FUTURE LEAP

Domestic Retrofit:

Summary of benefits, barriers, and best practice

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Cold Homes Energy Efficiency Survey Experts

Introduction

There are 25.2 million dwellings in England[1], which are responsible for 35% of all energy consumed and 20% of the carbon dioxide emissions nationally[2]. With an estimated 80% of current properties predicted to still be in use by 2050[3], the majority of homes will require some level of retrofit to achieve the decarbonisation required for the UK to reach its 2050 net zero goal[2]. In addition to the size of the challenge, the UK also has the oldest and least energy efficient housing stock in Europe[3], with 78% of dwellings having been built before 1980[4], and price increases are outpacing income rates, unlike across other European countries where this disparity has not been seen[4].

The process of decarbonising homes includes retrofit activities to increase the energy efficiency of the building followed by an upgrade of the site's energy systems. But it is not a straightforward, one size fits all solution, the type, condition, and age of a building must all be considered in the design and implementation[3]. 15% of the houses in England were built prior to 1900[5], older homes are less energy efficient and uniform, meaning a more tailored approach will be required to tackle the UK housing landscape, unlike a nation-wide approach like Germany's Passivhaus program[3].

There are two fundamental approaches to retrofit, shallow and deep. Deep retrofit involves a comprehensive renovation project, potentially involving the entire home, while shallow retrofit focuses on smaller maintenance measures that can be implemented individually such as draught exclusion, cavity wall insulation, or double glazing of windows[6]. In terms of CO_2 reductions, shallow retrofit typically ranges from 10% to 30% reduction, while deep retrofit can achieve a savings as high as 80%[6]. This report is to explore the benefits and barriers relating particularly to shallow retrofit, however due to limited literature specific to shallow retrofit and the interconnectedness of the benefits and barriers of both forms, it is difficult to describe one completely independently.

Benefits of Retrofit

At a macro level there are economic, social, and environmental benefits to the retrofitting of domestic housing.[2] PwC's Green Jobs Barometer series reported an estimated 580,000 skilled jobs could be supported annually based on the quantity of home retrofits required for the UK to meet its 2050 net zero commitments.[7] Health concerns associated with poor-quality housing is estimated to cost the NHS £1.4 billion annually[8], warmer homes with improved air quality could help to alleviate this pressure on the health system. Finally, carbon emission reductions will contribute to the global effort to mitigate climate change and its impacts. To the individual household, there are key financial and health benefits:

Financial Benefits:

- Reduced energy bills.
    - Increasing the energy efficiency of a home will result in savings on energy bills, increasing the household's disposable income.[2]
- Increased property value.
    - Any improvements made to the fabric of a dwelling and improvement of the EPC rating will be reflected in the property value.[3]

Health benefits

- Positive health outcomes.
    - Home retrofit can positively impact heath due to improved air quality, increased warmth and overall comfort, reduced dampness and mould, and elimination of draughts.[6]
    - Work by The International Energy Agency and Organisation for Economic Cooperation and Development suggests 75% of the advantages of retrofit are related to improved health outcomes.[9]
- Mental health.
    - Reduction of energy costs can alleviate mental health risks such as anxiety due to energy poverty or the cost-of-living crisis. [6]

Key Barriers

There are a multitude of barriers to energy efficiency retrofitting which need to be overcome to increase uptake and improve the UK domestic housing stock. These include the upfront costs and payback periods, the perceived risk and uncertainty of predicted performance and expected ROI, inconsistent government policy and lack of funding mechanisms, complexity of ownership structures and split incentives, disruption in the home, technical complexity and insufficient skilled workforce, and a lack of environmental concern.

Upfront costs and payback periods.

- While saving money on energy bills can be a motivator, as was found in a study of pre-1919 homeowners, respondents reported both the upfront cost of retrofitting and estimated payback periods as key barriers.[10]
- A literature review conducted by Sava in 2023 found financial barriers were mentioned most frequently, the most common issues being long payback periods, high upfront costs, cost-effectiveness, and split incentives.[3]
- Additionally, society's vulnerable households are most likely to live in the least energy-efficient homes, but their low-income level hinders their ability to invest in renovations, particularly those that could improve energy efficiency.[11]

Perceived risk and uncertainty of predicted performance and expected ROI.

- Homeowners are often sceptical of the reductions and cost savings promised by retrofit projects. In one example, a study by Hong et al. and the Warm Study Group found of 1372 properties treated through the Warm Front Scheme, a 49% fuel consumption savings was estimated for cavity wall and loft insulation but following implementation only a 10-17% savings was achieved.[12]

Key Barriers

Inconsistent government policy and lack of funding mechanisms.

- There have been several national retrofit programmes including 'The Green Deal', 'The Warm Front', 'The Carbon Emissions Reduction Target', and 'The Green Homes Grant', all of which resulted in less than anticipated energy demand reduction and several closed early due to low uptake[3]. This research will not investigate the shortcomings of these schemes but note the policy gap left for national funding of retrofit projects.
- In the government's new approach to net zero, £6 billion has been allocated to fund support from 2025 to 2028, which will help approximately 500,000 households reduce their emissions through energy efficiency measures.[13] If distributed through effective channels to gain robust uptake, this capital could reduce or remove this barrier to retrofit for many households.

Complexity of ownership structures and split incentives.

- People in rented accommodations do not have direct control over maintenance and upgrades to the property, making it difficult to activate retrofit projects.
- Landlords may be hesitant to invest in energy efficiency retrofit projects when it is their tenants who pay the utility bills and will therefore benefit from the reduced energy costs.[14]

Disruption in the home.

- Retrofit projects cause disruption within the home which can be a deterrent as many people do not have the option to relocate during construction and therefore would have to bear the upheaval caused.[15]

Key Barriers

Technical complexity and insufficient skilled workforce.

- Each home requires an individualized approach and workers with the correct skill set. The UK is experiencing a shortage of tradespeople with skills required to deliver energy efficiency retrofit projects[16], the PwC Green Jobs Barometer notes 10,000 to 66,000 new tradespeople will be needed each year to match the rising demand for retrofit projects.[7]

Lack of environmental concern.

- Basic knowledge and awareness has increased of both environmental issues and the available home energy retrofit solutions, but studies have found that while respondents agree reducing carbon emissions is important, it is not a reason for which they would choose to retrofit.[10]
- Yohanis (2012) found that while 77% of households they surveyed had a general awareness of energy and environmental issues, this did not align with equal levels of adoption of energy saving solutions.[17]
- A literature review by Sava found that even among homeowners who did not face financial barriers, a lack of environmental concern was a key barrier to efficiency improvements.[3]
- A disparity between awareness of environmental issues and level of action is common across industries, research suggests one reason for this misalignment is people do not believe their actions will make a difference.[18]

Motivating Factors

While reducing or removing perceived barriers is necessary to increasing the uptake of home retrofit, it can also be beneficial to consider motivating factors, why a consumer might undertake a home retrofit project.

Studies have shown that individual's motivations for retrofit projects are typically linked to aesthetics and comfort over health and the environment. A survey run by Halifax in 2009 on home improvement found that 44% of respondents sought to improve the design of their home, while 38% stated renovations were done to modernise the house.[18] Similarly, the study of homeowners of pre-1919 dwellings noted home comfort as a key driver when considering energy efficiency retrofit projects,[10] and while lack of personal interest in energy efficiency and carbon emissions reduction were not perceived to be barriers to these homeowners, aesthetic improvements were a key motivating factor.[10]

Another study by Power (2008) found that people prefer retrofitting projects relating to amenities, new kitchens or bathrooms, over strictly energy efficiency retrofits.[12] While increased energy efficiency may not be the motivating factor for some homeowners to consider retrofit projects, increased energy efficiency is often at least a by-product of home improvement projects.[18]

As previously stated, cost is a key barrier, however financial savings are also a motivation for homeowners to consider energy efficient home improvements.[10] The expected annual savings can be used to off-set the upfront cost of implementation and following the payback period increased energy efficiency and the associated cost savings can positively impact a household's disposable income.

Shallow Retrofit

Opting for shallow over deep retrofit minimises many of the key barriers. The up-front cost of a project is significantly lower, resulting in shorter payback periods. Hesitation due to perceived risk based on expected ROI can be lessened in relation to a less costly retrofit project. Interventions can be installed individually at a time to best suit budget and worker availability. Shallow retrofits are less disruption in the home and can be completed on a quicker timeframe. While shallow retrofit may not result in as significant energy savings as deep retrofit, the same benefits are still realised, energy bill savings, increased comfort, and reduced carbon emissions.

Shallow retrofit helps to reduce or eliminate many of the key barriers that have been identified in relation to general retrofit activities, however, there may be some misalignment with respect to motivating factors. As multiple studies identified, homeowners are interested in projects which will achieve a desired aesthetic or amenity. Shallow retrofit may have minimal impact of the overall design of a home, therefore not achieving the impact of a new or improved amenity; and may also lack the potential social gains related to such projects, potentially reducing a household's interest in investing in such projects.[12]

While households may value the savings they could realise from improved energy efficiency, a report by Cebr found 69% of survey respondents noted rising energy bills as a key financial concern[19], up-front cost could still be perceived as a barrier even to shallow retrofit in the absence of robust government funding schemes. The UK is in the midst of a cost-of-living crisis and the financial health of the UK population is poor with 65% of people reporting that if they lost their source of income they would not be able to last three months without having to borrow money[20]. Taking into account such figures are skewed toward the younger population, 18-24 year olds, it still could stand to reason that many households cannot afford the up-front cost of shallow retrofit.

Case Studies:
The Kirklees Warm Zone

Kirklees, in West Yorkshire, developed a program called ‘The Kirklees Warm Zone’ which ran from 2007 to 2010 with the aim of improving domestic housing energy efficiency. The goals of the program included tackling fuel poverty, reduce carbon intensity of the region, improve the uptake of state benefits support by residents, and create jobs.

The focus was on shallow retrofit interventions, in particular cavity wall and loft insulation. Energy systems were only upgraded where necessary. The programme cost £21 million and was funded by the council and CERT funding from energy providers. Social housing in the area had an EPC rating of C, therefore private residents were the focus, receiving the service for free. The project was rolled out street by street throughout Kirklees, with everyone receiving the same offer, with the aim of removing any stigma of accepting help. When presenting the project to residents the focus was on creating warmer and more comfortable homes, not about costs and energy saving.

Successes of the project:

- 133,746 energy assessments were carried out (80% of the properties in the region).
- 50% of the properties in the region had some level of retrofit completed.
- 42,999 properties received free loft insulation.
- 21,473 had cavity wall insulation installed.

warm zone
bringing warmer homes to Kirklees

The Kirklees Warm Zone programme tapped into the benefit of aggregating retrofit projects, appealing to residents’ motivations for retrofitting, and removing the cost barrier. It is a positive example of how shallow retrofit can help to improve the energy efficiency of an entire region and form the first steps of reaching the larger UK net zero goal.

https://www.kirklees.gov.uk/beta/delivering-services/pdf/warmzone-economic-impact-assessment.pdf
https://www.theiet.org/media/8758/retrofit.pdf

Case Studies:

A Warmer Flat in Clifton

The owner of a cold and droughty flat utilised shallow retrofit measures to improve the energy efficiency and increase the warmth and comfort of the dwelling.

The home is a first floor flat of a north facing Georgian end-terrace located in a conservation area. Due to the solid walls, high ceilings, single-glazed sash windows, and draughts, the home was difficult to heat.

Motivation for retrofitting:

Concern about climate change and a desire to be more comfortable.

Shallow retrofit measures installed:

Internal Wall Insulation

Suspended Ceiling

Secondary Glazing

Draughtproofing

Due to the conservation area location the windows could not be replaced, but secondary glazing was permitted, for which acrylic plastic and foam draughtproofing were used on the internal window face. Insulation-backed plasterboard was used to add insulation to the solid walls and an insulated suspended ceiling reduced both heat loss and volume of the room to be heated. The upgrades have not only increased the comfort of the flat, but the secondary glazing has prevented wood rot and mould on the the fragile heritage windows. The retrofit of this property highlights options for improvement even in properties with heritage restrictions, and those improvements can benefit and protect the fragile features.

https://www.retrofitwest.co.uk/case-study/see-how-rob-made-his-home-warmer/

Case Studies:
A Warmer Flat in Clifton

In East Oxford, an inter-war, 1930s three-bedroom end-terrace house was retrofitted to make it warmer, less costly, and greener. Homeowners, Eleanor and Chris, were motivated to retrofit their home due to climate change concerns and the responsibility they felt to reduce their carbon emissions. They wanted their home to be an example of what can be achieved through retrofit.

The home has cavity walls, bay windows and is heated by a gas boiler. A whole house retrofit plan was designed by Cosy Homes Oxfordshire to address the key heat loss issues and energy inefficiencies. While this case study high lights a whole house approach, some of the interventions could be considered shallow and have been implemented individually over time.

Retrofit measures installed:

- External wall insulation
- Loft insulation
- Triple-glazed doors and windows
- Demand controlled ventilation

Estimated savings:

•**27%** savings on carbon emissions.

•**26%** saving on fuel bills.

•Improvement of EPC rating from **C** to **B**

https://cosyhomesoxfordshire.org/case-studies/wrapping-our-whole-house-in-insulation/

References

1. Department for Levelling Up, Housing & Communities (2022) *Dwelling Stock Estimates, England: 31 March 2022:* https://www.gov.uk/government/statistics/dwelling-stock-estimates-in-england-2022/dwelling-stock-estimates-england-31-march-2022
2. Construction Leadership Council (2021) *Greening Our Existing Homes, National retrofit strategy:* https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2021/05/Construction-Leadership-Council-National-Retrofit-Strategy-Version-2.pdf
3. Sava (2023) *Reducing Demand for Energy in Residential Properties by 2035:* https://sava.co.uk/sava-edge/can-we-really-reduce-the-demand-for-energy-in-residential-properties-in-the-uk-by-2035/
4. Home Builders Federation (2023) *Housing Horizons: Examining UK Housing Stock in an International Context:* https://www.hbf.co.uk/documents/12890/International_Audit_Digital_v1.pdf
5. Office for National Statistics (2022) *Age of the property is the biggest single factor in energy efficiency of homes:* *https://www.ons.gov.uk/peoplepopulationandcommunity/housing/articles/ageofthepropertyisthebiggestsinglefactorinenergyefficiencyofhomes/2021-11-01*
6. M. Saffari and P. Beagon (2022) *Home energy retrofit: Reviewing its depth, scale of delivery, and sustainability*. Energy & Buildings, 269.
7. PwC, *Making homes more energy efficient could sustain 500,000 jobs:* https://www.pwc.co.uk/press-room/press-releases/making-homes-more-energy-efficient-could-sustain-500000-jobs-PwC.html
8. BRE (2021) *The cost of poor housing in England:* https://files.bregroup.com/research/BRE_Report_the_cost_of_poor_housing_2021.pdf
9. Cambridge City Council (2022) *Retrofitting Your Home:* https://www.cambridge.gov.uk/media/11677/retrofitting-your-home-report-non-accessible-version.pdf
10. B. Kaveh et al. (2018) *An investigation into retrofitting the pre-1919 owner-occupied UK housing stock to reduce carbon emissions*. Energy & Buildings, 176 (p. 33-44).
11. R. Barrella, J.C. Romero, A. Laguillo, and E. Sevilla (2023) *Assessing the Impact of Shallow Renovation on Energy Poverty: A Primary Data Study*. Energies 16 (21).
12. S. H. Hong, T. Oreszczyn, I. Ridley, and the Warm Front Study Group (2006) *The impact of energy efficient refurbishment on the space heating fuel consumption in English dwellings.* Energy & Buildings, 38 (p.1171-1181).
13. Department for Energy and Net Zero (2023) *Families, business and industry to get energy efficiency support:* *https://www.gov.uk/government/news/families-business-and-industry-to-get-energy-efficiency-support#:~:text=a%20new%20local%20authority%20retrofit,with%20measures%20such%20as%20insulation*

References

14. Department for Business, Energy and Industrial Strategy (2018) *What are the Barriers to Retrofit in Social Housing?* https://assets.publishing.service.gov.uk/media/5c9210e640f0b633f71989cb/Barrier__to_Retrofit_in_Social_Housing.pdf
15. M. Dowson, A. Poole, D. Harrison, and G. Susman (2012) *Domestic UK retrofit challenge: Barriers, incentives and current performance leading into the Green Deal*. Energy Policy, 50 (p.294-305).
16. The Institute of Engineering and Technology (2020) *Scaling up retrofit 2050:* https://www.theiet.org/media/8758/retrofit.pdf
17. Y.G. Yohanis (2012) *Domestic energy use and householders' energy behaviour*, Energy Policy, 41 (p. 654-665).
18. B. Mallaband, V. Haines, and V. Mitchell (2014) *Barriers to domestic retrofit: learning from past home improvement experiences*. Retrofitting the Built Environment (p.184-199).
19. Cebr (2022) *Financial Health Index Report 2022:* https://www.sjp.co.uk/sites/sjp-corp/files/media_centre_reports/SJP%20Financial_Health_Index_Report_2022%20FINAL.pdf
20. L. O'Brien (2024) *UK Savings Statistics 2024:* https://www.money.co.uk/savings-accounts/savings-statistics