefits to households: cost of energy

Research undertaken by the Green Finance Institute found that between 2021 and 2022, the proportion of homeowners who find it difficult to meet the cost of their energy bills has tripled. Energy bills are one of the major costs of running a home. As such, anything that helps reduce energy consumption can help reduce bills. GFI research also identified that close to nine in ten British homeowners now say that the energy efficiency of their property is important to them, a significant increase since Spring 2021.[11]

The financial opportunity for homeowners can be assessed by looking at the baseline energy performance of a home and estimating how much this would be reduced by installing a green technology solution or insulation.[12] Certified green technology installation companies will be able to help customers understand how much they will save from retrofitting their property. This will typically include examining their energy consumption and bills over a period of time. This should take into account seasonal differences in energy use. Other data sources include Energy Performance Certificates (EPC),[13] which provides an assessment of the energy costs for a particular building (for more information on EPCs, please see the appendix).

For properties in England and Wales, consumers can access the government energy advice service on www.gov.uk/improve-energy-efficiency. There's different advice services available in Scotland or Northern Ireland through Home Energy Scotland for Scotland or NI Direct for Northern Ireland. Some financial organisations are making available energy efficiency tools on their websites to help their consumers understand retrofit and renewable technology benefits.

How to calculate a payback period

Once the likely annual savings provided by a measure are known, a simple payback period can be calculated. For example, if a retrofit measure costs £3,000, and this saves £500 per year in running costs, then the retrofit will have paid for itself in six years, all other things being equal.

Cost of measure ÷ annual savings in running costs = number of years within which the payback can be made

[11] https://www.greenfinanceinstitute.co.uk/programmes/ceeb/property-linked-finance-rising-consumer-demand-for-energy-efficiency-and-financial-innovation/

[12] For example, see work by the CEEB on developing a standardised methodology for calculating 'metered', real time energy savings https://www.greenfinanceinstitute.co.uk/metered-energy-savings/

[13] https://www.gov.uk/buy-sell-your-home/energy-performance-certificates

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OPPORTUNITIES AND BENEFITS

The coronavirus pandemic will likely have an impact, relating to the future of work. Office workers who change permanently to working at least some of the time from home can expect to use more heat and electricity. Recent figures show that working from home could add more than £2,500 a year to already soaring energy bills.[14] This rise in price will magnify the savings of retrofitting a home.

Quantifying how these impacts interact is an important but complex process, which industry organisations are working to simplify. The Microgeneration Certification Scheme (MCS) includes within its standards for renewable technologies prescribed methodologies to calculate the energy saved or generated for small-scale renewable technologies. The energy savings can then be translated into financial savings. Solar Energy UK has conducted research which has produced evidence on the running cost savings of solar and energy storage, suggesting that a solar PV system could, for a typical home, increase its sales price by at least £1,800, and reduce annual energy bills by more than £300.[15]

New findings by WWF and ScottishPower show that installing an air-source heat pump could increase the sales value of a home by around £5,000-£8,000; solar panels could increase sales value by around £1,350 - £5,400; and an EV charge point could increase it by around £5,400 - £7,400. In combination, these technologies could increase the value of a home by, on average, around £10,000 (excluding cost of installation).[16]

Another initiative currently underway, initiated by the GFI's Coalition for the Energy Efficiency of Buildings (CEEB), is to develop a standardised way of measuring, or 'metering' energy savings.[17] Since 2020 a CEEB working group has been convening technical and financial stakeholders to develop a specification for a Metered Energy Savings Protocol that uses smart meter data to evaluate savings from retrofit projects. EP Group and the Energy Systems Catapult carried out the first phase of development of open-source software to implement this specification in 2021-22, and are now supporting a second phase of R&D led by Carbon Co-op. Once complete, the protocol will offer both real-time monitoring of savings and development of a retrofit performance database to catalyse the development of new financial products, services and business models to scale the green home retrofit market.

[14] https://www.telegraph.co.uk/business/2022/08/17/working-home-cost-175-energy-bills-winter/
[15] https://solarenergyuk.org/wp-content/uploads/2021/10/The-Value-of-Solar-Property-report_SEUK.pdf
[16] https://www.wwf.org.uk/sites/default/files/2022-08/Better_Home%2C_Cooler_Planet_Report.pdf
[17] https://www.greenfinanceinstitute.co.uk/metered-energy-savings/

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OPPORTUNITIES AND BENEFITS

Benefits to households: Comfort, health and wellbeing

Retrofitting a home brings multiple benefits in addition to reduced energy bills. Many householders want their homes to be more energy efficient so that they can more easily heat it to a desired level, or manage the heating levels more effectively. Comfort is often the key driver of action, with associated financial savings often seen as secondary.

If a cold, poor-quality home is retrofitted, it is sometimes the case that there are no energy cost savings, as households may choose to spend the same amount of money to warm their home to a more comfortable temperature than they were previously able to (sometimes known as 'comfort taking' in an underheated home). In these cases, bill reductions will be less than modelled, but this should not be taken as a sign of underperformance.

A well-insulated, draught-proofed home is warmer, reducing the risk of cold spots, condensation and dampness. Damp and mould in homes can cause, or exacerbate, many health problems. Problems and diseases linked to cold homes range from blood pressure increases and common colds, to heart attacks and pneumonia. Besides poor physical health, cold-related illness can cause absences from work, social isolation, and sleep deprivation. They may also lead to mental or stress related illness.

Along with proper insulation, improving ventilation in homes also reduces the risk of condensation. Building effective ventilation into a refurbishment project can help remove or prevent the build up of moisture (from washing, cooking and breathing) and indoor pollutants and bring in fresh air from the outside. Pollutants, such as carbon dioxide and volatile organic compounds have a detrimental effect on our health.

Upgraded glazing and improved insulation can also reduce traffic and neighbourhood noise, making a home more peaceful. Having a quiet place to relax is important for our well-being. As well as being desirable for homeowners, these benefits may help make homes more attractive to prospective tenants.

With rising temperatures, extreme weather conditions are increasingly likely to impact the UK housing stock. Risks associated with the physical impacts of climate change include flooding and heat stress, including increased temperatures and droughts.

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OPPORTUNITIES AND BENEFITS

There are opportunities to improve the resilience of homes against the physical impacts of climate change. Home resilience encompasses water efficiency, measures to prevent overheating, passive cooling, and flood defence and mitigation (see Section 4 for examples of climate resiliency measures).

More generally, as climate change risks intensify, homes are becoming more vulnerable to severe weather conditions, with extreme temperatures during both winter and summer months, increased flood risks and disruptions energy supply. Retrofit and renewable energy technologies will help strengthen the buildings' and householders' resilience to these climate risks.

Benefits for society: Environmental benefits

The CCC, the Government's independent advisory body on climate change, estimates a total investment need of £360bn by 2050[18] - the year by which the UK has a legally binding target to reach a carbon-neutral economy. Millions of retrofit projects will therefore be required to deliver the decarbonisation required.

Carbon emissions from homes are both direct and indirect. Direct emissions include those produced by gas used in cooking and heating. Indirect emissions are those produced as part of the overall energy supply chain - for example, emissions produced generating the electricity which homes use from the national grid. Although the UK is producing an increasing proportion of its electricity from renewable sources, a significant proportion of its power is still based on fossil fuels.

Retrofit technologies help address this in two ways. First, they reduce the absolute amount of energy a home uses, by conserving heat and power. If a home retains its heat more effectively, because it has better insulation, then it requires less heat in the first place to warm it up. Second, green generation technologies help homes meet some of their own power demand themselves. This means they draw less electricity from the national grid, which is partly dependent on fossil fuels. As the grid continues to decarbonise, and ultimately moves to total or near-total renewable production, electric heating will no longer be responsible for carbon emissions, but efficiency to reduce the overall amount of heat a home uses will still be important, as it will mean less demand for electricity across the system as a whole.

[18] https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Buildings.pdf

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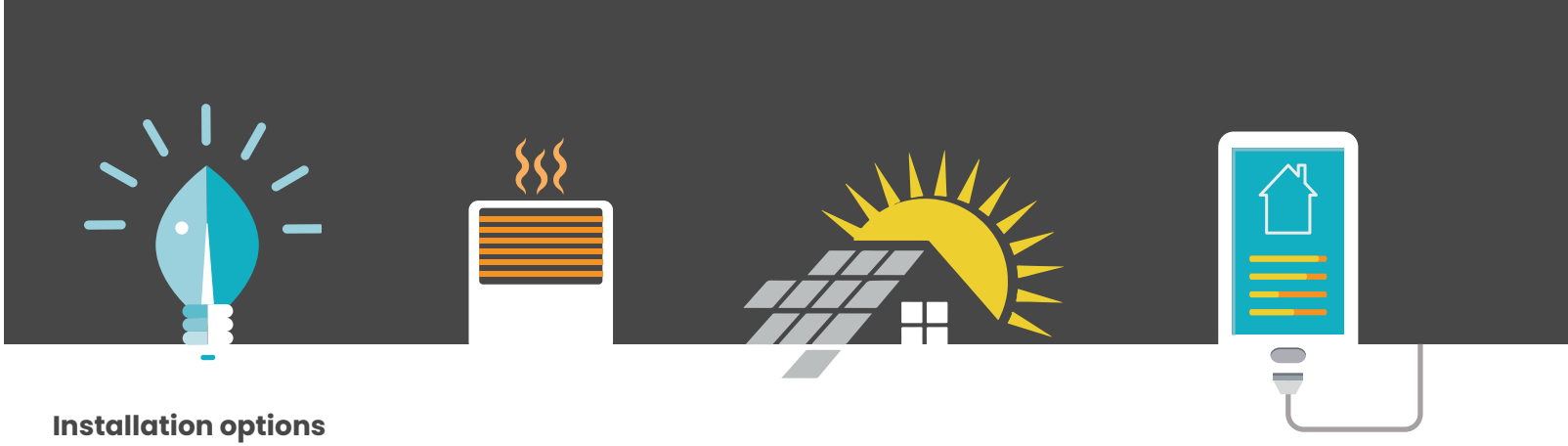
UNDERSTANDING APPROACHES TO RETROFIT



Installation options

Approach to installing green retrofit measures	Example	Additional information
Install individual technologies	Fitting energy-efficient LED lighting throughout their home as a standalone improvement	Most flexible approach but not necessarily the most time efficient or cheapest.
Pair complementary technologies	Installing a low-carbon heating system (e.g. heat pump) at the same time as putting solar photovoltaic (PV) panels on their roof	Ensures that as much of the electricity consumed by e.g. a heat pump is generated onsite, maximising the benefits of each measure.
Fabric-first approach	Considering when to improve the 'fabric' of a house - the components of the building itself, such as the walls, floor and roof, even before installing individual technologies. For instance, higher standards of building fabric make the performance of systems such as heat pumps as efficient as possible.	It is in general regarded as an appropriate and efficient approach in situations when efficiency is improved as far as reasonably practicable before, such as changing to a low-carbon heating system. It's important to consider fabric improvements early on in the retrofit design process, and certainly before specifying any new heating system, but there is no rule that says any particular insulation measure must be installed before a low carbon technology is considered. Reputable green technology companies can advise on a suitable sequence for the installation of home improvement measures to maximise this efficiency.

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UNDERSTANDING APPROACHES TO RETROFIT

Approach to installing green retrofit measures	Example	Additional information
Whole House Retrofit (when a full range of measures to make a home more sustainable is implemented as part of the same process)	The installation of energy efficient lighting, a heat pump, and solar PV, as above, whilst also ensuring that the walls, floors and ceiling are properly insulated, that windows and doors are double glazed, and that an energy storage system is included. Smart controls could also be implemented to ensure that the building's power, ventilation, heating and cooling systems interact and operate as effectively as possible.	While there will be a larger upfront cost with this approach, it can be more cost efficient than installing multiple individual measures at different points in time and will deliver the biggest comfort and environmental improvements. Other benefits include less disruption over the long-term, and the potential for relative cost savings on each measure (for instance because builders and scaffolding are already on site).
Whole Street Retrofit	Retrofitting multiple properties at once to drive cost efficiencies.	For more information on this, please see the appendix.

4

UNDERSTANDING APPROACHES TO RETROFIT

Energy Performance Certificates

The quality of a building's energy performance is measured in an Energy Performance Certificate (EPC). An EPC is required for properties when constructed, sold or let. The EPC provides details on the energy performance of the property and what can be done to improve it. For more information, including on the current limitations of EPCs, please see the Annex.

Building Renovation Plans

Building Renovation Plans, sometimes known as Building Renovation Passports (BRPs), could offer a useful and accessible means of planning and appropriately sequencing domestic retrofit projects. BRPs are designed to set out a bespoke plan for improving an individual property and collect all the data associated with the property, including energy consumption data, in one place. Further information can be found in the Annex.

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UNDERSTANDING GREEN MORTGAGES

Green Mortgages, or other forms of Green Home Financing, are any type of retail financial solution made available to finance or re-finance, in whole or in part, the following:

a) the retrofitting of domestic buildings (single-family or multi-family) to achieve verifiable improvements in their energy efficiency, carbon emissions, material use or climate resilience,

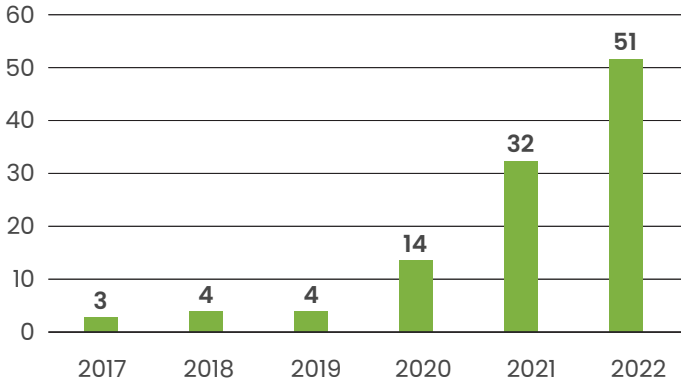
b) the acquisition of domestic buildings (single-family or multi-family) that meet or exceed relevant market standards on energy efficiency, carbon emissions, material use or climate resilience,

c) the self-build construction of domestic properties (single-family or multi-family) that meet or exceed relevant market standards on energy efficiency, carbon emissions, material use or climate resilience.

Green Mortgage products currently come in many different forms, from financing that offers lower interest rates or higher borrowing capacity, to non-financial benefits such as providing free energy efficiency assessments. All aim to incentivise homeowners to invest in improving the energy efficiency of their property.

Encouraged by the innovation of peers in this space, banks and building societies in the UK are launching green mortgage products at an ever-increasing rate.

Since 2004, 34 mortgage lenders have become active in this space, with the number of green mortgage products in the UK Mortgage Market increasing from 3 in 2018 to over 50 as of September 2022. Information on the latest green mortgage products is available on the Green Finance Institute's **Green Mortgage Hub.**



Graph 1: Growth of Green Mortgages Products in the UK Mortgage Market from 2017-2022 (figures as of September 2022)

In 2020, the Green Finance Institute launched the Green Home Finance Principles, to embed transparency and consistency into the green home finance market and minimise the risk of 'greenwashing' across the industry (see 'Green Home Finance Principles' box for more information).

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UNDERSTANDING GREEN MORTGAGES

Green Home Finance Principles

The Green Home Finance Principles (GHFPs) seek to create an industry-recognised framework of market standards and guidelines, which provides a consistent and transparent methodology for the application of financial proceeds towards the purchase, retrofit, or self-build construction of domestic buildings that achieves verifiable environmental benefits.

The GHFPs comprise voluntary recommended process guidelines that seek to promote integrity in the development of the green home finance market by clarifying the circumstances in which a retail financial solution may be categorised as a Green Home Financing.

It is hoped that the GHFPs will become a market standard for Green Home Financings such as, but not limited to, green mortgages and retrofit loans. The GHFPs may be applied by financial institutions on a product-by-product or deal-by-deal basis, depending on the underlying characteristics of the transaction. Financial institutions should determine how best to adopt and apply the GHFPs within their individual organisations.

The GHFPs are intended for broad use across the domestic property market, in order to promote the improvement of energy efficiency, climate resilience, material use or the reduction of carbon emissions across domestic properties as a whole.[19]

Within just one year, financial institutions with a combined mortgage balance of over £480bn have launched, or committed to launching, a green lending product aligned with the principles.

[19] To learn more about the UK's Green Mortgage Market, please visit: www.greenfinanceinstitute.co.uk/green-mortgages

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UNDERSTANDING GREEN MORTGAGES

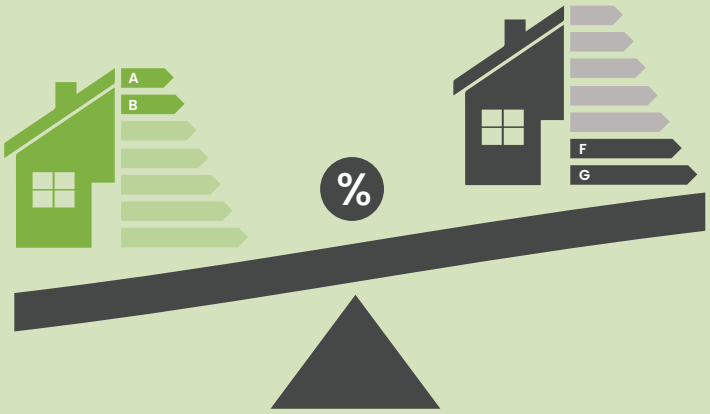
Case Study

NatWest Group

NatWest Group's Green Mortgage presents an example of product aligned with the Green Home Finance Principles (GHFPs). This product seeks to reward customers for purchasing or remortgaging an energy efficient home by offering a reduced mortgage rate on a 2-year or 5-year fixed rate mortgage. The lower interest rate is available for customers purchasing or remortgaging a property with a valid Energy Performance Certificate (EPC) rating of A or B.

The Green Mortgage supports the bank's pledge to help customers become more energy efficient with an ambition that 50% of the bank's mortgage book is at or above EPC C or equivalent rating of C by 2030.

NatWest Group also provides Green Buy to Let Mortgages giving a discounted 2-year or 5-year fixed rate Buy to Let mortgages for remortgaging or purchasing a Buy to Let property with a valid EPC rating of A or B.



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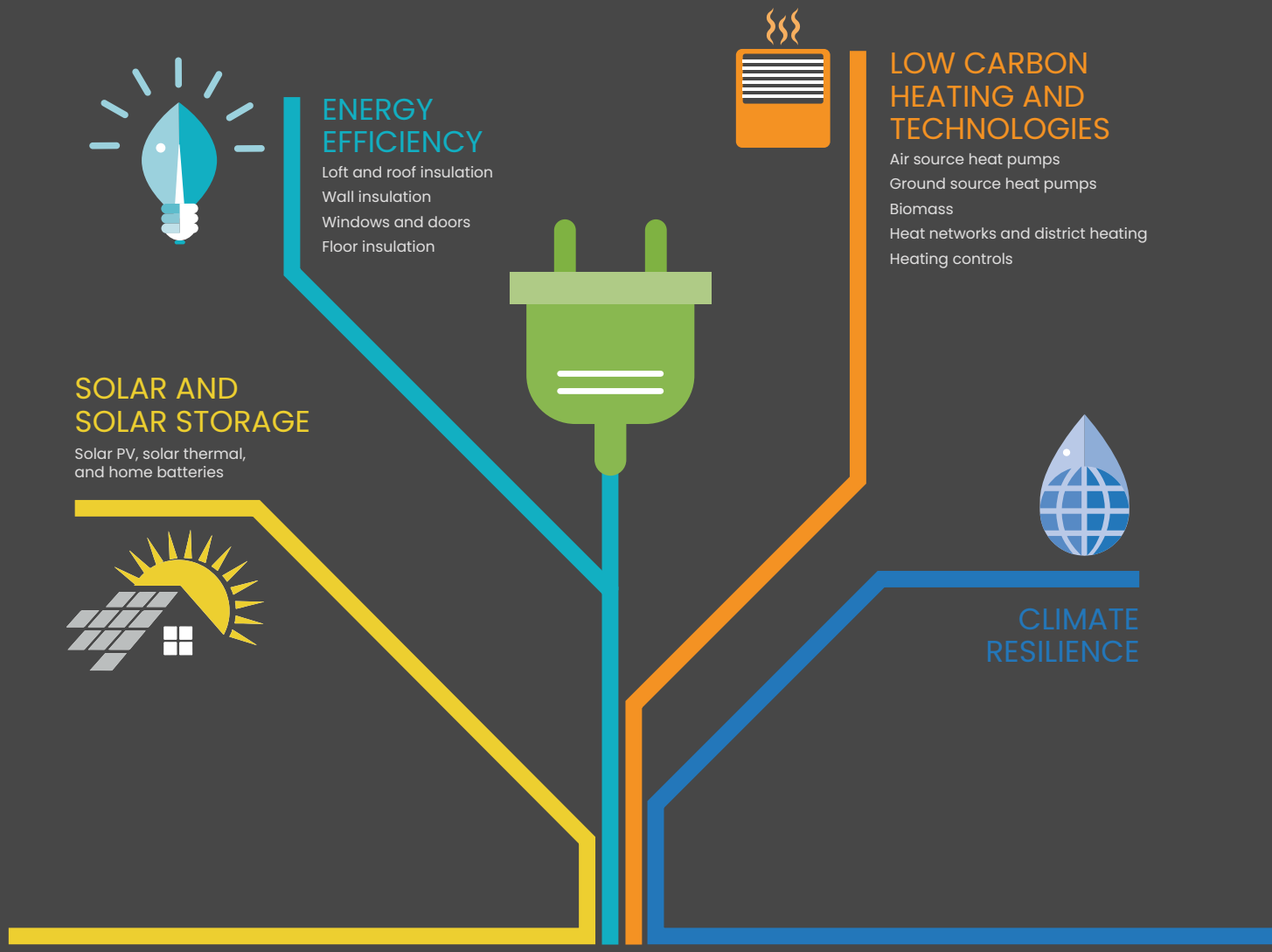
PROFILES OF RETROFIT SOLUTIONS AND TECHNOLOGIES



This section describes different retrofit measures and technologies that homeowners may consider to improve their home. These include energy efficiency, low carbon heating, renewable energy generation and storage, and measures to enhance climate resilience to floods and heatwaves. For each section, after a short overview of the category, specific measures and technologies are described as follows:

Key: Table structure layout for profiles

CATEGORY

[e.g. energy efficiency, heat, solar, resilience measure]

- Price range (prices are national averages at the time of writing)
- Return on investment on savings
- Impact on property value etc

NAME OF TECHNOLOGIES

[e.g. heat pump, rooftop solar]

Building type(/s) appropriate for installation [e.g. is it suitable for flats, need a garden, sufficient insulation, etc]

Short overview of what the technology is, how it works and is installed, changes needed for customers' houses etc.

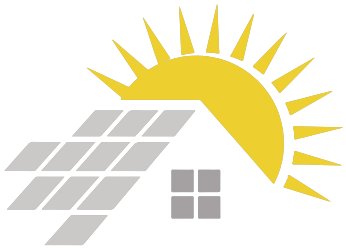
Key opportunities and benefits

Risks or issues

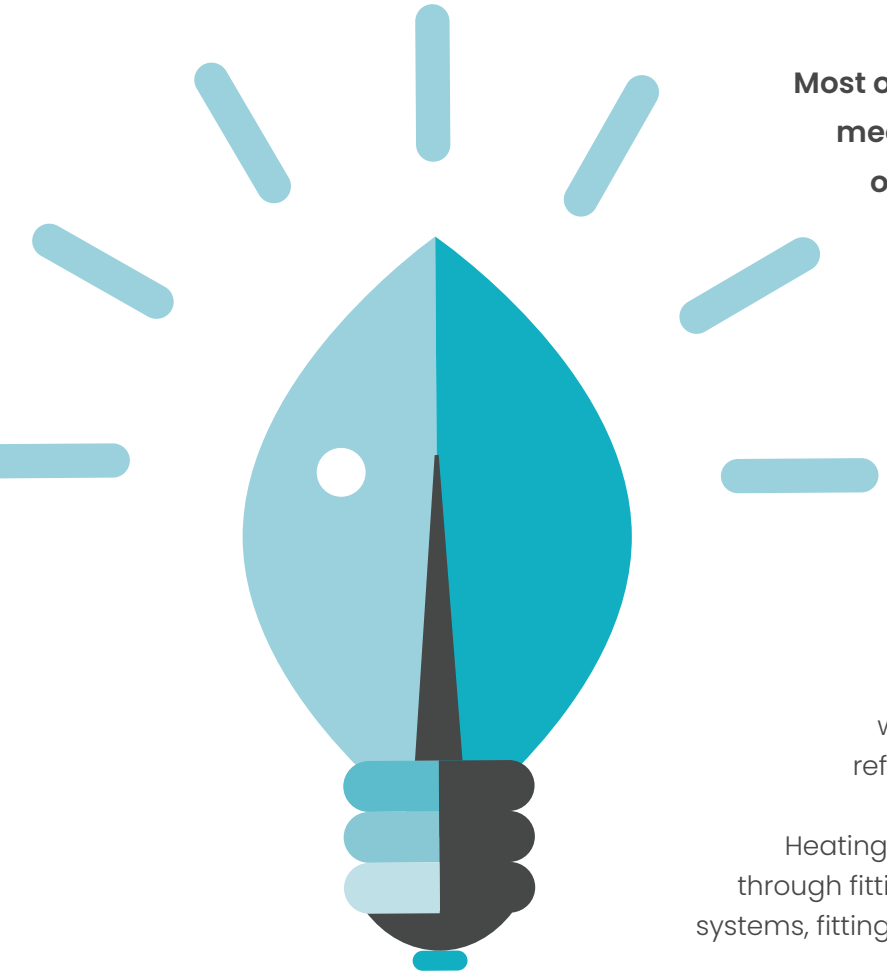
Any potential risks, additional considerations before installing/ financing, and means to mitigate these, covering as appropriate:

- Counterparty credit risk
- Liquidity risk
- Market risk
- Performance risk
- Technology risk
- Policy risk
- Government support

Interactive index of retrofit measures (click on technology to view profile)

CATEGORY	NAME OF TECHNOLOGY	
Energy Efficiency	Loft and roof insulation Wall insulation (cavity walls, and internal and external insulation for solid walls) Windows and doors Floor insulation	
Heating	Air source heat pumps Ground source heat pumps Biomass Heat networks and district heating Heating controls	
Solar and storage systems	Solar PV, solar thermal, and home batteries	

ENERGY EFFICIENCY MEASURES



Most of the energy used in our homes is for space heating, and so most energy efficiency measures concentrate on reducing this demand, largely through improving the fabric of the building.

Many homes have the potential for increased levels of insulation in the roof, walls and floor, or for more efficient doors and windows – reducing the rate at which heat is lost to the outside.

Draught-proofing can also reduce heat loss, although it is always important to maintain adequate ventilation, particularly when carrying out major refurbishment.

Heating demand can also be reduced through fitting more efficient, low carbon heating systems, fitting appropriate heating controls, and ensuring that pipework and any hot water cylinders are fully insulated. Other energy efficiency options include LED lighting, efficient kitchen appliances, and a whole range of behavioural changes that can be promoted to a customer alongside a refurbishment project.

Please visit the Government's new website 'Find ways to save energy in your home' for more information.[20]

[20] https://www.gov.uk/improve-energy-efficiency

ENERGY EFFICIENCY

- Full loft insulation - cost £480, annual saving £355
- Carbon savings 610 kg CO2e per year
- Top up insulation from 120mm - cost £390, annual saving £35
- Carbon savings 55 kg CO2e per year
- Excellent payback if no existing insulation. Top up of existing insulation is also often financially worthwhile.

LOFT AND ROOF INSULATION

Suitable for houses, bungalows and top floor flats with a pitched roof and an unheated and accessible loft space, where there is currently no insulation, or less than 150mm.

If there is an unheated loft with no insulation, the simplest way to insulate is to add rolls of mineral wool between the joists (the horizontal timbers that make up the 'floor' of the loft), and then to add further rolls at 90° up to a depth of 270mm. Alternatively this can be done using rolls of sheep's wool or hemp insulation, or by spraying in loose fill cellulose fibre made from recycled newspaper.

Many lofts already have some insulation between the rafters but can still benefit from an additional layer to reach the recommended thickness.

Where a loft has previously been converted into living space it may well be inadequately insulated and may not be insulated at all. Insulating an existing room in a roof is a complex process, involving different solutions for different elements of the room. A professional will be required to provide a bespoke quotation to carry out this type of renovation. It is also possible to insulate a loft at the rafter level (directly beneath the sloping roof). This is more expensive than standard loft insulation but creates a warmer loft.

LOFT AND ROOF INSULATION

Key opportunities and benefits

- Reduced bills
- Increased comfort
- No lifestyle changes required
- Reduced carbon emissions
- Can help to optimise heat pump performance

Risks or issues

- Need to ensure ventilation is maintained in the loft
- Need to ensure pipes and water tanks in the loft are suitably insulated

- Most homes with an accessible loft will have some insulation already, so opportunities for fast payback renovations may be limited
- Roof insulations using spray foam (be it “closed cell” or “open cell”) can lead to reductions in the value of the property, especially if carried out inadequately. Poorly installed spray foam insulation can cause structural safety problems, and can result in severe condensation in the roof space. As a result of these concerns, some lenders may have a policy not to accept any property with spray foam insulation and as such future saleability can be adversely affected.

ENERGY EFFICIENCY

- Cavity wall insulation – average cost £1,000, annual saving £395
- Internal wall insulation - cost £8,500, annual saving £540
- External wall insulation - cost £12,000, annual saving £540
- Carbon savings:
  - Cavity 670 kg CO_2e per year
  - Int/Ext 910 kg CO_2e per year
- Installation costs will vary considerably from property to property, especially for internal and external insulation.
- Payback is generally good for cavity wall insulation. External wall insulation payback is significantly longer.

WALL INSULATION (cavity walls; internal and external insulation for solid walls)

Cavity wall insulation may be suitable for homes that were built with an uninsulated cavity (typically built between 1920 and 1980), where the cavity has not since been insulated, and where the property is not too exposed to driving rain (regular exposure to driving rain can lead to penetrating damp). Internal wall insulation may be suitable for homes built without a cavity (typically before 1920, or non-standard construction) where the rooms have sufficient space, and internal architectural detail does not need to be preserved.

External wall insulation may be suitable for homes built without a cavity (typically before 1920, or non-standard construction) where the external appearance of the building does not need to be preserved. A technical survey will always be required to assess suitability for any wall insulation option.

A typical uninsulated home loses about a third of its heat through the walls. Insulating those walls to reduce heat loss can therefore significantly cut fuel bills and improve comfort levels and, for cavity walls, often at a modest cost. All wall insulation should be carried out by an approved specialist contractor, who will start with a technical survey to determine suitability for different options.

If the external walls of the house contain a cavity, this can be filled with insulation injected from the outside. Cavity wall insulation is injected from the outside, with minimal disruption to the householder. Usually, mineral wool or polystyrene beads are injected, though it may also be polyurethane foam or similar.

WALL INSULATION

External wall insulation involves fitting layers of insulation and an external protective layer, usually rendered, to the outside of the property. External pipework, guttering, windowsills and other fitting may need to be moved or extended, and scaffolding is usually required.

Internal wall insulation is the most disruptive and generally requires the home, or at least the relevant rooms, to be emptied. Insulation and plasterboard are then fitted to the internal surface of any external walls, and around the recess of any windows.

Key opportunities and benefits

- Reduced bills
- Increased comfort
- No lifestyle changes required
- Reduced carbon emissions
- Can help to optimise heat pump performance
- 25-year independent guarantees available

Risks or issues

- All insulation must be installed appropriately to avoid risks of damp problems through changes to the way moisture behaves in the building fabric. This generally means ensuring that any existing damp problems are resolved before insulating, and that the insulation solution is appropriate for the building and its location and is fitted in line with manufacturers' and product certificates' guidance.
- Cavity wall insulation cannot be installed in timber or metal framed buildings where the cavity between the frame and cladding has been filled after initial construction.
- Internal and external wall insulation may not be permitted in listed buildings. External wall insulation may not be permitted in conservation areas and would require planning permission. It may also not be considered appropriate in some locations outside conservation areas.
- Internal and external wall insulation are expensive measures and are unlikely to be justified purely on the basis of financial payback through energy bill savings. However, there are many other social, comfort and environmental benefits.

ENERGY EFFICIENCY

Replacing all single glazed windows in a typical 3 bed semi with A-rated windows, assuming an average efficiency mains gas boiler:

- Cost variable, average annual saving £195
- Carbon saving 330 kg CO_2e per year
- Cost unlikely to be recovered through bill savings alone - usually justified through multiple social and environmental benefits.

WINDOWS AND DOORS

Suitable for any home with single glazed windows. Older double glazing may also be replaced, but bill savings will be smaller.

Old single glazed windows are likely to be the coldest element in a room. Replacing these with modern, efficient double or triple glazed units will significantly reduce heat loss from the room. Secondary glazing might also be considered, although double glazing is approximately twice as effective as secondary glazing at stopping heat escaping the home.

Windows are rated from G to A++. There are a wide range of windows available in the A rating band and above, including both double and triple glazed units, with PVC, softwood, hardwood or metal frames. Energy efficient doors are also available to replace older external doors.

Key opportunities and benefits

- Reduced bills
- Increased comfort
- Increased property value
- Reduced carbon emissions
- Can help to optimise heat pump performance
- Can reduce maintenance requirements

Risks or issues

- Expensive if viewed only as an energy saving measure.
- Replacement may not be allowed, or choices may be restricted, in conservation areas and listed buildings.
- Provision should be made to ensure that means of escape in case of fire is maintained and made no worse as a result of a replacement glazing installation.

ENERGY EFFICIENCY

- Cost £1,800 to £4,300, annual saving £110
- Carbon saving 190 kg CO_2e per year

FLOOR INSULATION

Suitable for houses, bungalows and ground floor flats with a suspended wooden floor, or with an uninsulated concrete floor and sufficient headroom to allow a modest increase in floor height. Also suitable for rooms above an unheated space, such as a garage or cellar. Concrete floors built after 2000 are likely to be insulated already.

If a home has a wooden floor at ground floor level, this can often be insulated by lifting the floorboards, fitting netting between the joists and laying mineral wool insulation (or other flexible insulation material) on top of the netting, between the joists, before replacing the floor boards. If the ground floor is made of concrete, it may be possible to add a layer of rigid foam insulation on top of the concrete, before adding a new floor surface on top of that.

Key opportunities and benefits

- Reduced bills
- Increased comfort
- No lifestyle changes required
- Reduced carbon emissions
- Can help to optimise heat pump performance
- May be the only remaining fabric upgrade available in many homes

Risks or issues

- Long payback, if based purely on cost saving calculations
- Significant disruption during installation, therefore most likely to be carried out when other renovation work or flooring replacement is taking place

ENERGY EFFICIENCY

There are a number of smaller and less expensive energy efficiency measures that may be included in a retrofit package. They can also be installed on their own but are unlikely to require financing as a standalone project. These include:

- Draught-proofing, including around doors and windows and around the edge of suspended floors
- Insulating hot water and heating system pipework
- Increasing the insulation of hot water cylinders
- Fitting reflective panels behind radiators on external walls that cannot be insulated to reflect heat back into the room
- Fitting low-flow aerating shower heads and taps

Any significant retrofit project should also take account of the need for ventilation. After major refurbishment, a building is likely to end up with less natural ventilation. The insulation applied will also affect how vapour moves through the building and will change the temperature of different parts of the building, often in complex ways. It is usually necessary to provide additional ventilation as part of a major refurbishment, to maintain internal air quality and minimise condensation risks. This may simply require some additional extractor fans, or it may need a whole house ventilation system in the most efficient homes. In this case a mechanical ventilation system with heat recovery (MVHR), which provides filtered fresh air into a building while minimising heat loss via the exhaust air (warm air leaving a building), may be the most effective solution.

LOW CARBON HEATING

Alongside energy efficiency measures to reduce energy demand, heat pumps will have the largest role to play in decarbonising our heat supply. The CCC, in its 'Balanced Pathway' modelled scenario, says that heat pumps will need to be installed in 75% of existing homes by 2050.[21] Other readily available technologies that will play an important role include district heating, solar thermal and biomass heating systems. Heating controls will also help by allowing greater control of energy demand and directing heat only where it is needed.

The CCC estimates that by 2050, heat networks and district heating will need to meet around 18% of UK heat demand. There are currently around 14,000 heat networks in the UK, consisting of a mix of both large district networks and smaller communal networks, which serve multiple dwellings in a single building. Though the majority of UK heat networks still operate on fossil fuels, many emerging schemes are making use of cheap heat from industrial processes or energy from waste plants.

Many more are moving to electric sources of generation such as ground and water source heat pumps, and are able to operate the networks at significantly lower temperatures. All of these developments are helping to improve the consumer offer for efficient, low carbon heat, with those living on heat networks paying an average of approximately £100 less annually than those with individual gas boilers.[22]

[21] https://www.theccc.org.uk/2021/02/01/the-numbers-behind-the-budget-six-ways-to-explore-the-sixth-carbon-budget-dataset/
[22] https://www.gov.uk/government/publications/heat-networks-consumer-survey-consumer-experiences-on-heat-networks-and-other-heating-systems

HEATING

- Installation cost typically £15,000, annual saving up to £395 depending on the age of the old boiler
- Carbon savings of around 1,900 kg CO_2e per year
- Often benefit from Government support (please see Section 8: Understanding the policy and regulatory landscape for more details)

AIR SOURCE HEAT PUMPS

Air source heat pumps are suitable for most houses and ground floor flats with a small amount of outdoor space.

They are often most financially attractive where mains gas is not available.

As the Government moves to phase out fossil gas heating systems, heat pumps will become an increasingly attractive solution for homeowners to comply with forthcoming regulation.

An air source heat pump takes heat from the outside air, and upgrades this to a higher temperature so that it can provide heating for the home and hot water. A heat pump uses electricity – which is currently more expensive than gas due in part to the way that fuel bills are structured – but the technology is much more efficient than other heating systems, so the cost for heating may be similar to other options, or lower in many cases. It is possible that the policy costs which currently contribute to the relatively high price of electricity compared to gas will be removed in coming years, which would make heat pumps even more attractive to run.

Most heat pump systems in the UK connect to a conventional radiator system and a hot water cylinder. They are controlled much like a conventional central heating system. They work particularly well with underfloor heating. There are also air-to-air systems that distribute warm air through the house.

Heat pump efficiency varies considerably and is affected by many factors. In some older homes it may be necessary to upgrade the insulation or replace the radiators with larger alternatives to ensure the heat pump can operate at a high efficiency.

AIR SOURCE HEAT PUMPS

Good system design and appropriate operation for the heating system and thermal efficiency of the house are also essential, and in some instances it may be necessary to install a hot water tank, as a larger thermal store (a means of storing heat until it is needed). A qualified installer and technical assessment can ensure the heat pump design achieves maximum efficiency.

High temperature heat pumps may be specified for some properties to ensure heating provision is sufficient. Hybrid systems are also available, typically with a heat pump alongside a gas or oil boiler, with either the heat pump or the boiler providing heat depending on circumstances.

Key opportunities and benefits

- Technically suitable for many homes
- Significant carbon saving
- Often benefit from Government support such as Boiler Upgrade Scheme and Renewable Heat Incentive (please see Section 8: Understanding the policy and regulatory landscape for more details)

Risks or issues

- Higher capital cost than traditional heating systems (e.g. gas boilers)
- Bill savings are unclear until the Government outlines measures to rebalance the costs of gas and electricity
- Current lack of funding support for shared infrastructure (when considering networked heat pumps)
- Can produce more noise than other heating systems and may require larger radiators throughout the property
- In very rare circumstances, usually for larger properties, installing a heat pump might require an upgrade to the electricity supply. In general, installing a heat pump requires permission from the local District Network Operator (DNO), but an installer typically does this on behalf of the consumer and it is exceptionally rare for this to cause any problems. In the very few instances where there is likely to be an impact on other local users, many DNOs will upgrade the nearest transformer for free.

- Installation cost typically £22,000, annual saving £220
- Carbon savings of around 1,900 kg CO_2e per year
- Often benefit from Government support (please see Section 8: Understanding the policy and regulatory landscape)

GROUND SOURCE HEAT PUMPS

Ground source heat pumps require more outdoor space than air source heat pumps but generally exhibit a higher coefficient of performance (the ratio of useful heat output to energy input) than air source, and have a longer asset lifespan.

Most likely to be financially attractive if mains gas is not available.

A ground source heat pump takes heat from the ground, and upgrades this to a higher temperature so that it can provide heating for the home and hot water. The heat may come from a horizontal loop, buried a metre or more below the surface in a field or large garden, or from vertical boreholes drilled typically 50 to 150 metres down (75 to 100 metres is the most common range). Qualified installers can ensure the right measures are taken to maximise the efficiency of the heat pump.

Ground source heat pumps may also operate using a shared loop, where multiple households' heat pumps are connected to a network of pipes, which in turn draw heat from a number of boreholes. These shared loop systems can lead to even greater efficiencies and allow for a phased installation approach over a larger geographical area.

GROUND SOURCE HEAT PUMPS

Key opportunities and benefits

- Significant carbon saving
- Often benefit from Government support such as the Boiler Upgrade Scheme (please see Section 8: Understanding the policy and regulatory landscape for more details)

Risks or issues

- Higher capital cost than traditional heating systems (e.g. gas boilers)
- Bill savings are unclear until the Government outlines measures to rebalance the costs of gas and electricity
- Current lack of funding support for shared infrastructure (when considering networked heat pumps)
- Might require large scale excavation and generally only suitable for properties with large gardens/land
- In very rare circumstances, usually for larger properties, installing a heat pump might require an upgrade to the electricity supply. In general, installing a heat pump requires permission from the local District Network Operator (DNO), but an installer typically does this on behalf of the consumer and it is exceptionally rare for this to cause any problems. In the very few instances where there is likely to be an impact on other local users, many DNOs will upgrade the nearest transformer for free.

HEATING

BIOMASS

- Installation cost typically £14,000 for an automatic feed wood pellet boiler system and fuel store
- Running costs currently higher than gas heating
- Carbon savings 1,300 kg CO_2e per year
- Often benefit from Government support (please see Section 8: Understanding the policy and regulatory landscape for more details)

Pellet boilers may be suitable for houses with sufficient space for a large boiler and fuel store, and access for fuel deliveries.

More likely to be acceptable where there are no existing air quality concerns.

Biomass heating systems are generally considered low carbon provided the fuel comes from a sustainably managed source.

Biomass heating systems for UK homes nearly always run on wood fuel. This may be in the form of pellets, logs or sometimes chips. Wood pellets are made from compressed sawdust, and can be burnt in an automatic feed boiler, in place of a conventional gas or oil boiler. They can also be used in individual room heaters. Logs are commonly burnt in log stoves that heat a single room, but which may also heat radiators in the rest of the house. Log boilers are also available for heating a whole property.

Woodchip is made by slicing low grade timber to create reasonably uniform chunks that can be automatically fed into larger boilers. Wood chip boilers are usually too large for heating an individual home but can be suitable for running district heating systems.

There is increasing concern over particulate emissions associated with biomass systems in areas with poor air quality, especially with log stoves that may be operated inappropriately.

BIOMASS

Key opportunities and benefits

- Carbon savings (where biomass is sustainably sourced)
- Often benefit from Government support

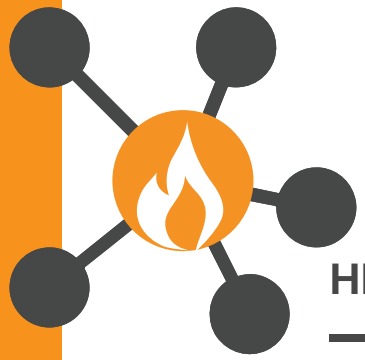
(please see Section 8: Understanding the policy and regulatory landscape for more details)

Risks or issues

- Growing concern over particulate emissions, especially in urban areas
- Higher capital cost than traditional heating systems (e.g. gas boilers)
- Requires significant space for the boiler and fuel storage
- Modest bill savings unless cheap resource is available locally
- Concerns around the sustainability of pellets and biomass

HEATING

- Installation costs vary and will generally be installed per household as part of a larger development
- Payback periods vary, but generally around 10-20 years (for whole development)
- Often benefit from Government funding
- On average, heat network customers pay £100 less than those on individual gas boilers



HEAT NETWORKS AND DISTRICT HEATING

Heat networks are particularly effective in areas of high heat demand density. With a ban on domestic gas boilers in new build properties from 2025 likely, they will become an even more attractive proposition to property developers.

The government is committed to supporting development of heat networks, which it has recently identified as a Department for International Trade High Potential Opportunity – with £320m invested to support the delivery of networks through the Heat Networks Investment Project and £270m to come through Green Heat Networks Fund. Local Authorities can also access support for project development through the Heat Networks Delivery Unit. Scotland also presents an equivalent fund named the "Heat Network Fund".

Heat networks vary in size and are generally defined as either communal or district. Communal schemes supply heat to a relatively small development (i.e., one or two buildings, particularly blocks of flats), whereas district heating distributes heat over a large area to multiple buildings, often a mix of domestic and residential.

Heat networks generally have a centralised generation source which is connected via a network of pipes to the buildings it supplies. Many schemes across the UK traditionally run on gas-CHP (combined heat and power), but many schemes are now moving to low carbon forms of generation such as heat pumps, or using available heat that may otherwise be wasted, such as heat from industrial processes.

HEAT NETWORKS AND DISTRICT HEATING

Key opportunities and benefits

- Heat networks are fuel agnostic and installations can be adapted to local contexts. This means that installations will be able to deliver low carbon heat to consumers well into the future, even as the fuel mix changes and electrical sources such as wind and solar PV become more prevalent.
- Incoming regulation will improve consumer awareness and standards, as well as introducing a trajectory for the decarbonisation of heat networks in the UK.
- Well managed, well performing schemes are non-disruptive to consumers as maintenance and improvements are centrally managed by the heat network operator.

Risks or issues

- The UK heat networks market is currently unregulated (but the Government is committed to regulating by 2025).
- It is difficult for individual homeowners to connect to a heat network. Connections will generally be as part of a larger development (either retrofit or new homes).

HEATING

- Costs £30 and upwards
- Payback time depends on the type of controls being upgraded and degree of upgrade, but payback can be quick
- Controls are often fitted alongside a new heating system to maximise the total benefit or saving
- Upgrading controls can be the cheapest way to improve a property's energy rating

HEATING CONTROLS

Heating controls are suitable, and necessary, for all building types and heating systems.

Heating our homes and hot water costs money regardless of the type of heating system. Heating controls can reduce that cost (and carbon emissions) by providing heat only when, where and in what temperature it is needed. Primary heating controls include thermostats and timers or programmers. They vary in the degree of sophistication and level of control. The following list is in approximate order of complexity, starting with basic controls:

- Simple time clock and room thermostat located in a circulation space such as a hallway. This is the minimum level of control that should be considered acceptable. The time clock is used to set on/off times for the system and the room thermostat only allows the system to operate when below a set temperature.
- As above, plus thermostatic radiator valves. These allow individual control of the temperature of each room or heated space.
- Programmable thermostats can be used to set different desired temperatures according to the time of day and day of the week. For example, the temperature required on a Saturday afternoon when the occupants are active may be different to a Sunday evening when relaxing in front of the TV. These can also be used with thermostatic radiator valves to provide more room-by-room temperature control.
- Full zone controls allow the temperature of each zone to be programmed individually using dedicated temperature sensors and motorised valves for each zone.

- Smart programmable thermostats can "learn" occupancy patterns and how the building responds to the heating system relative to outside temperature. These can be internet connected and controlled by smartphones.
- There are several advanced control mechanisms, including weather compensation, load compensation, optimisation and automation, that adjust either the temperature or the timing of the heating output. Many smart control systems will include some of these functions, but they are also mostly available as standalone control systems.

HEATING CONTROLS

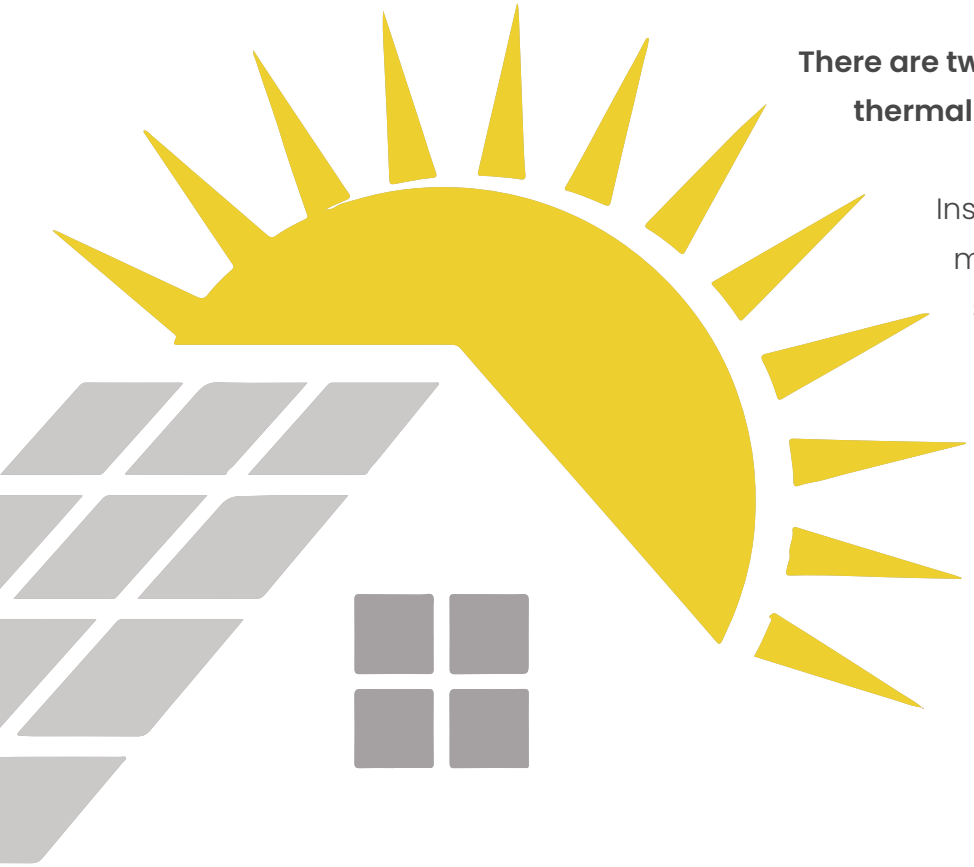
Key opportunities and benefits

- Relatively easy to upgrade existing controls
- Improved levels of comfort
- Reduced heating costs

Risks or issues

- Provided they are installed by a competent person (e.g. a qualified electrician or heating engineer) they represent negligible risk
- Full zone control can be difficult to retrofit as it may require the circulation system to be reconfigured to enable the installation of motorised zone valves

SOLAR AND STORAGE SYSTEMS



There are two main types of solar energy systems: solar photovoltaic (PV) and solar thermal.

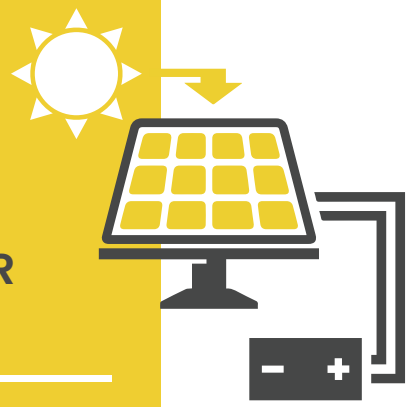
Installing a solar system is a popular home improvement: there are around a million solar PV systems on houses around the country, and nearly 100,000 solar thermal. Each type of system includes panels installed on a roof.

Key considerations are outlined below.

ROOFTOP SOLAR AND STORAGE

PV, thermal, and batteries

- For a typical home, installing a solar system could reduce energy bills by £1,276 annually. Meaning a payback period of just 5.9 years.
- In a typical heat pump heated home, installing solar would mean annual savings of £1,454, which despite a longer pay back period of 14 years, delivers a significantly higher NPV (net present value) and a decarbonised home.
- In a best-case scenario (based on location, age of property and financing method), annual savings could reach more than £2,997 in a gas-heated home, and £3,089 in a heat pump heated home.



SOLAR PV, SOLAR THERMAL, AND HOME BATTERIES

Solar systems can be installed on flat or sloping roofs. The roof space needs to be free from shading (for example, from chimneys or trees). Solar can be installed on multi-occupancy properties, although this may entail more complex billing arrangements.

Residential solar systems do not usually require planning permission.

Panels can be installed on a mounting rack fixed to the roof, or as part of the roof itself, by replacing tiles.

Other requirements will include space for the inverter, for a PV system - which ensures the electricity meets domestic supply needs - and a battery, if one is installed. Solar thermal systems will need space for a solar water cylinder.

PV systems convert light into power. A typical system will likely include 10-14 solar panels, which connect directly to a house's electricity system. Any power that is not used in its appliances can be sent to the national grid, helping to power other homes as well. Homeowners can receive payments from their energy supplier for this. Alternatively, many new PV systems are now also installed with a battery, meaning surplus power can be stored and used later.

Solar thermal systems feed the sun's energy into a home's hot water or space heating system. Solar thermal panels heat fluid which is used to transfer heat around the home, working with a boiler, immersion heater or other system to pump this to where it is needed.

SOLAR PV, SOLAR THERMAL, AND HOME BATTERIES

Domestic energy storage systems, such as batteries, can help maximise the benefits of solar, by storing any surplus power produced - for example, during the afternoon when electricity generation may exceed a home's needs - to be used later, such as during the evening, when appliances and lights are switched on. Battery storage is playing an increasingly important role in the UK energy system..

Key opportunities and benefits

- Reduced bills
- Opportunity to sell surplus power back to the grid
- Futureproofing: ensuring a source of clean, cheap energy for future needs, such as electric vehicles and heat pumps
- Reduced carbon emissions and improved environmental performance of a home

SOLAR PV, SOLAR THERMAL, AND HOME BATTERIES

Risks or issues

- **Solar PV:** Maintenance and inspection requirements, as with any electrical or mechanical installation. However, properly installed systems should last for 30 years or more, and most maintenance requirements should be minimal - for example, periodic cleaning and occasional safety testing, typically every five years.
- Valuation/surveyance assessment might be needed to consider whether the roof is capable of bearing the increased load.
- Residential solar PV systems in the UK must be certified by the Microgeneration Certification Scheme (MCS) in order to be eligible for the Smart Export Guarantee, which allows households to sell energy back to the grid, and for the Renewable Heat Incentive.

- **Solar thermal:** Maintenance and inspection requirements, as above. Properly installed systems should last for 20 years or more, and most maintenance requirements should be fairly minimal - for example, periodic flushing and replacement of the solar fluid – typically every 5 years.
- Installers who wish to become MCS certified must also be a member of a Chartered Trading Standards Institute approved Consumer Code to guarantee a high standard of consumer protection in the sector.

CLIMATE RESILIENCY

With rising temperatures, extreme weather conditions are increasingly likely to impact the UK housing stock. Risks associated with the physical impacts of climate change include:

Flooding:

Probable risks to housing include internal and external building damage, higher chance of slope instability, and increased insurance premiums in flood risk areas. Currently, over 5.2 million homes and properties in England alone are at risk of flooding and coastal erosion, with around 2.4 million properties in immediate flood risk areas in England and a further 2.8 million UK properties susceptible to surface water flooding.[23]

Heat stress, including increased temperatures and drought:

Probable risks to housing include soil shrinkage and subsidence, faster deterioration in concrete, and internal overheating of some buildings.

[23] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/920944/023_15482_Environment_agency_digitalAW_Strategy.pdf

CLIMATE RESILIENCY

There are opportunities to improve the resilience of homes against the physical impacts of climate change. Home resilience encompasses water efficiency, measures to prevent overheating, passive cooling, and flood defence and mitigation. Examples of climate resiliency measures include, but are not limited to:

Green roofs: Roofs that are partially or entirely covered with vegetation, planted over a waterproofing membrane. They can reduce the risk of overheating, help alleviate flood risks (as more water run-off is absorbed), provide a habitat for biodiversity and absorb gaseous pollutants

Solar shading: Installing shutters, curtains or reflective blinds for windows helps protect homes from the sun's heat, reducing indoor temperatures during warm weather.

Relocating appliances and raising electrical sockets can help guard against flood damage.

Passive cooling measures: Passive cooling measures are those which require little to no energy consumption, and are a practical way to combat overheating. Low-cost options include ceiling fans, or night purging, where windows are closed during the day and opened at night to flush out warm air.

Property Flood Resiliency (PFR) measures: PFRs can include flood doors and windows, demountable flood barriers, resilient wall and floor finishes, and resilient insulation.

Overview of data inputs and calculations available to measure benefits and improvements

MEASUREMENT	SUPPORTIVE DATA	
Energy consumption and household behaviour Some details of occupancy patterns are relevant for an effective retrofit strategy as they will give an indication of actual consumption. It should be borne in mind that the current occupants may have quite different behaviours to a future household. We note this information will not be available for new builds.	• Current EPC rating and other data contained with the Certificate • Energy Efficiency Ratio (EER) • Environmental Impact Rating (EIR) • Total annual electricity use kWh • Total annual fossil gas use kWh • Total annual kWh/m^2, per fuel • Total annual CO_2/m^2 • Total annual GBP on energy / m^2	• Tariff(s) • Smart meter data • Metered energy savings • Real-time data on performance • Any other smart devices and credentials • Thermal imagery/3D scanning (relative material vs thermal performance, visual/visible texture mapping)
Information relating to climate resiliency	• Flooding risk • Subsidence risk • Over-heating risks (i.e. CIBSE TM59 assessments)	• Green space • Tree canopy cover
Circular economy considerations and enhanced climate information	• Environmental Product Declarations (EPD) for retrofit materials and systems • Construction details • Sustainable material use • Toxicity considerations	• Capacity for deconstruction • Component change/reuse • Embodied carbon (likely derived from other variables) • Energy carbon intensity
Indoor monitoring systems to measure comfort	• Indoor air quality (humidity; particulate matters (i.e., PM10, PM2.5)) • CO_2 monitoring	• Indoor room temperature • Daylight • Air change rates

7

INSTALLER STANDARDS AND QUALITY ASSURANCE

There are a number of Government-backed schemes which help protect consumers from poor quality installations. A brief overview of each organisation is provided below.

Organisation

TrustMark

Brief Overview

- The government endorsed quality scheme covering work a consumer chooses to have carried out in or around their home.
- Oversees standards and quality assurance for energy efficiency and other retrofit measures
- Established to ensure quality across a breadth of trades, including all those involved with repair, maintenance and improvement, energy efficiency and retrofit measures; it also addresses legacy mis-selling problems associated with energy efficiency measures.
- Operates by mandating that work is undertaken to certain standards, including relevant Publicly Available Specifications (PAS), e.g. PAS 2035 which is a specification for 'whole-house' retrofit.

Links to source

www.trustmark.org.uk;

www.trustmark.org.uk/tradespeople/pas-2035;

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INSTALLER STANDARDS AND QUALITY ASSURANCE

Organisation

Microgeneration Certification Scheme (MCS)

Brief Overview

- Ensures that companies installing or working on renewable technologies adhere to approved standards and methods
- Certifies low-carbon energy products and installers and works alongside consumer codes to address potential mis-selling of renewable technologies.
- As a condition of MCS membership, installers must also be a member of a Chartered Trading Standards Institute (CTSI) approved consumer code. This combined regulatory approach provides a high level of consumer protection without creating unnecessary barriers to deployment.

Links to source

https://mcscertified.com/

https://www.tradingstandards.uk/

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INSTALLER STANDARDS AND QUALITY ASSURANCE

Organisation

Retrofit Coordinators

Brief Overview

- Under PAS 2035 standards all retrofit projects must have a retrofit coordinator, who are responsible for overseeing property assessments and specifying and monitoring the energy efficiency measures installed.
- Can work on behalf of Local Authorities to grow consumer awareness of different retrofit options, advise as to the best solutions for individual households, and help people access centralised funding and lending products.

Link to source

https://retrofitacademy.org/retrofit-coordinator/

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UNDERSTANDING THE POLICY AND REGULATORY LANDSCAPE

Title	Description
Boiler Upgrade Scheme (BUS) *England and Wales*	Supports the decarbonisation of heat in buildings. It provides upfront capital grants to support the installation of heat pumps and biomass boilers in homes and non-domestic buildings in England and Wales.
Link to source	**https://www.ofgem.gov.uk/environmental-and-social-schemes/boiler-upgrade-scheme-bus**
Energy Company Obligation (ECO) *England, Scotland, and Wales*	ECO is the government's long-standing fuel poverty policy, which requires the largest energy suppliers to install efficiency measures in eligible low-income homes. The latest iteration, ECO4, will be in place until 2026, with its value boosted from £640m to £1bn per year, with a greater emphasis on deeper, multi-measure retrofits.
Link to source	**https://www.ofgem.gov.uk/environmental-and-social-schemes/energy-company-obligation-eco**
ECO Plus *England and Wales*	In the November 2022 Autumn Statement, the Chancellor announced new obligations on energy suppliers to help customers take action to reduce their energy bills, with an "ECO Plus" scheme worth £1bn over three years launching in April 2023. The scheme expands eligibility for support to those living in the least energy efficient homes in lower council tax bands, as well as those on the lowest incomes. It will focus mostly on installing low-cost insulation such as loft and cavity wall insulation. The final design of ECO Plus will be announced in 2023 after the consultation running in December 2022 concludes.
Link to source	**https://energysavingtrust.org.uk/what-is-the-uk-governments-eco-scheme/**

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UNDERSTANDING THE POLICY AND REGULATORY LANDSCAPE

Consumer Support & Incentives

Title	Description
Home Upgrade Grants (HUG) *England*	The Conservative manifesto pledged £2.5bn, with £150m committed for 2021-22 and £700 million so far committed in 2023-24 and 2024-25, to support deep retrofit measures for low income households in inefficient properties off the gas network, distributed through local authorities.
Link to source	**https://retrofitacademy.org/memberships/wp-content/uploads/2022/02/Designing-an-effective-Home-Upgrade-Grant-Scheme-2.pdf**
Energy Industry Voluntary Redress Scheme *England, Scotland and Wales*	Ofgem fund, managed by Energy Saving Trust, to distribute payments from companies who may have breached Ofgem rules. Registered Charities, Community Interest Companies, Co-operative Societies and Community Benefit Societies can apply for funds to deliver energy related projects. Core priority of the fund is to help people who are most at risk from cold homes and high energy bills.
Link to source	**https://energysavingtrust.org.uk/programme/energy-industry-voluntary-redress-scheme/**

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UNDERSTANDING THE POLICY AND REGULATORY LANDSCAPE

Financial

Title	Description
Green Home Finance Accelerator *UK-wide*	The GHFA programme will provide up to £20 million grant funding to support UK retail lenders to design, develop and pilot a range of finance propositions which encourage domestic energy efficiency and low carbon heating retrofits. The GHFA is part of the Department for Business, Energy and Industrial Strategy's £1 billion Net Zero Innovation Portfolio. Launch date Autumn 2022.
Link to source	**https://www.gov.uk/government/publications/green-home-finance-accelerator**
Consumer Duty and implications for green lending *UK-wide*	The final rules and guidance for a new Consumer Duty that will set higher and clearer standards of consumer protection across financial services and require firms to put their customers' needs first have been published. These will come into force on a phased basis: for new and existing products or services that are open to sale or renewal the rules come into force on 31 July 2023; for closed products or services, the rules come into force on 31 July 2024.
Link to source	**https://www.fca.org.uk/publications/policy-statements/ps22-9-new-consumer-duty**
Green Heat Networks Fund *England and Wales*	£270m fund to help the development of new low carbon heat networks, and the decarbonisation of existing networks. The scheme will launch in April 2022 and run until March 2025.
Link to source	**https://www.gov.uk/government/publications/green-heat-network-fund-ghnf**

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UNDERSTANDING THE POLICY AND REGULATORY LANDSCAPE

Financial

Title	Description
Improving home energy performance through lenders *England and Wales*	Consultation led by BEIS setting out a range of proposals that could improve the energy performance of mortgaged properties, and deliver substantial emissions reductions. Response yet to be published. There is a proposed requirement for mortgage lenders to improve the average rating of homes they lend on to EPC C by 2030, in part to kick-start a market in green mortgages, with lenders offering better rates to properties with higher energy efficiency performance ratings.
Link to source	**https://www.gov.uk/government/consultations/improving-home-energy-performance-through-lenders**
Local Authority Delivery (LAD) scheme *England*	Launched in 2020, alongside the subsequently withdrawn Green Homes Grant voucher scheme, the LAD scheme is an area-based funding scheme open to local authorities and their partners to deliver cross-tenure improvements to low-income and low energy performance households. Over the course of its funding rounds, the LAD will distribute £600m for delivery by December 2022.
Link to source	**https://www.gov.uk/government/publications/green-homes-grant-local-authority-delivery-scheme-phase-2-funding-allocated-to-local-net-zero-hubs**
The Heat & Buildings Strategy *UK-wide*	Sets out the policy framework the government hopes will drive decarbonisation across all housing tenures over the next decade and beyond.
Link to source	**https://www.gov.uk/government/publications/heat-and-buildings-strategy**

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UNDERSTANDING THE POLICY AND REGULATORY LANDSCAPE

Financial

Title	Description
Future Homes Standard (FHS) *England*	The Future Homes Standard, to be introduced by 2025, will require newly built homes to produce 75-80% fewer emissions than current building standards, with low-carbon heating and higher levels of energy efficiency, such that no further retrofit will be required to reach net zero.
Link to source	**https://www.gov.uk/government/consultations/the-future-homes-standard-changes-to-part-l-and-part-f-of-the-building-regulations-for-new-dwellings**
Heat Network Market Framework/ Heat Networks (Scotland) Act *UK-wide*	The UK and Scottish Governments are committed to regulating heat networks by 2025 and 2023 respectively under these legislative instruments. The regulations will introduce standards around consumer protection, pricing, technical performance of networks and emissions.
Link to source	**https://www.gov.scot/publications/heat-networks-delivery-plan/**
Heat network zoning *England*	The government consulted on a framework that would allow local planning authorities to designate areas where low carbon heat networks are deemed to be the most suitable heat decarbonisation option, based on whole system costs. Legislation on heat network zoning has been included in the Energy Security Bill.
Link to source	**https://www.gov.uk/government/consultations/proposals-for-heat-network-zoning**

Financial

Title	Description
Low Carbon Infrastructure Transition Programme *Scotland*	The LCITP was introduced by the Scottish Government in 2015 to support the development of primarily large scale, multiple building low carbon infrastructure projects through offering expertise and financial support for project development. Since 2015, over £60 million has been committed through the LCITP, which is now closed. The successor was due to be announced in Spring.
Link to source	**https://www.gov.scot/policies/renewable-and-low-carbon-energy/low-carbon-infrastructure-transition-programme/**
Social Housing Decarbonisation Fund (SHDF) *England*	The Conservative manifesto committed to spending £3.8bn over 10 years through the SHDF, distributed to registered social housing providers, to upgrade a significant proportion of the social housing stock to EPC C by 2030. £800m has been made available for the period 2022-23 to 2024-25
Link to source	**https://www.gov.uk/government/publications/social-housing-decarbonisation-fund-wave-2**
Local Heat and Energy Efficiency Strategies (LHEES) *Scotland*	LHEES aim to establish local authority area-wide plans and priorities for systematically improving the energy efficiency of buildings and decarbonising heat in Scotland. There have been a number of pilot schemes in recent years and LHEES are the methods proposed in the Scottish Heat in Buildings Strategy by which all Scottish local authority reviews should be conducted under the Heat Networks (Scotland) Act 2021.
Link to source	**https://www.gov.scot/publications/local-heat-energy-efficiency-strategies-lhees-phase-2-pilots-evaluation/**

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UNDERSTANDING THE POLICY AND REGULATORY LANDSCAPE

Financial

Title	Description
Minimum Energy Efficiency Standards (MEES) Private rented sector *England and Wales*	Since April 2020, under the UK Government's MEES, landlords can incur a fine if they lease (be it a new or existing lease) any properties with an EPC rating of F or G (subject to a limited number of temporary exemptions in certain circumstances). If the rental property has an EPC rating of F or G, landlords will need to take steps immediately to ensure it complies with the minimum standard requirements. In 2019, the UK Government consulted on a proposed update to MEES that would require an EPC rating of C or higher by 2025 for new tenancies, and by 2028 for existing tenancies. The results are expected in 2022, with the possibility that a number of fast-approaching deadlines are on the horizon for the Private-Rented Sector. The maximum cost cap – the maximum price landlords can be required to pay to meet the regulation - is likely to increase from £3,500 to £10,000 per property. Landlords who fail to make these changes will face a potential fine up to £30,000. These changes to regulation are set to act as a trigger point for landlords.
Link to source	**https://www.gov.uk/guidance/domestic-private-rented-property-minimum-energy-efficiency-standard-landlord-guidance**

ANNEX

Air change rates and Air Charges per Hour (ACH): A measure of the air volume replaced within a defined space by ventilation and infiltration (measured in cubic feet per time interval (hour).

Building Renovation Plans (BRPs): BRPs provide information to homeowners about options to decarbonise their property. BRPs typically contain a digital logbook of renovations at a property-level, with historical and contemporary information about the property, its construction and operational performance; and a long-term renovation roadmap that identifies future retrofits and installations to decarbonise the property, along with links to contractors, other service providers and finance options. They can provide links to public and private financing options, as well as outline any future relevant regulatory changes that may affect landlords and tenants (e.g. mandatory replacement of gas boilers). This concept has been called on by the Green Finance Taskforce, the CCC amongst others. The Green Finance Institute is developing a UK standardised framework for organisations looking to develop or support BRPs.

CIBSE TM59 assessments: A standardised approach to predicting overheating risk for residential building designs.

Circular Economy: A model of production and consumption, including the use of sustainable materials and embodied carbon; recycling, reusing and repurposing of existing materials and components within a retrofit or construction project; etc. In this way, the life cycle of products is extended. In practice, it implies reducing waste to a minimum.

CO_2 monitoring: A method for determining indoor air quality by using the concentration of carbon dioxide as an indicator.

Demand Aggregation Financing: The Built Environment Programme is running a demonstrator working group to develop this financial product. The concept would be to establish a 'critical mass' in demand in an area to bring down the price of zero carbon heating solutions, enabling customers to access cheaper solutions, while scaling supply chains through guaranteeing a minimum number of purchases. A financial institution supports customers making purchases through low-interest loans.

Embodied carbon: Capturing all the CO_2 emitted in producing materials. It is estimated through calculating the energy used to extract and transport raw materials as well as emissions from manufacturing processes.

Energy Efficiency Ratio (EER): A room air conditioner's efficiency is measured by the energy efficiency ratio (EER). The EER is the ratio of the cooling capacity (in British thermal units [Btu] per hour) to the power input (in watts). The higher the EER rating, the more efficient the air conditioner.

Energy Performance Certificate (EPC): An EPC gives a property an energy efficiency rating from A (most efficient) to G (least efficient), alongside a numerical score out of 100, and is valid for 10 years. EPCs are generated using the Standard Assessment Procedure (SAP) methodology, and are produced by an accredited assessor registered with a certification body.[24]

Currently, EPCs have several well-known limitations. The quality of assessment can be variable, necessary data is not always available or accurate, and the SAP methodology sometimes penalises actions that lower the carbon output of a building (such as installing a heat pump) without sufficiently lowering its running costs. SAP ratings can therefore have a perverse impact on decarbonisation. The 10-year validity of an EPC also means that properties can come into new ownership several times without new retrofit measures being recognised in the rating. The Government is aware of these issues and launched an EPC Action Plan consultation in 2020.[25]

EPC ratings are the key measurement tool used in Government energy efficiency regulation, such as Minimum Energy Efficiency Standards (MEES). As the Government introduces more policies aimed at improving the energy performance of buildings, as part of its efforts to reach net zero emissions, the accuracy and quality of EPCs is likely to become an increasingly important issue. Future regulations targeting the buying and selling process could give EPCs financial value, which means they will need to be consistently reliable and replicable.

[24] https://www.gov.uk/guidance/standard-assessment-procedure
[25] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/922660/EPC_Action_Plan.pdf

EPCs are generally considered a poor source of forward-looking information on individual homes, in particular for the most energy efficient homes. In the future, Building Renovation Plans (also known as building renovation passports) may be a useful tool to provide a more holistic and tailored roadmap of measures for homeowners.

Environmental Product Declarations (EPD): Defined by ISO 14025 as a Type III declaration that "quantifies environmental information on the life cycle of a product to enable comparisons between products fulfilling the same function."[26]

Environmental Impact Rating (EIR): A measure of a home's impact on the environment in terms of carbon dioxide (CO2) emissions. The higher the rating the less impact it has on the environment.

kWh/m^2: Average electricity consumption per square meter.

Particulate matter (PM): The term for a mixture of solid particles and liquid droplets found in the air. Particulate matter contains microscopic solids or liquid droplets that are so small that they can be inhaled and cause serious health problems.

Real-time data on performance: Allows users to process data streams, get insights, and act on data points immediately - or soon after the data enters the system.

Smart meter: An electronic device that records information such as consumption of electric energy, voltage levels, current, and power factor. This information is communicated to the consumer for greater clarity of consumption behaviour, and electricity suppliers for system monitoring and customer billing.

Subsidence: Sinking of the ground because of underground material movement. Due to climate change's hotter and drier summers, the likelihood of the ground under houses shrinking and cracking is increasing.

[26] https://www.iso.org/obp/ui/#iso:std:iso:14025:ed-1:v1:en

Thermal imagery/thermography/3D scanning: Measures surface temperatures by using infrared video and still cameras. These tools see light that is in the heat spectrum. Energy auditors may use thermography to detect thermal defects and air leakage in building envelopes.

Whole-street retrofit: A whole-street approach requires coordination, either by a local authority, housing association, private firm or group of interested households. This can be a financially attractive approach to retrofit as bulk-purchasing can introduce even greater economies of scale. Platforms which aggregate retrofit demand could also provide lenders an opportunity to support multiple customers through low-interest loans. The Built Environment Programme's work on Demand Aggregation Financing (DAF)[27] aims to increase the availability of financing for this model of retrofit.

[27] See Annex

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