Green Finance Institute

LENDER'S HANDBOOK ON GREEN HOME RETROFIT AND TECHNOLOGIES

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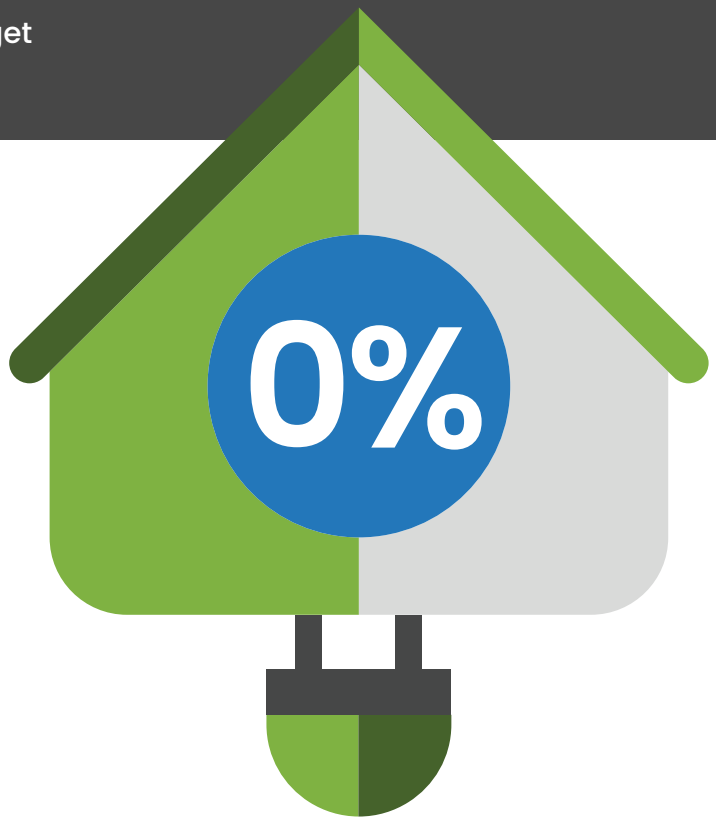
1

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 our housing stock net-zero ready will 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 our building stock to meet the UK'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.[1]

This handbook seeks to inform lenders about different green home retrofit solutions and technologies by providing a profile of the options available and their associated opportunities and risks, as well as quality assurance standards.

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

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

Green Finance Institute

Coalition for the Energy Efficiency of Buildings (CEEB): Established by the Green Finance Institute and supported by E3G, the CEEB 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.

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.

MCS:
MCS develops the standards, and provides the means of certification and registration, for low-carbon products and installations used to produce electricity and heat from renewable sources.

Solar Energy UK:
Solar Energy UK is the trade association working for and representing the entire solar and energy storage value chain.

Renewable Energy Consumer Code (RECC):
RECC sets out high consumer protection standards for businesses who are selling or leasing renewable energy generation systems to domestic consumers.

The Association for Decentralised Energy:
The leading trade association for decentralised energy, representing over 140 parties from across the industrial, commercial and public sectors.

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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.[2]

Drivers of action

Some common and cross-cutting behavioural drivers and motivations that apply across the different housing tenures include: environmental consciousness, a desire to lower energy bills, 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. For landlords and social housing providers, the need to meet regulatory standards and targets can also drive action. 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 retrofits

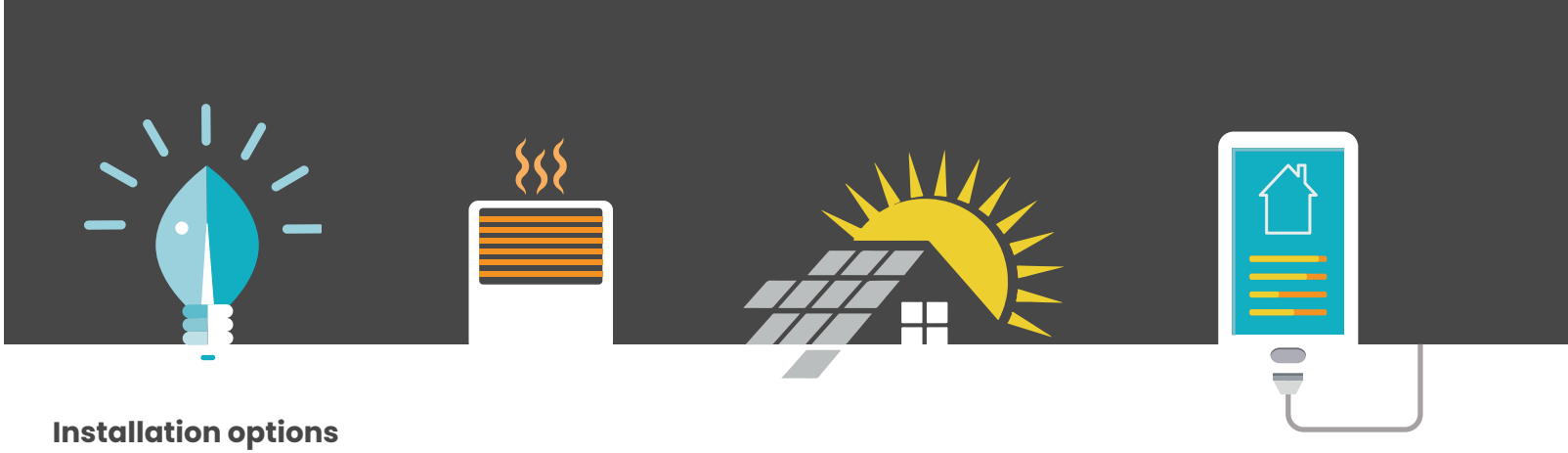
'Trigger points' describe moments where property owners are more likely to make changes to homes. Common examples include before or soon after moving into a property, when families grow or children leave home, and when having other work done to a property (such as the installation of a new kitchen).

Landlords may choose to make changes 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.

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

3

UNDERSTANDING APPROACHES TO RETROFIT



Installation options

There are several approaches to installing green retrofit measures. The first is to **install individual technologies** as desired and affordable. For example, a customer might choose to fit energy-efficient LED lighting throughout their home as a standalone improvement.

The second is to **pair complementary technologies**. In this scenario, a customer might choose to install a low-carbon heating system (such as a heat pump) at the same time as putting solar photovoltaic (PV) panels on their roof. This would ensure that as much of the electricity consumed by the heat pump as possible was generated onsite, maximising the benefits of each measure.

A third approach is **'whole house retrofit'**. This is when a full range of measures to make a home more sustainable is implemented as part of the same process. This could include, for example, the installation of energy efficient lighting, a heat pump, and solar PV, as above. It would also include ensuring that the walls, floors and ceiling are properly insulated, that windows and doors are double glazed, that an energy storage system is included, and that smart controls are 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 the whole house retrofit 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. It also offers other benefits, including less disruption over the long-term, and the potential for relative cost savings on each measure (for example, because builders and scaffolding are already on site). Similarly, it is also possible to retrofit multiple properties at once to drive cost efficiencies. This process is sometimes known as a **'whole-street retrofit'**. For more information on this, please see the annex.

3

UNDERSTANDING APPROACHES TO RETROFIT

One important installation consideration is when to improve the 'fabric' of a house - the components of the building itself, such as the walls, floor and roof. Higher standards of building fabric make the performance of systems such as heat pumps as efficient as possible. Reputable green technology companies can advise on a suitable sequence for the installation of home improvement measures to maximise this efficiency.

The **'fabric-first' principle**, by which fabric efficiency is improved as far as reasonably practicable before, for example, changing to a low-carbon heating system, is sometimes regarded as an appropriate and efficient approach. However, this theoretical hierarchy is not always appropriate for the practical decisions that have to be made when refurbishing an individual home. It is 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.

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, 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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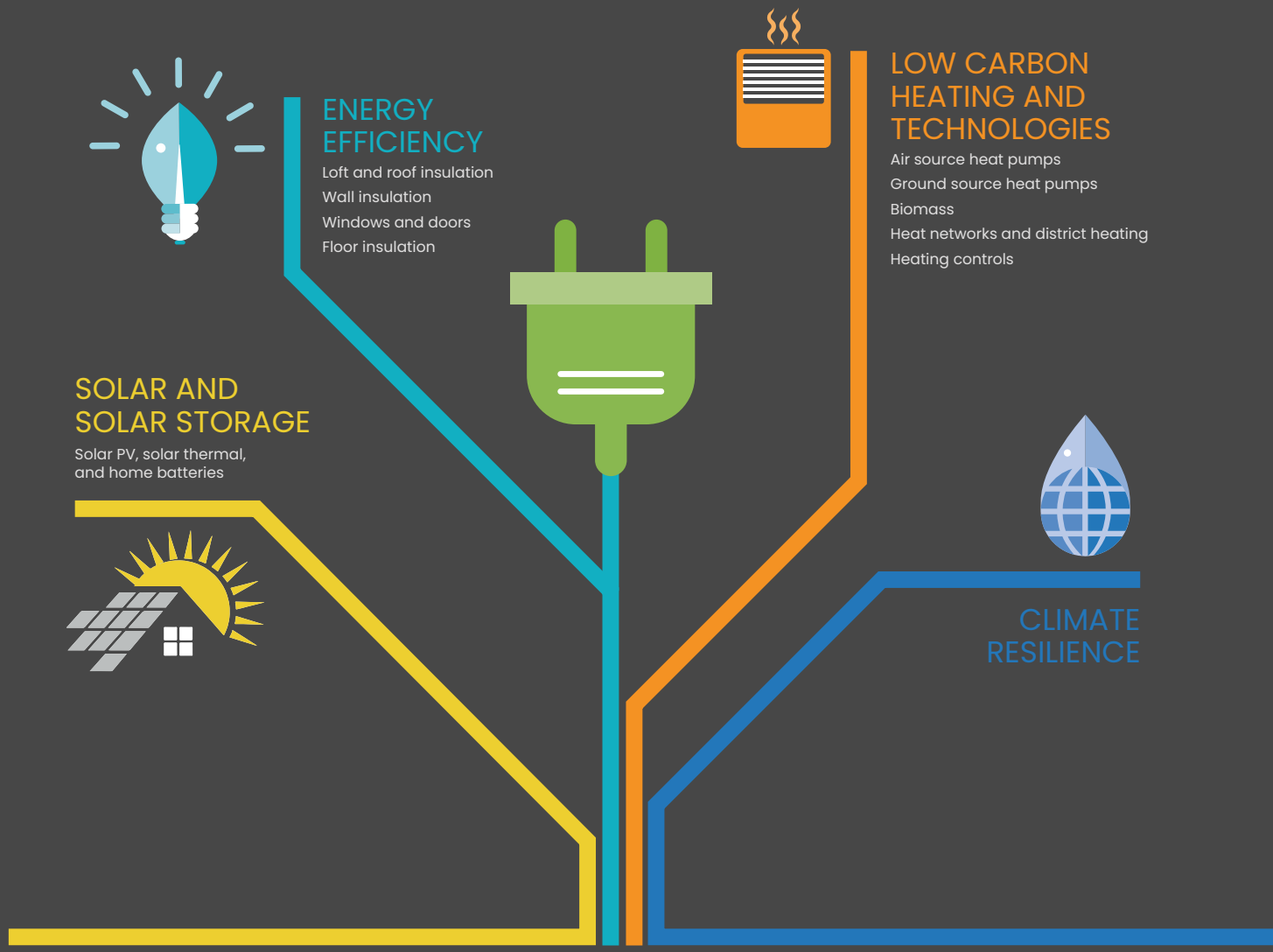
PROFILES OF RETROFIT SOLUTIONS AND TECHNOLOGIES



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

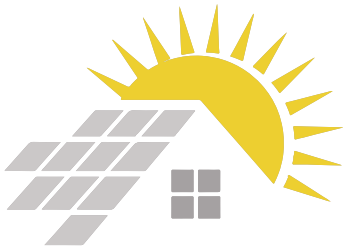
Risks or issues

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

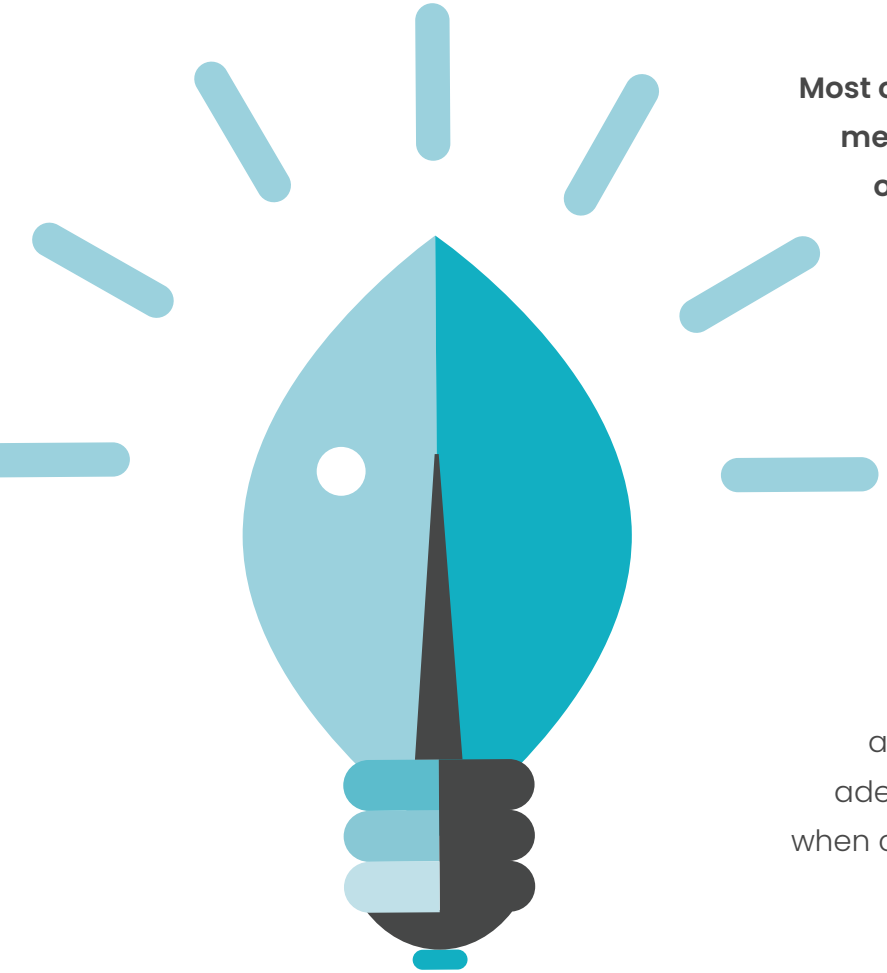
- Counterparty credit risk
- Liquidity risk
- Market risk
- Performance risk
- Technology risk
- Policy risk
- Government support

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.

ENERGY EFFICIENCY

- Full loft insulation - cost £300, annual saving £135
- Carbon savings 2,750 kg CO_2e per year
- Top up insulation from 120mm - cost £240, annual saving £13
- Carbon savings 255 kg CO_2e 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 quote 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

ENERGY EFFICIENCY

- Cavity wall insulation – average cost £475, annual saving £155
- Internal wall insulation - cost £8,200, annual saving £210
- External wall insulation - cost £10,000, annual saving £210
- Carbon savings:
  - Cavity 3,100 kg CO_2e per year
  - Int/Ext 4,200 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 with minimal disruption to the householder. Usually, mineral wool or polystyrene beads are injected, though it may also be polyurethane foam or similar.

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.

WALL INSULATION

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.
- 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-detached home with A-rated windows, assuming an average efficiency mains gas boiler:

- Cost variable, average annual saving £75
- 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 requirementsthrough multiple social and environmental benefits

Risks or issues

- Replacement may not be allowed, or choices may be restricted, in conservation areas and listed buildings.

- Cost £500 to £1,300, annual saving £40
- Carbon saving 175 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 Climate Change Committee (CCC), in its 'Balanced Pathway' modelled scenario, says that heat pumps will need to be installed in 75% of existing homes by 2050.[3] 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.[4]

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

HEATING

AIR SOURCE HEAT PUMPS

- Installation cost typically £9,000 to £11,000
- Running costs often similar to gas heating, or lower with flexible tariffs and/or high energy efficiency
- Carbon savings of around 1,630 kg CO_2e per year
- Often benefit from Government support (please see Section 8: Understanding the policy and regulatory landscape for more details for more details)

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 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 savings
- Future-proof the home for changing regulation
- Often benefit from Government support such as upcoming Clean Heat Grant and existing 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)
- Current lack of funding support for shared infrastructure (when considering networked heat pumps)
- 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.

GROUND SOURCE HEAT PUMPS

- Installation cost typically £13,000 to £19,000
- Running costs often similar to gas heating, or lower with flexible tariffs/high energy efficiency
- Carbon savings of around 1,630 kg CO_2e per year
- Often benefit from Government support (please see Section 8: Understanding the policy and regulatory landscape for more details for more details)

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

- Future-proof the home for changing regulation
- Significant carbon savings
- Often benefit from Government support such as the upcoming Clean Heat Grant (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)
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HEATING

- Installation cost typically £11,000 to £17,000 for an automatic feed wood pellet boiler system and fuel store
- Running costs often similar to gas heating
- Carbon savings 2,000 kg CO_2e per year
- Often benefit from Government support (please see Section 8: Understanding the policy and regulatory landscape for more details for more details)

BIOMASS

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 burned 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. It is also essential that fuels are sustainably sourced to avoid problems like biodiversity loss and deforestation.

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

- 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 possible, they may 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.

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).

- 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 at 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

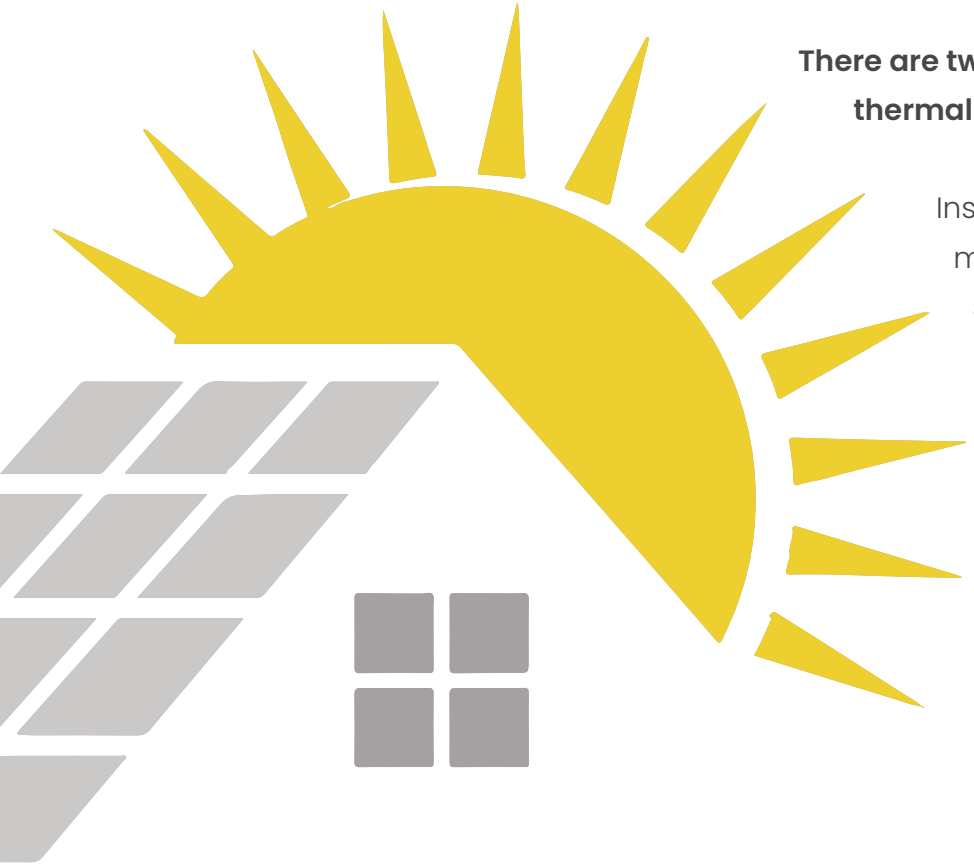
Key opportunities and benefits

- 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

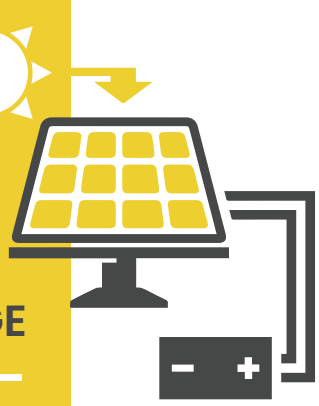
SOLAR AND STORAGE SYSTEMS



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.



SOLAR AND STORAGE

- £3,000 - £6,000 for a typical solar PV or thermal system (for a residential PV system, this would be around 3 – 5 kW)
- £3,000 - £5,000 for a battery connected to a PV system, depending on its size
- Payback times can be less than 10 years, although this will vary depending on how much energy a home uses, and how this is produced. For example, a PV system may deliver bigger savings for a home with electric rather than gas heating. This is because electricity currently costs more than gas, so producing power on site helps displace a more expensive source of heat. Solar installation companies have tools to help customers calculate how much they will save.
- Carbon savings 820 kg CO_2e per year.

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.
- 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.

- **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.
- Residential solar thermal systems in the UK must be certified by the **Microgeneration Certification Scheme** (MCS) in order to be eligible for the **Renewable Heat Incentive**.
- 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.[5]

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.

[5] 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.

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.

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

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

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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 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

Many leading UK banks and building societies have set net zero targets. Work to decarbonise mortgage portfolios and other exposure to the built environment will be critical to make progress towards these targets. Offering products and services to support the decarbonisation of buildings is an opportunity to de-risk portfolios and generate attractive risk-adjusted returns.

Even for those institutions which have not yet set climate targets, promoting greener homes can help mitigate transition risks and help banks prepare for a low carbon future.

There are reputational benefits for banks 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 may come under increased investor scrutiny on actions and disclosures related to net zero.

Banks with expertise in green home retrofits can support 'early adopter' households and customers, and will be well positioned to benefit as the market grows. Rapid market growth is particularly likely to follow new regulations, such as Minimum Energy Efficiency Standards for owner occupiers and legislation to phase out fossil fuel boilers, coming into force.

Benefits to households: cost of energy

Energy bills are one of the major costs of running a home. As such, anything that helps reduce energy consumption can help reduce bills. 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.[6]

Certified green technology installation companies will be able to help customers understand how much they will save from retrofitting their property.

[6] 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/

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OPPORTUNITIES AND BENEFITS

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),[7] which provides an assessment of the energy costs for a particular building (for more information on EPCs, please see the annex).

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

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. This 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 save a typical home around a third on the average electricity and gas bill, as well as increasing the value of the property.[8]

[7] https://www.gov.uk/buy-sell-your-home/energy-performance-certificates
[8] Contact Solar Energy UK for more information

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OPPORTUNITIES AND BENEFITS

Another initiative currently underway, initiated by the CEEB, is to develop a standardised way of measuring, or 'metering' energy savings.[9] The Metered Energy Savings protocol seeks to provide actionable data and real-time performance monitoring to catalyse the development of new financial products, services and business models to scale the market for green home retrofits.

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 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 health, cold-related illness can cause absences from work, social isolation, and sleep deprivation. They may also lead to mental or stress related illness.

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.

[9] https://www.greenfinanceinstitute.co.uk/metered-energy-savings/

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OPPORTUNITIES AND BENEFITS

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.

Benefits for society: Environmental benefits

The UK's building stock accounts for around 23% of its greenhouse gas emissions and the majority of homes which will be in use in 2050 - the year by which the UK has a legally binding target to reach a carbon-neutral economy - have already been built. 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.

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

6

FINANCE OPTION

Consumers may need to finance retrofit work. They can do this through secured or unsecured funding.

Secured Funding

Secured funding refers to a loan that is secured against an asset, such as a property. Secured funding for retrofitting is typically in the form of a first charge mortgage, or further advance on an existing mortgage, to fund the purchase and installation of relevant retrofit measures.

Property Linked Finance (also known as Property Assessed Clean Energy financing) is another form of secured funding that is well-established in the United States, whereby a loan is attached to a specific property rather than an individual. The Green Finance Institute is exploring opportunities to introduce this option into the UK market.

Unsecured Funding: Personal Finance

Unsecured funding is lending that does not require any tangible security or collateral against the loan. Consumers may consider financing a retrofit project with a credit card, personal loan or finance agreement.

Green Mortgages

Lenders are increasingly offering green mortgage products, where a borrower can benefit from preferential mortgage terms if the funds are used to retrofit a property, or acquire or construct an energy efficient property.[10]

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. 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.

[10] https://www.greenfinanceinstitute.co.uk/wp-content/uploads/2021/05/GREEN-FINANCE-GREEN-MORTGAGES.pdf
For more information please visit: https://www.greenfinanceinstitute.co.uk/green-mortgages/

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FINANCE OPTION

The risk to a lender depends on whether the consumer is seeking finance through a debtor-creditor agreement or a debtor-creditor-supplier agreement:

- **A debtor-creditor agreement** is generally a personal loan agreement between a consumer (the debtor) and a lender (the creditor). The lender may wish to know what category of work a consumer is looking to spend the money on, however the consumer is free to spend the borrowed money freely.

- **A debtor-creditor-supplier agreement** usually flows from a contract between a consumer and an installer for the supply of goods and/or services. The installer (the supplier) may have a separate arrangement with a lender, which allows them to offer the consumer finance from that lender when buying the specific goods and/or services being offered.

Credit risk is the biggest risk for lenders under both types of agreement. The credit risk of a consumer must be assessed and managed by the lender, who will be familiar with the relevant affordability checks to mitigate this risk.

Lenders in a debtor-creditor-supplier agreement are exposed to an additional risk, as they are bound by the Consumer Credit Act 1974. Under section 75 of the Consumer Credit Act, a lender may be liable for the breaches of an installer in relation to the purchase financed by the debtor-creditor-supplier agreement. The lender is jointly and severally liable to the consumer for any claim by the consumer against the installer in respect of a misrepresentation or breach of contract.

Historically, this risk was challenging to mitigate as access to Government funding schemes allowed disreputable companies to mis-sell the financial and performance benefits of specific renewable technologies and retrofit measures. This could expose lenders to claims under the Consumer Credit Act. However, the introduction of consumer codes, the Microgeneration Certification Scheme (MCS) and TrustMark have all helped to establish quality assurance and higher standards across the sector. Access to Government funding, for example through the recent Green Homes Grant, is now dependent on formal compliance with these standards. These bodies and standards are covered in more detail in the following section.

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INSTALLER STANDARDS AND QUALITY ASSURANCE

There are a number of Government-backed schemes which help protect consumers from poor quality installations. TrustMark oversees standards and quality assurance for energy efficiency and other retrofit measures. The Microgeneration Certification Scheme (MCS), another Government-endorsed organisation, exists to ensure that companies installing or working on renewable technologies adhere to approved standards and methods. A brief overview of each organisation is provided below.

TrustMark

TrustMark is the government endorsed quality scheme covering work a consumer chooses to have carried out in or around their home. It was established to ensure quality across a breadth of trades, including all those involved with repair, maintenance and improvement, energy efficiency and retrofit measures. TrustMark also addresses legacy mis-selling problems associated with energy efficiency measures.

TrustMark delivers consumer confidence through its network of scheme providers and their registered businesses. Scheme providers commit to meeting the framework operating requirements, and ensuring their registered businesses maintain the required standards of technical competence, customer service and trading practices.

TrustMark operates by mandating that work is undertaken to certain standards, including relevant Publicly Available Specifications (PAS). Of particular note are:

- PAS 2030 – specifications for installing energy efficiency measures
- PAS 2035 – specifications of best practice to guide retrofit projects (primarily domestic)
- PAS 2038 – specifications of best practice to guide retrofit projects for commercial buildings

Each of these standards is developed by a steering group at the British Standards Institute.

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INSTALLER STANDARDS AND QUALITY ASSURANCE

The Microgeneration Certification Scheme (MCS)

The Microgeneration Certification Scheme certifies low-carbon energy products and installers. As a condition of MCS membership, installers must also be a member of a Chartered Trading Standards Institute (CTSI) approved consumer code such as the Renewable Energy Consumer Code (RECC) or the Home Insulation and Energy Systems Consumer Code (HIES). MCS works alongside consumer codes to address potential mis-selling of renewable technologies.

Through membership of a CTSI approved Code, MCS certified installers agree to abide by the strict requirements of that code as well as the MCS installer standards. This combined regulatory approach provides a high level of consumer protection without creating unnecessary barriers to deployment.

The CTSI Consumer Code sets a high, minimum standard for installer contracts with domestic consumers. The codes in the renewables sector cover all the factors that contribute to a high standard of consumer service, before, during and after a contract is agreed. Consumers who enter contracts with code members must be provided with clear and consistent information, including accurate performance estimates for each technology. These performance estimates should be calculated in line with the MCS installer standards and should allow a consumer to easily compare like for like quotes.

The consumer codes offer alternative dispute resolution schemes, approved under the Alternative Dispute Resolution for Consumer Disputes (Competent Authorities and Information) Regulations 2015, to ensure that consumer/installer disputes can be resolved speedily and effectively. Installers are required to provide consumers with clear product guarantees and a workmanship warranty which is protected so that consumers are able to rely on the warranties should the installer cease to trade during the warranty lifetime.

7

INSTALLER STANDARDS AND QUALITY ASSURANCE

The codes and MCS, working together, are responsible for monitoring and enforcing compliance with the relevant standards. Failure to comply with the requirements of a code by an installer who has undertaken to comply with it amounts to a breach of the Consumer Protection from Unfair Trading Regulations 2008.

Measures paid for through certain Government programmes and incentives must be installed by TrustMark (with the work recorded in the TrustMark data warehouse) or MCS certified installers. The recent Green Homes Grant stipulated that installers must meet MCS standards when putting renewable energy systems in place, and PAS 2035 standards when installing energy efficiency measures.

Retrofit Coordinators

Under PAS 2035 standards all retrofit projects must have a retrofit coordinator. Retrofit coordinators are responsible for overseeing property assessments and specifying and monitoring the energy efficiency measures installed. Retrofit coordinators can also 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.

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UNDERSTANDING THE POLICY AND REGULATORY LANDSCAPE

The UK Government published the Heat & Buildings Strategy in October 2021, alongside several other strategy documents related to net zero. The Heat and Buildings Strategy sets out the policy framework the Government hopes will drive decarbonisation across all housing tenures over the next decade and beyond. The following section overviews existing and planned regulations, subsidies and other policies related to domestic heat and energy efficiency.

The Government's current overall approach to heat and buildings is to pursue low or no-regret options, work with the grain of consumer decision-making, use natural product replacement cycles as trigger points for change, and by and large (though not exclusively) to target direct financial support at low income, fuel-poor or otherwise vulnerable households.

In line with its low-regrets approach, the Government is focusing its efforts in the 2020s on decarbonising existing homes and buildings off the gas grid alongside new builds, while supporting the heat pump market to grow so that costs fall, the supply chain expands, and installers are trained such that heat pumps become the natural consumer choice for on-gas-grid homes.

The devolved administrations also play an important role in heat and energy efficiency policy, as do local authorities, particularly when it comes to policy delivery.

Regulation

Phasing out the installation of fossil fuel heating in homes off the gas grid: the Government plans to introduce regulation to end the installation of new fossil fuel heating appliances (such as oil, coal, and LPG (liquid petroleum gas) systems) in homes not connected to the gas grid from 2026. It also intends to introduce equivalent regulations for non-domestic buildings off the gas grid from 2024.

Ambition to phase out all new fossil fuel heating in 2035: the Government announced an ambition to end new fossil fuel heating installation in all homes by the middle of the 2030s, but stopped short of proposing an official regulatory end date (as they have done for the sale of internal combustion engine vehicles).

Minimum energy efficiency standards (MEES): existing regulations govern the minimum EPC rating homes must achieve before they can be rented out in the private sector. The Government has consulted on tightening these regulations so landlords are

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UNDERSTANDING THE POLICY AND REGULATORY LANDSCAPE

obliged to improve their housing stock to EPC C by 2025 for new leases, and by 2028 for existing leases, as long as the required improvements cost less than £10,000. The Government has previously said it will consult on introducing MEES for the owner occupier sector, potentially requiring certain energy or carbon performance standards for all homes at the point of sale, possibly by 2028-2030. No consultation has yet been announced.

Social housing regulation: the Government has committed to review the Decent Homes Standard – which sets the minimum standard for housing in the social rented sector – to consider how it can better support decarbonisation and energy efficiency. The Government also announced in the Heat and Buildings Strategy that they would consider setting a long-term regulatory standard to improve social housing to EPC C, in line with MEES in the private rented sector.

Future Homes Standard (FHS): to be introduced by 2025, the FHS 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 as standard. The Government also plans to issue a consultation on the idea of regulating to end new connections to the gas grid from 2025.

Heat network zoning: the Government consulted on a framework in 2021 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.

Heat Network Market Framework/Heat Networks (Scotland) Act: 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.

Local Heat and Energy Efficiency Strategies (LHEES): LHEES aim to establish local authority areawide 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 developing LHEES is likely to soon become a statutory duty for all Scottish local authorities.

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UNDERSTANDING THE POLICY AND REGULATORY LANDSCAPE

Market-based mechanism for low carbon heat: the Government has proposed introducing an obligation on manufacturers of fossil fuel heating appliances to sell a set number of heat pumps, based on a proportion of their overall appliance sales. This number would rise over time. The proposed policy would also introduce a "credit-trading" system, whereby companies who had sold more heat pumps than they were obligated to could sell credits to companies who had sold too few. As of 2022, this policy is still in the early design phase, but the Government intends to introduce it from 2024. The intention of the policy is to stimulate innovation and increase the range and attractiveness of consumer options and finance packages in the air source heat pump market.

Lender's disclosure requirements: the Government has consulted on setting a voluntary target of 2030 for mortgage lenders to achieve an average of EPC C across their portfolios, with the option of making the target mandatory with sufficient progress, in order to kick-start a market in green mortgages, with lenders offering better rates to properties with higher energy efficiency performance ratings. No response was included in the Heat and Buildings Strategy, but this may still be an option under consideration later in the 2020s.

Financial support and incentives

Home Upgrade Grants (HUG): local authorities will be able to apply for funds to support upgrades to the worst-performing low income off-gas-grid homes in England from 2022. £150m is available in the first phase, with a further £950m available from 2022/23 – 2024/25. This means £1.1bn has been announced in total.

Boiler Upgrade Scheme (BUS): the BUS will provide grants to households and small businesses to help them install new low-carbon heating systems. The BUS will offer £5000 for an air source heat pump and £6000 for ground source heat pump. It will become available in Spring 2022. The BUS has £450m to distribute over three years, meaning at current prices it could support around 90,000 air source heat pumps.

Energy Company Obligation (ECO): ECO is the Government's primary fuel poverty policy. It requires the largest energy suppliers to install efficiency measures in low-income homes. The latest iteration, ECO4, will be in place from 2022 to 2026, with its value boosted from £640m to £1bn per year, and with a greater emphasis on deeper, multi-measure retrofits.

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UNDERSTANDING THE POLICY AND REGULATORY LANDSCAPE

Fairness and Affordability Call for Evidence: the Government has announced it will consider options to lower the relative cost of electricity compared to gas, and that they will look at options including rebalancing energy levies (which pay for programmes to support renewables investment and the Energy Company Obligation) by taking them off electricity – where they currently disproportionately sit – and either moving them on to gas bills or paying for them through a different mechanism. The Government will also consider carbon pricing options, while limiting the impact on bills overall. It is not clear which of these policies is likely to be taken forward, or when they would be introduced.

Social Housing Decarbonisation Fund (SHDF): the SHDF aims to upgrade social housing stock currently rated below EPC C. £160m was made available in 2021/22, and the Heat and Buildings Strategy announced a further £800m over 2022/23 – 2024/25. The 2019 Conservative manifesto committed to spending £3.8bn over 10 years through the SHDF, in order to upgrade a significant proportion of the social housing stock to EPC C by 2030, meaning £2.84bn will be left to be spent in the second half of the 2020s.

Green Heat Networks Fund (GHNF): the GHNF will have £270m from 2022-25 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. It applies to England and Wales.

Heat Networks Market Framework: a new market framework will introduce maximum CO2 emissions limits for district heating by the early 2030s at the latest and will set rules to ensure that gas generation is swapped out. The market framework will also cover consumer protection, bringing heat networks in line with other utilities, market growth, and decarbonisation.

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 for 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.[11]

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 CEEB 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 would support customers making purchases through low-interest loans.

[11] For more information, please see https://www.greenfinanceinstitute.co.uk/building-renovation-passports/

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. For more information, please visit https://www.leti.london/ecp and https://www.london.gov.uk/what-we-do/planning/implementing-london-plan/london-plan-guidance-and-spgs/whole-life-cycle-carbon-assessments-guidance-consultation-draft

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.[12]

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.[13]

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

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

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.

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".[14]

Environmental Impact Rating (EIR): A measure of a home's impact on the environment in terms of carbon dioxide (CO_2) 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.

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

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.

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 CEEB's work on Demand Aggregation Financing (DAF)[15] aims to increase the availability of financing for this model of retrofit.

[15] See Annex

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