Quick guide to domestic building fabric retrofit

Market overview

The UK has the oldest and least energy efficient housing stock in Europe; with evidence suggesting that UK homes lose heat more than 3 times faster than those in Norway and twice as fast as homes in Italy[1]. Whilst UK homes have undergone major improvements over the last few decades (since 2009, 7.5 million professional insulation measures have been carried out under energy supplier obligations alone[2]) as of 2021, there remained over 5 million un-insulated cavity walls, over 7 million un-insulated solid walls, over 8 million lofts with less than 125mm of insulation and at least 2.7 million homes with predominantly single glazed windows[3]. In 2023, **the average Energy Performance Certificate (EPC) for homes in England & Wales is D** and domestic energy bills are at a record high[4]. The Committee on Climate Change (CCC) estimate that **£250 billion will need to be spent to fully decarbonise the housing stock by 2050**[5].

The benefits of retrofit

Recent evidence suggests that people are increasingly concerned about energy prices, are motivated to improve the energy efficiency of their homes and **are willing to pay almost 10% more for energy efficient properties**[6].

Improving the thermal fabric of homes has multiple benefits:

- **Health and comfort:** upgrading the thermal fabric can make homes **easier to keep warm and more comfortable to live in**; it can protect the building and **reduce the need for maintenance**; and it can be part of an effective solution for common issues such as damp, condensation and mould, helping to **improve people's health**. The Building Research Establishment estimate that improving the energy efficiency of the 700,000 homes that are defined as excessively cold in the UK **could save the NHS up to £540million per year**.[7]
- **Financial:** From a financial point of view, reducing the demand for heat **reduces household bills and limits people's exposure to future energy price volatility**. Reducing heat loss also **reduces the cost of installing new heating equipment** such as heat pumps and is likely to improve their performance in operation. Homes with better thermal efficiency are also better able to **benefit from lower cost time of use tariffs** that require the flexible use of heat, which is likely to be a key feature of our future energy system[8]. For lower cost measures such as cavity wall and loft insulation, these savings can generate a positive return on investment for homeowners in as little as 2 – 3 years[9].
- **Carbon:** From a carbon point of view; reducing the demand for heat in the housing stock is beneficial to an overall low carbon energy system. The CCC scenarios for reaching net zero by 2050 indicate that **over half of homes will require energy efficiency improvements by 2035**[10].

The challenges of retrofit

Whilst the potential is large and the benefits are clear, engaging the 'able to pay' market in thermal fabric retrofit has proved particularly challenging[11]. Evidence suggests that many **homeowners are unaware of the potential benefits** of thermal fabric retrofit[12]. For more affluent households **concerns about paying energy bills are low** which removes what is often seen as a key driver for thermal fabric retrofit[13]. **High up-front costs** of measures are often seen as a key barrier for many homeowners[14] . Householders' decisions are strongly **affected by the length of time they expect to stay in their current home** and many higher cost measures such as solid wall insulation are unlikely to generate a return on investment within the average period of home ownership of 18 years[15][16].

A high proportion of poorly insulated homes are in the private rented sector, where tenancies are less than 4 years on average and **landlords have fewer incentives to improve energy efficiency**. Also, many poorly insulated flats in urban areas **require freeholder consent** before improvements to walls and roofs can be undertaken[17].

Concern around the potential level of disruption associated with installing measures is also a barrier[18]. There is also a perception that it is **difficult to navigate the complex and sometimes contradictory advice** available on the best retrofit strategies[19] and that finding trusted installers and **co-ordinating the installation is challenging**[20]. Furthermore, **trust in the quality of installation** from the current supply chain is low and homeowners are **sceptical about whether the measure will deliver the stated benefits**[21] and **concerned about the potential risk of un-intended negative consequences** such as the failure of cavity wall or solid wall insulation[22]. The Government recognises that good quality advice and information is key in developing homeowner's trust. The Energy Saving Advice Service has therefore been established to provide homeowners with impartial advice about energy saving home improvements[23].

Bespoke solutions

Furthermore, high-level statistics of remaining potential can over-simplify the **complexity and diversity of UK homes and the approaches needed to retrofit them.** There is increasing recognition that homes require a bespoke approach, taking into account the nature and condition of the existing structure and the requirements of the occupants. For example, aesthetic, heritage and conservation considerations will often constrain and shape options for retrofitting homes with solid walls and single glazing[24]. Around 2.3 million lofts with potential for insulation are considered hard to treat or unfillable and a further proportion of lofts may be inaccessible due to being used for permanent storage[25]. Although over 5 million cavity walls remain un-insulated, **between 1.3 million and 3.5 million of these cavity walls are classed as non-standard**[26] including walls in areas of high exposure to wind driven rain, walls with faults or walls over 3 stories in height. Whilst all of these examples can be retrofitted, this may often require specialist assessment, design and installation.

Getting retrofit right

Retrofit assessment and a whole house approach: There is increasing recognition of the need to take a whole house approach to retrofit. This involves a dedicated assessment of the options for improving the thermal performance of the home, where possible based on assessment of monitored energy use, and developing a sequential plan for those improvements taking in to account the interactions between fabric measures, heating systems and on-site generation.

Focus on quality and detailed design to overcome the performance gap: There is also increasing recognition of the importance of high-quality design and installation of measures, to ensure that measures perform as intended. This involves close attention to the architectural details of measures such as, for example, how windows and doors join with the wall insulation to ensure air-tightness and minimise thermal bridging[27].

Build tight, ventilate right: It is also better understood that improving the thermal fabric and improving a buildings air tightness will increase the requirement for mechanical ventilation to ensure that a healthy and comfortable internal environment is maintained. Appropriate ventilation will ensure that excessive humidity does not build up which can lead to condensation damp and mould[28].

Trigger points – a convenient truth: Disruption and up-front cost are two key barriers to undertaking fabric retrofit. However, when undertaken alongside other home improvement works (such as renovations, extensions or loft conversions) the marginal additional cost can be much lower and disruption can be minimised. Spending on private housing repairs, maintenance and improvement in the UK is around £22billion a year[29]. Evidence suggests that homeowners are increasingly considering energy efficiency measures as part of these projects[30]. In a recent YouGov poll, 19% of homeowners planning home improvements sited energy efficiency measures as a priority[31]. Therefore, building energy efficiency improvements into the existing market for home improvement will be key to delivering the scale of improvements required.

A framework for quality retrofit: PAS 2035, PAS 2030 and Trustmark

A 2022 YouGov survey on attitudes to home retrofit found that 98% of homeowners cited 'quality of work' as a top priority and 97% cited trust'[32]. In order to help ensure quality outcomes for homeowners and avoid common risks associated with retrofit, **PAS 2035 has been created as an over-arching standard for delivering home retrofit.** PAS 2035 is sponsored by the Department for Energy Security and Net Zero and designed by the British Standards Institute (BSI). **PAS 2035 sets out the process to be followed for the provision of advice, assessment, co-ordination, design, installation and monitoring of domestic retrofit projects. PAS 2030 is the relevant certification concerning the commissioning, installation and handover of domestic retrofit projects, such as installing insulation**. Businesses registered with Trustmark must demonstrate full compliance with PAS 2035 and PAS 2030[33].

Table 1. Key fabric retrofit options for homes

Cavity wall insulation: Around 20 million homes have cavity walls in the UK and around 5 million of those are un-insulated[34]. Insulating the cavity wall typically represents a low-risk measure with a relatively fast payback on the up-front cost. However, around 3.5 million of the remaining cavity walls are 'non-standard' in some form[35]; requiring care in the application of the appropriate solution[36]. In some cases, such as cavity walls in areas of high rain exposure, the cavity may not be suitable for filling.
Solid wall insulation: There are over 7 million un-insulated solid walls in the UK[37]. External wall insulation can greatly reduce energy consumption, providing a cohesive thermal envelope around the thermal mass of the dwelling and minimising thermal bridging[38]. Internal wall insulation can also greatly reduce heat loss although additional consideration has to be given to minimise the risks of interstitial condensation and thermal bridging[39]. Many older solid wall properties have a high heritage value and so external wall insulation is typically avoided on the front for aesthetic or heritage reasons but may be suitable to the rear of the property. In all cases, great care must be taken to ensure walls are in good condition prior to the works and that there is appropriate moisture management.
Loft and roof insulation: Around 25 million homes in the UK have a loft and around one third of those have less than 125mm of insulation[40]. Where there is currently no loft insulation, installing insulation is typically the single most cost-effective measure that can be undertaken. Where a loft already has 125mm of insulation, the additional benefit of 'topping up' is much smaller[41] but by ensuring there is a cohesive thermal barrier, including insulating loft hatches and around penetrations through the ceiling, savings can still be made. Room in roof insulation can have a similar impact but is often more challenging and disruptive to install when undertaken as a stand-alone measure[42].
Floor insulation: There are approximately 10 million suspended timber floors in the UK[43]. For suspended timber floors (most common in pre 1950s properties) insulating between the floor joists can be a highly effective to reduce heat loss, reduce draughts and improve air tightness. It is important to make sure that the underside of the floor remains ventilated by ensuring that existing air bricks are not blocked. Solid concrete floors (more common in homes built post 1950) can be insulated by removing the existing floor covering, placing rigid insulation over the solid surface, then replacing the floor covering at a raised level. Care should be taken to ensure that interstitial condensation can escape the underside of any non-permeable membranes added to the floor structure.
Double and triple glazing: Nearly 9 out of 10 properties already have double glazing. However, a high proportion of this was installed pre-2002[44] and therefore does not benefit from the highest thermal efficiency values that triple or high performance double glazing can offer. The most efficient triple glazed windows can achieve U-values as low as 0.5 which delivers up to 5 times less heat loss than older double glazed units[45]. Draught proofing around glazing can

often be poor with gaps between the window and wall causing draughts so close attention to detail in the installation process is essential.

Ventilation and heat recovery: Changes to the energy efficiency of a property will invariably change the way that moisture behaves within the home, especially where those measures affect the vapour permeability of building elements or reduce the level of natural ventilation. In these cases, it is essential to ensure that ventilation is increased in the property to avoid the build-up of moisture and condensation. This could be via simple extractor fans. However, a Mechanical Ventilation with Heat Recovery (MVHR) system will ensure that air is managed whilst retaining heat within the building. Centralised MVHR systems can be expensive and difficult to retrofit into buildings. De-centralised or single-room MVHR systems are one alternative for retrofits[46].

References

[1] TADO (2020) 'UK homes losing heat up to 3 times faster than European neighbours' (**https://www.tado.com/gb-en/press/uk-homes-losing-heat-up-to-three-times-faster-than-european-neighbours**)
[2] BEIS (2021) 'Household energy efficiency detailed release' (**https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/970064/Detailed_Release_-_HEE_stats_18_Mar_2021_FINAL.pdf**)
[3] See 2
[4] Ofgem (2023) 'Energy price cap' (**https://www.ofgem.gov.uk/information-consumers/energy-advice-households/check-if-energy-price-cap-affects-you**)
[5] UK Parliament (2022) 'Decarbonising heat in homes – Report Summary' (**https://publications.parliament.uk/pa/cm5802/cmselect/cmbeis/1038/summary.html**) n.b Includes both low carbon retrofit and thermal fabric efficiency measures.
[6] Santander (2022) 'Buying in to the green homes revolution' (**https://www.santander.co.uk/about-santander/media-centre/press-releases/a-green-premium-house-buyers-willing-to-pay-almost-10**)
[7]BRE (2023) 'Tackling cold homes would save the NHS £540 million per year' (**https://bregroup.com/press-releases/tackling-cold-homes-would-save-the-nhs-540mn-per-year-new-bre-research-reveals/**)
[8] Carbon Trust (2020) ' Heat Pump Retrofit in London' (**https://www.london.gov.uk/sites/default/files/heat-pump-retrofit-in-london-v2.pdf**)
[9] University College London (2022) 'Insulating Britain: If not now, When?' (**https://www.ucl.ac.uk/bartlett/environmental-design/news/2022/jun/insulating-britain-if-not-now-when**)
[10] CCC (2020) 'The Sixth Carbon Budget: the UKs path to net zero' (**https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf**)
[11] Open Access Government (2021) 'Why is the UK's green Homes grant Scheme failing to deliver?' (**https://www.openaccessgovernment.org/uks-green-homes/104560/**)
[12] CREDS (2022) 'Options for accelerating retrofit rates in the domestic owner-occupier sector' **https://www.creds.ac.uk/publications/options-for-accelerating-retrofit-rates-in-the-domestic-owner-occupier-sector/**
[13] See 11
[14] National Housing Federation 'New NHF research highlights barriers to retrofitting homes' (**https://www.housing.org.uk/resources/barriers-retrofitting-homes/**)
[15] National Statistics (2020) English Housing Survey Home Ownership 2017-2018 (**https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/817623/EHS_2017-18_Home_ownership_report.pdf**)
[16] University College London (2022) 'Insulating Britain: If not now, When?' (**https://www.ucl.ac.uk/bartlett/environmental-design/news/2022/jun/insulating-britain-if-not-now-when**)
[17] The ADE (2020) 'Taking action to improve energy refurbishment of flats' (**https://www.theade.co.uk/news/blogs/taking-action-to-improve-energy-refurbishment-of-flats**)
[18] London Borough of Lewisham (2022) 'Findings from the barriers to retrofitting privately owned homes online survey' (**https://councilmeetings.lewisham.gov.uk/documents/s96657/03%20Appendix%203%20-%20Survey%20findings%20250222.pdf**)
[19] Ashden (2021) 'Stimulating local supply and demand for low carbon retrofit in the West of England' (**https://ashden.org/news/how-to-support-the-home-upgrades-that-bring-climate-targets-within-reach/**)
[20] Regen (2014) 'Retrofit Supply Chain Study Summary' (**https://www.regen.co.uk/wp-content/uploads/Ready-for-Retrofit-Supply-Chain-Study-Summary.pdf**)
[21] See 14
[22] Which (2023) 'Cavity Wall Insulation damp problems' (**https://www.which.co.uk/reviews/insulation/article/cavity-wall-insulation/cavity-wall-insulation-damp-problems-a5QkW7q4Hi8f**)
[23] HM Government (2023) 'Find ways to save energy in your home' **(https://www.gov.uk/improve-energy-efficiency)**
[24] University of Warwick (2023) 'Conservation area restrictions are stifling climate action' (**https://warwick.ac.uk/fac/soc/economics/news/2023/2/conservation_area_restrictions_are_stifling_climate_action_new_research_finds/**)
[25] See 2
[26] Energy Saving Trust for DECC (2016) 'Quantification of non-standard cavity walls and lofts in Great Britain' (**https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/656865/160628_Non-standard_cavity_walls_and_lofts.pdf**)

[27] Sustainable Traditional Building Association (2015) (**https://sdfoundation.org.uk/wp-content/uploads/2018/01/2015_bristolsolidwallinsulationguidance.pdf**)
[28] Passive House Plus (2020) 'No insulation without ventilation in Green Homes Grant scheme – TrustMark' (**https://passivehouseplus.co.uk/news/ventilation/no-insulation-without-ventilation-in-green-homes-grant-scheme-trustmark**)
[29] Construct UK (2022) 'Private housing mini market report' (**https://constructuk.com/private-housing-rmi-market-report-uk-2021-2025-new-report-from-ama-research/**)
[30] See 25
[31] Trustmark (2022) 'Nearly two thirds of homeowners unaware of what retrofit is' (**https://www.trustmark.org.uk/news/press-releases/2022/05/04/nearly-two-thirds-of-homeowners-unaware-of-what-retrofit-is---trustmark's-guide-can-help**)
[32] See 27
[33] Trustmark (2022) 'PAS 2035' (**https://www.trustmark.org.uk/tradespeople/pas-2035**)
[34] See 2
[35] See 22
[36] Energy Saving Trust (2017) 'Determining the costs of insulating non-standard cavity walls and lofts' (**https://www.gov.uk/government/publications/determining-the-costs-of-insulating-non-standard-cavity-walls-and-lofts**)
[37] See 2
[38] BEIS (2017) 'Understanding best practice in deploying external solid-wall insulation and internal wall insulation in the UK' (**https://www.gov.uk/government/publications/understanding-best-practice-in-deploying-external-solid-wall-insulation-and-internal-wall-insulation-in-the-uk**)
[39] BEIS (2021) 'Retrofit internal wall insulation – guide to best practice',(**https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1019707/iwi-guidance.pdf**)
[40] See 2
[41] Energy Saving Trust (2023) 'Roof and loft insulation' (**https://energysavingtrust.org.uk/advice/roof-and-loft-insulation/**)
[42] BEIS (2022) 'Room in roof insulation – guide to best practice' (**https://www.gov.uk/government/publications/room-in-roof-insulation-riri-best-practice**)
[43] Energy and Buildings Journal (2023) 'Suspended timber ground floors: Heat loss reduction potential of insulation interventions'(**https://www.sciencedirect.com/science/article/pii/S0378778817311350#:~:text=There%20are%20approximately%2010%20million,has%20not%20been%20widely%20investigated**.)
[44] Statista (2023) 'Insulation in dwellings in England' (**https://www.statista.com/statistics/292265/insulation-in-dwellings-in-england-uk-y-on-y/**)
[45] Passive House Institute (2023) 'Windows for Passive Houses –Superior Quality of Transparent Components' (**https://passiv.de/former_conferences/Passive_House_E/windows_passive_houses_06.html**)
[46] Passivhaus Trust (2023) 'The case for MVHR' (**https://www.passivhaustrust.org.uk/guidance_detail.php?gId=46**)

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