

BUILDING ON OUR STRENGTHS

A market transformation approach
to energy retrofit in UK homes

July 2021





A joint project
between the FMB
and CREDS

ABOUT THIS REPORT

This report is a joint project between the Federation of Master Builders and the Centre for Research into Energy Demand Solutions. It investigates what is needed to integrate domestic energy efficiency retrofit into the everyday practices and activities of builders and tradespeople in the repair, maintenance and improvement (RMI) market.

ABOUT THE FEDERATION OF MASTER BUILDERS



The Federation of Master Builders (FMB) is the UK's largest trade association for the construction industry. The FMB has a proud history of supporting and promoting small and medium-sized building companies – including sole traders – across the UK since it was established in 1941. The FMB is a champion of quality construction work and advocates for continuous improvement in building standards.

ABOUT THE CENTRE FOR RESEARCH INTO ENERGY DEMAND SOLUTIONS



The Centre for Research into Energy Demand Solutions (CREDS) was established as part of UK Research and Innovation's Energy Programme in April 2018, with funding of £19.5M over five years. Its mission is to make the UK a leader in understanding the changes in energy demand needed for the transition to a secure and affordable, low carbon energy system. CREDS has a team of over 140 people based at 24 UK universities.



This report was written by a team with decades of combined experience

ABOUT THE AUTHORS

The report was written by a team with decades of combined experience in research and practice relevant to retrofit, energy policy and construction.

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“Our homes have never been more important for our lives and wellbeing”



FOREWORD - BRIAN BERRY, CHIEF EXECUTIVE, FMB

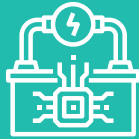
This report is published as the UK economy begins to unlock following the coronavirus pandemic and as the FMB celebrates its 80th anniversary. It has been a difficult and uncertain time for everyone, and our homes have never been more important for our lives and wellbeing; but now it is time to look ahead.

Just as the FMB was formed in 1941 to help rebuild London after the Blitz, builders stand ready once again to support our economic recovery and build back better.

Ahead of the United Nations Climate Change Conference in November 2021, I am joining calls for a green recovery, and for a long-term plan to green the nation's homes to be at the heart of this. A burgeoning retrofit market will improve the affordability and comfort of our housing stock, create thousands of jobs, and reduce our collective carbon footprint.

The FMB has long supported the need for a comprehensive policy framework to unlock the retrofit market. I am pleased that since the publication of our report, 'Building a Greener Britain' in 2008, we have been able to move the debate on, including with today's report. I am grateful to CREDS for the opportunity to bring together academic and builders' voices into one coherent call on Government for change.

I would like to thank the members of the FMB who took part in the research. Their on-the-ground experience have added real value to shaping the outcomes of this report.



“Approximately 30% of the UK’s energy is used in our homes”

FOREWORD – PROFESSOR NICK EYRE, DIRECTOR, CREDS

I welcome the collaboration between colleagues in CREDS and the FMB that has produced this report. Co-producing research reports and recommendations with expert organisations such as the FMB is an important way for CREDS to ensure that our research is grounded in real world problems and has impact in the wider world.

The report provides analysis and evidence-backed proposals about how to reduce energy use and carbon emissions from UK homes. It provides an important contribution to enabling the UK to meet its net zero carbon goals, as well as to delivering high-quality jobs and better homes and living conditions for their occupants.

Approximately 30% of the UK’s energy is used in our homes. The total amount has fallen in recent years, due to the increasing efficiency of building fabric, heating systems, appliances and lights. The building trades and professions have been important in delivering these improvements through millions of installations. Household renewable energy systems have also become significant, with hundreds of thousands of solar PV systems installed on UK roofs.

Progress has slowed in the last decade, as government policy support has become less effective. However, the aim of this report is not to dwell on past failings, but rather to learn from them and to present suggestions for future policy that build on research and practitioner experience.

There is a huge amount to do if the residential sector is to achieve zero emissions by 2050. Many of the ‘easy’ efficiency improvements – like cavity wall and loft insulation and condensing boilers – have already been done in most homes. Future improvements will require more significant changes, including whole-house retrofit and non-fossil fuel heating systems, such as heat pumps. Delivering this more radical change will require a skilled workforce and customers who understand why change is needed. This will not happen without a supportive policy environment, including better regulation and financial support for householders who will not otherwise be able to afford the changes needed.

The report sets out detailed recommendations for achieving this transformation, by focusing primarily on those who will do the work, their skills and building the market for retrofit work. The voice of builders, particularly those in small and medium-sized enterprises, is too rarely heard in policy debates. By drawing on their experience and recognising their importance in low carbon retrofit, we can start to deliver a high quality housing stock, which meets the needs of people and the planet.





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“There are 29 million homes which have generally poor energy efficiency”



EXECUTIVE SUMMARY

Overview

Energy retrofit must become embedded into the everyday practices of builders working in the repair, maintenance and improvement (RMI) market if we are to significantly reduce carbon emissions from housing and achieve net zero carbon emissions by 2050.

Policy efforts to develop energy retrofit have not delivered the scale of activity needed to meet climate policy goals. Firms operating in the RMI sector are ideally placed to carry out energy retrofit. However, recent policy initiatives have not served the sector well.

Opportunities for improving the energy efficiency of the nation's homes are routinely missed because they are not planned for. These 'trigger points' represent around £11bn of RMI works each year. A policy mix is needed to help deliver a changed market for retrofit, so that it becomes a normal activity, sought by households and delivered by competent builders, supported by supply chains, intermediaries and other local stakeholders.

Research question

How can the market for repair, maintenance and improvement be transformed so that opportunities for energy retrofit are integrated into everyday practice and market activity?

Research methodology

For this report, academic researchers, industry experts, the FMB and their members have joined together to develop a system-wide approach to understanding the role of the RMI sector. Through discussion with those operating in the sector, the report identifies specific recommendations for policy makers and industry bodies to support the RMI sector in delivering energy retrofit.

Key Findings

- The market for retrofit must be transformed, supported by a policy mix including minimum standards which improve over time, better information for householders and financial incentives.
- Occupational standards must also be transformed, equipping the workforce with the necessary competence to carry out retrofit. Skills can be acquired through on-the-job training as well as via colleges.
- These alterations must be made together, in order to deliver a changed market for retrofit. This will enable retrofit to become a normal activity, sought by customers and delivered by competent builders and installers, supported by supply chains, trade bodies, and other local stakeholders.
- The work would create significant numbers of new jobs in every UK nation and region. New roles and professions will emerge as energy retrofit becomes mainstream.
- Policy is also needed to support change among other relevant stakeholders outside the construction sector; a cross-sectoral 'systems thinking' approach is needed.
- Place-based demonstrator programmes are a suitable way to develop the market (as is happening in Wales and Scotland), and it is crucial that these form part of longer-term policy support.



“Energy retrofit must become embedded into the everyday practices of builders”





“There is no simple policy ‘fix’ for housing retrofit. A joined-up, cross-sectoral approach is needed”

RECOMMENDATIONS

There is no simple policy ‘fix’ for housing retrofit. A joined-up, cross-sectoral approach is needed with several key features: a commitment to creating a long-term market; developing finance mechanisms to leverage private investment; improved quality and competence based on a licence to trade; and space and funding to trial innovative approaches in the real world.

Policy to create a long-term market for retrofit

Building Standards need to be tightened, and existing support for monitoring and evaluation needs to be developed.

- Building Regulations need to return to a regular cycle of revisions and be tightened over time to gradually improve the energy efficiency of homes.
- Local Authority Building Control needs to be better resourced in order to provide all-important compliance and advisory services for the industry.
- Energy Performance Certificates (EPCs) need to be reformed to improve accuracy and credibility, based on good-quality building surveys and design software. Recommendations in EPCs should be based on key trigger points and informed by how consumers make decisions in the RMI market.

Finance and fiscal measures

A package of financial and fiscal measures are needed.

- Reducing the VAT rate on all RMI work to zero or 5% in order to disincentivise cash-in-hand deals in the parallel, unregulated economy and to reduce the costs of retrofit for property owners.
- Strategic use of public sector investment to pump-prime the market and lever in private investment. For example, government-backed loans should provide the necessary capital up-front, with repayment schedules that allow universal and fair participation.
- Providing and supporting funding mechanisms (grants, loans, green mortgages) to support owner-occupied, privately rented and socially rented homes.



Improvements to retrofit quality and workforce competence

The existing RMI workforce are crucial for kick-starting retrofit at the rate and scale needed. To support the workforce:

- A licence to trade should be introduced for the construction industry. By applying the licence to the firm, not the individual, there would still be employment opportunities for all.
- A broad foundation course in buildings and energy should be integrated into all construction training so that trainees have a common basis of understanding before specialising.

Supporting new approaches

Space and funding is needed to foster new approaches to energy retrofit.

- A series of real-world field trials should be carried out in all regions to test and refine innovative processes and practices, using real homes, occupants, supply chain firms and local authorities (similar to the Optimised Retrofit Programme in Wales and the Energy Efficient Scotland programme).
- Innovative building information management ideas, such as building renovation passports, should be trialled.





INTRODUCTION

The UK housing stock must undergo huge transformation in the coming years. There are 29 million homes which have generally poor energy efficiency; they are wasteful and difficult to heat affordably, especially for vulnerable groups. These need to become homes which provide affordable warmth with net zero carbon emissions.

The Climate Change Committee recommends that no new gas boilers should be installed in existing homes from 2033¹. Minimum efficiency standards for increasing proportions of the housing stock are being set; these will need to increase in ambition over time.

Overall UK Government targets are for net zero emissions by 2050, with Scotland setting an earlier date of 2045. This transformation, which will involve upgrading the building fabric, changing heating systems and installing renewables like solar panel, must be led by the building professions and trades that already exist. However, this will only happen if a sustainable market for energy retrofit (see Box 1) can be created. There is good evidence that the best way to do this is to build on the existing market for repair, maintenance and improvement (RMI). The vision is of a world where energy retrofit is normal professional practice delivered by builders and their supply chains, valued by home owners, landlords and

tenants, and supported by effective, long-term policy (see Box 2).

This report outlines how the industry can make the most of this opportunity and help the UK to build back better. It also outlines the policy changes needed to support this transformation.

¹ CCC (2020) The sixth carbon budget, The Climate Change Committee. Available at: <https://www.theccc.org.uk/wp-content/uploads/2020/12/The-Sixth-Carbon-Budget-The-UKs-path-to-Net-Zero.pdf> [accessed 8 July 2021]



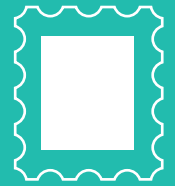
BOX 1

What is retrofit?

Retrofit is a process of making changes to buildings and technical systems in buildings so that energy consumption and associated carbon dioxide emissions are reduced, in line with energy and climate and policy goals.

The work involves reducing heat loss (via insulation, minimal thermal bridging, improved airtightness and controlled ventilation), installing low carbon heating systems such as heat pumps, as well as efficient lighting and appliances and building-integrated renewable energy technologies, such as solar panels. Retrofit can reduce an individual household's energy consumption and carbon dioxide emissions by up to 90%. Decarbonisation of energy supply will be needed as well in order to reach net zero. **In this report the integrated, high-quality work to upgrade homes in this way is termed 'energy retrofit' - or 'retrofit' for short.**

BOX 2



A postcard from the future

All across the country, building work is being done in response to changing household needs by hundreds of thousands of competent installers. They are skilled, knowledgeable and effective service providers, who listen to customer requirements, and also provide guidance and support. Depending on the project, they may advise on technologies, share information about the affordable finance options available, and bring in specialist experts.

On each project the lead contractor takes responsibility for updating a central retrofit register, which records the major repairs, maintenance and improvements to every home. Homes are required by law to meet minimum standards of energy performance, which change over time as new products and business models are developed. Cash-in-hand deals from unlicensed operatives are a thing of the past. Instead, building firms work under a 'licence to trade', which means that company owners/directors have to meet qualification standards. Apprentices and experienced (but unqualified) workers are supported and encouraged to gain qualifications, subsidised by the state in recognition of the important role that the industry plays in maintaining healthy, energy efficient homes. Firms are audited regularly, and they keep abreast of new ideas and regulatory changes through continuing professional development.

Whenever homes are put up for sale or rent, high-quality and detailed building surveys evaluate if they meet a minimum rating on their energy performance certificate (EPC). Finance for the retrofit works is provided through combinations of loans, grants and tax incentives as well as what homeowners need to invest in maintaining their property. Lenders offer low interest rates because the whole process is low-risk: under-written by the state, at least in the early years, and underpinned by robust and reliable systems for building energy rating and installer accreditation.

Fuel poverty and unfit housing are almost unknown. Local authorities perform compliance checks through a well-resourced Building Control function, which also provides technical advice to firms. The work done on buildings is coordinated with the management of local energy networks so that all elements of the system are compatible with each other.



“RMI projects offer significant opportunity for retrofit activities”.

An overview of the UK housing stock and RMI sector

Housing in the UK is mostly owned privately (Figure 1). The three broad types of property ownership (owner-occupied; privately rented; social housing) involve different stakeholders and need different approaches if retrofit is to become mainstream. Even so, some elements of a retrofit strategy will be applicable or adaptable between different tenure types. The primary focus of this report is on the privately owned stock, where building services are predominantly provided by small and medium-sized enterprises (SMEs) in the construction industry.

The work required to bring the nation’s housing stock up to standard is on a massive scale – given that virtually all of the UK’s 29 million homes require retrofit. Fortunately, there is a mature and active market for RMI; the sector is of the scale needed to start delivering this ambitious agenda. RMI projects offer significant opportunity for retrofit activities to be carried out when work is being contemplated anyway.³

Approximately 40% of RMI work (such as renovating kitchens and bathrooms) provides good trigger points for doing retrofit at the same time.^{4,5} For scale, the UK construction industry is worth £158bn to the UK economy each year, of which £29bn (18%) is spent on housing RMI⁶ (estimated using five-year averages, 2016-2020). Retrofit represents both a challenge and an opportunity for the thousands of SMEs in the construction industry, who undertake the bulk of RMI work in homes.

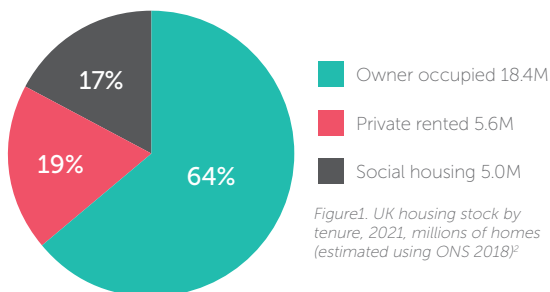


Figure 1. UK housing stock by tenure, 2021, millions of homes (estimated using ONS 2018)²

² ONS (2018) Dwelling stock by tenure, UK, Table 2. Available at: <https://www.ons.gov.uk/peoplepopulationandcommunity/housing/datasets/dwellingstockbytenureuk> [accessed 7 July 2021]

³ Fawcett, T. & Killip, G. (2014) Anatomy of low-carbon retrofits: evidence from owner-occupied superhomes. Building Research and Information 42(4): 434–445

⁴ Killip, G. (2011) Latent market opportunities for low-carbon housing refurbishment. Energy and People: Futures, Complexity and Challenges conference, University of Oxford. Available https://www.eci.ox.ac.uk/publications/downloads/2011-Latent_markets_low_C_housing.pdf [accessed 1 July 2021]

⁵ Maby, C. and Owen, A. (2015) “Installer Power”. A report funded by the Sainsbury Trust’s climate collaboration. Available at: http://www.see.leeds.ac.uk/fileadmin/Documents/research/sri/Installer_Power_final_report.pdf

⁶ ONS (2021a) Output in the construction industry, Table 7. 11 June 2021 release <https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/datasets/outputintheconstructionindustry> [accessed 1 July 2021]

THE BENEFITS OF RETROFIT



Make homes more comfortable and attractive to live in



Improve the health and well-being of residents



Cut heating bills significantly



Support large numbers of jobs across all regions of the UK

“Despite the many benefits of retrofit, there is no functioning market to deliver it”

The benefits of retrofit

Retrofit has multiple benefits beyond delivering energy and climate policy goals, it can:

- Improve the health and well-being of residents
- Make homes more comfortable and attractive to live in
- Cut heating bills significantly
- Support large numbers of jobs across all regions of the UK

Despite the many benefits of retrofit, there is no functioning market to deliver it: there is little demand or interest, currently from property owners, and limited capability in the building industry to do this kind of work to the right quality. RMI work carries on with too little regard for retrofit. Neither governments nor the finance sector are offering the range of funding mechanisms that will be necessary to transform the market. Policy support is needed to remedy this situation.



“We have been put off by stop/start policy schemes - they are too risky for a smaller firm. However, we do want to get more involved in this market”* - Master Builder

Learning from past mistakes

Recent policy initiatives have not paid sufficient attention to the need for consistent, joined-up policy across multiple domains. The Green Homes Grant scheme, launched in 2020, was intended to kick-start the market as part of a post-Covid economic recovery, but it failed and was abandoned after a few months. Similarly, the Green Deal in 2013-2015 failed to stimulate a market for retrofit.⁷ Both schemes suffered from poor policy design and a failure among policy-makers to take a systems approach. These failures not only cause delay; they also undermine industry and public confidence in government programmes generally, making firms more cautious about taking part in future.

The sector has recognised these failings, and recent reports highlight the need for change. In December 2020

a National Retrofit Strategy was published for consultation by the Construction Leadership Council.⁸ It highlighted the need for interdependent ‘modules’, incorporating leadership, research and innovation, finance, training and accreditation, amongst others. This report secured the support of more than 50 organisations in construction, the energy sector, and beyond.

Meanwhile, Each Home Counts⁹ highlighted the need for a Quality Mark to support the work of those operating in the sector. Building on these initiatives, and through engagement with RMI workers, this report takes a system-wide approach to develop further policy recommendations for change.

*All comments from builders attending the research workshop on 18 June.

⁷ Rosenow, J. & Eyre, N. (2016) A post mortem of the Green Deal: Austerity, energy efficiency, and failure in British energy policy, *Energy Research & Social Science* 21:141-144

⁸ CLC (2020) *Greening Our Existing Homes: National Retrofit Strategy*. Construction Leadership Council. Available at: <https://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2021/05/Construction-Leadership-Council-National-Retrofit-Strategy-Version-2.pdf>

⁹ Bonfield, P. (2016) *Each Home Counts: An Independent Review of Consumer Advice, Protection, Standards and Enforcement for Energy Efficiency and Renewable Energy*. Available at: <https://www.gov.uk/government/publications/each-home-counts-review-of-consumer-advice-protection-standards-and-enforcement-for-energy-efficiency-and-renewable-energy>



“Policies are often put together by people with little understanding of the sector. So the solutions they come up with can be too complex for small companies.”

- Master Builder



HOW WE DID THIS WORK

- This research has been carried out by a combination of academic researchers, industry experts and the FMB.
- It builds on published research and the practical, real-world experience of those working in the sector.

The voices of SME builders are very rarely heard in policy debates about energy in housing. To help make their views heard, a three-hour stakeholder workshop was conducted with directors/owners of SME construction firms. A set of policy recommendations was presented by the report-writing team, based on existing research. This was the starting point of a discussion about how the industry needs to change if retrofit is to become mainstream. This involved criticising the policy ideas put forward, having the opportunity to present alternative ideas, and debating advantages

and disadvantages. The workshop was a first attempt by researchers to co-create policy ideas with the stakeholders whose working lives would be most directly affected by the market transformation of the housing RMI sector. Illustrative quotes from FMB members are used throughout the report.

The proposals for change and policy prescriptions in this report have been developed in collaboration between academics, practitioners and members of the FMB. They are well-evidenced and intended to bring about change in the real world.

RETROFIT AND RMI

- RMI builders are predominantly SMEs. They have considerable influence on their customers' choices and currently operate successfully without engaging with retrofit.
- RMI builders operate within a system of market activities and constraints, a range of people, organisations and influences.
- Retrofit and RMI need to become much more closely aligned and integrated in order to meet climate policy goals.

RMI is a source of employment, and Gross Domestic Product (GDP). Over 45,000 firms work in the domestic buildings sector, of which over 95% are SMEs; over 80% of all firms in the sector are micro enterprises with one to three employees.¹⁰

Most firms are SME, working predominantly in the private domestic sector. Builders and tradespeople are highly skilled and knowledgeable, taking pride in their work, and often providing trusted guidance and product recommendations to their clients. Builders are required to problem solve on practically every job, as only once they are on site, and the underlying nature of a structure has been exposed, can they identify the real issues.

The RMI market is very active, and it has been particularly so during the coronavirus pandemic lockdown when enquiries for home improvement works surged¹¹. There is little incentive for these in-demand firms to engage in policy development, nor take risks by entering new markets.

The RMI market is diverse according to project type but also location, with variety in the types of work and expertise in different places. However,

within each area, remarkably stable networks of small firms across a range of trades will operate, using the same wholesalers and merchants from job to job.¹²

Where builders do take risks, they have been encouraged by clients who are willing to spend more time and money than average on a project. But these learnings are not necessarily carried forward to the next job, as once again time and money constraints take over for most.

RMI builders operate within a system of market activities and constraints, a range of people, organisations and influences. Builders and installers are influential; they negotiate relationships with customers (and their advisors), other building firms, designers, merchants, manufacturers, local authorities and national policy. RMI sits at the heart of a complex interlocking network of players (Figure 2).

Two examples can illustrate how these networks operate – RMI firms' relationships with their supply chains, including merchants and manufacturers, and Local Authority Building Control.

¹⁰ ONS (2021) Construction statistics annual, Table 3.4a. Available at: <https://www.ons.gov.uk/businessindustryandtrade/constructionindustry/datasets/constructionstatisticsannualtables> [accessed 8 July 2021]

¹¹ FMB (2021), State of Trade Survey Q1 2021, available at <https://www.fmb.org.uk/resource/state-of-trade-survey-q1-2021.html>

¹² Maby, C and Owen, A (2015) "Installer Power". A report funded by the Sainsbury Trust's climate collaboration. Available at: http://www.see.leeds.ac.uk/fileadmin/Documents/research/sri/Installer_Power_final_report.pdf

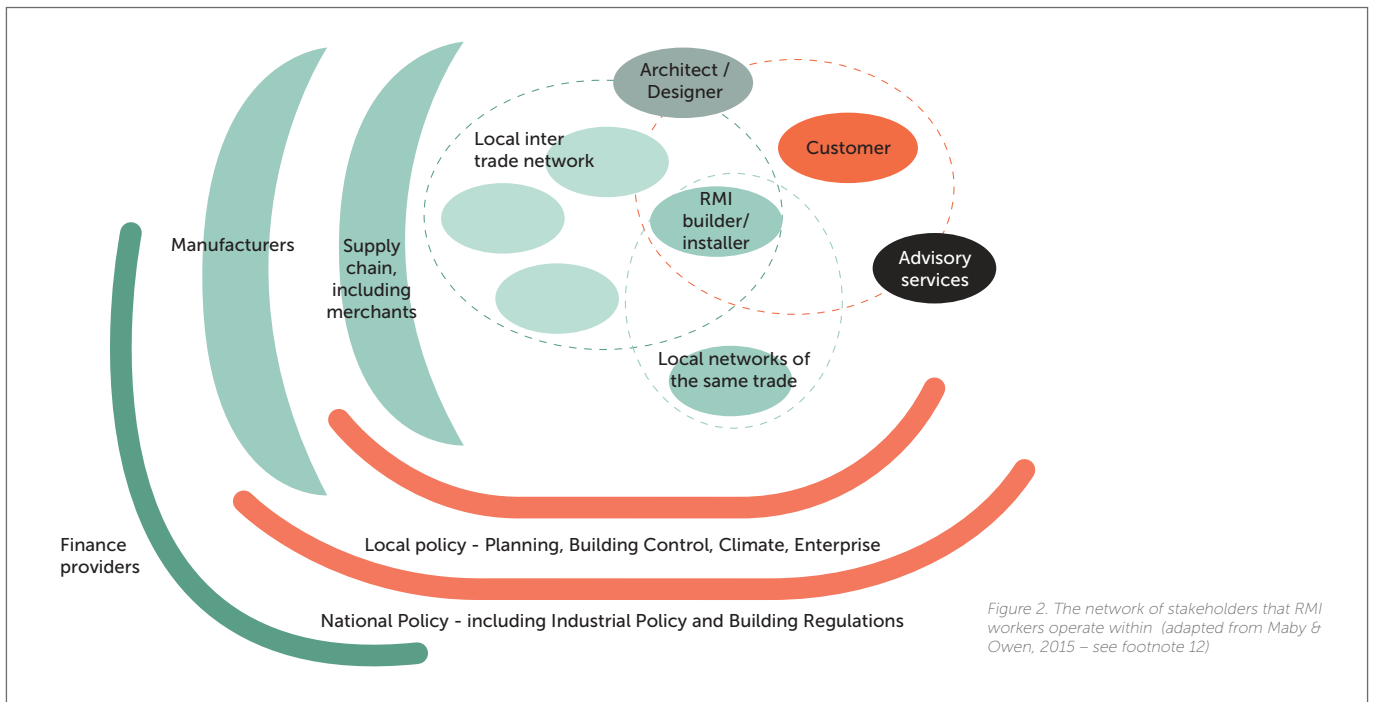


Figure 2. The network of stakeholders that RMI workers operate within (adapted from Maby & Owen, 2015 – see footnote 12)

Merchants & manufacturers

Builders’ merchants in particular play a key role in local RMI works. Many small construction firms do not hold materials on their job site, but rely instead on stock held at the merchant’s yard to carry out tasks in the next few days. Materials that are readily available in the local supply chain tend to be preferred, and the repeated specification of the same products reinforces their market dominance. Merchants can be highly influential, playing two key roles. First, they are a source of trusted advice about what will work, and what is affordable, in local market conditions.

This can include technical specifications and product recommendations. Second, merchants’ relationships with manufacturers, brand preferences, contractual obligations and informal sales incentives can all shape the products that merchants stock and recommend¹⁵. This directly influences the materials and equipment used in local RMI work. Despite this influence, merchants rarely have formal training or qualifications for delivering low carbon buildings or energy retrofit.

¹⁵ Wade, F., Shipworth, M. & Hitchings, R. (2016). Influencing the central heating technologies installed in homes: the role of social capital in supply chain networks. *Energy Policy*, 95, 52-60.



“There has been a 27% reduction in surveyors since 2010 due to funding cuts”

Local authority building control

Local authorities have historically held tremendous expertise, especially by Building Control surveyors, who have an in-depth of understanding of existing housing stock, including vernacular materials and design and non-standard construction. Building Control has been a competitive function since 1985 with Local Authorities competing for work with Approved Inspectors. This has also led to competition for experienced surveyors and to the situation where contractors can shop around until they find a provider who will potentially accept a less compliant solution. There has been a 27% reduction in surveyors since 2010¹⁴ due to funding cuts, retirement and insufficient entrants to the profession. This has diminished the previous position of Building Control as being trusted by local builders and adding value to the work that they deliver for their customers.¹⁵

New initiatives on training and development are beginning to

bring change. The new Building Safety Regulator and new Building Safety Bill, which removes choice of building control provider for buildings in scope, is intended to halt the ‘race to the bottom’ identified by Dame Judith Hackitt after the Grenfell tragedy. The Building Act, Regulations and Approved Documents are being revised in response to calls for clearer standards, better consistency and improved compliance. These changes should increase numbers of competent surveyors and improve accessibility, response times and trust by local builders, national contractors and the general public.

Local authorities are already well trusted, and over 90% operate under the LABC 9001 Quality Management System. Local authorities have important resources and knowledge: understanding of the local area; knowledge and data about the building stock; databases of local businesses, and means of engaging with them.^{16,17}



“Government should invest in Building Control, so they have the skills and funding to do the work properly. Work with the existing structures rather than inventing new ones.”

- Master Builder

¹⁴Inside Housing (2021) Hundreds of building control surveyor posts cut by councils since 2010, research reveals. 28 April 2021. Available at: <https://www.insidehousing.co.uk/news/news/hundreds-of-building-control-surveyor-posts-cut-by-councils-since-2010-research-reveals-70525> [accessed 7 July 2021]

¹⁵Murtagh, N., Achkar, L. & Roberts, A. (2018) The role of building control surveyors and their power in promoting sustainable construction, *Construction Management and Economics*, 36:7, 363-374, DOI: [10.1080/01446193.2017.1397721](https://doi.org/10.1080/01446193.2017.1397721)

¹⁶Wade, F. & Webb, J., (2020) Local Heat and Energy Efficiency Strategies (LHEES) Phase 2 Pilots: Evaluation Report. Available at: <https://www.gov.scot/publications/local-heat-energy-efficiency-strategies-lhees-phase-2-pilots-evaluation/pages/8/>

¹⁷Webb, J., Tingey, M. & Hawkey, D., (2017) What we know about local authority engagement in UK energy systems: Ambitions, activities, business structures and ways forward. London, UK Energy Research Centre and Loughborough, Energy Technologies Institute.

“RMI works can be the trigger for energy retrofit works.”

RMI and retrofit are ongoing processes

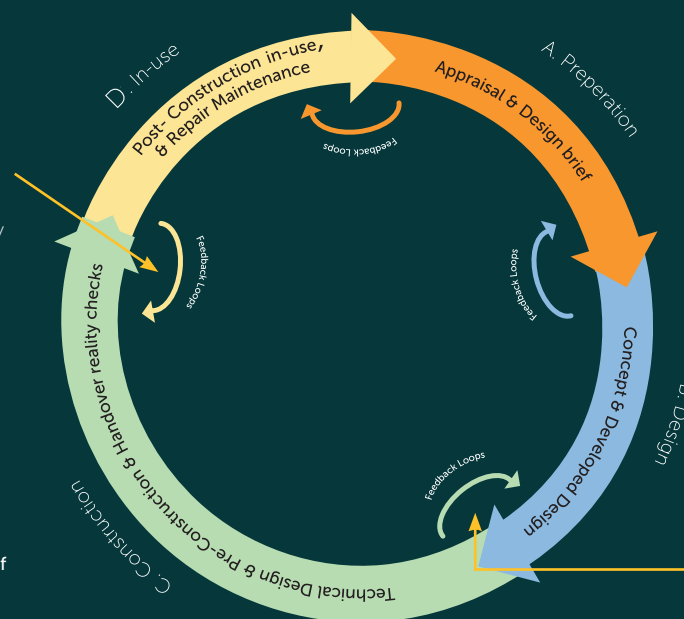
RMI activities are carried out throughout a building’s life in response to wear and tear (repair and maintenance) or changing needs (improvement). RMI works can be the trigger for energy retrofit works¹⁸. Depending on the trigger¹⁹, the starting point for retrofit works can be at any of the four key workplan stages:

- A. Preparation: appraisal of a building’s existing condition and design brief with the client;
- B. Design: from concept to final design processes;
- C. Construction: on-site processes from technical design to installation and building control checks; and
- D. In-use: building operation, and RMI works throughout the building’s lifespan.

For example, retrofit can start at the Construction stage triggered by a project for a new kitchen. The workplan stages are cyclical rather than linear, and good retrofit requires feedback loops from each stage to the previous one (Figure 3).

Example of feedback loop from Post-construction in-use and Handover/reality checks stage:
Find causes of misalignment between construction and in-use. And offer continuity in roles and responsibilities to single people or teams at a crucial stage of delivery where users are often left with no aftercare support.

Figure 3: Outline of keys work stages in the retrofit process and examples of feedback loops (Adapted from ^{20,21}).



Example of feedback loop from construction to design stage:
Help the design team, the construction teams and clients to re-evaluate and inform often overoptimistic design aspirations. And allow problem-solving to be communicated to (and amongst) different actors (designers, contractors and users) at early stage before problems become irreversible and cannot be treated).

¹⁸ Green Finance Institute. (2020). Financing energy efficient buildings: the path to retrofit at scale. Available at: <https://www.greenfinanceinstitute.co.uk/wp-content/uploads/2020/06/Financing-energy-efficient-buildings-the-path-to-retrofit-at-scale.pdf>

¹⁹ Topouzi, M., Fawcett, T., Killip, G., & Owen, A. (2019). Deep retrofit approaches: managing risks to minimise the energy performance gap. Paper presented at the Proceedings of ECEEE Summer Study - Belambra Presquile de Giens, France.

²⁰ Topouzi, M., Fawcett, T., Killip, G., & Owen, A. (2019). Deep retrofit approaches: managing risks to minimise the energy performance gap. Paper presented at the Proceedings of ECEEE Summer Study - Belambra Presquile de Giens, France.

²¹ Topouzi, M., Killip, G., & Owen, A. (2017). 'Learning from 'horror' stories: a plan of work to reduce the performance gap in deep retrofit. Paper presented at the Proceedings of 33rd Passive and Low Energy Buildings (PLEA) International Conference, 2th-5th July 2017. Edinburgh



“ We must avoid incentivising bad quality retrofit work. There are technical risks to the building if retrofit work is only done partially - improving one element can lead to increasing problems elsewhere.” - Master Builder

There are important differences between RMI and retrofit, as well as overlaps and similarities. For example, retrofit may involve some delivery partners not found on RMI projects – but builders are common to both; the planning and funding arrangements for retrofit are likely to be more intricate than for RMI – but both will involve private investment; retrofit involves more specialist skills and roles than typical RMI work – but practical skills and problem-solving are common to both; and assessment for retrofit is likely to

require more formal data processes and methods than those used in RMI. These are set out by category in Table 1.

Good communication and co-ordinated feedback loops need to support well-informed decisions on-site to improve quality of installation. Finding causes of misalignment between construction and in-use can help to reduce the gap between ‘doing’ and ‘managing’ and to define the roles and responsibilities for the next stages of RMI.²²

Retrofit can be carried out all at once or in a series of phased projects over time as other priorities and circumstances allow. The most ambitious energy standards (including airtightness and whole-home ventilation systems) only really lend themselves to being done all at once, but ‘over time’ approaches can bring savings of 60% or more, and the market potential is bigger, with more diverse trigger points.²³

Table 1: Differences and similarities between Retrofit and RMI

Category	Retrofit	Repair Maintenance & Improvement (RMI)
Delivery partners	Tradespeople Accredited Retrofit installers for measures and systems Design team, project manager, Retrofit coordinator Contractor/Sub-contractor Retrofit surveyor, assessor, specialist consultant or other Energy advisor	Tradespeople (e.g. General builders, bricklayers, plasterers, roofers, painters, plumbers) Measures and systems installers (heating, ventilation systems) Design team, project manager Contractor/Sub-contractor
Building works planning	Packages of measures or whole house intervention one-off or over time Planning permission where required Private or public financing and procurement process Leverage of additional private investment	Repair, maintenance or replacement of individual measures or systems Planning permission where required Paid for by property owners
Skills and knowledge	Depending on the scale and complexity of the project: Key principles of Low Zero Carbon whole-house approach Assessment energy use, retrofit risks and specifications Retrofit lifecycle, funding option Building physics, building fabric combines solutions Monitoring, evaluation feedback approaches Communication and coordination, risk management, on-site problem solving	Depending on the scale and complexity of the project: Building services, materials and products specifications Experience/familiarity and underpinned tacit knowledge of building fabric elements and systems Costing and funding option Risk management, on-site problem solving
Assessment	Set of methods and often systematic collection of data (including digital) for different stages of the retrofit process (e.g. energy performance audits, thermal imaging, airtightness tests, user handover etc.)	Single methods of data collection depending on the service often involving informal assessment based on experience

²²Topouzi, M., Killip, G., & Owen, A. (2017). Learning from ‘horror’ stories: a plan of work to reduce the performance gap in deep retrofit. Paper presented at the Proceedings of 33rd Passive and Low Energy Buildings (PLEA) International Conference, 2th-5th July 2017, Edinburgh

²³Fawcett, T. (2013) Exploring the time dimension of low carbon retrofit: owner-occupied housing. Building Research and Information, 42(4): 477-488.

MARKET TRANSFORMATION

- Market transformation can be achieved by applying multiple policies simultaneously to permanently change the market for products or buildings towards those with lower environmental impact.
- A foundation of technical and market analysis and a long-term commitment to industry engagement are critical.
- Transforming a service market like RMI requires policy interventions to change the behaviours of many different stakeholders.

Market transformation can be achieved by applying a suite of policies over time so that whole stocks of products or buildings move towards lower environmental impact. This approach has been used extensively in EU products policy, where a combination of measurement protocols, minimum efficiency standards, energy labels and national financial incentives has resulted in transformation of markets for lights and appliances.²⁴ A similar policy mix has been used to transform the Australian market for commercial offices towards higher environmental performance.²⁵

In the case of appliances, the key actors are manufacturers, retailers and customers. Manufacturers, for example, have been involved in expert groups agreeing technical measurement standards, and in negotiations with policy makers over the level of minimum standards. The minimum standards, energy labels and economic incentives introduced have been shown to shift the range of products available towards efficiency, with manufacturers competing to produce highly energy efficient

products. Market transformation is a long-term approach – it has informed product policy in the EU for more than 25 years, and is still evolving to deliver improved efficiency and environmental performance. For example, energy labels have recently been revised removing A+++, A++ and A+ categories, and test standards recalibrated, to give more useful information to consumers, and to incentivise manufacturers to develop even more efficient products. Mandatory minimum standards continue to increase in their ambition.

Can this approach be successfully applied to residential energy retrofit? The market for building work and retrofit is complex and varied; the customer is buying a customised and negotiated service rather than a standard product or a finished building. Minimum standards, energy labelling and financial incentives can support the transformation of existing homes. However, this relies on the retrofit market being able to deliver these improvements. More fundamentally, there is currently no significant market for energy retrofit – one needs to be created.

For products, introduction of energy labels created a new market for energy efficiency; no structural change in the industry was required to do this, just product innovation. Greater change will be necessary to create a retrofit market which values and delivers energy efficiency and renewable energy technology. This transformation relies on a system-wide approach, incorporating the skills of people working on buildings, and changing behaviours across the organisations, influencing homeowners and the construction industry amongst others – it is not primarily about technical innovation.

Residential energy policy has historically treated energy installations as being specialist ‘measures’ outside the RMI market; market transformation takes the very different approach of integrating the energy-related works into the mainstream RMI market. Not all RMI projects lend themselves to being developed into retrofit projects, but many do – and there is potential for the RMI market to grow in size as a result of integrating energy efficiency and micro-generation works.

²⁴Boardman, B. (2004) New directions for household energy efficiency: evidence from the UK, *Energy Policy*, 32(17): 1921-1933, <https://doi.org/10.1016/j.enpol.2004.03.021>

²⁵Mallaburn, P., Azhari, R., Fawcett, T. and Topouzi, M. (2021) Australian non-domestic buildings policy as an international exemplar. *Buildings and Cities*, 2(1): 318-335., 2(1): 318-335.





“Short term incentives seem a bad idea - we need longer term thinking.” - Master Builder

BOX 3

A METHOD FOR DETAILED POLICY DESIGN

Transforming a service market like RMI requires policy interventions to change the behaviours of many different stakeholders. It requires a cross-sectoral approach and cross-disciplinary ‘systems’ thinking. The market cannot be transformed by one policy in isolation, but it can be done with good policy ‘toolkits’ where multiple policies work in concert.

The Capability, Opportunity, Motivation – Behaviour (COM-B) model of behaviour change is a systematic method for policy design, which

works backwards from the target behaviours (the desired outcomes of policy) to an analysis of Capability, Opportunity and Motivation. It is a powerful way of understanding behaviour change among different stakeholders, and could support the development of market transformation policies in the RMI market.

The COM-B approach is being used to develop retrofit policy in Wales.

See Appendix B for more details.

TRANSFORMING THE MARKET: FROM CURRENT TO FUTURE POLICY?

- A combination of increasing minimum standards for both buildings and builders, appropriate metrics and information and more attractive finance offers will be needed to transform the market.
- Building standards will remain important, but they need to be reformed so they can be updated more quickly, include smaller RMI works, and treat the building as a system.
- New professional qualifications under the PAS 2030/2035 standards need to be joined with other qualification and training opportunities.
- A licence to trade will be needed to create the necessary push towards occupational standards.
- Energy Performance Certificates (EPCs) are becoming an increasingly important part of policy making; they cannot reliably be used for all purposes proposed without reform.
- Building Renovation Passports could be valuable, in addition to EPCs, as a route to facilitating greater renovation activity.
- Access to finance, innovative funding mechanisms and government support, will be needed to grow the market.
- Cutting VAT on RMI would reduce the incentive to use unlicensed builders in the parallel economy, and reduce the costs of retrofit for property owners.

Market transformation will require actions to encourage change across all groups involved in energy retrofit, including householders, tradespeople, supply chains and policy makers. From a policy perspective, some of the most crucial mechanisms include: setting minimum building and occupational standards, ensuring accurate building information and metrics, and supporting financial and fiscal mechanisms. Each of these are now discussed, considering both their current status and future improvements that are needed.

Building standards

Minimum standards apply to a greater or lesser extent to both buildings, via building regulations, and the people who work on them, via occupational standards. Building and occupational standards which guide the current market are described briefly below, followed by suggestions for change which will contribute to transforming the market.

Current status

Building regulations set minimum standards of performance for energy-related interventions in homes. The minimum standards set vary between the nations of the UK. Building work is subject to different technical performance requirements, definitions and procedures, via Building Regulations Part L1B for existing buildings for England and Wales, and a system of technical handbooks in Scotland and Northern Ireland. In addition to regulatory standards, independent organisations such as the Energy Saving Trust, the Association for Environment Conscious Building and British Standards Institution have developed more technically ambitious standards. These standards set higher energy performance targets than in current building regulations, and generally focus on whole-house retrofit approaches.

Future improvements

Building standards are important for the industry and are likely to remain so. To contribute to the transformation, they need to recognise the building as a system. Energy efficiency, glazing, ventilation and standards on other topics (e.g. structural safety) all need to make consistent demands. Greater guidance on how to navigate the different standards would be valuable. Streamlined processes are needed to facilitate more regular updates and increases in standards. Lessons learned from the application of more ambitious voluntary standards should inform the regular revision of mandatory standards.

Occupational standards

Energy standards for buildings need to be supported by occupational standards, so that the desired outcomes are achieved in practice. Significant gaps between design intent and real-life energy performance are due in part to industry training and culture: a lack of technical knowledge; poor communication skills; and unclear roles and responsibilities between members of project teams.²⁶

²⁶ ZCH (2014) Closing the gap between Design and As-Built Performance: end of term report. London: Zero Carbon Hub. Available: <https://www.zerocarbonhub.org/resources/reports/closing-gap-between-designed-and-built-performance-end-term-report> [accessed 1 July 2021]

“We need to provide firms with good quality hands-on training.” - Master Builder

Current status

Building firms can operate perfectly well in the RMI market without having the technical, communications and business management skills required for high-quality retrofit.²⁷ They do have practical craft skills and problem-solving capabilities – which are necessary but not sufficient for retrofit. There are no qualification requirements for most of the trades which currently undertake RMI work in homes. Compared with other European countries, British construction training is fragmented, narrowly defined by tasks and job roles without a shared understanding of the construction process as a whole, nor any shared responsibility for the quality of the end-product.²⁸ A broad education and higher orders of learning (eg self-reflexivity; evaluation of the whole project, not just individual tasks) are particularly important for retrofit because they underpin quality assurance and collective responsibility for energy outcomes.²⁹

“Aspirational is a key word - workers want to see routes to improving their skills.” - Master Builder

Arising from the 2016 Each Home Counts review,³⁰ a framework of technical standards for retrofit, known as PAS 2035:2019, has been introduced for homes.³¹ PAS 2035 is an innovative standard which sees the building as a system. It sets key process requirements and guidance for: assessing a building’s existing condition; identifying and evaluating the options of improvement and the risk involved in the design and specification of the energy efficiency measures; setting the monitoring and evaluation requirements; and the skills of the actors involved in all stages of a retrofit process. It also identifies the risks of getting things wrong, for example when a repair or replacement takes place using inappropriate methods or materials. PAS 2035 introduces a number of new roles – i.e. Retrofit assessor, coordinator, designer, installer and evaluator– and formal qualifications underpin each of these roles. There is a separate standard (PAS 2030:2019) that sets specification and performance requirements for the retrofit installer.³² PAS 2035/2030 is currently a voluntary system, which is mandatory only under specific conditions, for example in retrofit programmes funded via the Energy Company Obligation scheme. However, this scheme does not fund integrated retrofit, so PAS 2035/2030 is being used primarily where individual measures are installed, not for the more integrated approach for which it was intended.

The occupational skills and standards required by PAS 2035/2030 are new, with relatively few people having undertaken the training to date. PAS 2035/2030 has been developed largely with at scale retrofit and large developers in mind. There was some concern in the workshop with FMB members about the ambition and complexity of PAS 2035/2030 standards, and questions about how they could be simplified, and diffused to all trades working on site. There are long-standing concerns about skills gaps in the construction sector, and the need to attract new entrants. In the FMB workshop, it was suggested that the new roles and qualifications emerging with PAS 2035/2030, which focus on delivering environmental benefits as well as high quality retrofit, could attract younger workers.

“An element of retrofit should be included in all construction NVQs - along with basic literacy.” - Master Builder

Future improvements

PAS 2035/2030 needs a flexible mechanism for regular revision and amendment that allows evidence from retrofit projects to feed back in the loop for technical requirements, qualifications and evaluation of the retrofit process. The standards need also to be available through more user-friendly mainstream formats at a low cost (or zero cost) to increase uptake from smaller companies and individuals. One route to do this would be to integrate elements of the PAS 2035/2030 course into mainstream Further Education college provision.

More generally, a ‘licence to trade’ requirement for all firms in the sector would drive up quality.³³ This would mean every company director (including the self-employed) would need specified qualifications or other proof of competence in order to operate in the sector. By applying the licence to the firm, not the individual, there would still be employment opportunities for all. This transformation of sector requirements was widely supported in the FMB workshop, as long as there were proportionate routes to compliance for workers with good existing skills and experience.

²⁹ Killip, G. (2020). A reform agenda for UK construction education and practice. *Buildings and Cities*, 1(1), 525–537. DOI: <http://doi.org/10.5334/bc.43>

³⁰ Bonfield, P. (2016) Each Home Counts: An Independent Review of Consumer Advice, Protection, Standards and Enforcement for Energy Efficiency and Renewable Energy. Available at: <https://www.gov.uk/government/publications/each-home-counts-review-of-consumer-advice-protection-standards-and-enforcement-for-energy-efficiency-and-renewable-energy>

³¹ BSI. (2019). PAS 2035:2019 Retrofitting dwellings for improved energy efficiency - specification and guidance. Available at <https://www.airflow.com/assets/pdf/knowledge%20center/pas%202035-2019.pdf>

³² BSI. (2019). PAS 2030:2019 Specification for the installation of energy efficiency measures in existing dwellings and insulation in residential park homes. Available at: <https://www.airflow.com/assets/pdf/knowledge%20center/pas%202030-2019.pdf>

³³ FMB (2018) Licence to build: a pathway to licensing UK construction. Available at <https://www.fmb.org.uk/resource/licence-to-build-a-pathway-to-licensing-uk-construction.html> [accessed 5 July 2021]

Information/ metrics

Current status

EPCs are required for new homes, and at the point of sale or rental for existing homes. An EPC contains information about energy use and typical energy costs, recommendations about how to reduce energy use, and an energy rating on a scale of A to G. This rating is an energy cost index: it is the cost to achieve a specific space heating regime, and provide adequate hot water and sufficient lighting, divided by the dwelling's total floor area (i.e., £/m²/year). The EPC is playing an increasingly important role in UK renovation policy. It is currently used to set minimum energy standards in the private rented sector. The UK Government has proposed that all fuel poor homes should be upgraded to EPC Band C by 2030 and 'as many homes as possible to be EPC Band C by 2035 where practical, cost-effective and affordable'.³⁴ The Scottish government has also proposed new standards based on EPCs, distinguished by tenure – owner occupied EPC C by 2035, social housing EPC B by 2032 and private rented EPC C by 2028.³⁵ Welsh Government has set higher standards than England and Scotland.

“The existing EPC system could be improved by including much more detailed opportunities for positive changes. For example, it could suggest changing extractor fans for heat recovery fans – an opportunity which is currently invisible.” - Master Builder

Future improvements

Debates about the strengths and weaknesses of EPCs, particularly the underlying metrics and A to G energy rating, are both longstanding and ongoing.³⁶ The more influential EPCs become, the more their accuracy, replicability and appropriateness matters.

EPCs should reflect the 'trigger point' approach, highlighting the potential to do energy retrofit when building works are being planned anyway. This would provide information on retrofit options at precisely the time when cost and disruption were already being contemplated.

'Building Renovation Passports' could facilitate greater renovation activity. Already in early use in several European countries, they contain information about the property, its operational performance and historic renovations; and a long-term renovation roadmap that identifies future retrofit measures.³⁷ Containing much more detailed information than an EPC about technical and operational changes during a building's life, building renovation passports could be influential on householder decisions. Creating such a logbook of building interventions would need to dovetail with accreditation and training initiatives – making the accurate updating of the logbook part of normal working practice. Digital processes could also help.

³⁴ BEIS. (2017). The clean growth strategy: Leading the way to a low carbon future. Retrieved June 2020 from <https://www.gov.uk/government/publications/clean-growth-strategy>

³⁵ Scottish Government (2021) Heat in buildings strategy – achieving net zero emissions: consultation. Available at: <https://www.gov.scot/publications/heat-buildings-strategy-achieving-net-zero-emissions-scotlands-buildings-consultation/>

³⁶ Fawcett, T. and Topouzi, M., 2020. Residential retrofit in the climate emergency: the role of metrics. *Buildings and Cities*, 1(1), pp.475–490. DOI: <http://doi.org/10.5334/bc.37>

³⁷ Green Finance Institute (2021) Building renovation passports: Creating the pathway to zero carbon homes. A report by the Green Finance Institute's Coalition for the Energy Efficiency of Buildings. Available at: <https://www.greenfinanceinstitute.co.uk/wp-content/uploads/2020/06/Financing-energy-efficient-buildings-the-path-to-retrofit-at-scale.pdf>

Finance and fiscal measures

Current status

There is currently very little financial assistance for householders in England, Wales and Northern Ireland undertaking retrofit, particularly those who are 'able to pay'. In Scotland there are loan schemes for up to £15,000 (£17,500 for renewable heating) targeted at owner-occupiers and private landlords. A pilot equity loan scheme is in operation in more deprived areas, whereby up to £40,000 can be borrowed from the Scottish Government and repaid only when the property is sold (See Appendix A). Important lessons can be learned from overseas. For example, France has a 0% loan scheme for private property-owners, which offers 7-30,000 euros per project, depending on the ambition of the works carried out.³⁸

The private and community sector can also offer routes to help pay for retrofit work. There is an increasing volume of long-term investment capital seeking low risk, low carbon asset classes to support. However, offers to consumers, in terms of green mortgages, or similar products, remain thin on the ground. There is also the growing movement of Community Municipal Investments, a form of green bond raising capital for investments which produce a financial return with carbon reduction, usually renewable energy.

Future Improvements

Undertaking retrofit will be more expensive than conventional ongoing RMI works, especially in the early years when the retrofit market is immature. Early pioneers of retrofit assembled finance from different sources, including savings and inheritance.³⁹ For the mainstream owner-occupier market, some combination of loans, mortgage extensions and grants will be needed in addition to provide the necessary capital and to provide further impetus to action. This report does not suggest particular funding offers from government; there are a number of different routes available (see Appendix A for examples).

Area-based retrofit programmes, characteristic of social housing, might be of considerable interest to investors, if the model for financial return can be developed. Such area-based schemes encompassing all building sectors are currently being developed in Scotland's Local Heat and Energy Efficiency Strategies (see Appendix A). For lenders the reduction of loan risk typically needs the support of one or more schemes to certify that standards are met for building energy ratings and installer accreditation. Higher volumes of lending also help spread the risk. The lenders themselves do not need to understand the full technical detail of retrofit, so long as the schemes function well enough to support the general risk assessment. There is a clear interplay between lender appetite for investment, building energy ratings and workforce training/accreditation: developing the last two should help to increase the first.

Given that retrofit is such an immature market, with uncertainties in many inter-dependent domains, a good starting point could be some form of field trial or demonstrator programme, which incorporates explicit evaluation and future scaling elements. The systems for finance, energy performance and training/accreditation should be tested together, as is being done in the Optimised Retrofit Programme in Wales and Scottish Government's Energy Efficient Scotland programme (see Appendix A).

VAT

The FMB and others have campaigned for a VAT reduction on RMI work over many years. Arguments for a VAT rate of 5% or zero include the promotion of regeneration in less privileged areas⁴⁰ and a general boost to economic activity in times of recession. Research by CBI Economics found that reducing VAT for a temporary 5-year period would unlock a £51 billion economic stimulus.⁴¹ For retrofit a key argument for VAT reduction is to reduce the incentive to have work done in the unregulated 'parallel' economy. With VAT charged at 20%, firms offering services 'cash in hand' can undercut VAT-registered firms by a significant amount. A VAT rate of 5% or zero would reduce the incentive to have work done outside the regulated system. A VAT cut would support a shift towards a licence to trade and the introduction of occupational standards, both of which will be needed for retrofit.

³⁸ <https://www.ecologie.gouv.fr/eco-pret-taux-zero-individuelthe-path-to-retrofit-at-scale.pdf>

³⁹ Fawcett, T. & Killip, G. (2014) Anatomy of low-carbon retrofits: evidence from owner-occupied superhomes. *Building Research and Information*, 42(4): 434-445

⁴⁰ SDC (2006) Stock take: delivering improvements in existing housing. Sustainable Development Commission, July 2006. Available: http://www.sd-commission.org.uk/data/files/publications/Stock_Take.pdf [accessed 1 July 2021]

⁴¹ FMB (2021) Cut the VAT: a proposal for building back better and greener. FMB/RICS. Available at: <https://www.fmb.org.uk/resource/cut-the-vat.html> [accessed 8 July 2021]



CONCLUSIONS

A Market Transformation approach is required, based on a policy 'toolkit' - multiple policy instruments that need to work together. The approach has been successful in product markets but has not been attempted for a service market like RMI. Key to its success are several factors that arose in the FMB workshop: long-term and consistent policy; engagement of policy-makers with the industry they seek to enrol in the work; proper understanding of the market.

The three pillars of market transformation (minimum standards, information, finance) need to be adapted for the service market of RMI. Quality assurance is an essential part of retrofit, and that requires a well-coordinated policy toolkit affecting many different stakeholders. That includes construction firms in the RMI sector.

Energy standards need to be matched with occupational standards, so that the workforce have the competence needed to deliver work of the necessary quality (in energy terms). That in turn means changes to vocational education and training, which needs to be broader and deeper than current provision. The training will only gain traction if it is genuinely useful in the market for work. A licence to trade would create that need and demand for training, and once firms are licensed it becomes possible to renew knowledge and skills through requirements for continuing professional development.

Robust systems for building energy rating and industry accreditation are important pillars of future financing: they are needed to reduce and manage investment risk.

Some elements of a successful retrofit strategy are clear:

- Finance will be needed, with the potential to leverage significant amounts of private investment if the public funding models are well designed and implemented
- Minimum standards for buildings need to be revised regularly
- A licence to trade for firms needs to be created on a new central register
- Education and training reforms are needed to improve levels of competence
- Energy Performance Certificates need reform to improve accuracy and link to trigger points
- More work is needed to design policy in detail. The COM-B approach (Appendix B) provides a suitable framework, based on a methodical approach to stakeholder analysis.

In the short term there are several elements of a strategy that could be implemented quickly.

- Provide adequate resources for local authority building control
- Commit to regular revisions of Building Regulations and tightening standards over time

Many uncertainties remain in the detailed development of processes and business models for retrofit at scale. A series of demonstrators needs to be launched in England to complement and coordinate with the Optimised Retrofit Programme in Wales, alongside Scotland's established financial support mechanisms, and Energy Efficient Scotland programme.

Transforming the market for retrofit will take several years – but not decades. With consistent policy support and a clear indication of the future strategy, it should be possible to find reliable and robust solutions. It is important to get it right. Every policy initiative that fails to engage with the realities of the RMI sector, and develop a wide suite of mechanisms to support it, only causes further delay before real progress can begin to be made.



“This national scale coordination and local delivery helps to provide consistency”



Appendices - Appendix A Long-term, system-wide policy for retrofit

Energy Efficient Scotland

The Scottish Government designated energy efficiency as a National Infrastructure Priority in 2015 (see Scottish Government, 2015). This ensures long-term stability for energy efficiency and heat funding, and provides certainty to home and business owners, and private sector partners for investing. Energy Efficient Scotland is a core part of delivering this; the programme commenced with three rounds of pilots and is due to run for the next 20 years (Scottish Government, 2018). The cross-sector scheme has provided opportunities for iterative learning, and incorporated pilots for physical retrofit and consumer engagement, alongside Local Heat and Energy Efficiency Strategies (LHEES). LHEES are intended to establish 20-year strategies for cross-sector, area-based, costed plans for delivering energy efficiency and heat decarbonisation. These should incorporate prioritised ‘zones’ for activity, for example a town centre suitable for district heating installation. Scottish Government (2017) are proposing that LHEES becomes a statutory duty for local authorities to deliver, and have outlined the process for developing LHEES as including:

1. An assessment of existing local and national strategies and data availability
2. Authority-wide assessment of the existing building stock’s energy performance and heat supply.
3. Authority-wide setting of aggregate targets for heat demand reduction and decarbonisation of buildings – short and long term
4. Socio-economic assessment of potential energy efficiency and heat decarbonisation solutions .

5. Selection of areas/ prioritisation of opportunities leading to the designation of zones

6. Costing and phasing of delivery programmes.

The early introduction and systematic piloting of the programme has been crucial for developing the knowledge and personnel capacity needed for coordinated cross-sector energy retrofitting. All 32 of Scotland’s local authorities have now participated. The Scottish Government also commissioned formal evaluation of the three pilot rounds to support institutional learning (see: Wade & Webb, 2020; Scottish Government, 2019). This national scale coordination and local delivery helps to provide consistency, but also opportunities for tailoring to local circumstances. The key here is that policy makers can provide long-term certainty and foster coordinated piloting and roll-out of innovative schemes. This type of approach will be crucial for creating certainty amongst RMI supply chains to upskill and engage in energy retrofitting activities. LHEES is part of a system-wide policy approach. It underpins proposals for a zone-based regulatory approach, for example setting specific backstop dates for both energy efficiency and heat in mixed-tenure and mixed-use buildings based on their date of zoning through LHEES (Scottish Government, 2021). Crucially, through creating costed and prioritised plans for area-based energy efficiency, LHEES creates potential efficiencies through targeting different sectors together, and provides certainty to homeowners and businesses who may need to invest in works. An approach like this is likely to be highly beneficial for encouraging retrofitting activities.

Funding in Scotland

The Scottish Government have funding mechanisms in place to support energy retrofit across domestic properties, including the privately owned and rented homes, along with social housing. Some of these schemes have been in place for several years. This longer-term approach to funding provides the certainty and continuity needed for householder demand to grow and, in turn, for supply chain actors to invest in

training to undertake retrofitting. In addition, Home Energy Scotland has been established to act as a central hub for homeowners and occupiers looking to make improvements; they provide energy efficiency advice and administer several of Scottish Government's financial support mechanisms. Table A-1 details Scottish Government's ongoing financial support mechanisms.

Scheme Name	Type of Funding	Sector	Date From	Managing Organisation	Details
Home Energy Efficiency Programmes for Scotland: Area Based Schemes	Funding to local authorities; blended with ECO	Low income & social housing	2013	Scottish Government	Area-based schemes designed and delivered by councils with local delivery partners. Target fuel-poor areas to provide energy efficiency measures.
Warmer Homes Scotland	Government directly fund works	Low income & fuel poor	2015	Home Energy Scotland	Includes energy efficiency measures and gas boilers (often replacing e.g. solid fuel systems). Applicable to those in receipt of qualifying benefits. Interest free loans also available for more expensive measures.
Home Energy Scotland Loan	Interest free loans & Grants	Domestic owner occupiers	2017	Home Energy Scotland	Interest-free loans of £15,000 for energy efficiency measures and £17,500 for renewable heating. Some measures also include cashback.
Private Rented Sector Loan	Interest free loans	Private sector landlords	2020	Home Energy Scotland	Loans of up to £15,000 for energy efficiency works, £17,500 for renewable energy technologies, and £6,000 for energy storage. Available for improvements to domestic dwellings listed on the Scottish Landlord Register.
Local Heat and Energy Efficiency Strategies (LHEES) (pilot)	Funding to local authorities	Local Authorities	2016	Scottish Government	LHEES are area-based plans and priorities for heat decarbonisation and energy efficiency. They are currently proposed as a statutory duty for local authorities. Scottish government have funded 3 rounds of pilots, but potential funding for future LHEES is unclear.
Equity Loan (pilot)	Equity Loan	Domestic owner occupiers	2017	Scottish Government	Equity loan scheme for energy efficiency and essential repairs in participating areas. Allows homeowners (including private landlords) to borrow up to £40,000 for eligible works, and repay when the home is sold or ownership transferred.

Table A-1; Scottish Government's financial support mechanisms for energy retrofitting across domestic buildings.



“Welsh Government has committed a further £50M to the second phase of the Optimised Retrofit Programme”

Wales's Optimised Retrofit Programme

Welsh Government's independent advisory group on residential decarbonisation issued its report, Better Homes, Better Wales, Better World, to Welsh ministers in July 2019. One of its recommendations was that ideas should be tested before being rolled out across the nation.

The most visible outcome of this to date has been the Optimised Retrofit Programme (ORP). ORP is a large field trial involving social landlords, designed to learn lessons that will inform future residential decarbonisation policy, and make residential decarbonisation faster, cheaper and better. Five teams have been awarded contracts to undertake this work; these are described in Table A-2.

Welsh Government originally committed £9.5M, but soon raised this to £19.5M, roughly matching the funds committed by the landlords themselves. As a result, over 2,000 homes will now be surveyed, upgraded and the outcomes monitored. Monitoring and evaluation includes social and economic outcomes as well as technical ones. Every home that has its energy efficiency improved has a device known as an Intelligent Energy System or IES installed that, as well as helping control internal conditions, captures the home's gas and electricity consumption every 15 minutes, plus its internal temperature, RH and CO₂ concentration. Data is transmitted to the Active Building Centre (ABC) in Swansea for analysis and evaluation. All five teams use a common data format and common data naming when transmitting information to the ABC.

Also under development is some software called Pathways to Zero which will advise designers of the choices available to them to put each home on the optimum path to net zero.

Additional projects underway include: the preparation of a retrofit guide for social landlords; forecasting grid decarbonisation to 2050; modelling the use of low carbon thermal technologies to assist the decarbonisation of domestic hot water and space heating provision; and a Continued Professional Development (CPD) programme to be available for all construction professionals in Wales.

Welsh Government has committed a further £50M to the second phase of the Optimised Retrofit Programme, which will be launched during the summer of 2021. Again it will be aimed at social landlords, but this time they will be required to upgrade privately-rented homes as well as their own. Discussions are underway about the scope and funding of the third and fourth phases of the Programme. Welsh Government is working with the Office of the Future Generations Commissioner, the New Economics Foundation, the Development Bank of Wales and others to design and make available appropriate funding for residential decarbonisation across all tenures.

Like Scottish Government, Welsh Government also recognises that a long-term pipeline of work is essential to give confidence to the SMEs and micro-enterprises that Wales wants to deliver residential decarbonisation to all tenures: confidence to undertake energy efficiency work, confidence to invest in training, confidence to take on apprentices, and confidence to innovate.

Table A-2: Schemes initially selected for the first phase of the Optimised Retrofit Programme

Applicant Name	Project Name	Project Description	No of homes on gas	No of homes off gas
Vale of Glamorgan Council	Rural Vale Hybrid retrofit	This proposal includes the supplementing of 37 existing off gas heating systems with air source heat pumps to create hybrid heating systems and the installation of Intelligent Energy Systems (IES) in a broad sample of their housing stock. This will retain familiarity with the current heating source for the occupants combined with the reduced running costs and carbon reductions associated with modern carbon neutral heating systems and provide data and a 'pathway' to decarbonise their homes by 2030.	96	41
Carmarthenshire County Council	Voids retrofit project	Identify an innovative and replicable solution that improves the energy efficiency and reduces carbon emissions from one of our most prevalent housing archetypes. The aim is to find a solution which can be replicated across this type of housing stock at scale and pace to mitigate fuel poverty for some of their vulnerable tenants.	6	1
Anglesey County Council	Pont y Brenin, Llanggoed & Maes Gwyn Llanddona and Min y Môr, Aberffraw.	Off gas properties with bulk LPG as a main fuel source. The properties included in this bid form part of a combined £6.78m investment on two planned maintenance contracts which have commenced on site and integrates their Decarb goals into the scheme and draw on external funding such as RHI and ECO3.	0	120
Collaboration of 26 HAs and 1 Local Authority	Optimised Retrofit Pathfinder	The scale of the collaboration provides opportunity to develop survey and management tools which can be used to accurately determine the right measures, products and schedule (aligned with RMI programmes) for individual homes. These will be trialed through this round of ORP with the installation of IES and measures across a wide range of property types and across all of Wales. The proposal sets out good practice in management and funding solutions (including the use of loan funding) which will be shared across the sector. It commits to the development of innovative labour and material frameworks targeted at creating a 'green economy' by upskilling Welsh SMEs and manufacturers, not as sub-contractors to larger organisations but with a 'mentoring' structure. These frameworks will be open to all public sector organisations	968	404
Denbighshire County Council	Council Housing External Major Repairs + ORP	The scheme is expanding their existing roof replacement programme with the addition of PV and battery storage. Their contracts for the RMI works were already being tendered but the introduction of ORP has required changes, specifically to the requirement to maximise local benefits and upskill existing supply chain and DLO. The proposal is further developing a solution which aligns their maintenance and decarb programmes by the installation of IES across their housing stock. It is integrating the funding into their ongoing programme which will demonstrate how their RMI schedules need to be, and can flexible and react to funding opportunities as they arise.	80	25

Totals

1150

591

Homes

1741

“It is necessary to adopt a systems approach”



Appendices - Appendix B – example of detailed COM-B analysis

COM-B

A focus solely on the actions of owner-occupiers, landlords and tenants neglects the important ways in which the behaviours of these groups are influenced by the actions of other actors in the energy system, such as banks, building societies, builders and builders’ merchants, and others. To help design policies to bring about widespread retrofit it is necessary to adopt a systems approach that recognises the influences that the many different actors have on each other.

COM-B is an established behavioural science framework to understand the influences on behaviours and develop interventions to change them. Originally developed in the healthcare sector, it is described in West et al (2020). Its application to retrofit is described in Wilson and Marselle (2016), Murtagh et al (2020), Murtagh et al (2021) and Simpson et al (2021).

The COM-B model identifies three factors that need to be present for any behaviour to occur: capability, opportunity and motivation. Capability refers to a person’s physical (e.g. strength, dexterity) and psychological attributes (e.g. understanding, memory). Opportunity refers to attributes of the physical environment (e.g. finances, policy content, material resources) and the social environment (social norms, culture). Motivation refers to the reflective (e.g. beliefs, identity) and automatic psychological processes (e.g. habits, emotions) that drive a behaviour when the capability and opportunity are present.

These three factors form an interacting system with behaviour (Figure B-1). If just one of these is not in place, then the desired change will not occur. Therefore it is important not only to remove barriers to the behaviours required, but also put in place targeted enablers to support capability, opportunity and motivation where needed.

The COM-B process

This has three stages, but for the sake of brevity only the first two included in the example provided below in Figure B-2.

Stage 1: Understand the behaviour

Step 1. Define the problem in behavioural terms. This means being specific about the target individual, group or population and about the behaviour itself.

Step 2. List candidate target behaviours and select one. Local knowledge and research literature may help choose which to begin with, based on

- a) the likely impact of the behaviour change
- b) the ease of changing the behaviour
- c) the likelihood that the behaviour change will impact other behaviours in a beneficial way
- d) how easy it is to measure the extent to which the behaviour has changed.

Step 3. Specify the target behaviour in appropriate detail: who, what, when where, how often and with whom?

Step 4. Identify what needs to change in the individual, group or population and/or the environment. The more precise this can be, the better the analysis is likely to be.

In Figure B-2 the target group is small builders, what needs to change is small builders’ reluctance to undertake retrofit and the target behaviour is that they actively seek retrofit work.

Stage 2: Identify intervention options

Step 5. Identify interventions, which could be to maximise capability, opportunity or motivation. Nine types of intervention are used in COM-B, and these are defined in Table B-1

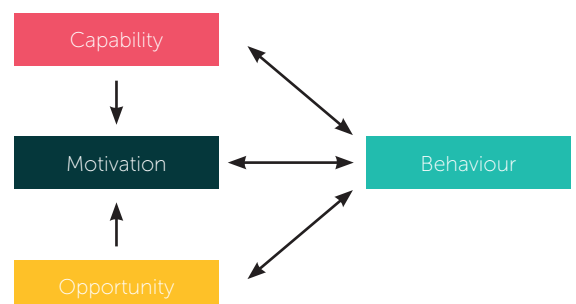


Figure B-1. The COM-B model of behaviour.

Table B-1. Definitions of intervention types

Intervention Type	Definition
Coercion	Changing the attractiveness of a behaviour by creating the expectation of an undesired outcome or denial of a desired one
Education	Increasing knowledge and understanding by informing, explaining, showing and providing feedback
Enablement	Providing support to improve ability to change in a variety of ways not covered by other intervention types
Environmental restructuring	Constraining or promoting behaviour by shaping the physical or social environment
Incentivisation	Changing the attractiveness of a behaviour by creating the expectation of a desired outcome or avoidance of an undesired one
Modelling	Showing examples of the behaviour for people to imitate
Persuasion	Using words and images to change the way people feel about a behaviour to make it more or less attractive
Restriction	Constraining performance of a behaviour by setting rules
Training	Increasing the skills needed for a behaviour by repeated practice and feedback

Guidance is provided in Wilson and Marselle (2016) about which interventions impact which aspects of capability, opportunity and motivation.

Step 6. Identify actions by the public sector and others that support the interventions. Seven types of action are used in COM-B, and they are defined in the table below.

Public Sector Actions	Typically characterised by
Communications and marketing	Mass media campaigns, digital marketing campaigns, and correspondence
Environmental and social planning	Architecture, urban and rural planning, object and location design, and planning for housing, social care, employment, equality, benefits, security and education
Fiscal measures	Use of taxation, tax relief and financial incentives
Guidelines	The development and dissemination of documents that make evidence-based recommendations for action in response to defined situations
Legislation	Use of laws, bylaws and similar legislative instruments to set the boundaries for acceptable behaviour with penalties for infringement
Regulation	Development and implementation of rules regarding behaviour that instruct the behaviour and possibly provide rewards and punishments for conforming
Service provision	Provision of services, materials and/or social resource and aids, whether they be structured or ad hoc, financed or unpaid

Table B-2. Definitions of public sector actions

Stage 3: Identify content and implementation options

This stage contains two more steps, the identification of what behaviour change techniques to employ and their modes of delivery. While these are important steps, for the sake of brevity they have been omitted in the worked example in Figure B-2 right.

Figure B-2 is an example of one target behaviour by one group and it should be read from left to right,

beginning with the target behaviour. Adjacent to the target behaviour are the capabilities, opportunities and motivations that would support the target behaviour. To the right of those are some interventions to provide the necessary capabilities, opportunities and motivations, plus suggestions of the organisations that could intervene. And finally, on the right-hand side of the diagram, are some actions by, mostly, the public sector, to support/facilitate/mandate the interventions.

Figure B-2 is just one example of one target behaviour by one group. A methodical approach requires that all target behaviours by all groups are identified, followed by their COM-B analyses. For example, another target behaviour might be for owner-occupiers to seek to increase their mortgages to help pay for retrofit.

FIGURE B-2 A WORKED EXAMPLE OF THE COM-B APPROACH FOR ONE ASPECT OF RETROFIT POLICY DESIGN

This worked example demonstrates the COM-B method over four steps:

1. Identify the target behaviour (the B in the COM-B model)
2. Identify factors required for the target behaviour to occur (using Capability, Opportunity, Motivation – the COM in the COM-B model)
3. Propose interventions by existing organisations and institutions (using the nine types of intervention listed in the COM-B method)
4. Identify supporting actions required by the public sector (using the seven types of action listed in the COM-B method)

KEY

Actions in regular text

Possible actors in blue italics

Acronyms:

- AoC – Association of Colleges
- BEIS – Department for Business, Energy and Industrial Strategy
- CITB – Construction Industry Training Board
- DBW – Development Bank of Wales
- DfE – Department for Education
- FMB – Federation of Master Builders
- GAAP – Green Apprenticeships Advisory Panel
- GFI – Green Finance Institute
- GJT – Green Jobs Taskforce
- HA – Housing association
- IfATE - Institute for Apprenticeships and Technical Education
- LA – Local Authority
- NIB – National Infrastructure Bank
- SNIB – Scottish National Investment Bank

1. Target behaviour	2. Factors required for behaviour to occur	3. Interventions	4. Supporting actions by the public sector
<p>Small builder actively seeks retrofit work.</p>	<p>Capability Small builder:</p> <ul style="list-style-type: none"> • knows why decarbonisation is important • knows that residential retrofit is an important part of decarbonisation • knows where to seek advice • knows how to carry out the work well <p>Opportunity Small builder:</p> <ul style="list-style-type: none"> • knows there is a good demand for residential retrofit • has time and budget to train staff and seek retrofit work • has the necessary tools to do the job • knows others who are doing it successfully • has triggers to prompt action • has support from others <p>Motivation Small builder:</p> <ul style="list-style-type: none"> • wants to undertake retrofit • cares about negative consequences of not doing so • believes that it would be a good thing to do • believes that it can deliver a pipeline of profitable work • develops a plan for winning more retrofit work • develops a habit of carrying out retrofit work 	<p>Education Topics to include: the importance and many benefits of residential decarbonisation, why good data about a home is important, the meaning of net zero, setting appropriate targets for a home, what can be done to decarbonize a home, potential costs, avoiding waste, grid decarbonisation, PAS 2030 & PAS 2035, Energy Company Obligation and funding mechanisms in Scotland – <i>AoC, CITB, DfE, GAAP/IfATE, GJT, HE/FE colleges and community energy organisations, national retrofit organisations, professional institutions, trade bodies, FMB</i></p> <p>Enablement Lead work to define a national standard for building renovation passports – <i>GFI</i> Prepare building renovation passports – Retrofit Coordinators employed by local community energy organisations, national retrofit organisations, private consultants and small builders Arrange pilots/field trials of new funding models with early adopters – <i>GFI, NIB, DBW, SNIB</i> Provide retrofit financial advice – <i>Citizens Advice, banks, building societies, accountants</i> Provide new retrofit funding models – <i>Banks, building societies, supported by NIB, DBW, SNIB</i></p> <p>Environmental restructuring Develop ‘pattern books’ showing locally-appropriate external energy efficiency measures (including standard construction details and preferred finishes) that do not require planning permission – <i>LA planners with local architects and engineers, professional institutions, FMB, trade bodies</i> Publish standard homeowner/builder contracts for retrofit – <i>Joint Contracts Tribunal</i> Host stock models that enable builders and suppliers to gauge potential local demand for goods and services – <i>LA, builders’ merchants</i> Fund and staff Building Control to provide retrofit advice and quality control – <i>LAs</i> Provide support for small builders completing accreditation paperwork – <i>FMB, builders’ merchants</i> Provide a steady and assured pipeline of work in the early years – <i>LAs, HAs</i> Manage/facilitate work on behalf of private landlords and owner-occupiers – <i>HAs</i></p> <p>Modelling Provide examples from credible sources that small builders would look up to – <i>LAs, Constructing Excellence, FMB, trade bodies</i></p> <p>Incentivisation Create annual regional and national award schemes for retrofit projects – <i>Constructing Excellence, BEIS</i> Research, field trial and, if successful, roll out Council Tax/Stamp Duty changes to encourage decarbonisation – <i>UKGov, devolved administrations</i></p> <p>Coercion Explain harmful consequences for the community and nation, if we fail to decarbonize – <i>BEIS, devolved administrations, LAs</i></p> <p>Training Topics to include: working across trade boundaries, accessing knowledge, how to keep learning and developing, PAS 2030, domestic energy efficiency assessor and retrofit coordinator– <i>AoC, CITB, DfE, GAAP/IfATE, GJT, Local HE/FE colleges and community energy organisations, national retrofit organisations, professional institutions, FMB</i></p> <p>Restriction Define enduring policies, set outcomes to be achieved and target dates – <i>UKGov, devolved administrations, LAs</i> Mandate processes to be followed where public money is involved Defines interim requirements, such as:</p> <ul style="list-style-type: none"> • Fabric first • At no stage may a tenant’s bills increase as a result of work done to their home <p>Persuasion Show how undertaking retrofit work will benefit the builder, its staff, its customers and the local community Create annual local retrofit award schemes that celebrate best practice Provide information from credible sources that builders would look up to Show SMEs and homeowners examples of successful residential retrofits – <i>LAs, Local health trust/board, Local chamber of commerce, FMB</i></p>	<p>Service provision Ensure adequate numbers of competent consultants, builders and installers – <i>AoC, CITB, DfE, GAAP/IfATE, GJT, HE/FE colleges</i> Provide contact information for local competent consultants, builders and installers – <i>LAs, builders’ merchants</i></p> <p>Communication Conduct media campaigns to communicate the importance and benefits of retrofit, and showing a homeowner and a builder what steps to follow: National and international benefits – <i>UKGov, devolved administrations</i> Local and personal benefits and what steps to follow – <i>LAs, Royal Institution of Chartered Surveyors, building societies, banks</i></p> <p>Guidelines Develop and disseminate recommendations for retrofit actions by local authorities and others – <i>UKGov, devolved administrations</i></p> <p>Fiscal measures Allocate to HAs and LAs sufficient money to enable decarbonisation of their homes and to resource Building Control for enhanced retrofit role – <i>UKGov</i> Provide clarity about long-term funding arrangements – <i>UKGov</i> Provide guarantees that reduce the interest rates charged on loans for energy efficiency improvements – <i>National Infrastructure Bank</i> Extend Enhanced Capital Allowances to fabric and heating measures for privately-rented properties – <i>HM Treasury</i></p> <p>Regulation Oblige, with penalties for non-compliance, estate agents and letting agents to provide standard energy cost information when a home is offered for rent or sale – <i>UKGov, devolved administrations</i> Define retrofit quality regime suitable for small builders working on homes – <i>UKGov, devolved administrations, FMB, professional institutions</i> Define conditions under which social landlords may benefit from metered energy savings – <i>UKGov, devolved administrations</i> Require building renovation passports to be provided by, say, 2030 when a home is offered for sale – <i>UKGov, devolved administrations</i></p> <p>Legislation Set mandatory residential minimum energy efficiency/carbon emission standards to be enforced by, say, 2030, 2040 & 2050 – <i>UKGov, devolved administrations</i></p> <p>Environmental/social planning Mandate and assist LAs to define the acceptable appearance of external energy efficiency measures – <i>Chief Planners in each nation</i> Commission and make available building stock models for every LA that requests one – <i>UKGov, devolved administrations</i> Commission research and disseminate findings on critical technical issues including embodied carbon and ASHP refrigerant best practice – <i>UK research bodies</i></p>

