Energy Efficiency Market Analysis and Economic Opportunity Assessment

Prepared by:

Built Environment - Smarter Transformation on behalf of Scottish Enterprise

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BE-ST activity included desktop research, data analysis, report writing, interviews and online surveys.

Energy Efficiency Market Analysis and Economic Opportunity Assessment

This report was commissioned by Scottish Enterprise to establish the scale and nature of market opportunities for Scottish businesses across energy efficiency sub-sectors within the retrofit market, both in the UK and internationally.

Building on existing investigation and research undertaken by industry, academia and public sector partners, this report seeks to identify and confirm the innovations (product, process & business) driving the products and services in the domestic and non-domestic sectors.

Note: heat pumps, associated tech and district heating are out of scope of the supply chain analysis. Focus on non-domestic is the public sector estate.

Aim & Objectives

The aim of the report is to describe the current state of play in the Scottish retrofit market including regulation and adoption of standards as well as identifying the drivers and barriers to change and the scale of demand focusing on economic opportunity for Scottish businesses. To achieve this, the following objectives have been carried out:

1. Describe the nature of retrofit and size of market opportunity.
2. Map out supply chains and products, innovation potential in services.
3. Quantify potential demand and investment in retrofit market.
4. Determine solutions for scale up.

The project methodology is qualitative in nature and involved desk-based research, literature reviews, stakeholder surveys and online one-to-one interviews. This research methodology has been illustrated in Figure 1. A breakdown of the organisations and interviews can be found in Appendix B.

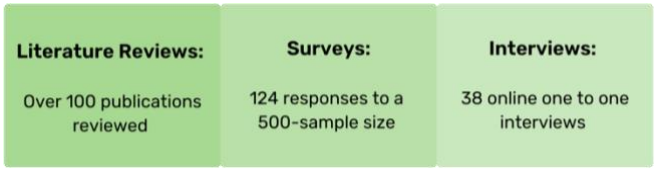


Figure 1 – Research methodology.

Case studies

A list of potential case studies was created from primary research utilising our network of key stakeholder contacts as well as secondary research to expand the search as wide as possible.

Limitations

The availability and accuracy of up-to-date data in the housing sector is limited.

For example, the most recent Scottish Housing Condition Survey was published in 2021, when it was incorporated into the Scottish Household Survey, with limited published data. Other potential datasets, such as Energy Performance Certificates (EPC) are only triggered by/sale rent of a property and are only valid for 10 years. A more holistic review of housing data in Scotland is required to represent the 2023 market.

Contents

Executive Summary

A successful retrofit strategy would result in warmer homes, reduced energy bills, better physical health for inhabitants, and an equitable sharing of the benefits and burdens of the energy transition.

Scotland, with circa 2.6 million domestic properties, is on the frontline of a significant retrofitting challenge. Aiming to enhance energy efficiency standards, and progress towards a net-zero carbon future, with only 1% of the country's existing housing stock achieving an Energy Performance Certificate (EPC) rating of A (denoting a high level of energy efficiency), the task is daunting. With around 79% of households still relying on gas central heating, the dependence on carbon-intensive heat sources is evident[1].

Domestic retrofit market

Generally, the combined potential market for energy efficiency measures in social housing and private rented sectors has been estimated at £9.8 billion and for the owner-occupied sector £20.05 billion, in Scotland alone. This is driven by an aim for Energy Performance Certificate C or better by 2028.

Figure 2 - Average cost in Scotland 3-bedroom detached house (median of insulation costs)

*Note heat pump and installation costs vary from £5000- £15,000 on average depending on size of property and alterations (including changing pipes or location radiator) and are **not included in these figures**.*

Non-domestic retrofit market

In Scotland, publicly owned non-domestic sector amounts to circa 23,000 properties. The Scottish Government plans to focus attention on difficult to treat buildings, such as hospitals, by allocating £200 million over 5 years to the Scottish public sector estate with the aim of reducing energy consumption through energy efficiency measure and installation of zero emissions heating systems.

To ensure robust findings, the methodology for this report employed multifaceted research. An in-depth review of the existing retrofit market, regulatory landscape, national and international standards, policy documents, market reports and available academic research was undertaken. To develop projections for market scalability across different housing sectors, economic statistic calculations were carried out. Supply chains were analysed through industry reports, semi-structured stakeholder interviews, and case studies to spotlight innovation opportunities and inform our strategic recommendations.

This research was enhanced through ongoing dialogue with industry experts, regulators, and practitioners, providing valuable first-hand insights into the retrofitting landscape. The findings were compiled and analysed to offer a comprehensive review of Scotland's retrofit industry, its growth potential, and identifies the key challenges and opportunities it faces.

Key Findings

The report finds that four key themes are prevalent to effectively scale up the retrofit industry in Scotland. These include;

- the importance of a guaranteed pipeline to foster supply chain investment in skills,
- product innovation,
- service enhancements and
- overcoming skill shortages.

The skills shortage is identified as the most significant obstacle impeding the delivery of large-scale retrofit initiatives, thereby highlighting the need for enhanced competencies across the industry.

There is a complex network of challenges that the retrofit sector currently faces. Addressing these issues could unlock substantial opportunities, with the primary challenges being product and service availability, skills gaps within the supply chain, accessible financing, and demand-side incentives. The report recommends a series of strategies designed to boost the retrofit market and encourage greener practices across multiple sectors in Scotland.

There is a critical role for green finance and private investment in stimulating the retrofit market. Furthermore, it highlights the need for regulatory mechanisms for minimum energy efficiency targets in the private market, the definition of an "energy efficient retrofit," universally accepted retrofit standards, and the potential for large-scale, place-based retrofits.

The implications of this report cut across all sectors, including government bodies, industry stakeholders, and individual citizens. Foremost among these is the need for a stable and predictable investment environment to propel the growth of the supply chain, calling for the creation of supportive government policies and industry buy-in. The report's identification of a skills gap calls for a coordinated response from educational institutions and industry players to build a workforce capable of tackling the retrofit challenge.

Moreover, the report highlights the critical role of green finance in enabling retrofitting on a significant scale. It's a call to action for policy makers, financial institutions and investors to innovate and develop attractive financial models that drive retrofitting forward. The report also points to the importance of public awareness in driving demand for retrofits, suggesting the need for a collaborative approach to spread knowledge about the benefits of retrofitting.

In conclusion, achieving Scotland's ambitious climate goals and stimulating the growth of the retrofit sector necessitates a holistic, well-rounded approach. The path to a net-zero future requires a focus not only on innovation and financing but also on the development and refining of skills within the sector. This report provides a comprehensive, robust framework that Scottish Enterprise, the Scottish Government, and other relevant agencies can use to foster sustainable growth in the retrofit market. This combined effort will accelerate the journey towards a net-zero future, making a significant contribution to both local and global climate change mitigation efforts.

Introduction - state of play in Scotland.

The Scottish Government has a legal requirement to achieve net-zero emissions by 2045, with an interim target of reducing emissions by 75% by 2030. To do this, they have published the Heat in Buildings Strategy (HiBS) which outlines the steps Scottish Government will take to reduce greenhouse gas emissions from Scotland's buildings and remove poor energy performance as a driver of fuel poverty [2]. It sets out a £1.8 billion investment over the life of the current parliament to achieve zero emission buildings by 2045. At a sector level, the recent Climate Change Plan update requires a 68% reduction in emissions from Scotland's building stock by 2030. Most of the buildings in Scotland will still exist in 2045 and so strategies to reduce energy use for heating and cooling must be delivered at scale. The overall ambition is for a large majority of domestic stock to achieve a 'good' standard of energy efficiency by 2030-2033, non-domestic public sector estate by 2038 with all remaining by 2045. The HiBS, published in October 2021, is the key policy document for the decarbonisation of existing buildings.

Fabric first energy efficiency measures to reduce heat demand, are the first step required to successfully support the large-scale installation of low carbon heating systems. Often, the effectiveness of low carbon heating systems, and other energy saving measures, are curbed when installed into leaky buildings. Therefore, repair and maintenance measures such as, installation of insulation, upgrading of windows, airtightness and ventilation should be prioritised in a retrofit programme.

Energy Efficiency Measures in domestic retrofit addresses both climate change and fuel poverty obligations, delivering social and environmental benefits. In addition, significant economic opportunity exists within energy efficiency for domestic and non-domestic for new products, services, and skills. A 2018 report estimated that for every £100m spent in this sector supports approximately 1200 jobs[3].

There is no current Scottish or UK government approved definition of an energy efficient retrofit or energy demand target for existing buildings. However, the Scottish Government has committed to introducing new regulation and standards. For example, as part of the Scottish Governments Heat in Buildings Strategy (HiBS), the domestic Energy Performance Certificate (EPC) system, used for measuring energy efficiency, is currently under reform, which was consulted upon in Summer 2021[4].

A major challenge exists for the energy efficiency market in terms of the variety of skills and training required within energy efficiency (EE) job roles. EE installers do not have have dedicated titled apprenticeships, however, there is the opportunity to upskill the existing workforce to bridge the current skills gap. The multi-skilled nature of this role is challenging given the current apprenticeship model as there are multiple cross-trade certifications required to ensure compliance.

Similar to the EPC consultation, the Scottish Government have also been consulting on proposed improvements to a number of topics relating to the energy and environmental performance of buildings which has demonstrated clear consensus to set long term energy efficiency targets[5]. The HiBS strategy sets out a minimum Energy Performance Certificate (EPC) rating of C for all homes to achieve at sale or rental by 2033, currently for the social housing sector this target is set higher. The

Scottish Government are committed to reforming the EPC assessment process. There are no minimum energy efficiency ratings set through regulation for the non-domestic market above 1000m^2 in Scotland regardless of usage, for example, shops, offices, factories, warehouses or hotels. Therefore, the EPC regulation currently being developed by Scottish Government is a key driver in the non-domestic retrofit market.

There are approximately 2.6 million homes in Scotland with only 11% (278,000) of these having a renewable or low emissions heating system installed. To achieve the 68% reduction by 2030 target, modelling scenarios estimate an additional one million homes in Scotland will be required to convert to zero or low emissions heating by 2030. There are an estimated 220,000 non-domestic buildings in Scotland with a target of 50,000 non-domestic to be converted to low or zero emissions heating systems.

The Scottish Government have created a virtual Agency – Heat & Energy Efficiency Scotland[6]. The Agency will support and build public understanding for both low carbon heating and energy efficiency for homes and building across Scotland.

As part of this work, interviews with stakeholders, identified opportunities to improve the EPC services, especially in the non-domestic sector:

> *"Better regulated energy demand targets and the use of EPC needs to be widespread and better understood. The science and formulas within EPC calculations are sound it is just people aren't using them properly. The value of an EPC service is literally minutes, and the quality of EPC certification has dropped. A properly calculated EPC with an architect can take days to work it out. A non-domestic surveyor takes a couple of hours on site*."

Interviewees also mentioned the issue of retraining the existing workforce and how this could be achieved. As argued by one, there needs to be the right incentive and benefits to get people to retrain. The development of digital technology and upskilling within the EPC sub-sector will increase the demand for new products and services.

There is an ongoing debate about the suitability of the EPC system as it uses modelled data and is an indicator of energy cost efficiency rather than energy efficiency and the EPC could be expanded to consider other measurements.

In March 2021, the Zero Emissions Social Housing Taskforce (ZEST) was engaged by Scottish Government to articulate how social housing could maximise its contribution to climate change targets and commented on the need for the EPC system to reform[7]:

> *"UK-wide assessment methodologies like SAP on which EPC's are based need to be appropriate for the Scottish context. As a cost-based indicator, the current Energy Efficiency rating does not incentivise some zero emissions technologies and penalises others like MVHR (mechanical ventilation heat recovery). The current approach fails to recognise the difference between modelled and actual performance and does not consider wider factors such as air tightness, indoor air quality (IAQ), embodied energy and CO2* emissions".

Cognisant of the Scottish Government's ongoing EPC system review, this report assumes current EPC targets as a baseline to estimate the market demand whilst noting the ongoing debate. Further analysis is provided in Chapter 4.

01.

Retrofit Overview

Chapter 1: Retrofit Overview

This chapter provides a definition of domestic and non-domestic retrofit, EPC's, overview of standards and guidance, funding, and skills. These are key drivers to deliver the scaling of the market and underpins consistent market demand.

Domestic Retrofit - Domestic retrofit refers to the process of upgrading or improving the energy efficiency and overall performance of existing residential buildings. The London Energy Transformation Initiative (LETI)[8], comprising of over 1,000 built environment professionals, described retrofit best practice as being:

> *"…underpinned by taking a fabric first approach. This approach is to improve the building fabric's energy efficiency before introducing low carbon technologies. This approach should follow a step-by-step retrofit informed plan".*

Non-domestic Retrofit - Building size, type and use make the definition of an energy efficiency retrofit in non-domestic stock complex and has been broadly categorised into light and deep retrofit by the UK Green Building Council (UKGBC)[9]:

> ***"**Broadly, light retrofit focuses on performance optimisation, basic remodelling, replacement, or adaptation of existing building elements which tend to focus on a single aspect or feature (lighting upgrades, optimisation of building controls and operation, etc). Deep retrofit focuses on significant works of size or scale that result in a fundamental change to the building structure and/or services".*

Energy Performance Certificates - Domestic and Non-Domestic

Any retrofit process requires an assessment of the current energy performance of the property. The EPC system adopts a point-based approach for Standard Assessment Procedure (SAP) calculations to provide an EPC. Reduced data Standard Assessment Procedure (RdSAP) is a simplified version which can also be used, with the Simplified Building Energy Model (SBEM) for non-domestic buildings. At the time of writing, the EPC system is undergoing a period of consultation. This will ensure that the energy performance rating on the EPC aligns with the Scottish Government's net zero objectives. The EPC assessment process will be reformed before it is used as the standard by which properties are measured.

EPC assessors use these calculations to assess the energy efficiency of a building and recommend improvements. This is the system both Scottish and UK governments use currently. There are no minimum EPC ratings set for non-domestic buildings over 1000m^2 in Scotland (unlike England and Wales). Therefore, when targets are set, this will help drive the non-domestic EPC services market. In the domestic sector, Home Energy Scotland grants and loans cannot be accessed without a valid EPC so the domestic assessors' services market and relevant technology will also be required to scale.(VIII)

In the interviews, the domestic market was a common discussion point and revealed a perceived lack of skills and service provision spanning the domestic market across the whole retrofit journey, from design to post-installation support. This was identified as being crucial for long term retrofit success, as highlighted by an interviewee:

> *"Everyone must understand the building as a system including how it's used. And this must feed into how any retrofit measures are applied so modelling of a retrofit and designing are key.* "

Quality was also highlighted as key to unlocking consistent market demand. To tackle this, two Publicly Available Specification (PAS) documents have been produced. PAS 2030:2019[10] certification, was developed to ensure that funding set aside by the government was only used to fund high quality retrofit projects. Unlike PAS 2030, PAS 2035:2019[11] is not a certification but an industry standard which specifies the minimum requirements that retrofit projects must meet to be compliant.

A wide range of projects have been funded through Scottish and UK Government schemes [7]. These have been aimed at enhancing the effectiveness and reliability of retrofit works whilst avoiding unintended consequences such as poor ventilation leading to damp and mould [14].

The survey and interviews reveal a widespread lack of knowledge and awareness of best practice in the retrofit market. Reinforcing the existing understanding as a major gap across the retrofit sector. See Appendix B and D for further comments.

Interviewees highlighted the importance of 'getting it right' to build up trust in the retrofit technologies and market. It was felt that many householders had lost faith due to past mistakes in the sector. Previous retrofit measures carried out under The Energy Company Obligation (ECO) funded schemes, failed to deliver the required quality assurance, resulting in unintended consequences such as mould and damp. It was felt that any further missteps could create irreparable damage to the retrofit sector:

> "*Quality must be central to any mass retrofit programme otherwise the mistakes made in the last decade are likely to be repeated and any remaining trust lost.'*
> "*No two buildings are the same, EPC measurements are not defined enough, need to be concise about the energy targets we are trying to hit. Not enough people are aware of PAS 2035, LETI, EnerPHit or the RIBA 2030 Guidance. There is nothing set in place for retrofit by government for the private market*. "

Retrofit Best Practice

Performance Gap

Two widely adopted performance standards have been developed which can be applied to the design of domestic and non-domestic retrofit projects. This is where a retrofit project achieves set design targets for space heating demand, energy use and air tightness levels.

These are industry-led examples of design best practice and are not mandated by Scottish or UK Government. All industry-led standards and guidance aim to reduce heating demand of a building by improving the energy efficiency of the building fabric. There is a recognition from Scottish Government that energy demand targets should be introduced into building standards to drive quality and consistency of retrofit work.

A Scottish Government Building Standards Division (SGBSD) consultation to introduce energy performance standards for existing buildings has been ongoing since 2021[5,12].

Standards & Guidance

Passivhaus EnerPHit [13] – Developed by the Passive House Institute (PHI) as a building energy efficiency standard and certification. It is specifically designed for the retrofit of existing buildings to meet rigorous energy performance standards. To achieve EnerPHit certification, a building must meet specific criteria for heating and cooling demands, primary energy use, air tightness and thermal comfort. EnerPHit certification can be achieved in a single stage or through a step-by-step approach.

AECB CarbonLite Retrofit Standards Level 1 and 2[14]: The Association for Environment Conscious Building (AECB) produced a retrofit standard, based upon the Passivhaus methodology, which recognises that every building is unique. Therefore, it focuses on managing retrofit risks to avoid unintended consequences. The primary focus, like EnerPHit, is a whole building solution, through a fabric first approach. The AECB retrofit standard has a certification of performance ranges and limits.

Climate Emergency Retrofit Guide (LETI): The London Energy Transformation Initiative (LETI), established in 2017, is a voluntary network of over 1,000 built environment professionals who support, understand, clarify and develop the actions needed to meet the UK climate change targets. Launched in October 2021, the Climate Emergency Retrofit Guide[15] offers support to architects, engineers, local authorities, social landlords, energy professionals, contractors and clients for best practice in retrofit. The guide focuses on LETI best practice and LETI exemplar.

A comparison between each of the standards and guidance discussed has been illustrated in **Error! Reference source not found.**

Retrofit Best Practice

Process Guidance

PAS 2035:2019 *Retrofitting dwellings for improved energy efficiency – specification and guidance*[11]*.*

Published by the British Standards Institute (BSI), this guidance document promotes a fabric first, whole house retrofit approach when delivering domestic retrofit projects. The guidance focuses on the process of retrofit planning and quality assurance, through the required appointment of accredited professionals. This includes the appointment of a Retrofit Coordinator. PAS 2035 does not set targets and focuses on the steps a domestic retrofit should follow in the project management process.

Using computer modelling early in the design process, the approach considers building physics and assesses how existing building elements work together. Insulation and ventilation strategies are considered in tandem. Projects can choose from several energy standards to target operational energy demand such as the EnerPHit and / or AECB energy standards. There are defined roles within the PAS2035 guidance e.g., assessor, co-ordinator, designer, installer. The guidance also sets out a series of risk assessments, retrofit plans, procedures, compliance, energy efficiency measures and monitoring post installation. The process, and roles, within PAS 2035 can be seen in Figure 3.

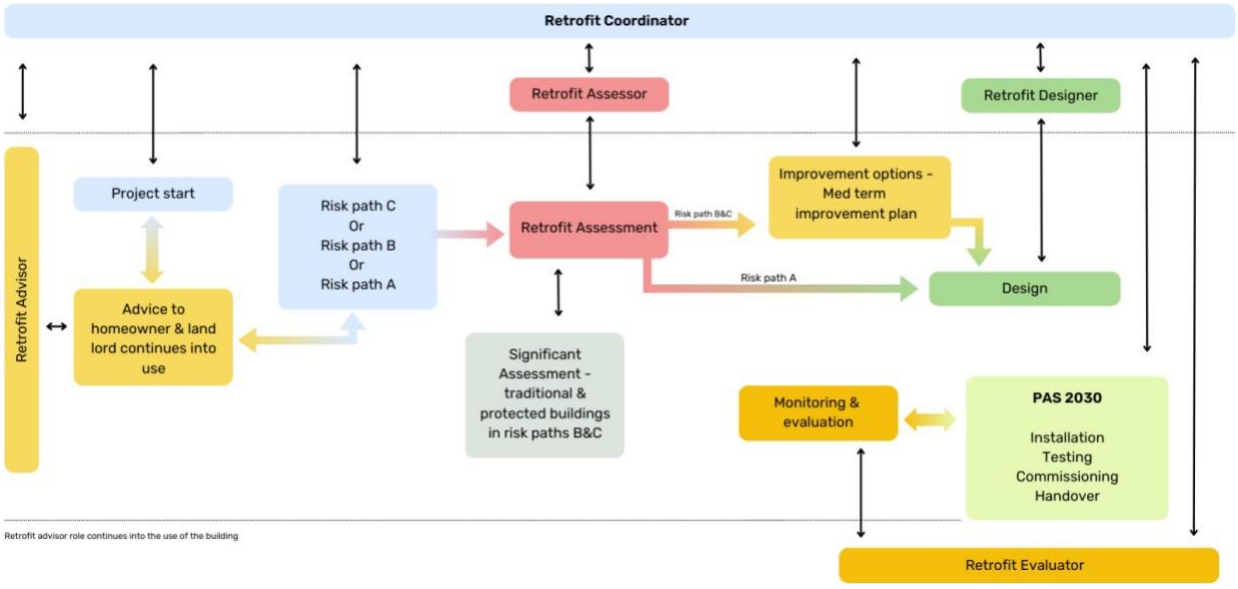


Figure 3 - A flow chart illustrating the domestic retrofit process.

This process is a major shift for clients, professional services, and installers in the retrofit market. Three quarters of the interviewees highlighted the adoption of the PAS 2035 (PAS 2030/MCS for installers) guidance as a significant investment for the supply chain and therefore a potential barrier to scale in the retrofit market.

Funded support for construction operatives and clients in order to develop the relevant competencies to allow adoption of PAS2035/PAS2030 accreditation would offer significant business growth opportunities within the supply chain for retrofit across both professional and installer job roles. See Chapter 4 for further detail.

One interviewee from a managed scheme shared:

> "*PAS 2035 assessors and co-ordinators are lacking. Government funded contracts are complex to manage from a funding perspective. Lack of available skills in local authorities and housing associations for these services. Only circa 200 retrofit co-ordinators in Scotland. Domestic Energy Assessors (DEA) need to be upskilled to be retrofit assessors under PAS 2035. We have 30 surveyors who will be undertaking the training but how will SME's pay for this. Funding for PAS 2035 training is key*. "

PAS 2038 *Best practice standard for retrofitting non-domestic buildings for energy efficiency.* Published by the BSI, this guidance follows a similar process with defined roles e.g., lead assessor, lead designer, risk assessments and procedures for retrofitting non-domestic commercial buildings. Knowledge of PAS 2038 is occasional and it is not mandated for any government funded programmes. Please see Appendix B.

Regulation and Funding

PAS 2038	PAS 2035	PAS 2030
Commercial The main point of difference is that this standard is applicable to commercial buildings	**Domestic** This standard is applicable to homes and commercial units considered too small to be covered under PAS 2038	**Commercial/Domestic** This standard follows on from either PAS 2035/38 dependent if the building is commercial or domestic
Assessment/Design PAS 2038 covers the process of assessing and designing retrofit energy solutions for commercial properties	**Assessment/Design** PAS 2035 covers the process of assessing and designing retrofit energy solutions for domestic properties	**Installation** PAS 2030 covers the process of taking the retrofit design (PAS 2035 or PAS 20238) and installing it to the design
Certification You can gain a "certification of conformity" to demonstrate you follow and meet the requirement standards	**Certification** You can gain a "certification of conformity" to demonstrate you follow and meet the requirement standards	**Certification** This is an accredited UKAS certification which allows your business to register as an installer. This is a "certification of registration"
Suitable for Architects, building surveyors, facility management and contractors that provide services to enhance existing commercial building stock	**Suitable for** Architects, building surveyors, contractors/installation companies that provide services to enhance existing homes	**Suitable for** Organisations that install insulation, gas, glazing and electrical measures for both commercial and domestic buildings

Figure 4 - Breakdown of PAS guidance

As highlighted, retrofit standards and guidance differ for domestic and non-domestic building stock, no energy demand targets are set for existing buildings by the Scottish Government. There was consensus amongst interviewees that most retrofit projects are still being undertaken by addressing single measures, as opposed to taking a holistic approach. This highlights the significant shift required in moving an informed retrofit plan approach which works to standards.

Therefore, Government levers such as, regulation and public funding are additional aspects of retrofit which should be considered to scale the market. All interviewees cited long term government policy as a driver of a consistent demand:

> "*Component manufacturers need a 10-year certainty in pipeline before they are likely to look at large scale investment*."
>
> "*Chicken and egg of funding, accreditation is expensive and time consuming. There isn't a lack of ambition but no certainty to back it up*."

A No Regrets Strategy

The Scottish Government is aware of the need to develop standards and regulations as part of their no and low regrets targets which is included in the HiB strategy[2].

“The Scottish government has committed to deliver regulations to support the installation of cost-effective energy efficiency first improvements in all buildings (e.g., roof, windows, wall and floor insulation). This will provide certainty and assurance to secure the private sector investment needed to drive the retrofit market.”

Before regulation can be passed, extensive public consultations must take place. The HiB also sets out consultation timelines for private domestic and non-domestic from 2023 to 2025.

We have summarised all key dates for consideration as these timelines will affect the market demand in the short (2 years), medium (5 years) and long term (10 years)Figure 5.

	Proposed Standard	Date for regulations	Date to meet standards	Backstop dates for compliance
Owner Occupied	Reach an equivalent of EPC C	Consultation 2023-25	Triggers proposed 2025-32	2033
	Zero emissions heating*	Consultation 2023-25		2045
Private Rented Sector	Reach a level equivalent of EPC C for new tenancies	Regulation by 2025	2025-27	2028 for all tenancies
	Zero emissions heating*	Regulation by 2025	2025-27	2028 for all tenancies
Social Housing	Reach a level equivalent of EPC B	EESSH2 reviewed in 2023	2024-31	2032
Multi Tenure/ Mixed Use	Reach a level equivalent of EPC C	Consultation 2023-25/ LHEES Zoning by December 2023	2025-40	2045
	Zero emissions heating*	Consultation 2023-25/ LHEES Zoning by December 2023	2025-40	2045
Non Domestic Buildings	More challenging energy improvement targets to reduce demand for heat and ensure zero emission heat supply at trigger points	Consultation 2023-25/ LHEES Zoning by December 2023	Trigger proposed 2025-2044 Public Sector estate to install zero emissions systems by 2038	2038-2045

Figure 5 - Regulation timelines

Funding

The Net Zero Public Sector Building Standard[16] is owned by the Scottish Government and applies to public sector new build and refurbishment projects. This voluntary standard which unlocks funding to Local Authorities for public building projects has driven the uptake in the number of Passivhaus public buildings in Scotland. This precedent demonstrates that regulation is likely to be the key driver for the energy efficiency market after 2025, however, it is not certain, and the government must gain consensus.

The current cost-of-living crisis is pushing more people into fuel poverty[17]. Consideration must be given to the affordability of retrofit to support the scale needed after regulation is passed. Therefore, public and private funding pathways for domestic and non-domestic stock are considered when estimating the market opportunity. Further analysis is provided in Chapter 4.

It should be noted that current funding support is seen as complex and fragmented Figure 6. 62.3% of construction and built environment professionals survey respondents had medium to high awareness of public sector funding. It was frequently mentioned in the interviews that funding routes were limited and the landscape ever-changing, with several mentioning a lack of awareness of funding for the owner-occupied sector. Comments varied significantly suggesting that there are a lot of mixed messages and complexity around funding availability:

> "*Cost of operation versus cost of delivery is a major barrier for individuals in the retrofit space. People getting into personal debt where there is a carrot and stick approach is not going to work*."
>
> "*Huge decrease in people looking to invest. Home Energy Scotland services increased can't cope with the time it's taking to access funding*."
>
> "*Electricity costs more so don't want to push more people into fuel poverty*."

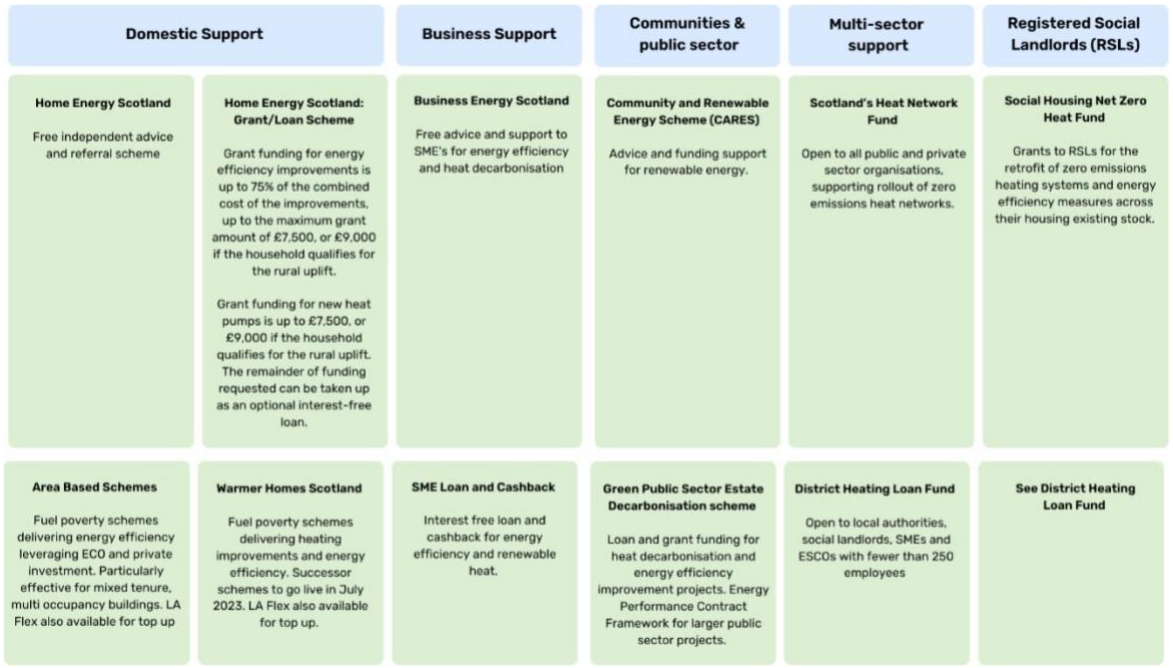
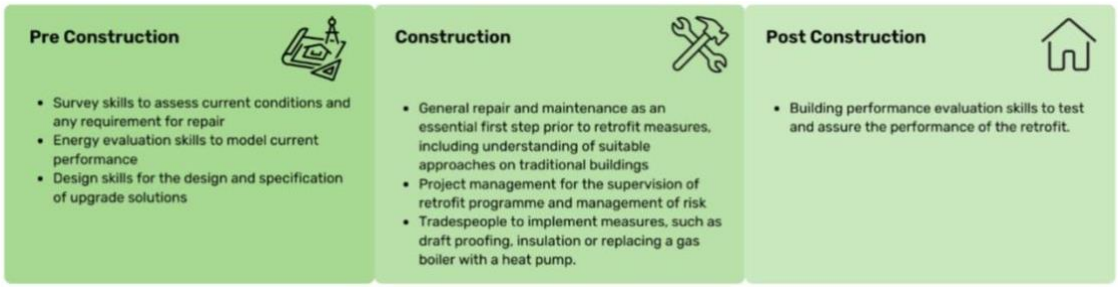


Figure 6 - Current Funding Support Summarised

Skills

Skills and training was a reoccurring theme and cited by all interviewees. Responses discussed the limitations on skills, throughout a retrofit project, from designer, coordinator, installer and through to evaluation. Each skill set throughout a retrofit project is critical to ensure success (Figure 7). Interviewees highlighted a lack of existing skills, specifically, the need to expand the supply chain with more skilled individuals or upskilling the existing workforce. A need for householder support



services post-installation was also identified to provide guidance with new technology and behaviour change.

Regulation and funding were previously identified as major drivers of the retrofit market in the next decade with skills being identified as the key barrier. The ability to scale

Figure 7 - CITB, 2021, retrofit skills overlay

products, services and innovation within energy efficiency must also be considered in the context of the ongoing skills crisis across the construction sector. A number of research reports carried out within the last 3 years estimate the additional numbers of skilled workers is between 20,000 and 50,000Figure 7. Please see Appendix H for further information.

In 2020, it was estimated between **16,800 and 24,100** people were employed in the energy efficiency and low carbon sector in Scotland.

There needs to be a **huge increase** in the energy efficiency and net zero heating workforce in order to meet targets.

UK **Construction workforce has contracted** in recent years and the demand for skilled workers is very high.

Many of the **core skillsets** needed to contribute to heat decarbonisation **already exists** and can be complemented by short **upskilling** courses.

There are particular supply chain and workforce issued in **remote and rural areas.**

Source	Occupation	Demand	Year
Clean Heat and Energy Efficiency Workforce Assessment - CXC	Thermal Insulation Installers	4,500 - 5,4000	By 2030
	Heat Pump Installers	5,100 - 12,700	By 2030
	Heat Network Installers	320 - 4,000	By 2030
	Direct Electric Installer	580 - 1,200	By 2030
Building Skills for Net Zero in Scotland - CITB	Project Managers	4,600	By 2028
	Plumbing and Heating Engineers	4,300	By 2028
	Consultation 2023-25/ LHEES Zoning by December 2023	1,900	By 2028

Figure 8 - CESAP Heat Decarbonisation Research 2022

The additional new entrants and upskilling requirements across the retrofit industry over the next decade are significant in a sector which already suffers chronic skills shortages. Therefore, as all interviewees and participants in the online survey highlighted skills as a barrier and skills are an issue for the built environment this can be considered the most significant barrier for adoption of retrofit at scale. Further analysis is provided in Chapter 4.

In summary, estimating the market demand depends on many interlinked factors such as, government policy; regulation; energy performance standards; skills; and available funding.

02.

Market Demand

Chapter 2 - Market Demand

The potential number of houses requiring energy efficiency measures within each ownership group can be understood by examining data from the Scottish Housing Condition Survey (SHCS) most recently published in 2021[17]. The report cites the estimated number of houses and estimated percentage of EPC targets per ownership tenure: owner-occupied, social, and private rented. The data has been used to estimate market demand in the short, medium, and long term for each group.

Short term demand will come from the social sector where minimum EPC targets are already in place, medium term from the private rented sector with minimum targets set by 2025. In addition, government funding is linked to achieving fuel poverty reduction within these tenures. The owner occupier sector is the longer-term market demand with consultations between 2023 and 2025 and targets for all domestic stock by 2033.

Number of Houses and EPC by Tenure

Owner-occupier

Between 2023 and 2025 the Scottish Government will reform the EPC assessment process and the current targets that are set. This will likely set targets for owner occupiers to reach EPC rating of "C" at point of sale by 2033. The Scottish Housing Condition Survey (SHCS) determined that approx. 52% of owner-occupied housing is below EPC C with approximately 842,000 requiring interventions.

Private rented Sector

Current legislation targets the private rented sector with a minimum standard of EPC rating of "C" by 2025 with a backstop of 2028. The SHCS 2021 reports that 50% of the private rented sector is below EPC C with approximately 178,000 requiring interventions.

Note the PRS sector requires consideration as to whether owners are incentivised or able to act.

Social

Social landlords have recommended energy efficiency targets of The Energy Efficiency Standard for Social Housing (EESSH1)[18] Band **D** and Band **C**, where appropriate, in place since 2014. The SHCS 2021 reports 35% of the social housing sector is still below EPC C/D with approximately 38,000 requiring interventions now.

The above sectors highlight the expected future market demand for skills within the energy efficiency sector. It is imperative that this gap is filled and met by a modern, realised retrofit strategy.

Note this demand could be significantly higher by understanding the number of social landlord housing with current exemptions in place. EESSH2 demand potential is examined further in report.

Quantifying Investment- Average Costs

There is a lack of accurate, publicly available data on costs attributed to individual energy efficiency measures. Therefore, an average scale of cost based on the 2017 BEIS report “Updating the Cost Assumptions for BEIS’s Energy Efficiency Modelling” [19] adjusted for inflation has been adopted (Figure 9).

House Type	Small flat	Large flat	Small mid-terrace house	Large mid-terrace house	Small semi-detached/ end - terrace house	Large semi-detached/ end - terrace house	Small detached house	Large detached house
Floor area:	<54m²	>54m²	<76m²	>76m²	<80m²	>80m²	<117m²	>117m²
Internal wall insulation:	£3,768	£4,710	£4,979	£5,383	£9,152	£9,421	£9,690	£12,651
External wall insulation:	£7,133	£9,017	£9,152	£10,094	£10,498	£11,305	£13,728	£15,478
Cavity wall insulation:	£511	£578	£619	£679	£712	£888	£915	£1,278
Replacement double glazing (panes & frames):	£3,230	£4,845	£5,249	£6,729	£7,402	£8,614	£7,941	£11,171
TOTAL:	**£14,642**	**£19,150**	**£19,999**	**£22,885**	**£27,764**	**£30,228**	**£32,274**	**£40,578**

Figure 9 - BEIS Retrofit Costs Report 2017 (adjusted for inflation)

The above averages have been cross referenced with desktop analysis data from Energy Savings Trust, anecdotal data from surveys, and data gathered from the interviews to create a cost model for Scotland based on a 3-bedroom average sized detached house, the results of which can be found in Figure 10.

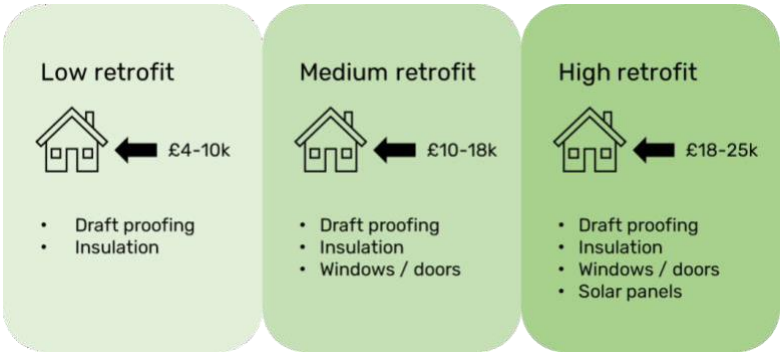


Figure 10 - Average cost in Scotland 3-bedroom detached house (median of insulation costs. Note heat pump and installation costs vary from £5000-£15,000 on average depending on size of property and alterations (changing pipes or location) and are not included in these figures.

Retrofit costs vary significantly depending on the combination of measures, energy targets, size of house and geography. We have also provided examples of costs from smaller regional reports and case studies. Please see Appendix E for further information.

Cost of Investment

Using the average cost model, costs for low, medium, and high retrofit have been mapped against the EPC targets (below band C) for each tenure group (Figure 11). This data has provided an initial overview of the potential costs of different retrofit solutions but it is proposed that further work using more precise house number data would enhance this work and provide a more granular picture.

	EPC band	No. dwellings (thousands)	Cost for low retrofit (£B)	Cost for medium retrofit (£B)	Cost for high retrofit (£B)
Owner occupied	D (55-68)	607	2.43 - 6.07	6.07 - 10.93	10.93 - 15.18
	E (39 - 54)	182	0.73 - 1.82	1.82 - 3.28	3.28 - 4.55
	F (21-38)	46	0.18 - 0.46	0.46 - 0.83	0.83 - 1.15
	G (1-20)	7	0.03 - 0.07	0.07 - 0.13	0.13 - 0.18
	Total (D-G)	**842**	**3.37 - 8.42**	**8.42 - 15.16**	**15.16 - 21.05**
Private rented	D (55-68)	125	0.50 - 1.25	1.25 - 2.25	2.25 - 3.13
	E (39 - 54)	32	0.13 - 0.32	0.32 - 0.58	0.58 - 0.80
	F (21-38)	17	0.07 - 0.17	0.17 - 0.31	0.31 - 0.43
	G (1-20)	4	0.02 - 0.04	0.04 - 0.07	0.07 - 0.10
	Total (D-G)	**178**	**0.71 - 1.78**	**1.78 - 3.20**	**3.20 - 4.45**
Social sector	D (55-68)	163	0.65 - 1.63	1.63 - 2.93	2.93 - 4.08
	E (39 - 54)	34	0.14 - 0.34	0.34 - 0.61	0.61 - 0.85
	F (21-38)	4	0.02 - 0.04	0.04 - 0.07	0.07 - 0.10
	G (1-20)	[w]			
	Total (D-G)	**201**	**0.08 - 2.01**	**2.01 - 3.62**	**3.62 - 5.03**
All sector total	D (55-68)	8895	3.58 - 8.95	8.95 - 16.11	16.11 - 22.38
	E (39 - 54)	248	0.99 - 2.48	2.48 - 4.46	4.46 - 6.20
	F (21-38)	67	0.27 - 0.67	0.67 - 1.21	1.21 - 1.68
	G (1-20)	11	0.04 - 0.11	0.11 - 0.20	0.20 - 0.28
	Total (D-G)	**1221**	**4.88 - 12.21**	**12.21 - 21.98**	**21.98 - 30.53**

Figure 11 - Cost of Investment in Billions- Low/Medium/High

Market Demand Short Term- Further Analysis

Despite a smaller number of homes being below the necessary EPC C/D band in the social housing sector, this may present a significantly larger short term market opportunity when understood within the context of the Energy Efficiency Standard

Social Housing (EESSH) non-statutory targets set out in guidance developed by Scottish Government. These targets are set to become more stringent and are currently under consultation. Scottish Government funding for retrofit projects includes improving energy efficiency, reducing cost and reducing carbon emissions so this could mean a further drive in the social housing sector to achieve the new targets.

Guidance for social landlords on the Energy Efficiency Standard for Social Housing EESSH1

The first Energy Efficiency Standard Social Housing milestone (EESSH1) set a target for social housing by house and fuel type (equivalent to high D or low C depending on property) by December 2020. A second milestone EESSH2 sets a target for all social housing to meet or be treated as meeting, EPC B or be as energy efficient as possible within the limits of cost, technology, and consent by December 2032. EESSH2 is under formal review in 2023, brought forward from 2025 to assess progress and identify additional requirements.

EESSH2 Cost

The Scottish Federation Housing Association (SFHA) reports the cost of housing associations and co-operatives meeting the proposed EESSH2 are estimated at £2bn based on figures dating back to 2017-19. Modelling does not take account of the need to transition to low and zero emissions heating systems and will be subject to revision once a new EESSH2 target has been confirmed. Initial estimates from the Scottish Government, which are inclusive of local authority stock, suggests costs of closer to £6bn if they include low and zero emissions heating.

In summary, the social housing sector has undertaken significant investment to date to achieve an EPC C for a large percentage of its domestic stock. However, EESSH2 or indeed a higher net zero target, will drive the market even further in the short term. The sector will need increased investment from Scottish Government to achieve this. When legally binding fuel poverty targets are considered, public funding should be a prime focus. This will drive increased demand for products, services, and digital technology in the shorter term.

Local Heat and Energy Efficiency Strategy (LHEES)

Fuel poverty targets and assumptions laid out in the HiBS must also be understood in the context of quantifying demand as this will drive the market demand for building fabric energy efficiency products in the short-term and for those in society who are fuel poor. Data shows that homes with poor EPC band ratings are occupied with people who are fuel poor. This identifies where fabric first interventions are needed most. Through the LHEES delivery plans all Local Authorities will prepare maps to evidence this, highlighting proposed energy efficiency zoning areas. Engagement with LHEES officers would enable Scottish Enterprise and other agencies to focus on areas where the greatest needs exist. Fuel poverty sits across all ownership tenures and according to latest published figures are set to almost double, further driving the demand.

Owner-occupiers, social housing, and private rented sector will need to significantly increase applications for government funded programmes to deliver the scale required. For example, area-based schemes such as Energy Efficient Scotland: Area Based Schemes (EES: ABS), Social Housing Net Zero Heat, Warmer Homes Scotland as well as Home Energy Scotland all offer grants and loans. ECO 4 Funding, Local Authority Flex and other public funding could also form part of the solution. Therefore, stakeholder engagement with the funders of these programmes would also ensure Scottish Enterprise and other agencies are offering support to the supply chains in the areas most in need. See Appendix F for further information.

In summary, the market demand in Scotland will be influenced by several factors. Firstly, the EPC targets outlined in the HiB strategy. These targets aim to improve the energy efficiency of buildings, encouraging homeowners and landlords to undertake retrofit measures. Additionally, the EESSH2 targets for social housing will contribute to market demand especially as it is currently under consultation and aims to set higher targets. Rises in fuel poverty will also drive market demand, as more people struggle to afford their energy bills, there will be an increased need for energy-efficient solutions to reduce energy consumption and lower costs.

These factors are interconnected and drive the demand for government funding. Individuals and organisations may seek access to government funding either individually or through government-funded retrofit programs to undertake energy efficiency measures. This emphasises the business case for large-scale, place-based retrofit projects funded by local and national governments. Multiyear funding pathways offer pipeline surety, which encourages the supply chain to invest in skills and resources to meet the market demand. This approach ensures that both current and future individuals at risk of fuel poverty can be supported swiftly and effectively. For a more detailed analysis of these factors and their impact on the market please see chapter 4.

UK and International Demand

Estimating the market demand across the UK and Europe can be determined by the number and type of buildings cross referenced with energy performance. The Royal Institution of Chartered Surveyors (RICS) determined the following:

“There are approximately 131 million buildings within the European Union, majority of these buildings are residential. However, if measured by floor area the residential building stock accounts for approximately 75% of the total with the remaining 25% being non-residential buildings. Across the EU there are 119 million residential buildings: France (21m) has the largest number followed by Germany (19m), with a further eleven million in the UK, and 10 million in Spain and Italy. The remaining thirty-nine million are distributed between the other 23 EU Member States.” [20]

These values have been used in conjunction with the cross-referenced energy performance to determine the UK and international market demand.

Energy performance of the EU building stock

42% of non-residential buildings and 38% of residential buildings were built pre-1970, before the widespread adoption of energy efficiency measures. The age of the EU building stock suggests that to reach agreed energy efficiency targets a significant level of intervention will be required. Currently, approximately 12% of the EU residential built stock has been renovated to meet climate change targets, whilst 9% of the non-residential stock has been renovated. The data indicates that a significant opportunity exists for energy efficiency retrofits to both residential and non-residential buildings throughout the EU. Across the EU 35% of buildings have an EPC rating between D and G, suggesting that there is considerable scope for improving existing buildings to reach the most efficient energy performance rating[21].

The data above reveals a potential market in Europe of millions of residential homes requiring retrofit investment. Other reports estimate that 130,000 homes per annum for 2045 targets in Scotland, 850,000 per year in England and Europe 11 million[22]. It has been estimated that the UK's housing stock will require £65 billion of investment to bring the housing stock to EPC Band C by 2035[23]. This highlights the significant size of demand and investment potential in UK and across Europe.

In summary, investment potential is substantial however unlocking the certainty of pipeline is the key for supply chain investment in skills and accreditation pathways. Further analysis is provided in Chapter 4.

Market Demand - Non-Domestic

Quantifying potential demand and investment within the non-domestic sector for Scotland, UK and internationally is difficult due to significant complexity within non-domestic stock as highlighted in Chapter 1. Ownership and leasing models are fragmented across the non-domestic sector and are not underpinned by EPC regulation in Scotland. In addition, asset management, asset valuation strategies, building design and use, product certification, professional skillset and business case articulation vary significantly across the UK and global market. Therefore, the focus of this report is to examine the non-domestic public sector estate potential market opportunity in the short-term for Scotland**.**

Public estate opportunity

There are approximately 220,000 non-domestic buildings in Scotland, a complete dataset of this stock is not currently available, only 61,038 non-domestic buildings in Scotland have an EPC lodged in the register since 2013[24].

Scottish Government estimates approximately half non-domestic buildings are already heated by traditional direct electric or to a lesser extent other Zero Direct Emissions Heating (ZDEH) technologies. The majority of these use electrical heating, either in the form of direct electric, reversible air conditioning or Variable Refrigerant Flow (VRF)

systems. Only a very small proportion currently use heat pumps and heat network heating systems, potentially offering the lowest operational cost for ZDEH systems[25].

Approximately 23,000 non-domestic existing building stock are in the public estate, varying by size, construction type, and use. New regulations for minimum EPCs are expected to be introduced by 2025. This will require owners to reduce demand for heat through energy efficiency improvements where feasible, and install a zero-emissions heating supply, within the extent of Scottish Government. All non-domestic public sector estate buildings where technically feasible must meet zero emissions heating requirements by 2038[2].

The market opportunity in the short term (2038 backstop) for the non-domestic retrofit sector in Scotland will therefore be driven by public sector funding incentives. Scottish Government plan to target difficult buildings e.g., hospitals first and as a result, £200 million over 5 years has been dedicated to the Scottish public sector estate to improve and reduce energy use and install zero emissions heating systems.

Scottish Green Public Sector Estate Decarbonisation Scheme

The HiBs strategy outlines a new Scottish Green Public Sector Estate Decarbonisation scheme as the main government-led capital funding mechanism to support the decarbonisation of buildings owned by the public sector. The scheme has three support elements, the Non-domestic energy efficiency (NDEE) framework, a zero-interest loan, or the energy efficiency grant scheme[26].

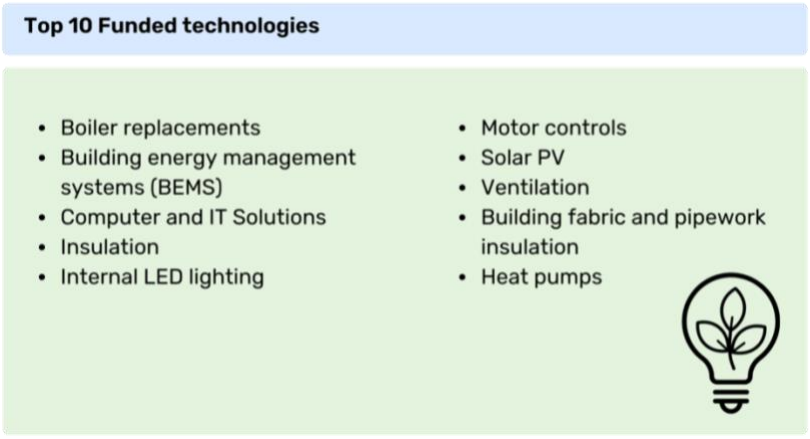


Figure 12 - Public Sector Loan Scheme

Energy Efficiency Grant scheme

The fund will support public sector decarbonisation, encompassing a variety of pathways and green technologies vital in achieving zero emissions heating systems across the public sector estate.

The first round of funding was announced in June 2021. 23 applications for capital support were successful, with investment totalling over £10 million in 2021/2022, £15 million in 2022/2023 and £30 million in 2023/2024. Capital funding budget for 2024/2025 will be announced in early 2024. Resource support of £1.5 million for pre-capital projects will also be offered through the fund in 2023/2024, to enable the building of a pipeline of investment-ready, strategic heat decarbonisation and energy efficiency projects across the public sector[27].

Figure 13 and Figure 14 provide certainty about the market opportunity within the public sector for energy efficiency measures. For example, there have been increasing trends in the spend on energy saving measures since 2021, with the trend expected to continue into 2023. For example, there was a near £28 million spend on insulation in 2021, with an increase of £4 million in 2022. Window and door upgrades resulted in a spend of almost £26 million in 2022, a significant increase from circa £15 million in 2021. Each of these figures demonstrate the increasing opportunity to exploit a relatively untapped market.

Vendor Category	College	Council	Emergency Services	NHS	Public Sector - other	University	Total
Air Sealing, Acoustics & Testing Cont	£7,093	£23,408		£104,284	£1,050	£46,070	£181,905
Architects & Design Consultants	£185,899	£21,278,418	£102,646	£3,895,351	£27,384,991	£3,014,029	£55,861,334
Battery Suppliers		£108,203	£113,592	£1,036,955	£17,557	£330,674	£1,606,981
Energy Efficient Product & Service	£25,495	£5,360,140	£41,772	£80,691	£1,286,426	£20,592	£6,815,116
Energy Management Solution Providers	£21,037	£3,571,060	£71,918	£1,998,840	£429,177	£514,300	£6,606,332
Energy Plant Contractors		£50,431,910	£2,544	£1,350	£80,484	£76,720	£50,593,008
Insulation Service Providers		£22,201,496		£43,901	£34,073	£67,373	£22,346,844
Rendering & Cladding Contractors		£9,996,550		£38,804		2,565	£10,037,919
Renewable Energy Providers		£13,502,040		£751,454	£2,616,999	£1,386,700	£18,257,193
Window & Door Installers	£48,667	£13,212,999	£214,047	£843,745	£63,393	£544,225	£14,927,076

Figure 13 - Procurement Spend Data - 2021

Vendor Category	College	Council	Emergency Services	NHS	Public Sector - other	University	Total
Air Sealing, Acoustics & Testing Cont	£4,000	£126,892	£1,053	£108,484		£56,430	£296,860
Architects & Design Consultants	£412,003	£31,203,128	£213,596	£4,463,800	£28,165,627	£3,151,909	£67,610,063
Battery Suppliers		£67,245	£113,677	£1,051,587	£13,126	£211,825	£1,457,460
Energy Efficient Product & Service	£14,287	£3,322,951	£589,863	£21,657	£665,522	£58,600	£4,672,880
Energy Management Solution Providers	£14,340	£7,703,290	£91,993	£2,424,999	£681,288	£815,321	£11,731,231
Energy Plant Contractors		£49,951,575			£113,128	£60,737	£50,125,440
Insulation Service Providers	£3,627	£27,670,796		£88,474	£73,532	£115,904	£27,952,332
Rendering & Cladding Contractors		£10,431,306					£10,431,306
Renewable Energy Providers	£11,739	£15,805,418		£763,301	£29,879,484	£2,061,405	£48,521,346
Window & Door Installers	£56,179	£24,513,645	£22,521	£688,011	£101,190	£362,306	£25,743,852

Figure 14 - Procurement Spend Data - 2022[1]

[1] *Note spend figures provided from the Scottish Government Core Directorates 2021 and 2022 across the public sector estate shows aggregated figures and only includes those public entities who provided information. This cannot be attributed to individual organisations without permission for the purposes of this report and does not provide separate domestic stats*.

03.

Supply Chain Mapping

Chapter 3 Supply Chain Mapping

This chapter aims to understand the capability and capacity of the supply chain, within Scotland and the wider UK, as well as determining the opportunities that may arise with the up scaling of the energy efficiency sector.

The list below highlights the various interventions for consideration as part of a typical domestic retrofit project:

- building stock
- insulation (all types)
- ventilation (all types)
- windows/doors
- Airtightness
- vapour control
- ventilation (all types)
- heating system
- renewables
- smart controls

The size and specification of these interventions will differ significantly for both domestic and non-domestic. Each energy efficiency measure (EEM) has sub-categories – insulation (internal, external, roof, cavity, room in roof), ventilation (mechanical, balanced, decentralised) or windows (wood, aluminium, PVC-U) depending on the use and location in the building. *Note: only a sample has been listed for each*. Typically, within each of these sub-categories there are various solutions, specifications, and product ranges. Each can be manufactured differently depending on materials, components, and manufacturing processes across multiple supply chains.

As part of the literature review and desktop analysis, specific focus was place on high-value and high-growth potential supply chains that aligned with reshoring manufacture, low carbon, local, natural, and sustainable practices which align with government policy. Similarly, we focussed on the specialist services and digital technologies which offer Scottish businesses the most significant opportunity for scale. Further investigation is required to map and understand supply chains across other sub sectors, such as draught proofing and smart meters.

High Performing Windows

Deep retrofit aims to provide a continuous line of airtightness and insulation around a building envelop (where possible) with minimum gaps or penetrations to reduce thermal bridging and optimise thermal efficiency. Openings create a thermal break in the building fabric. The correct installation of double or triple glazed windows or doors, while considering ventilation in an existing home is key to an energy efficient retrofit. Window and door replacements when installed correctly will improve the buildings thermal performance, as illustrated in Figure 15.

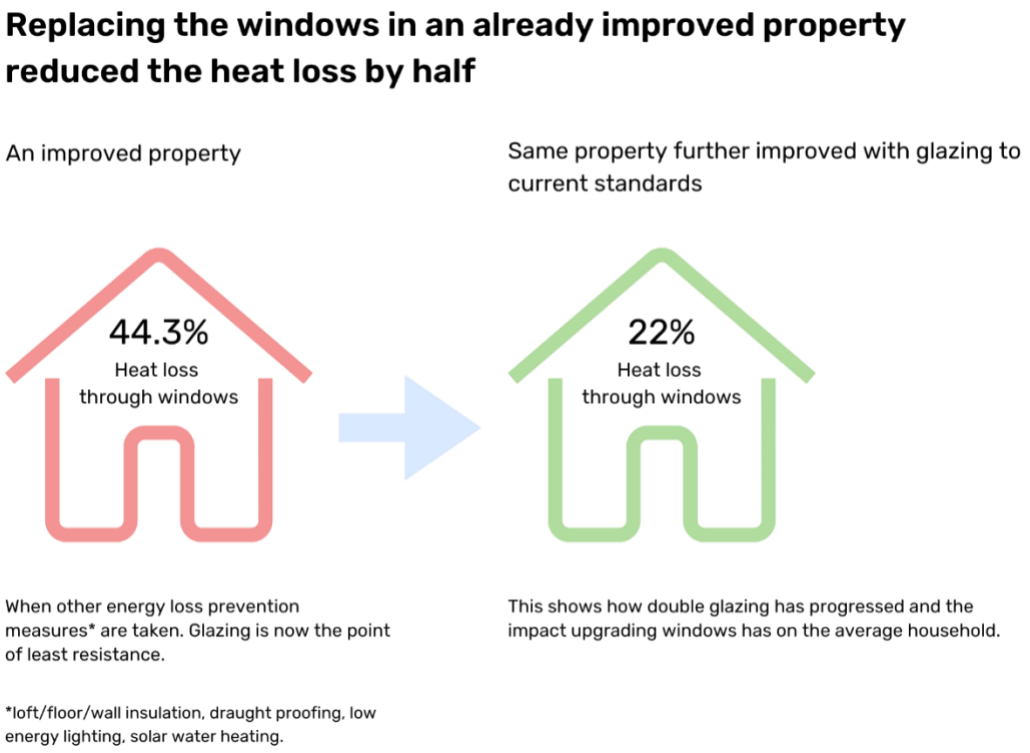


Figure 15 - Glazing Federation infographic, 2023

Structure of market

The windows and door manufacturing and installation market in Scotland and UK is complex, consisting of silos of system producers, fabricators, and installers. Windows can be manufactured from wood, aluminium, PVC-U or hybrid/composite products. Systems producers design the window and door systems (profiles) from raw materials which they sell to fabricators, who in turn produce made to measure window units. Fabricators can be installers or sell to sales companies or other independent installers depending on the business model.

Most PVC-U and aluminium window manufacturers buy their systems from a systems company. A small number of PVC-U fabricators are vertically integrated where they design the PVC-U system, fabricate, sell and install. Examples of this in Scotland would be CR Smith, Scotia or Sidey.

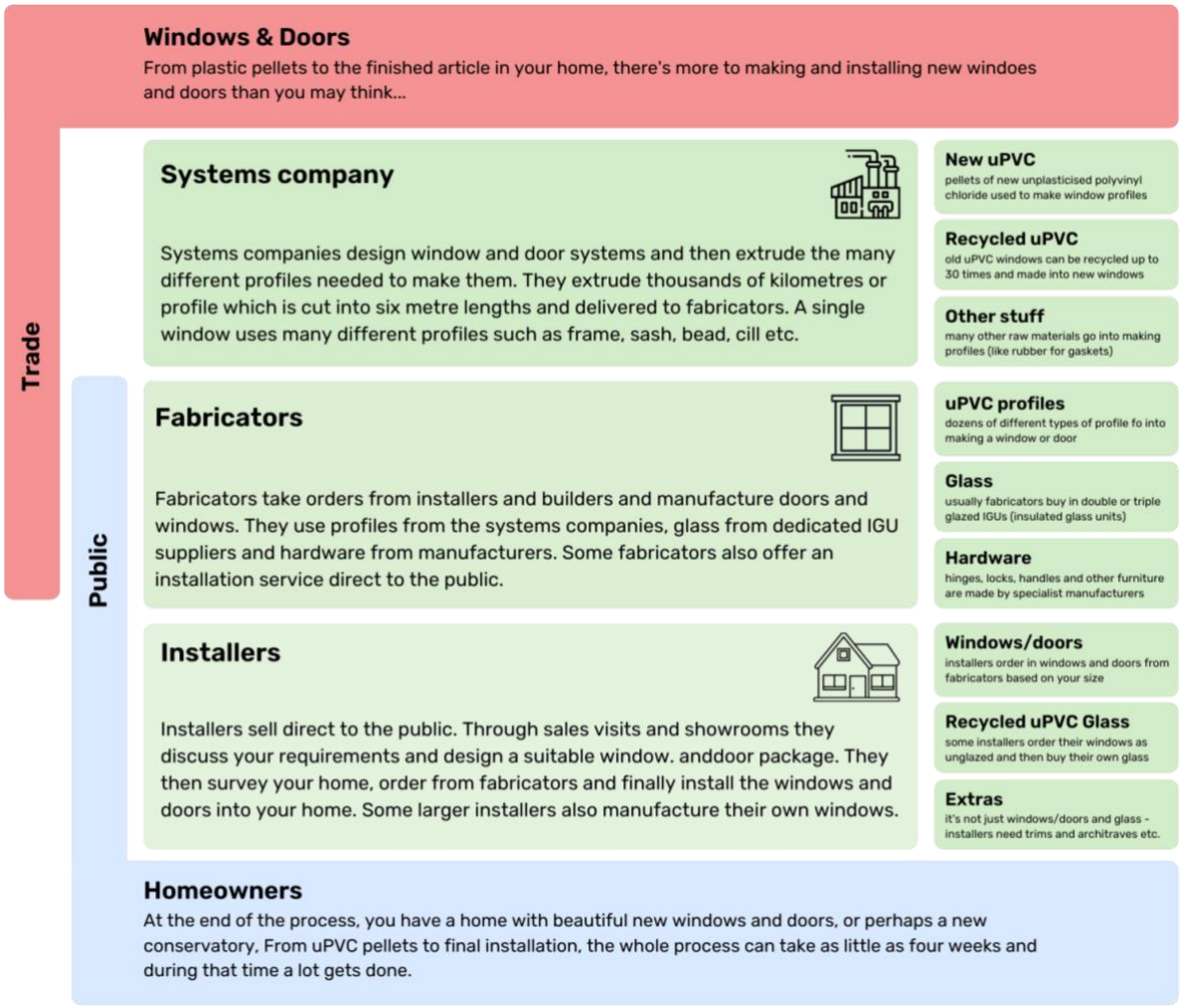


Figure 16 - Overview of windows + doors from design to installation

Fabricators manufacture the finished window, cutting and assembling the profiles together and adding hardware e.g., locks, hinges, handles, along with weather seals and gaskets (Figure 16). As of December 2021, there are 13,940 window, door, IGU and conservatory companies in the UK. There are 4,024 window fabricators (PVCu, aluminium, timber, or a combination (see Figure 17 and Figure 18). 12,209 firms are double glazing or conservatory installers, ranging from small single traders to national companies. This excludes builders who may install products as part of a new-build or refurbishment project. 3,269 firms are both fabricators and installers[28]. There is a lack of granular data for the glazing market in Scotland.

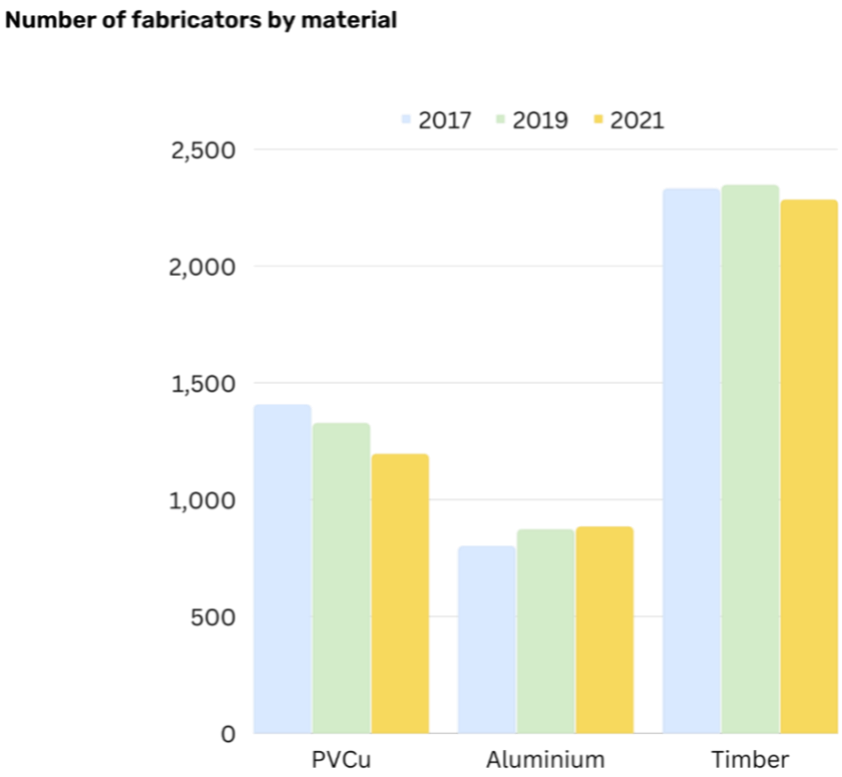


Figure 17 - Breakdown of Window and Door Fabricators

High performing windows			
Materials	**Components**	**Manufacturing & Assembly**	**Installers**
Wood	Profiles	uPVC & aluminium extrusion or systems	Window installers
uPVC	Frames (beads & sashes)	Fabricators	Window manufacturers
Aluminum	Insulation Glass Unit (IGU)	Assemblers	Window fabricators
Iron	Ironmongery (locks, hinges, handles)	Timber window manufacturers	Glazers/joiners
Glass	Composite Frames	Composite window manufacturers	
Chemicals	Trims & Architraves		

Figure 18 - High Performing Window and Doors - Supply Chain Map

Products

Double glazing refers to windows and doors fitted with a sealed unit, comprising two panes of glass with what is known as a ‘spacer bar’ around the edge. The edge is then sealed with a special sealant to prevent air and moisture. Triple glazing adds another pane of glass and spacer bar to the process however only a small number of UK profiles systems are designed for triple glazing.

Energy Efficiency

Glass

The most energy efficient type of glass for double and triple glazing is low emissivity (low-E) glass. Low-E glass has a microscopically thin coating of metal oxide on one of the internal glass surfaces which provides better thermal efficiency. Low-E glass radiates less energy allowing it to transmit less heat.

U-values

Domestic windows and doors (typically uPVC frames) have an energy rating and will have the 'U-value' of the window displayed on the energy label. The U-value is a measure of how easily heat passes through a material. It is not a complete measure of how efficient a window is and should be read in conjunction with the window's other properties. Typically, a Passivhaus certified window specifies a U-value of 0.8 with triple glazing. Double glazed and single glazed window or door U-values range depending on how they are made with the aim of achieving the lowest U-value possible. U-values are quoted for whole window/door or centre pane. The latter is the glass unit only and the former is the whole window (or door) with glass unit.
The U-values for different window types can be found in Figure 19.

Window type	Cavity	Low Emissivity Glass	U-Value
Single Glazing	Single	No	5.6 w/m2K
Double Glazing	Air Cavity	No	2.8 w/m2K.
Double Glazing	Argon Gas	No	1.8 w/m2K
Double Glazing	Air Cavity	Yes	1.6 w/m2K.
Double Glazing	Argon Gas	Yes	1.4 w/m2K
Aluminium Clad	Any	Yes	1.2 W/m²K

Figure 19 - Typical window type + glazing options

Window design i.e., overall dimensions, the size of the opening sashes, the style and design of window frame, has a critical impact upon the thermal efficiency of a window. The higher the ratio of glass to frame the more thermally efficient a frame will be, for instance.

The opportunity for high-value sustainable manufacturing is the reduction in embodied carbon, by utilising innovation in the processes for extraction, manufacture, and processing of the window materials. PVC-U has twice the embodied carbon and

aluminium windows have 4-times the embodied carbon of aluminium clad timber windows according to the Figure 20.

EMBODIED CARBON
WINDOWS

Materials	Embodied Energy and Carbon Coefficients			Comments
	EE- MJ/Kg	EC - $kgCO_2$/KG	EC- (GHG) $kgCO_2e$/kg	EE = Embodied Energy EC = Embodied Carbon
Windows	**MJ per Window**			
1.2x1.2 m Single Glazed Timber Framed Unit	286 (?)	14-6 (?)		Embodied carbon estimated from typical UK industrial fuel mix
1.2x1.2 m Double Glazed (Air or Argon filled)	-	-		
Aluminium Framed	5470	279		
PVC Framed	2150 to 2470	110 to 126		
Aluminium - Clad Timber Framed	950 to 1460	48 to 75		
Timber Framed	230 to 490	12 to 25		
Krypton Filled Add:	510	26		
Xenon Filled Add:	4500	229		

Typically (based on average ratings shown above) aluminium clad timber has c50%/half the embodied carbon of PVC-U and c25% that of aluminium.

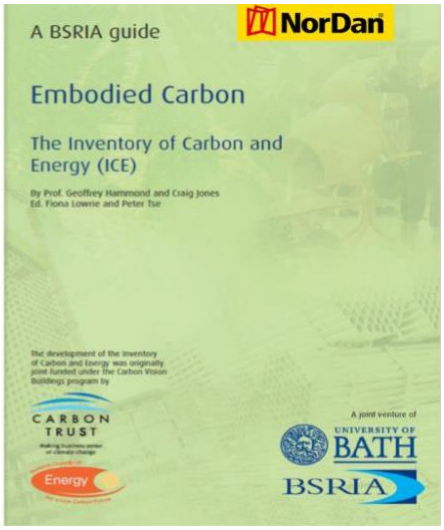


Figure 20 - BSRIA Guide – The Inventory of Carbon and Energy.

Innovation in Windows Manufacturing

Certification and Production Processes

There are many standards for windows and doors, covering material and performance requirements. Currently 25 BSI standards exist covering wood, aluminium, PVC-U and composite windows. However, formal certification of windows products by smaller SME fabricators in Scotland is not widely adopted. In tandem, increasing the energy efficiency of the components and U-value certification will be a huge driver in the future, and there is also a gap for Passivhaus Certified products. Engagement to improve process control in SME fabrication workshops has the potential to scale products. In addition, financial support around the certification process could reduce risk of smaller manufacturers being priced out. For Passivhaus projects there are two routes. Passivhaus certified, where the products have been assessed by Passivhaus and performance certified. This is costly to achieve and maintain. Second option where products perform to the Passivhaus requirements i.e., 0.8 W/m²K but are not certified. The manufacturer/supplier can provide the required data for Passivhaus software referred as Passivhaus Planning Package (PHPP). Many smaller fabricators do not have the certification to provide their information to specifiers as highlighted above.

Therefore, innovation in window manufacturing relates to certification, new composite materials, designs of profile systems and the need to reduce embodied carbon in the process of manufacturing. This is a gap in support which could be explored as part of the Green Heat Innovation Support Programme (GHISP) at SE.

Window and door manufacturer interviewed said;

> *"Innovation really relates to keeping up with the changes in building regulations and technical standards. European and Scandinavian manufacturers are ahead of the curve because systems have been using low operational carbon (thermally efficient and airtight) window and doors for decades. There is still work looking at other materials and how we can further reduce the embodied carbon. PVC-U windows in the UK, will have to invest significant money to make the transition to triple glazing or rely on new glass unit technology. The areas that need to innovate are in glass, still high carbon in production. Window installation in general has not changed for decades whereas buildings and fenestration have improved greatly where thermal efficiency and air tightness are concerned. Digital adoption of BIM and information being available to designers, specifiers, and contractors ."*

Another interviewee from a membership organisation shared,

> *"Recycling is a massive opportunity as glass can be recycled easily, high value product in short supply and PVC-U windows can also be ground down. Building standards in England now specify a 1.4 u-value, manufacturers need to find ways of making their products more energy efficient. Double glazing products are fifth generation now so even double glazing fitted 20 years ago is not as high performing in terms of U-value so there is still a massive opportunity to replace double glazing as well as increase the manufacture of triple glazing. It costs a large-scale manufacturer between 10 and 20 million to invest in a new triple glazing production line so won't want to do that without knowing there is scale in the market."*

One SME timber windows manufacturer shared,

> "*U-values are set by building standards and the systems (profile) companies in the UK do not design profiles which can make triple-glazed windows easily for a manufacturer. You need to change your whole tooling system which is costly. A double-glazed window is 20kg, triple-glazed 30kg which has repercussions for manual handling for delivery on site and the hinges are not designed for extra weight so the hinge producers also need to be involved. Innovation is needed from the systems companies who are all based down in England. Everyone we know for triple glazed at scale is importing from Europe as they have been doing it for years. The opportunity for scale is not selling to Europe they are way ahead of us. It's getting everyone together to design a new system which we can make here*."

Insulation

The insulation market in Scotland and the UK is dominated by synthetic insulation products with materials imported from China and Europe. An opportunity exists in the sustainable insulation market in Scotland for products which are made from natural materials and fibres. The predicted value of the synthetic insulation market in the UK is £700million[29].

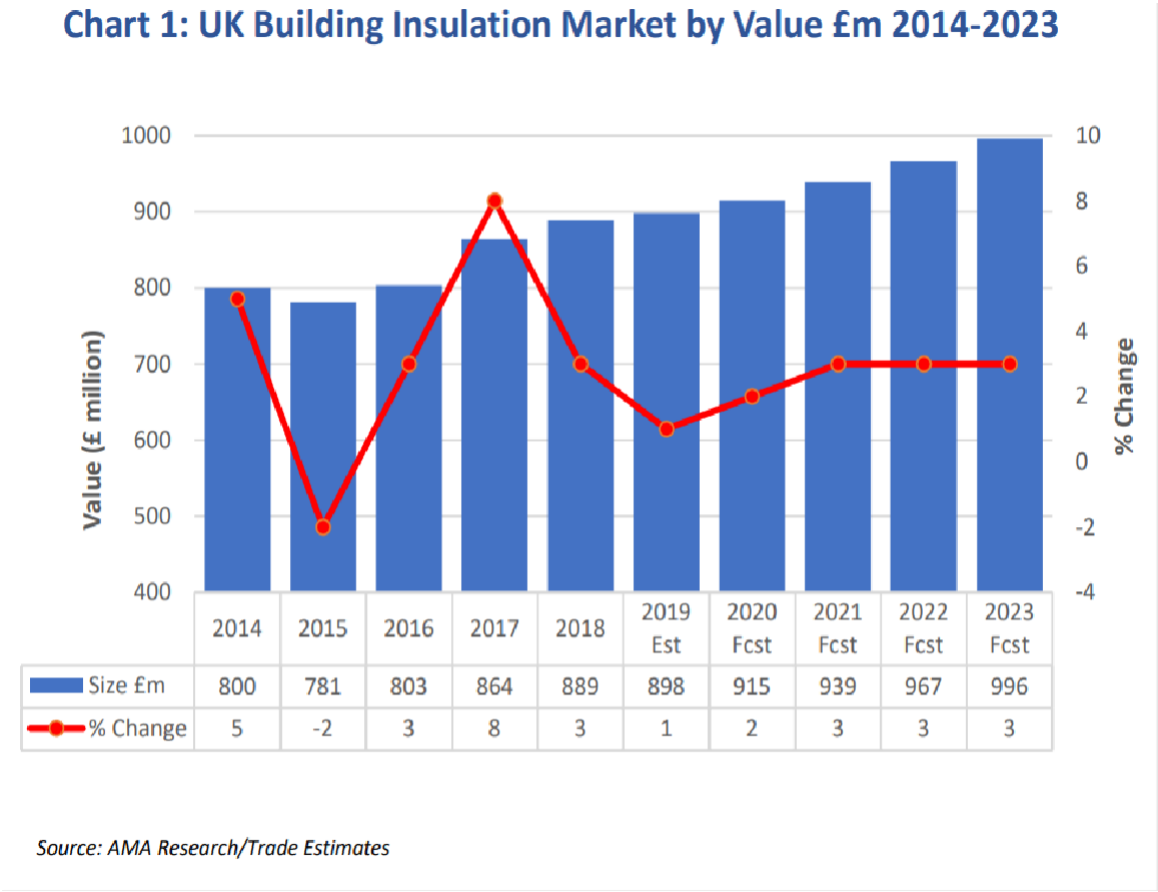


Figure 21 - UK Building Insulation Market by Value £m 2014-2023

Structure of Insulation Market

Synthetic

The main applications for thermal insulation products are primarily lofts, roofs, cavity walls, internal solid walls and underfloor insulation. Acoustic insulation products are mainly used on party walls, intermediate floors, and partitioning. There are few statistics at individual market, product or sector level. The insulation market is typical in terms of lack of availability of robust market data.

Synthetic insulation materials are the predominant insulation product used in retrofit projects because they offer high thermal performance, durability, and ease of installation. Further information on synthetic insulation properties can be seen in Figure 22. PUR/PIR products now have the largest market share of insulation

products, accounting for around 41% by value. The market value of natural mineral wool products accounts for 30% of the total market in the UK[29].

Materials	Manufacturing	Thermal conductivity (W/m.K)	Properties	Conditions of use
Expanded Polystyrene (EPS)	Crude oil - balls compression-bonded during molding	0,029-0,038	• fragile in the face of fire: requires associating it with plaster, for example • Unstable over time • Sensitive to the action of corrosives and rodents	• Recommended on regular surfaces for roof, wall and floor insulation. • In the form of plates
Extruded Polystyrene (XPS)	Crude oil - balls compression-bonded during molding	0,029-0,037	• Compression-resistant • Waterproof, cold, heat resistant • Fragile in the face of fire (combine with plaster)	• Basements, flat roofs, floors, heated underfloor, double walls • Panels with smooth or flush edges
Polyurethane (PUR)	Produced by the reaction of an isocyanate and a polyol of various types	0,022 - 0,030	• Good compression support • Moisture does not alter it • Micro-porosity of its structure: allows water vapour to migrate from the inside to the outside = > no need for vapour barrier • Dangerous in case of fire: releases toxic gases	• Roofs, flat roofs, floors, wall lining • Suitable for renovation and construction • Foam panels
Phenolic foam	Phenol-formaldehyde resin	0,018-0,035	• Fireproof and low smoke emission during combustion • Sensitive to moisture: requires water repellent	• Roofs, wall, floor • Panels
Thin insulating	lightweight and thin material. Aluminium layers adn other layers (felt, wadding, foam)=> multi layer or reflective insulation	0,1-1 prevent heat losses	• Lightweight • Low thickness • No health risk • Water vapour tight	• Handy, flexible • On all surfaces • Not irritating to the skin, so wearing gloves is not necessary
Vacuum insulating panels (VIP)	Composed of a central material (=aerogels) confined in a sealed film and placed in a vacuum	0,0042-0,0050 1cm VIP = 6cm EPS and 9cm of mineral wool	• Water vapour permeable (installation of a vapour barrier recommended) • Good compressive strength	• Suitable for flat surfaces • Disadvantage: must not be drilled and the panels cannot be cut

Figure 22 – Synthetic insulation materials and their associated thermal conductivity, properties and uses.

The two largest UK manufacturers of synthetic insulation products are Kingspan Group and Knauf Insulation. Other key suppliers are Saint Gobain Construction Products (Celotex and Isover), Xtratherm, Rockwool UK, Recticel Insulation, the Kay-Metzeler EPS division of Vita Cellular Foam, Jablite, Promat[29].

The key supply route for insulation products are the distributors, with key companies including SIG Group subsidiaries, Encon Insulation, CCF (Travis Perkins) and Minster Insulation (Saint Gobain). Builders' merchants account for approximately 19% of the market, the remainder being split between direct sales to installers, direct sales to external wall insulation systems companies, builders and a small share via DIY stores. The installation market is split between a small number of national companies and hundreds of regional and local businesses[29].

Natural insulation

Whilst the market is dominated by synthetic insulation, there are many benefits to using recycled or natural insulation. Due to the prevalence of raw materials such as wood fibre, sheep's wool, and hemp, there is an opportunity in Scotland to re-shore manufacturing. Natural insulation is lower in embodied carbon and can be considered negative in some cases, given the ability to lock in carbon. Companies in mainland Europe typically produce and export most natural fibre insulation products through small-scale distributors in the UK. Further information on synthetic insulation properties can be seen in Figure 23.

Materials	Manufacturing	Thermal conductivity (W/m.K)	Properties	Conditions of use
Foam Glass	Sand/limestone	0,038 to 0,055	• Non-combustible • Resistant to T C>430°C • Waterproof • Dimensional stability • Resistant to rodents, insects, acids	• Suitable for flat roofs, walls, foundations. Available in sheets, panels or granules • Not recommended for irregular surfaces
Glass wool	Silica and glass recovered by melting, then fibering and polymerization	0,03 to 0,04	• Resists up to 260°C • Non flammable in the presence of a vapour barrier • Resistant to rodents • Root proof but blows over when humid	• Suitable for sloping roofs, attics, wall partitions, ceilings • Available in semi-rigid panels, flakes or rolls • Wear gloves/glasses
Rock wool	Basalt, fondant and coke	0,032 to 0,04	• Fire/heat resistant • Excellent compressive strength • Moisture resistant and vapour permeable (possibility of respiratory discomfort)	• Suitable for sloping roofs, attics, wall partitions, ceilings • Available in semi-rigid panels, flakes or rolls • Wear gloves/glasses
Perlite	Volcanic silica rock crushed and heated to 1200°C	0,05 to 0,06	• Hydrophilic (must be combined with water) • Durable and ecological but expensive • High compressive strength • Effective against bacteria, rodents • Non combustable	• Suitable for ceilings, roofs and attics • Available in panels or granules
Vermiculite	Magnesium silicate, a natural and abundant resource	0,6 to 0,08	• Expanded under the action of extreme heat (1000°C) or water vapour => water repellent treatment required • Non combustible and rot proof • Not irritating • Resistant to rodents/insects • Good mechanical resistance	• Suitable for attics and roofs • Available in bulk or in panels
Expanded clay	Raw dried clay, reduced to flour, mixed with water and then heated	0,10 to 0,16	• Non combustible and fire-resistant • Permeable to steam and water resistant but must dry to regain its properties • Rot proof and resistant to corrosive/insects products	• Available in bulk in granules and bead-based building blocks

Figure 23 - Natural insulation materials and their associated thermal conductivity, properties and uses.

Scotland already has examples of natural insulation manufacturers. IndiNature (hemp batts), Superglass (recycled glass) and Engineered Foam Products (eps). There also companies based in Scotland who manufacture their products in other locations for example A. Proctor Group, Sisal Tech.

Funding research and development for new and emerging insulation manufacturers could be supported in various ways. For example, building the capacity of low carbon materials from renewable or circular sources to meet the growing demand. This prioritisation would favour the start-up companies challenging existing markets with innovative products which consider circularity and carbon sequestration.

IndiNature Case Study

IndiNature's innovative hemp insulation products have the potential to deliver significant reductions in embodied carbon in the construction process (c.4.4 tonnes of carbon can be saved building the average UK home compared with traditional products) and can enable the transition to net zero in the construction industry. The Scottish National Investment Bank has provided IndiNature with £5 million of investment to enable its first manufacturing plant in Jedburgh, creating long term jobs and increasing economic activity in the Scottish Borders. Support from the Bank will also allow IndiNature to bring a unique product range to market at scale. Furthermore, the Bank's investment has unlocked significant grant funding provided by Zero Waste Scotland (£803k) and South of Scotland Enterprise (£250k). As a result of this investment, IndiNature have been able to commit to the supply and installation of its insulation products into a number of domestic properties for Riverclyde Homes housing association,

Woodfibre

As it stands, there are no manufacturing facilities in the UK manufacturing woodfibre insulation and as a result, the product is imported from mainland Europe. Scotland accounts for 2/3rd of the UK timber stock so is well placed to support a wood fibre manufacturing facility to supply UK and Republic of Ireland markets. There are also opportunities to develop sheep's wool and combination products. Companies like Sisal Tech are using pre-consumer waste wool from other industries as a blend, ensuring that farmers get the best value while the manufacturers can find a use for the manufacturing by products.

Other considerations are natural and circular manufacturers securing raw material supply when compared with the much larger volumes of mineral and synthetic products. This market imbalance puts natural and circular products at a disadvantage seeking product testing and compliance testing. Most Scottish based manufactures recognise the value of a BBA certificate but achieving accreditation is a recognised challenge.

Certification and testing facilities in Scotland are under-invested and could be a key consideration for Scottish Government to encourage the sustainable insulation market.

There are several existing challenges and barriers to developing the natural insulation market in Scotland, these have been illustrated in Figure 24.

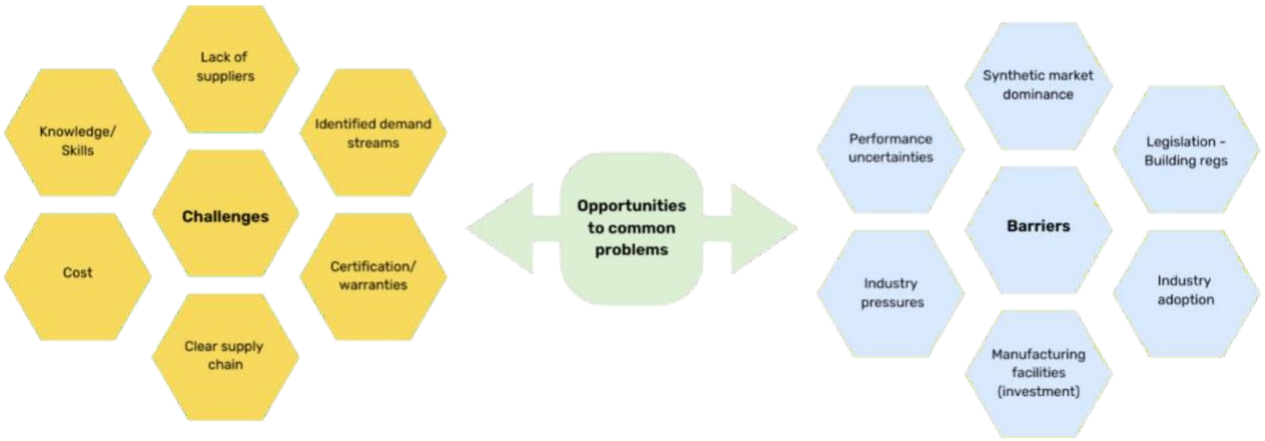


Figure 24 - Low Carbon Energy Supply chain report, 2022

Manufacturing Process and Facilities

Currently there is little investment into the UK production of natural fibre insulation or other sustainable insulation products. Some funding has been provided to emerging products for new manufacturing setups, but it does not expand across other products and supply chains. There is an opportunity to create partnerships between larger manufacturing businesses and those that have a similar process to some natural fibre insulation. One example is OSB and MDF composite boards which share similar supply chains but undergo different density levels. Supply chain issues and agreements need to be in place to push forward investment into manufacturing setups.

Suppliers and Supply Chain

There is an opportunity to engage with relevant industries e.g., sawmills, raw material suppliers, recycling ventures and manufacturing options, to outline partnerships and shared facilities such as manufacturing plants to facilitate the production stages. There needs to be collaboration among timber yards and suppliers as most supply chains are already in place. The connectivity between these and investment into machinery and establishing suitable factories is slow and recently stalled by COVID-19 and the 2022 cost-of-living crisis.

Innovation in certain components is essential to avoid the use of toxic or petrochemical-derived adhesives/ binders for manufacture.

Materials	Use	Manufacture & Assembly	Installers
Wood fibre	Loft	Natural insulation, wood, straw, hemp	Specialist insulation installers
Cellulose (recycled newspaper)	Room in roof	Recycled insulation, glass, plastic	Main Contractors
Wool	EWI		Renewables energy system installer
Glass	IWI		
Crops, Polymers, Cork	Underfloor		
Energy Plant Contractors	Cavity		
Flax	Roof		
Straw			
Timber			
Slag and ceramics			
Binding Agents			
Coatings			
Hydrophobis Agents			
Blowing Agents			

Figure 25 - Supply Chain Map

Certification & warranties

Established offsite timber panel manufactures, house builders and product manufacturers undertake certification of components, assemblies and systems which can often be an expensive and prolonged process, requiring a great deal of resource and effort. Any change or innovation in insulation products within a panel system for example would require further investment for testing, validation, and certification. As identified in the surveys there is a lack of certification and testing capability in Scotland which hinders new product development. Working with Scottish Government to support public investment in infrastructure to facilitate testing and certification e.g., test laboratories, would support the development of the market.

Legislation and Building Regulation

Influencing policy remains a barrier in the UK. Germany and France have natural fibre insulation guidance built into building regulations compliance. Clear net-zero carbon regulations are needed to embed circular construction practices. The Scottish Government recently consultated on the introduction of a Circular Economy Bill with a Route Map to 2025. This creates an opportunity for dialogue on the supply chains and the role natural fibre insulation has in the use of recycled supply chains, natural resources, and embodied carbon benefits. It will promote and support responsible production and consumption as well as limit the landfill of construction products. There remains a barrier on specifically advising the use of natural fibre insulation and other natural products. This is a barrier to unlock for designers and specifiers.

Supply Chain - Services - Digital

Several interviewees cited the need for an increase in digital tools within modelling services as a key area of innovation in the supply chain. Computer modelling is used in retrofit projects as part of the design process and is recommended within PAS2035 guidance. Currently it is widely procured through specialist consultancy services across the UK. There is a recognition scaling up of digital innovation in modelling platforms would be key to scaling up retrofit delivery. This is an opportunity for Scotland’s digital services market to develop new products.

Energy Modelling Software- innovation in energy performance modelling software

Company	Product
BRE Group	HSDC
Elmhurst Energy	Streamline
Sava	Intelligent Energy
Energy Savings Trust	Home Analytics
IRT Surveys	DREam
Parity Projects	Portfolio
Energy Audit Company	Uno

Figure 26 - Energy Modelling Software- innovation in energy performance modelling software

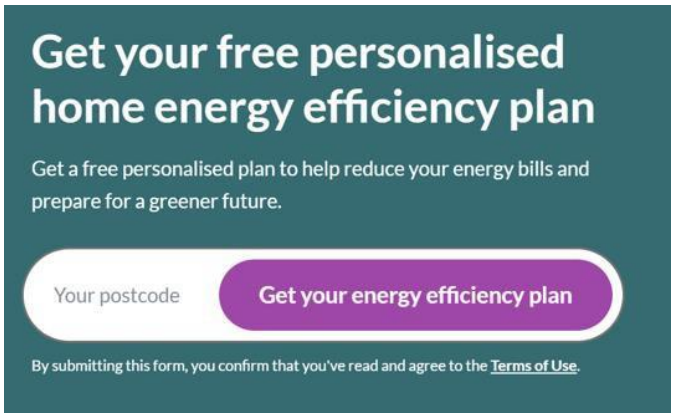
Digital platforms are used where complexity exists for larger scale domestic retrofit programmes. They provide stock modelling analysis and retrofit financing options. The software allows comparison of grant funding options and retrofit measures with an optimised route to achieve EPC targets within budget parameters. A list of energy modelling software currently available can be found in Figure 26.

Currently these digital platforms are largely used for retrofit projects across social housing where there is a similar typology. This has not been widely adopted within the private sector with a variety of unique individual properties. This type of focused work would support non domestic retrofit projects in developing retrofit plans and finance appraisals

Digital Software - Innovation Examples

Snugg

An Edinburgh startup who built a digital platform offering personal energy efficiency plans for home improvements. They also provide data analysis on stock portfolios to recommend energy efficiency measures and finance options for larger scale retrofit improvements.



Heero

Heero Technologies bespoke software provides homeowners with a one-stop shop solution from personalised home energy insights, through to financing and installation of energy home improvements

There is a gap in the market for digital software tools which provide other insights. For example, retrofit funded projects linked to geographical location. This would allow the opportunity to aggregate material purchasing and shared resources.

04.

Adoption- Barriers and Solutions

Chapter 4 Adoption- Barriers and Solutions

There are key drivers within the retrofit market that will drive its adoption, these include:

- climate change targets
- certainty of pipeline
- regulation
- EPC targets
- skills
- funding
- fuel poverty

The desktop analysis carried out highlighted the following barriers which prevent the widespread adoption of retrofit:

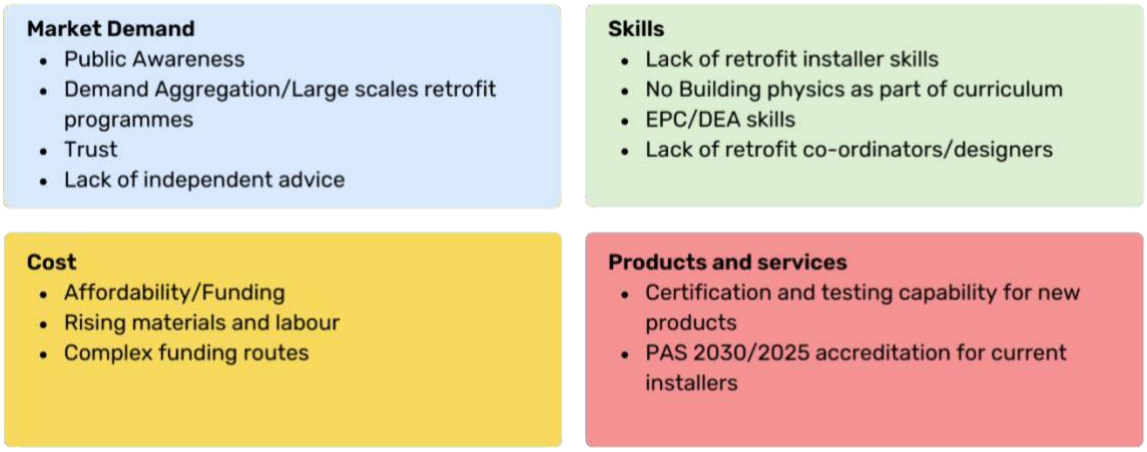


Figure 27 - Summary of Barriers to adoption of retrofit

It was concluded from the interviews that public awareness was one of the top barriers to the adoption of domestic retrofit at scale. Some commented a large proportion of the public don't understand climate change targets or know of the legislation that will be introduced for energy efficiency:

> "*The general public don't know this is coming and in the housing market people don't know what they are buying will need improved before they can sell again.*"
>
> *"People don't know how much carbon impact heating their house has."*

Solutions

Public Awareness

Existing Homes Alliance report makes recommendations in key areas for raising awareness of retrofit including building renovation passports, a national awareness campaign, digital enabling platforms, one stop shops and local retrofit intermediaries who can deliver advice and recommend contractors and installers at a local level for the domestic sector. Please see Appendix G for further information.

Collaborative Models - Retrofit Intermediaries

Loco Home Retrofit

Loco Home Retrofit CIC, Scotland's first community-led retrofit co-op. This Glasgow based co-operative is focused on promoting energy efficiency within homes. Loco Home retrofit aim to develop community-led approach to homeowner engagement and service development in retrofit. The are a community intermediary, supporting homeowners, tradespeople and professional navigate through the retrofit process.

> *"Locohomes seek to grow both the market and the local supply chain for effective retrofit. Households who are motivated and have budgets, headspace, and opportunity to retrofit are stuck - overwhelmed by the complexity and risk of retrofit and because they can't find contractors they can trust. At the simple end, households cannot find someone to clear a loft prior to insulation as installers won't do that. At the complex end, there is no-one providing airtight floor insulation in Glasgow. Locohomes are working to aggregate demand to make it worth new providers emerging in this field, upskilling, and getting accredited for funding."*
>
> *Chris Carus director of Locohomes Retrofit CIC LTD.*

EALA Impacts

A not-for-profit, community interest company, giving property and construction advice for retrofit projects including building condition surveys, design advice and procurement services.

NESFIT – North East Scotland Retrofit Hub

North East Scotland Retrofit Hub, a community led retrofit cooperative, helping householders achieve warmer, healthier, emissions free homes.

The aim is to scale these types of intermediary models in regional areas across Scotland. To raise awareness and support homeowners when undertaking retrofit work.

Collaborative models (Procurement and MMC)

Energiesprong is a collaborative approach to industrialised retrofit at scale. It is a Dutch initiative internationally recognised across Europe, including the UK, France, Germany, and Italy. The Energiesprong model aims to achieve net zero energy homes, by retrofitting and installing renewable energy systems such as solar panels to

generate the energy the building would need for heating, hot water, lighting, and appliances. It upgrades the cladding and insulation by using prefabricated roof panels with integrated solar panels, prefabricated wall panels and pre-assembled “energy pods” to provide high-efficiency, low-carbon heating, hot water, and renewable energy. The process allows the homeowner to remain in the house while the measures are being carried out. Delivering a whole house retrofit in 10 days[1,2] and has a 30-year warranty covering net zero energy. Energiesprong currently provide this service to social housing sector. A housing company will finance the retrofit solution which will include the saving on energy and repair and maintenance costs. The tenants pay the same monthly costs that they would on energy and repair and maintenance, known as a comfort cost. The ‘comfort’ cost pays the retrofit cost [2]. The Energiesprong model is a legally binding contract, which alters the tenants original rental agreements incorporating the ‘comfort’ charge.

There is an opportunity for offsite manufacturers in Scotland to design and manufacture retrofit panel solutions, such the roof/wall panels required as part of the Energiesprong model. These are external panels fitted around the outside of the existing house. SE innovation support could be designed to work with the offsite panel manufacturing supply chain to support the design of a retrofit panelised system.

The model introduces energy as a service, a significant shift for the registered social landlord sector in Scotland and identified in the finance analysis as a key opportunity to drive the market through service innovation. The energy-as-a-service model is identified by several of the interviewees as a solution for scale.

In 2021 BEIS published a report titled, “International Review of domestic supply chains”[30] where the demand for deep retrofit and developing supply chain was analysed.

“a funded programme of its scale would need to run for up to 10 years to build a self-sustaining market. One scheme, the Energiesprong programme, is now operating at a scale of multiple thousands of net-zero retrofits in the Netherlands, but this follows significant public investment in those countries and market development over almost a decade.”

[2] https://www.energiesprong.uk/how-does-it-work

Collaborative Models One Stop Shop Ireland (government and industry)

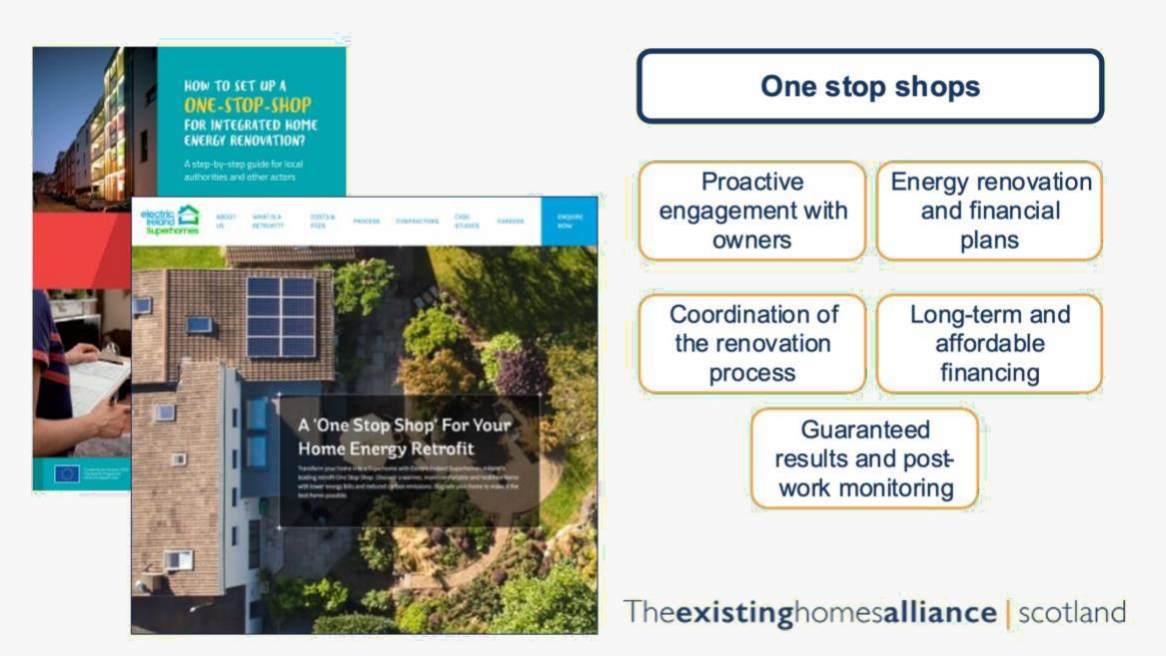


Figure 28 - Making Retrofit Work, Customer Journey, Nov 2022

'SuperHomes' is an initiative of the Tipperary Energy Agency and has received EU funding as well as support from Sustainable Energy Authority of Ireland, and Electric Ireland. They recently opened applications for grant funding under the new National Home Retrofit Scheme. This scheme is a key part of the strategy to retrofit 500,000 Irish homes to BER B2 standard or above by 2030. Grants of up to 35% of eligible costs are available to the public through one-stop shops such as SuperHomes, involving experienced professionals providing technical advice, specialist contractors, quality control, grant payment and finance advice, all in one carefully planned process.

The SuperHomes team includes engineers, programme managers, retrofit advisors, project coordinators, and support team, working with approved contractors. Grants vary from project –to project and the actual grant percentage will depend on the energy measures selected. A SuperHomes retrofit starts from approximately €30,000. The average cost of a full scale deep retrofit in 2020 was €56,000.

This is an example of government funding and industry working together to provide scale in the retrofit market and there are currently 22 operating in Ireland.

Local Authority Partnerships

Glasgow City Region Retrofit

Glasgow City Region Retrofit (GCR) have developed a 10-year investment plan, to upgrade the insulation for all properties in the Glasgow City Region. Supporting over 75,000 jobs and generate £4.4 billion in Gross Value Added (GVA) across the City Region. In addition to the employment and economic benefits, widespread insulation across the City Region could remove 10.7 million tonnes of carbon emissions per annum. The certainty provided by a long-term programme of investment in residential energy efficiency and clean energy will offer significant opportunities for local companies to grow exponentially to deliver an ambitious programme of work. It will also create supply chain opportunities for local manufacturing companies to grow and for new businesses to locate within the City Region and create sustainable jobs. This programme of investment is currently seeking funding.

South of Scotland Retrofit – Roadmap to Decarbonisation

Registered social landlords are (RSLs) taking the lead in delivering a just transition in Scotland. By developing the retrofit supply chain, registered social landlords in Dumfries & Galloway and the Scottish Borders could create more than 2,000 jobs and £112m in direct GVA by 2030.

Finance Solutions

Funding has been identified as a major driver and challenge for the retrofit market. The investment needed across the domestic portfolio for Scotland and UK has been estimated to be in the billions of pounds.

Government policy and regulation are driving certainty of pipeline. In the current cost-of-living crisis both private finance and public funding mechanisms are needed to unlock the scale required. Most interviewees cited finance or cost as a barrier to delivering scale:

> "*Budgets always comes first particular in non-domestic when looking at options for reducing energy demand. Additional money on surveying or technology options to deliver better solutions are not always considered due to additional costs on services".*
>
> *"The grant system needs simplified far too hard to work out eligibility."*
>
> *"A managed scheme has a degree of certainty but there is no equivalent for the private market*."

To understand the finance options in retrofit we consider the different barriers for each ownership group. Owner-occupiers experience long payback periods with limited impact on property value:

> "*Energy efficiency is a low indication of whether people buy a house*".
>
> *"50, 60-year payback periods are not attractive to the general market*."

Private-rented sector requires a 'split incentive', the landlord pays for energy efficiency improvements and tenants accrue the benefit through reduced energy bills. The tenant is incentivised by reduced energy bills and a comfortable, well ventilated home. However the landlord needs incentive either by Scottish Government incentive scheme or legislation in place. In the social housing sector, the short-term nature of grant schemes prevents more ambitious retrofit projects. Interviewees who work in social housing retrofit cited examples in multi tenure flats or mixed-use stock where large-scale retrofit projects were prevented due to private individual lack of uptake.

Previous grant programmes for decarbonisation have been competitive in nature with short application windows and complex application processes. Many social landlords have not been able to make applications to this type of scheme despite the need for financial support. A consistent multi-year fund, allocated based on need, would enable social landlords to plan more effectively and access the support required[31].

In 2020 the Green Finance Institute released a report with 21 scalable demonstrator projects, designed to overcome the barriers to mobilising capital towards the social rented, private-rented and owner-occupied domestic sectors. We have listed some of these below.

Type	Name	Demonstrator description	Tenure		
			OO	PRS	SRS
Energy service provided	Insurance backed comfort plans	An insurance backed guarantee for 'Comfort Plans' to increase confidence amongst early adopters (e.g. Social Landlords) and improve the financing available for deep retrofit projects.		✓	✓
	Comfort as a service	Financial mechanism to unlock the cash savings in energy efficient and optimised homes to support the investment case for housebuilders and homeowners to achieve high efficiency standards	✓	✓	✓
	MEES compliant funding	An energy performance guarantee that allows private rental landlords to procure long-term compliance with MEES requirements		✓	

Figure 29 - Extract of scalable demonstrator project, identified by Green Finance Institute (Energy service)

Please note MEES is the UK version of private rented sector EPC targets.

Type	Name	Demonstrator description	Tenure		
			OO	PRS	SRS
Data and enabling framework	Energy efficiency & property valuations	Research and development of practical solutions based on the relationship between energy performance and property valuation that unlock investment towards net zero homes	✓	✓	✓
	Metered energy savings	A standardised savings calculation methodology to deliver rich data on real-time energy savings over the lifetime of a retrofitted building	✓	✓	✓
	Building Renovation passports	A tool to increase the rate and depth of retrofits, providing information on what measures are possible and. along term renovation plan that can be achieved at a flexible pace	✓	✓	✓
	TrustMark 'Call to Action' platform	A platform to support customers through the full retrofit journey: identifying improvements, sources of funding and linking homeowners to a reputable supply chain	✓	✓	✓
	Residential Retrofit Principals	An industry-recognised certification for financial solutions that support the retrofit of residential buildings to a high standard to enhance the confidence of lenders and borrowers	✓	✓	✓
	Sustainable Housing Label	A certification scheme for green buildings and retrofit projects, spanning the full breadth of tenures to stimulate demand and investment into the sector	✓	✓	✓

Figure 30 - Extract of scalable demonstrator project, identified by Green Finance Institute (Data + enabling)

Type	Name	Demonstrator description	Tenure		
			OO	PRS	SRS
Lending procedure	Property assessed clean energy 'style' financing	Financial institutions provide long term capital for retrofit projects, while local authorities or associated independent third parties collect repayment via an addition property charge that. is passed through to the lender	✓	✓	✓
	Green equity release	Enables homeowners over the age of 55 to unlock the equity in their property for investment with favourable terms to incentivise investment into energy efficient improvement	✓	✓	
	'Help to Green' equity loan	Homeowners can borrow against the equity in their property in order to invest into energy efficiency improvements. Government support similar to Help to Buy scheme could facilitate favourable borrowing terms	✓	✓	
	Domestic Energy Efficiency Salary Sacrifice Scheme	A salary sacrifice scheme that allows employees to draw a loan through their employer for investment into home energy improvements which is repaid via gross salary contributions	✓		
	Leasehold financing	Provides an attractive financing offer to private leaseholders via social landlords or related intermediaries to foster positive engagement and consent for multi-property retrofit projects			✓
	Add-to-my-mortgage platform	A digital platform to streamline the process for homeowners to apply for a Further Advance (e.g. additional borrowing on their mortgage) at the 'point of sale' of energy efficiency measures	✓	✓	

Figure 31 - Extract of scalable demonstrator project, identified by Green Finance Institute(lendinf procedure)

Interviewees suggested green mortgages, VAT reduction, energy efficiency linked to lower council tax and loans with cheaper interest rates as ways of providing finance to the private market. One recommendation would be to work with the Green Heat Finance Taskforce to create a pilot:

> "*Funding, funding, funding. The industry is teeming with ideas but focus on those who are developing a range of services to support households and communities. You will see the delivery of retrofit measures emerge, but you will also see so much more in terms of a wider range of "co-benefit" impacts*."

Green Heat Finance Taskforce

The HiB Strategy also cited finance as a significant driver to deliver the strategy and included a commitment to establish a Green Heat Finance Taskforce. The group is developing a portfolio of innovative financial solutions and the final report will be published in September 2023.

It was noted,
"Local authorities may be best-placed to promote uptake of energy efficiency improvements to buildings by means of a 'place-based' approach and the green bond market has been the most popular model for retrofit. Sustainability linked loans have strong growth in the real estate sector. Other models were Green REITS (real estate investment trust)."

Housing Association Charities Trust

Housing Association Charities Trust (HACT) is a UK organisation which drives value in social housing by unlocking the potential for innovation and change. The charity supports the housing sector with research, case studies and online tools to generate insights, build trust with stakeholders and drive value. They delivered the first carbon offsetting scheme to deliver additional finance to social landlords. "Retrofit Credits" will provide a channel for investment in social housing retrofit by verifying the emission reductions and social value of housing retrofit projects and originating carbon credits backed by those emission reductions. The carbon credit programme, measures the increase in health benefits and the reduction in carbon emissions, with 1 ton of carbon emissions saved equalling 1 credit and the sale of 1 credit being £2,000.00.

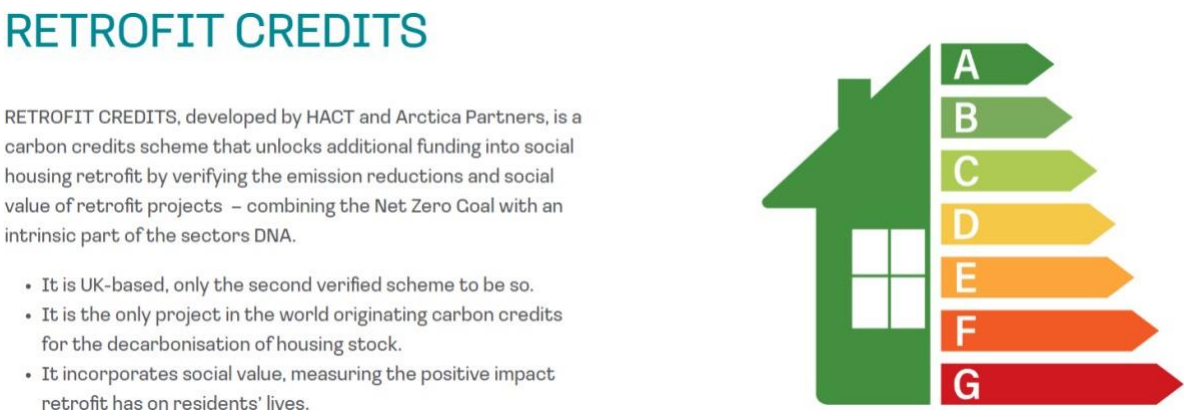


Figure 32 - Overview, Retrofit Credits - HACT + Arctica

Scotland and UK Finance

Scottish National Investment Bank

The Scottish National Investment Bank (SNIB) is a state-owned investment and national development bank who invest on a long-term and commercial basis in innovative businesses, projects, and communities, through debt, equity, and fund investment. Their analysis is that the individual, building by building approach is not generating enough demand for retrofitting to stimulate markets and deliver the kind of pace and scale needed to meet climate goals. Planned future regulation sets great ambitions for energy efficiency improvements and connection to net zero heat sources with clear dates, to drive increase in demand. SNIB have said that "Large scale approaches are not yet delivery-ready' and that Scotland needs an already proven pilot that demonstrates where SNIB should invest capital[32].

Banks without Boundaries – Net Zero Neighbourhoods

Banks without Boundaries (BwB) is a not-for-profit firm staffed with senior ex-bankers. They apply financial knowledge and concepts to projects with environmental and social outcomes to help mobilise private capital across a range of sectors.

One of their key goals is to develop a model capable of scaling both the delivery and funding for retrofit by overcoming existing barriers. Measures aimed at individual householders typically struggle to gain scale because of a significant mismatch between the unavoidable economic payback characteristics of deep retrofit (30-50 years) and the investment required per home.

A whole neighbourhood (1000 homes at a time) retrofit approach, including fabric first, heat decarbonisation and renewable generation/storage, allied with a range of neighbourhood investments e.g., mobility infrastructure, green infrastructure, community investments, named the NetZero Neighbourhood model as a solution. It uses a Pay as You Save model with no debt on the individual or the property, thereby making it theoretically fit for any ownership type. The model collects part of the energy saving via a utility bill collected "comfort fee" delivered into a Special Purpose Vehicle (SPV) on multi-decade property linked contracts. These can be aggregated and sold

to pension/insurance funds as part of a blended finance structure. 50-66% of the funding could be supported in this way with private capital, significantly reducing the need for public funding.

European Finance Models

Germany

The Kreditanstalt fur Wiederaufbau (KfW) is a government-owned bank in Germany established to aid post-war reconstruction. It provides financial support for retrofit projects by acting as a mediator between owners and capital markets.

The retrofitting of buildings, both public and private, is being driven by the German government through a three-pillar system. The first pillar involves regulation to reduce energy demand and promote renewables. The second focuses on creating financial incentives and stimulating investment to reduce energy demand. The third pillar emphasises providing energy-saving information and advice.

There are several key principles, these include, providing repayable loans with favourable terms, performance-based investment subsidies, qualified expert advice and installation services, and requirements for investments in energy efficiency before subsidies for renewable energy are paid.

Additionally, a whole-building (deep retrofit) approach to energy savings is adopted, and support is provided for experimentation and innovation building awareness for new approaches. The German government also recognises the significant role that public buildings play in demonstrating retrofit measures.

The KfW offers loan and grant programs to support the retrofit economy, with incentives for building owners to exceed base performance requirements. The program covers retrofit costs up to 100,000 Euros per unit and offers low interest rates, with up to 30% of the loan transferred to a grant if energy performance standards are met. The program covers technical measures such as increased insulation, replacement windows, and renewable energy sources. The program has led to significant investment, energy savings, and job creation in the building and supply-related industries in Germany.

Italy

The Super Ecobonus is an Italian government program launched in 2020 aimed at promoting energy-efficient retrofit in domestic and non-domestic buildings. The scheme pays homeowners to make their homes more energy efficient by providing incentives in the form of tax credits, grants, and subsidised loans.

The Italian government will fund up to 110% of the renovation costs for energy-efficient upgrades such as insulation, heating, cooling, ventilation systems, and renewable energy sources like solar panels. Homeowners can also claim tax credits of up to 50% of the total renovation costs. The program is open to all Italian citizens, including landlords and businesses, and there is no cap on the amount of funding that can be granted.

The aim of the Super Ecobonus scheme is to reduce Italy's carbon emissions and energy consumption, create new job opportunities, and boost the country's economy through increased construction activity. The scheme has been very successful, with over 350,000 applications received in its first year. Knauf Insulation, a manufacturer of insulation products, is calling for similar programs to be introduced across Europe to help other countries rebuild their post-pandemic economies.

Research and Development Funding Support

There are several initiatives ranging from public funding to competitive research grants in the research and development space for retrofit technology enablers.

Green Heat Innovation Support Programme - Scottish Enterprise

Green Heat Innovation Support Programme (GHISP) programme supports innovation and capital investment to accelerate the roll out and adoption of green heating solutions and associated products. It encourages the growth of Scotland's green heat market by helping support the development of energy efficiency products, thermal storage and enabling solutions like digital and smart controls. The programme also supports the heat pump and heat networks sectors although they are outside the scope of this report.

Transport Scotland/ BE-ST - NearHome - R&D Case Study

Helping retrofit public spaces into sustainable office alternatives, reflecting the changing working patterns of a post-Covid Scotland. The toolkit, which is freely available to businesses and construction firms, centres around a kit-of-parts structure which can be installed quickly and with minimal interference to the building's external fabric. It offers a retrofit solution for buildings that may have previously been considered too difficult or costly to retrofit. Sustainability is at the core of design, manufactured using Scottish timber, to form a structure which is easily deconstructed and re-used if required. This project is open source and can be used by any building owner.

Innovate UK's Net Zero Heat programme

Innovate UK works with key partners to overcome barriers for faster roll-out of decarbonised heat for buildings. Focused on market demand, green finance, and design engineering. These are competitive R&D funds a rolling basis which fund innovation within products and services to look at standardised information for interventions, green finance leading to growth in supply chains and localised deployment and support for fast growth companies to increase capacity and achieve accreditation. Design engineering also looks to reduce capital and installation cost across the system of net zero renovation (fabric and decarbonised heat technology, including installation). They have included programme like Innovate UK- Net Zero Heat - rapid assessment of building fabric and the Net Zero Living Fast Followers programmes.

In summary, each of the finance and R&D models identified highlights the need to unlock retrofit at scale. Place-based large scale retrofit delivered in partnership with local and national government is key to delivering the pipeline and certainty for the market. This would then allow the supply chain to invest in skills and accreditation pathways.

05.

Recommendations -opportunities for scale

Chapter 5 - Recommendations

As highlighted throughout the report there are many approaches which Scottish Enterprise, Scottish Government and other delivery agencies could take to support the growth of the retrofit market. In addition to supporting innovation for retrofit EEM products and services, unlocking a consistent market demand through green finance and raising public awareness.

Products

Glazed Windows and Doors

- Create a collaborative programme of support for grant funding investment to work with systems producers, fabricators, and associated supply chain to develop a new profile design to be produced in the UK for triple glazed IGU's.
- Support windows supply chain to look at innovation within component manufacture for embodied carbon or Passivhaus certification.
- Support windows supply chain to innovate within new composites using raw materials.
- Support investment by Scottish Government in certification and testing capabilities for new window products to unblock commercialisation challenges.

Insulation

- Develop a support framework to work with insulation manufacturers to build on integrating supply chain.
- Strengthen the fundamental and applied research into, for example, natural fibre insulation materials.
- Raise awareness about sustainable insulation amongst potential materials suppliers (for example wool and wood fibre demonstrating the potential to access new markets.
- Create networking events to foster relationships between potential suppliers and product manufacturers.
- Identify other Scottish case study examples to provide valuable data / insights to support policy initiatives for natural insulation.
- Provide investment to help potential suppliers enter the market (in addition to, for example, Zero Waste Scotland ZWS funding opportunities) – capital has been invested in manufacturers, but other members of the supply chain would benefit from support to de-risk the move into a new market for, for example, timber suppliers, etc.
- Review the accreditation and testing framework to better accommodate natural fibre insulation products.
- Work with funders to look at investment in certification and test facility infrastructure in Scotland.
- Work with Offsite panel manufacturers and clients with large scale retrofit need to design a panelised system.

- Work with the Offsite/energy supply chain to support the design of a retrofit energy pod.
- Work with supply chain on developing the installers skills for an Offsite panelised solution.

Services - Digital

- Work with industry to support a digital platform for the owner-occupied private rented sector.
- Increase innovation around the development of digital platforms.
- Raise awareness with social landlords on existing digital platforms to plan large scale retrofit programmes.
- Run workshops with private homeowners to find out what support they need.
- Run workshops with EPC services providers to examine opportunity to scale the retrofit market for example rapid assessment of building fabric.
- Increase innovation within digital solutions for modelling- thermal bridging, moisture.

Skills and training

- Develop a building physics module to be delivered to various levels of tertiary and university education.
- Develop a “Build the Junction-Model the Junction” workshop to help retrofit designers develop understanding of thermal modelling calculations.
- Develop a suite of retrofit training rigs that can be adopted widely.
- Funded large scale support for the adoption of PAS2035/PAS2030 accreditation.
- Workshops with supply chain to map support needed to upskill supply chain.
- Develop a train the educator course for the tertiary education systems and support further and higher education in retrofit training programme.

Finance

- Identify an opportunity for a large-scale neighbourhood retrofit at scale with collaborative partnerships.
- Work with retrofit intermediaries to replicate business models for local place-based organisations.
- Engage with the Green Heat Finance team to pilot finance model.
- Engage with funders of all government schemes to assess geographical supply chain opportunities for product/services.
- Engage with the public sector decarbonisation programme to map out product opportunities for building fabric for non-domestic archetypes.

General

- Increase access to sustainability-linked loans for SMEs
- Develop archetype solutions for housing stock retrofit pattern book hosted and maintained on BE-ST platform.
- Create dedicated “Green” or “Transition” SME funds.
- Create advisory hubs that bring together customers, suppliers, and finance providers.
- Create the rules and protocols to enable more accurate, real-time assessments of energy performance.
- Strengthen the ecosystem of SME accelerators and growth hubs.

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Appendix A - Organisations/Online survey analysis
Appendix B - Interview analysis
Appendix C - Cost case studies
Appendix D - Supply chain (confidential)
Appendix E - Existing Homes Alliance Case Study
Appendix F – Skills Research

Appendices

Built Environment — Smarter Transformation

Energy Efficiency Research: Scaling up products & services

Results
14 March 2023

Methodology

- Self-completed survey issued to a wide audience through BE-ST and multiple stakeholder channels

Sample

- 128 responses
- 43.7% from central belt of Scotland, 10.9% from Highland and Islands, 28.9% from rest of UK
- 1/3rd responses from organisations of over 250 employees, 23.4% micro businesses
- 52.3% professional services, 7.8% manufacturer, 22.6% public sector, 12.5% contractor also reflected in involvement in retrofit

Key findings:

- Average familiarity of the Heat & Buildings Strategy is around 56 from a scale of 1-100
- 57.% of respondents believe the EPC system should be reformed as first step before we use it to set targets, 37.6% didn’t know. Common views include a lack of flexibility, both in terms of metrics and taking into account different materials and technologies.
- A lot of feedback related to issues with the tool, the software is not flexible, can lead to inaccurate results, is not focused on building fabric, generally that the current tool is not fit for purpose and something like the PHPP would be better suited (all comments on slides 17-19).

Key findings:

- 47.7% of respondents believe the proposed EPC C targets are achievable with some work, 14.6% believe they are achievable, 22.9% believe they are not achievable. The most common barriers of cost, finance and lack of skills were most commonly highlighted, with the need for greater Government backing and more advice for homeowners. See all comments on slides 21-24.
- 33.9% respondents believe that previous EPC targets set by EESSH legislation for social housing are behind, 7.3% believe they are on track, 7.3% believe they are not achievable. Comments related to there being not enough focus on fabric performance, there is too much variation within EPC bands for this to be useful and the targets are not ambitious enough.
- 22.9% respondents believe that the average cost to retrofit a home is £20-30,000, 33% believe the figure lies between £35-50,OOO and 10% believe the cost is higher than £50,000. There is a common consensus that there are many variable factors which make this figure wide ranging. It was also noted that the closer to net zero, and the better quality retrofit, the higher the cost.

Key findings:

- 62.3% of respondents have a medium to high awareness of public sector funding for retrofit, 37.6% have no awareness. It was frequently mentioned that funding routes were limited and the landscape frequently changing, and several mentioned a lack of awareness of funding for the homeowner. Comments varied significantly suggesting that there are a lot of mixed messages and unclear guidance/communication around funding availability.
- 52.6% of respondents have engaged with retrofit resources and support to some extent, 15% extensively and 27.9% not at all. Most of the examples given were of low level engagement such as CPD, events and other knowledge exchange activity.
- 62% respondents had medium or high knowledge or experience with step-by-step whole-house retrofit vs single measure, 19.3% low and 13.9% none.
- 67.3% respondents had medium or high knowledge or experience with retrofit guidance, 23% had low and 4.4% had none.
- 36.26% respondents had low knowledge or experience with services/technology in non-domestic retrofit, 17.5% had none, 27.4% had medium and 13.1% high.

Key findings:

- The main enablers for the adoption of both domestic and non-domestic retrofit ranked similarly in order of importance:
  1. Funding
  2. Affordability
  3. Clarity on policy & regulation
  4. Availability of skills
  5. Availability of products & services
  6. Knowledge of climate change

Key findings:

- The main barriers to enabling retrofit in the supply chain were:
  - Skills was the highest ranked barrier to enabling retrofit in the supply chain (70.4% respondents), followed by clarity on government policies and targets (52.8%), public procurement (41.1%) and tenant engagement (40.1%)
  - Administration of paperwork, certification, pipeline, accreditation and public procurement were mainly ranked as medium barriers
  - Comments referred to lack of skills with mention of the uncertainty on quality assurance (PAS 2035) impacting on momentum to upskill the workforce, but also included delays in processing an insulation grant, VAT on new build vs VAT on retrofit, lack of support to enable contractors to gain accreditation especially in rural areas

Key findings:

There was a lot of feedback with regard to identifying areas of support to help stimulate further adoption and implementation of energy efficiency measures for domestic and non-domestic retrofit. The most common themes were:

- Need for a clear retrofit strategy, policy, standards from Government
- Incentives for people to skill up
- Incentives for homeowners to retrofit
- Better access to resources, knowledge & information
- Availability of funding
- Simplification of the process

See slides 42-46 for all comments.

Key findings:

There is an overall consensus that demand for products/services will increase over the next 5 years to meet opportunities created by retrofit. Varying degrees of the level of increase, comments included:

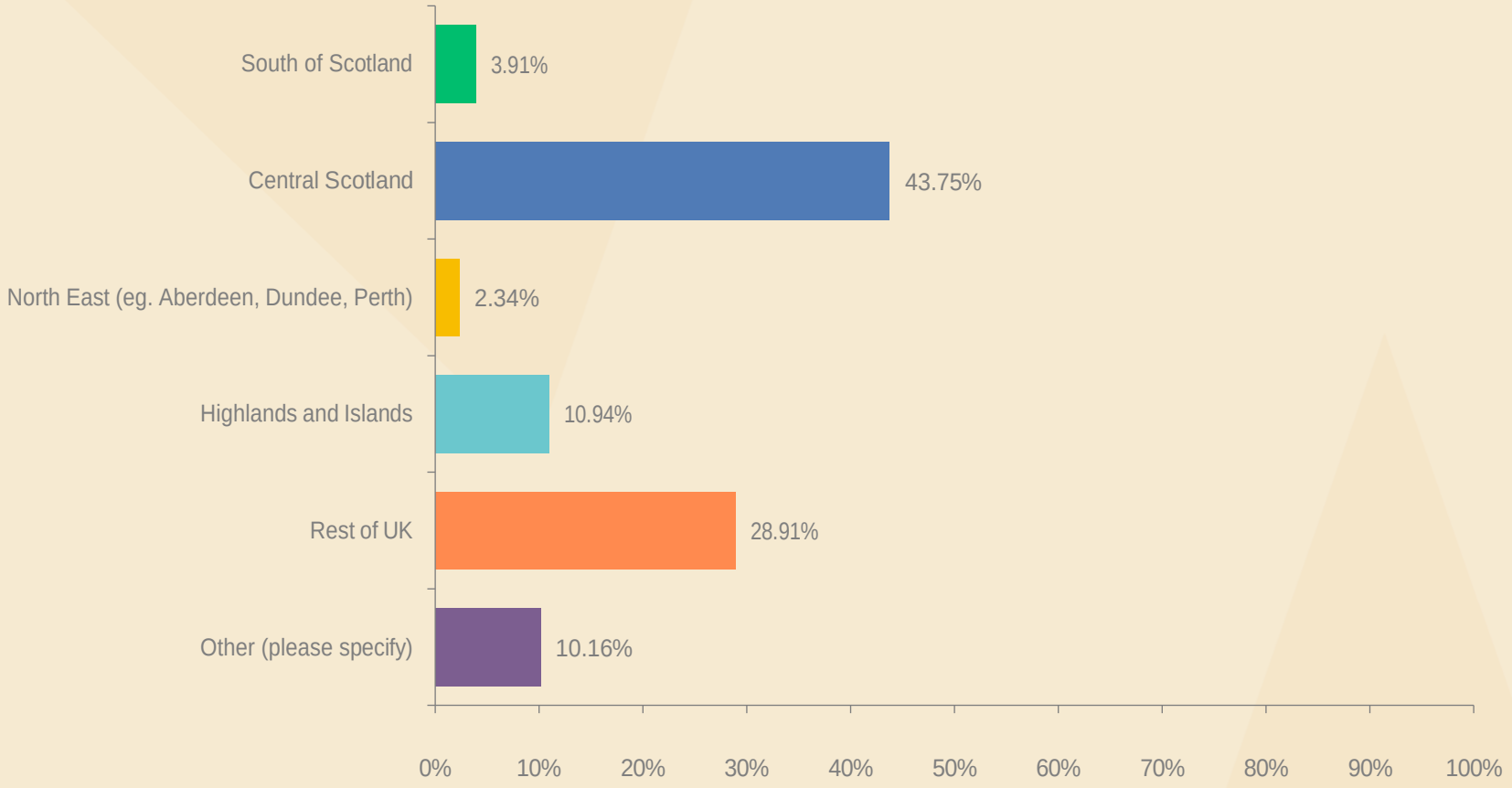
- 50% increase expected
- Increasing rapidly but a lack of skills holding that back
- Patchily at best, given the current policy environment
- Increasing but lack of funding
- Two mentions of investment needed were of £1-2m (retrofit products) and £6m+ (insulation)

See all comments on slides 47-52.

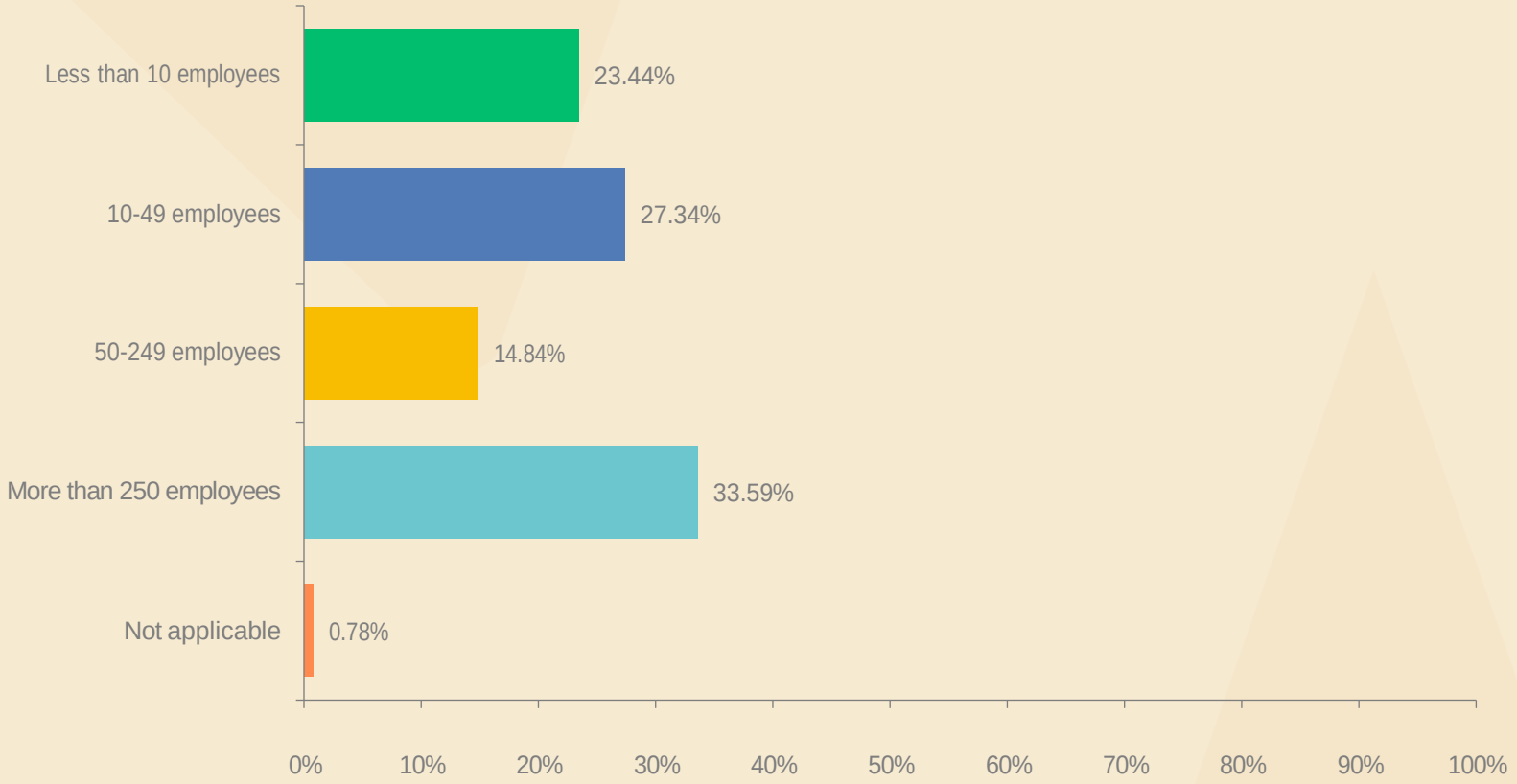
02

Full results

Q1: Please indicate the region in which your organisation mainly operates:

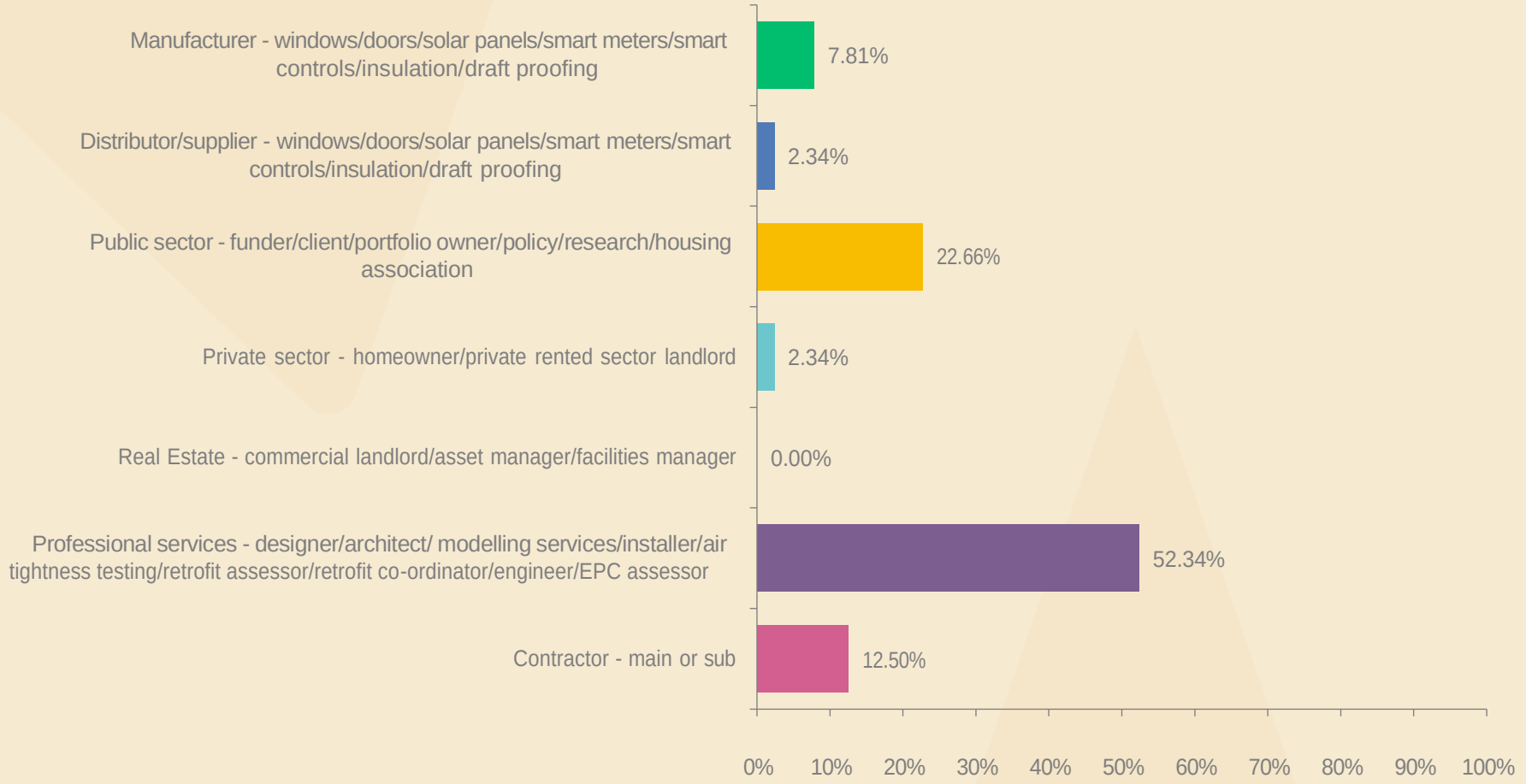


Q2: Organisation size



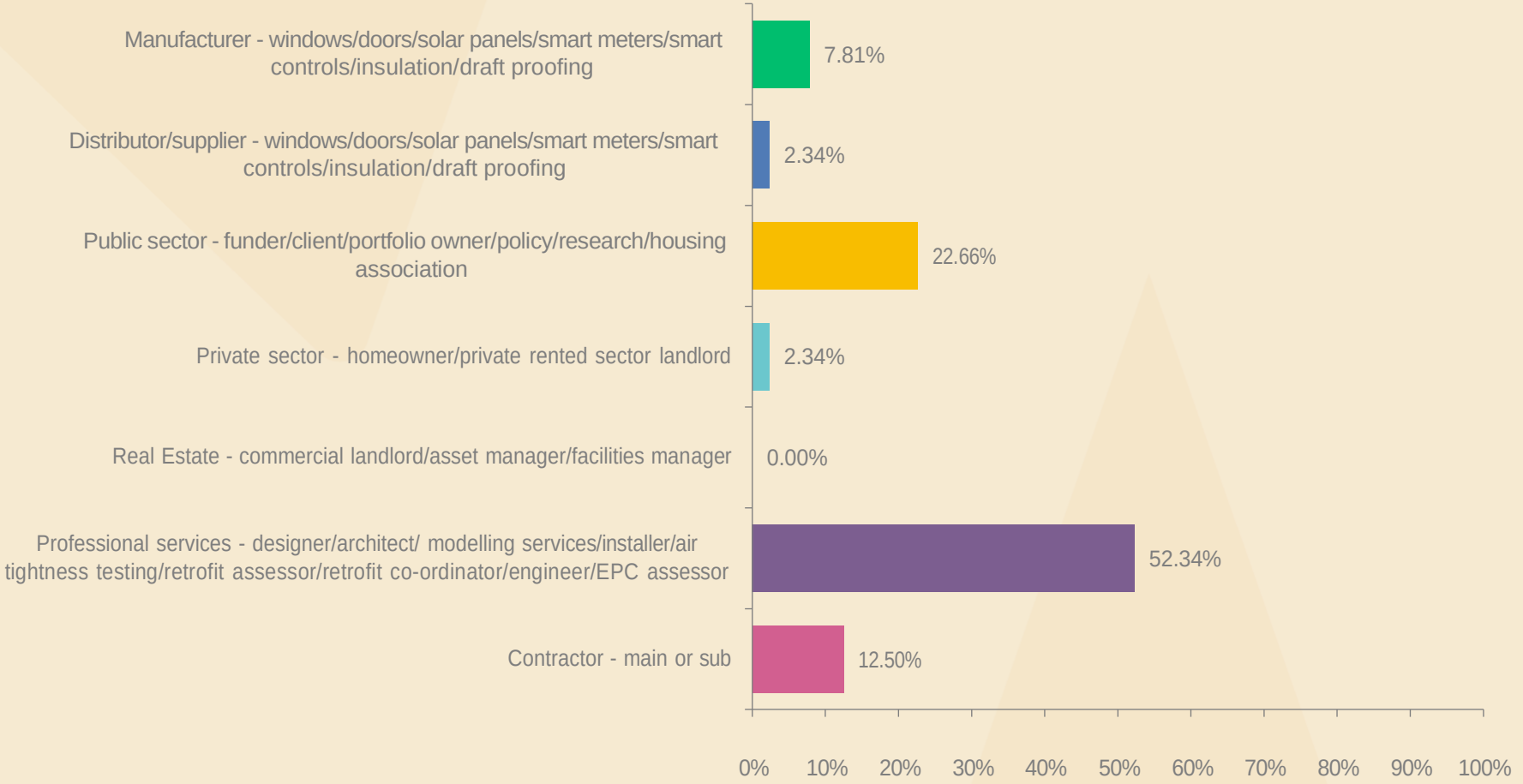
BE—ST

Q3: Which best describes your organisation?



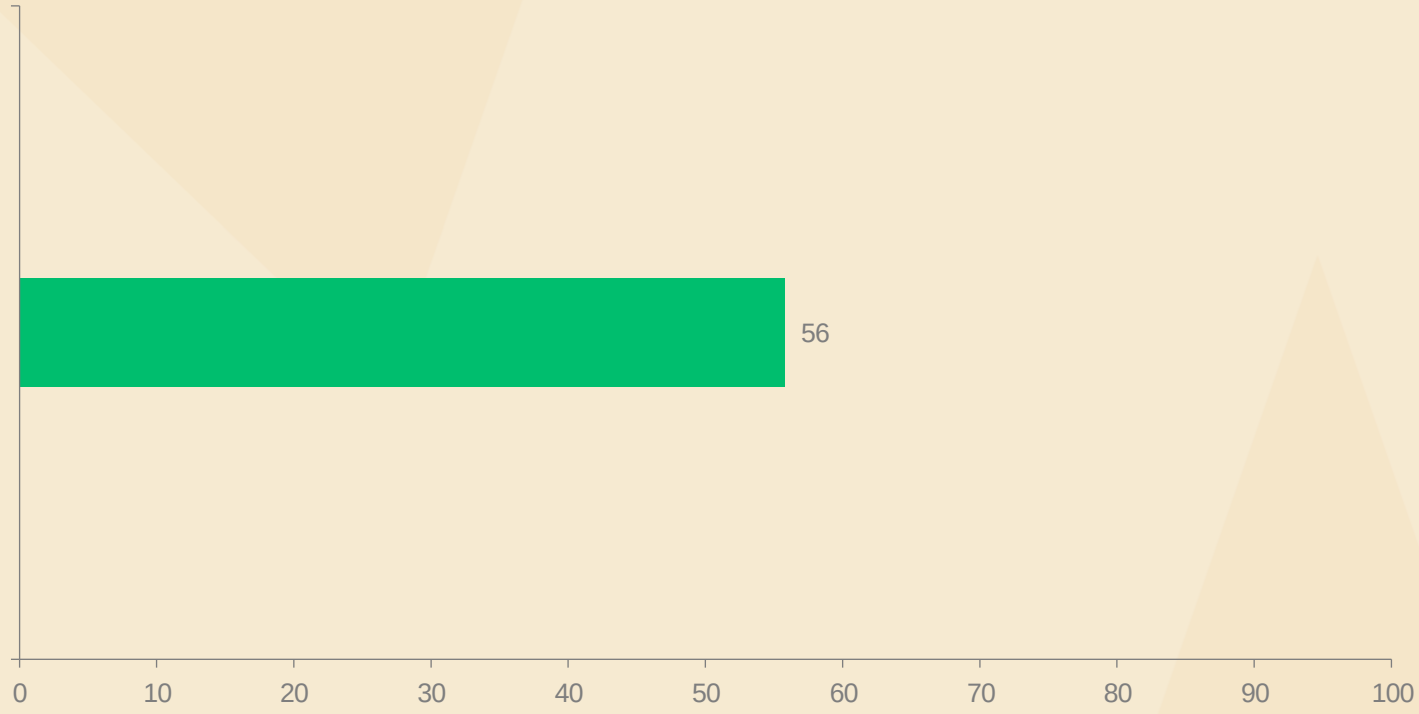
BE—ST

Q4: Thinking specifically about retrofit, in which way does your organisation work in the retrofit space? (Tick all that apply)

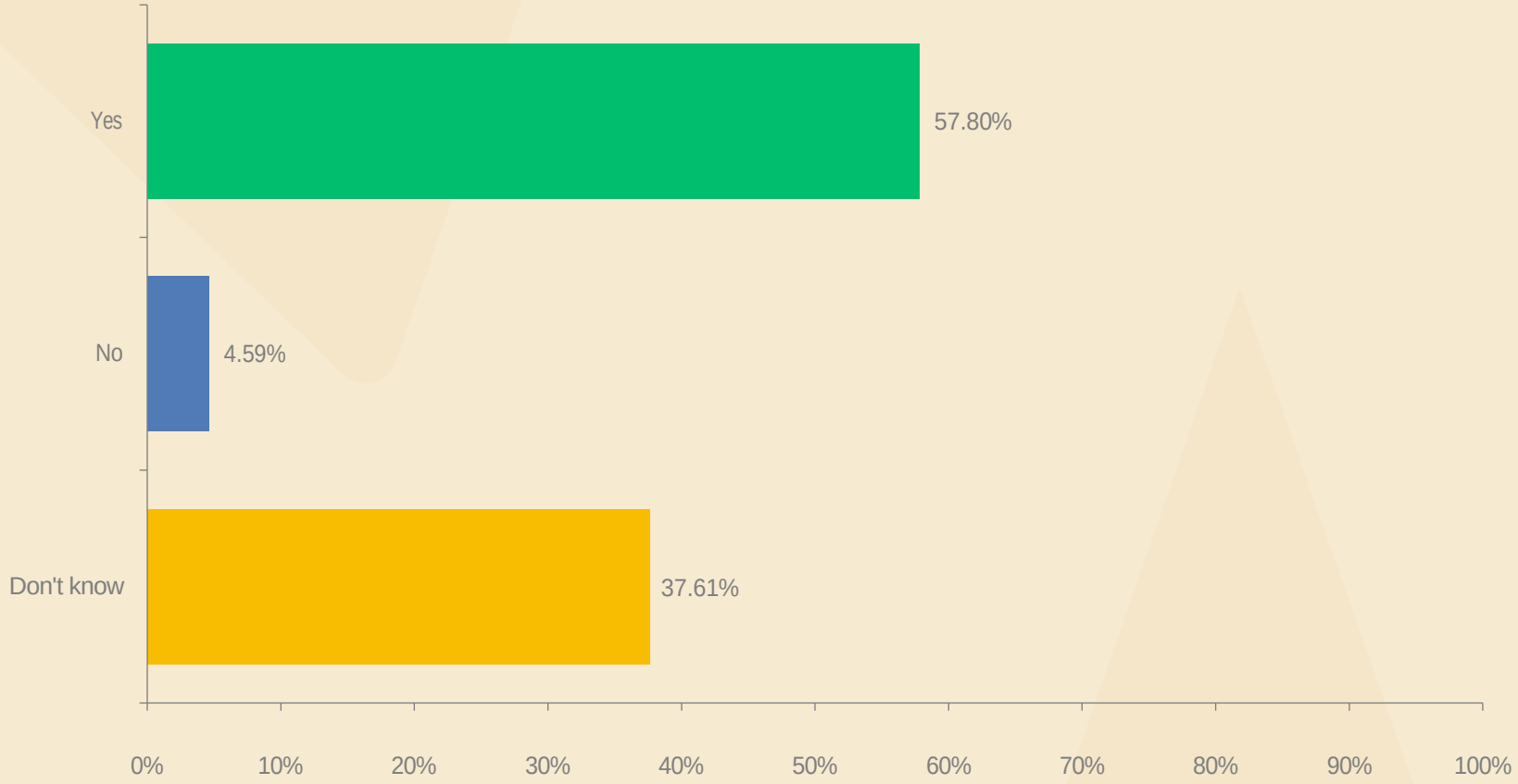


BE—ST

Q5: How familiar are you with targets set out in the Heat in Buildings Strategy which set out legally binding targets for EPC’s in all buildings? – Average rating



Q6: In your view should the EPC system be reformed as first step before we use it to set targets?



BE—ST

Q6: If yes, what changes do you feel are required?

It is not based on measured data and does not address real operational energy targets, often based on assumptions

Need to be changed to provide a more accurate estimate of energy bill savings, carbon savings.

There needs to be more flexibility in the software and scope for more detail.

The carbon content of electricity should be regionally defined. At present the uk electricity mix figures are used in Scottish Regulations. Combined with more extreme weather data, this works against any form of electric heating system, especially in north of Scotland. In general EpC methodology should be upgraded and furthermore it Should be redefined as a CPC carbon performance certificate.

Better calculation method needed eg Passivhaus, correlation between rating and actual performance is poor

Measured HTC instead of RdSAP 'date constructed' assumptions. Focus on kW and kWh/m2/yr.

Move away from cost based metric

A better way to value different measures and take into consideration actual vs anticipated performance

Should focus on the fabric first approach insulate doors windows wall roofs first

Different metrics are needed, for example kWh/m2/year or HLP

Materials choices should be taken into account

Fabric performance of the house should be the benchmark - minimum u-values and air-tightness.

Changes to underlying RdSap to better account for the impact of retrofitted measures. Additional accounting of the affordability of warmth for the occupant.

Make it more accurate and flexible - there are too many massive assumptions

Realists do take renewable tech into account

There needs to be clearer indicators of the required EE measures which reduce heat demand, prominent recommendations and advice on the switch to low carbon heating and clearer indicators of actual running costs.

It needs more detail, e.g. MVHR performance data, not just a tick box exercise.

Q6: If yes, what changes do you feel are required?

The calculation method is too simplified and relies on too many assumptions rather than real world performance. It also takes no account of embodied carbon.

PHPP for all buildings

Much more detailed analysis of building fabric as the current system is VERY inaccurate even for buildings of standard construction. I expect current statistics on housing stock EPC ratings are therefore not reflecting reality. A much more accurate system is essential in order to make informed decisions on suitable retrofit actions.

Preference for real world performance rather than presumed performance based on assumed fabric state. Need for it to better reflect carbon emissions and stop marking householders down for having a heat pump

Looking at Energy Use Intensity and measuring fabric better

Needs to become more closely matched with actual building performance

Build types are a guess most of the time with different build types being put forward for different buildings in the same block. If we are working towards fabric first glazing should be looked at more.

Carbon metric should be added, including embodied carbon of materials. There could also be a follow on check to make sure the building is performing a year after the initial certificate, to address the performance gap between what is claimed and actual energy use.

To reflect true energy performance and transition away from assumed, default values along with outdated cost and carbon values which does not currently incentive low carbon solutions.

Align or replace with a more rigorous standard such as Passivhaus which more closely reflects in-use energy and emissions, and has a more holistic approach to meeting targets. Embodied energy and emissions should also be counted, against the buildings design life. A further mechanism to compare targets in domestic dwellings per capita rather than per m2 could help normalise larger houses which have disproportionately high energy use per capita.

More accurate modelling which better reflects in use performance

Full SAP as a minimum required to establish EPC rating. Too many assumptions and not enough modelling invested in RdSAP. Should also include real time energy consumption

The EPC bands should be replaced with a requirement to achieve a heating demand target. This will help to ensure that a fabric first approach is implemented and remove barriers to the uptake of low carbon heating systems.

Q6: If yes, what changes do you feel are required?

It doesn't matter too much. If the business case stacks up, people will do it regardless

Additional Assessor training develop greater consistency, Add cost saving to existing payback period.

Identify levels of Direct Electric heating options and place a hierarchy on these based on performance in real life retrofits - not how they perform in a controlled research centre.

I feel the EPC should take an even view of all the items that will help reduce energy waste and not simple add items to achieve a score

This and it needs to be kept under regular review

Currently using gas gives higher band that electricity, eg heat pump. Discourages decarbonisation

Tighter guidelines and stricter inputs to prove accurate data

A move to a model that uses in situ monitored data and more accurate predictions using phpp

More reflective of actual building performance and not notional assumed or generic point scoring upgrades

Energy Use and not RdSAP - too limiting in predicting performance

Take cognisance of traditionally built structures (pre-1919 construction)

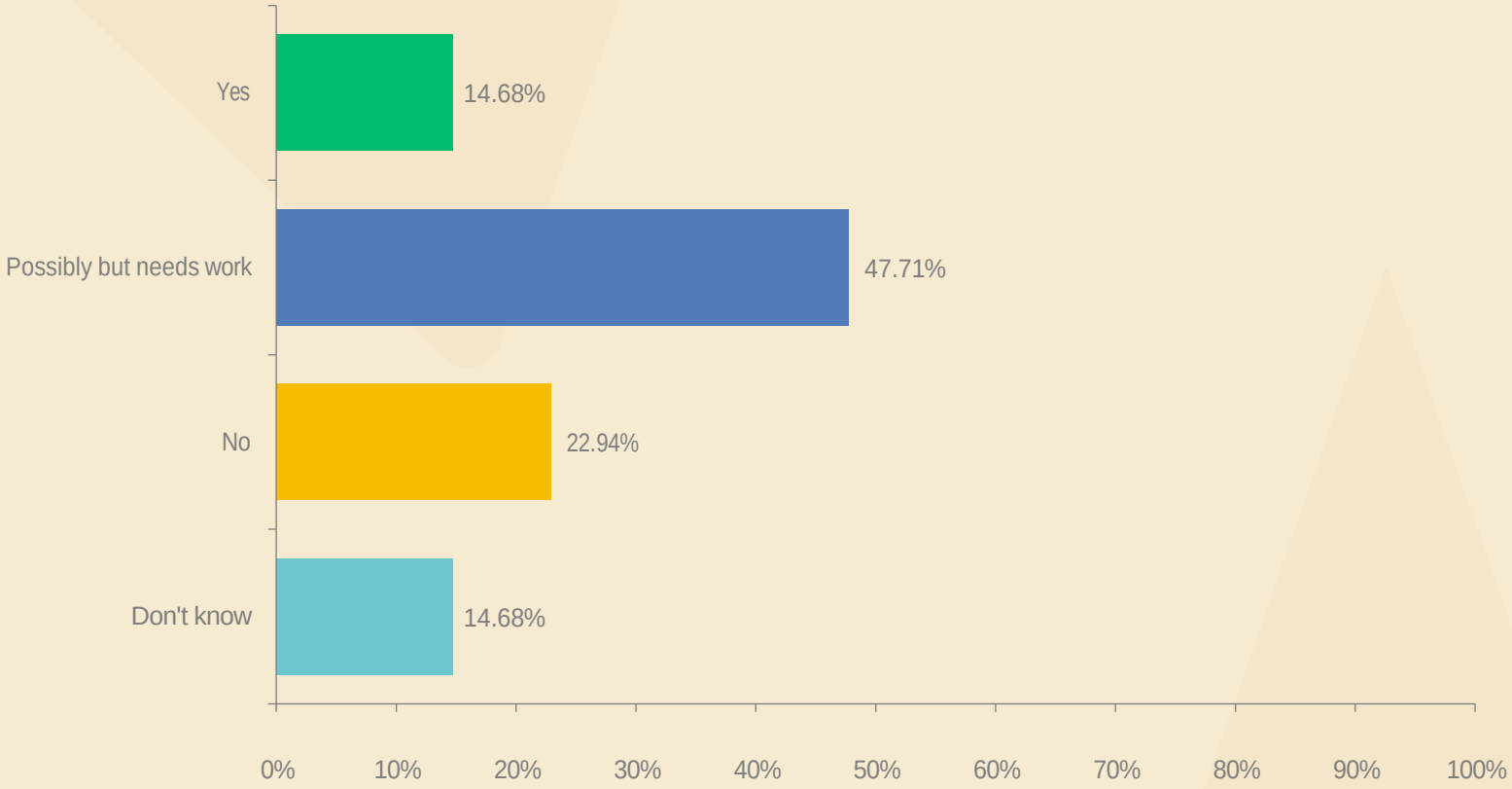
Too many assumptions are made. It's not detailed enough. Weighted towards gas boilers. Should link to a retrofit plan.

More accurate data on specific home types

Experts don't feel current system fit for purpose - little point in carry on using a broken system.

Consultations on proposed regulations will happen from 2023-2025 to set targets for owner occupied households to achieve an EPC C by 2033 (moved forward from 2040) at defined trigger points. Also in the consultation, where it is not technically feasible or cost-effective for EPC C, a minimum level of fabric energy performance through improvement to walls, roof, floor and windows would be required.

Q7: Do you think the above targets are achievable?



BE—ST

Q7: Do you think the targets are achievable?

Retrofit at scale needs to be accelerated

Funding, incentives and capacity

The sheer number of households and the lack of an established supply chain.

There doesn't seem to be enough money around, or skills or awareness.

The overall indoor air quality of any dwelling needs defined in order to prevent indirect consequences of the application of poor insulation

Large volume

Too costly for owners

It may not be feasible for property owners to cover the costs of retrofit upgrades - people are living in fuel poverty and may not be able to cover the capital costs.

LETI is developing innovative process/products/productivity improvement guidance to dramatically reduce retrofit costs

A lot of very expensive internal wall insulation work will be required for Scotland’s housing stock to meet an EPC C and there is no will for it or funding. More likely to have a fraudulent EPC carried out than to spend £25k ripping out kitchens and bathrooms to insulate solid walls

Yes but only if EPCs are reformed or replaced

Issue of scale, financing & practicalities for owners/residents

There is a cultural shift required to either accept loss of space internally to buildings or accept that the exterior of buildings will be aesthetically altered with external insulation

Measurement of results and workmanship is vital, grant funding or tax reduction essential

Defined min targets for traditional stone built properties are not appropriate and may cause harm to the property and peoples health, a holistic conservation based approach should be used to identify the an appropriate and achievable level of performance.

Sufficient mechanisms don't yet exist to support the delivery of these targets. This includes a competent and significantly scaled supply chain, a clear route of support for households and financial incentives to incentivise action.

The improvement of the fabric of buildings requires more than just insulation and air tightness products. It requires a completely different ventilation strategy. Our construction industry has no training in either of these and has not really moved forwards in its skills since 2007 due to the lack of training. Much more emphasis on training needs to be paid, in order to change anything in reality.

Q7: Do you think the targets are achievable?

Lack of funding, lack of will from general population who do not want the disturbance of Retrofit.

It is a sub par approach and we believe in having a superior target

I expect the key restriction to mass-scale retrofit is availability of skilled labour. In so far, aiming for EPC C level by 2033 would waste thus and other precious resources. Buildings retrofitted now are very likely to still be around in 2050 when much higher efficiency than EPC C will have to achieved. Therefore, if retrofitting now, wherever possible, aim for EPC A or preferably 'Passivhaus Institute EnerPHit' level. As shown by LETI research, buildings will need to reach EnerPHit level to bring CO2 emissions down to the required level. Any insufficiently ambitious retrofit measure taken now would therefore have to be dismantled and redone between 2033 and 2050. This would be an inexcusable mistake. So, please, wherever possible retrofit to EnerPHit level NOW and not after 2033. Achieving a higher efficiency level now will result in a smaller heating system, either reducing changes to existing central heating systems to be used with a heat pump or reducing heat demand to be met by a much cheaper air-to-air heat pump (as is used in Passivhaus CompactUnits).

Serious skills shortage for retrofit, retrofit expensive and technically challenging for householders

Owner Occupiers need better advice. Supply chain for owners needs to be improved in terms of numbers and technical competence

There needs to be more funding made available

There are plenty of case studies where even hard to treat properties have increased an EPC with a deep whole house retrofit - it requires commitment and funding but is achievable

Not convinced that there is the political weight behind this nor enough funding nor the skills + people needed within the construction sector

Legislation will hopefully drive demand allowing localised skills and capability to increase - but we also need a defined retrofit strategy with a combination of public and private finance mechanisms.

Lack of clear strategy or awareness of fundings.

Government needs to back even modest targets with investment in trades, skills, incentives and other financing

They are achievable in theory but greater support is required from government and in upskilling the industry to achieve this

Without a change in government funding, finance structures and homeowner support, this feels very difficult to achieve.

EPC band C is under ambitious. The standards should do more to encourage higher levels of efficiency through funding of whole house retrofit

Q7: Do you think the targets are achievable?

Half the EPC's are wrong and Govt will change their mind. Its a vote loser.

Inadequate funding, installer capacity, labour training

Owner occupiers are likely to find costs hugely prohibitive

There are a lot of old buildings which require work to meet this target.

it's very difficult to place controls on people's houses

We have the ability to make this happen but it will need funding for some sectors to scale up now.

Do not know enough about the topic

How can you force households to spend money, when they are already stretched by high inflation and wages that are not keeping pace.

Insufficient government commitment to the target

We need to upskill and really understand the whole building not simply single parts

If this for new builds of existing housing stock? If yes, what legal right do the government have to enforce that people upgrade their house to meet these requirements? This would seem very totalitarian.

Accessible grants and subsidies will be necessary

Not unless funding is provided for older properties

need to police this more and develop products and services with costs that can help achieve this

The level of skill, knowledge and supply chain are not developed to deliver this scale of retrofit

Disengagement and no route to market or funding for legislating or funding owner occupier EEMs in existing stock. Clarity should be sought on whether this question relates to all housing stock of just RSL stock

Cost to homeowners in order to achieve this

Requires education, funding and incentives

The supply chain isn't there, particularly in rural areas.

Funding, lack of skills/trades, lack of knowledge

Needs to work with services to avoid unforseen consequences. Whole house retorfit approach similar t oPAS2935 for accountability and diligence.

Q7: Do you think the targets are achievable?

Traditionally built structures perform differently to modern (post 1919) structures. A different way to measure their energy performance requires to be calculated/ developed

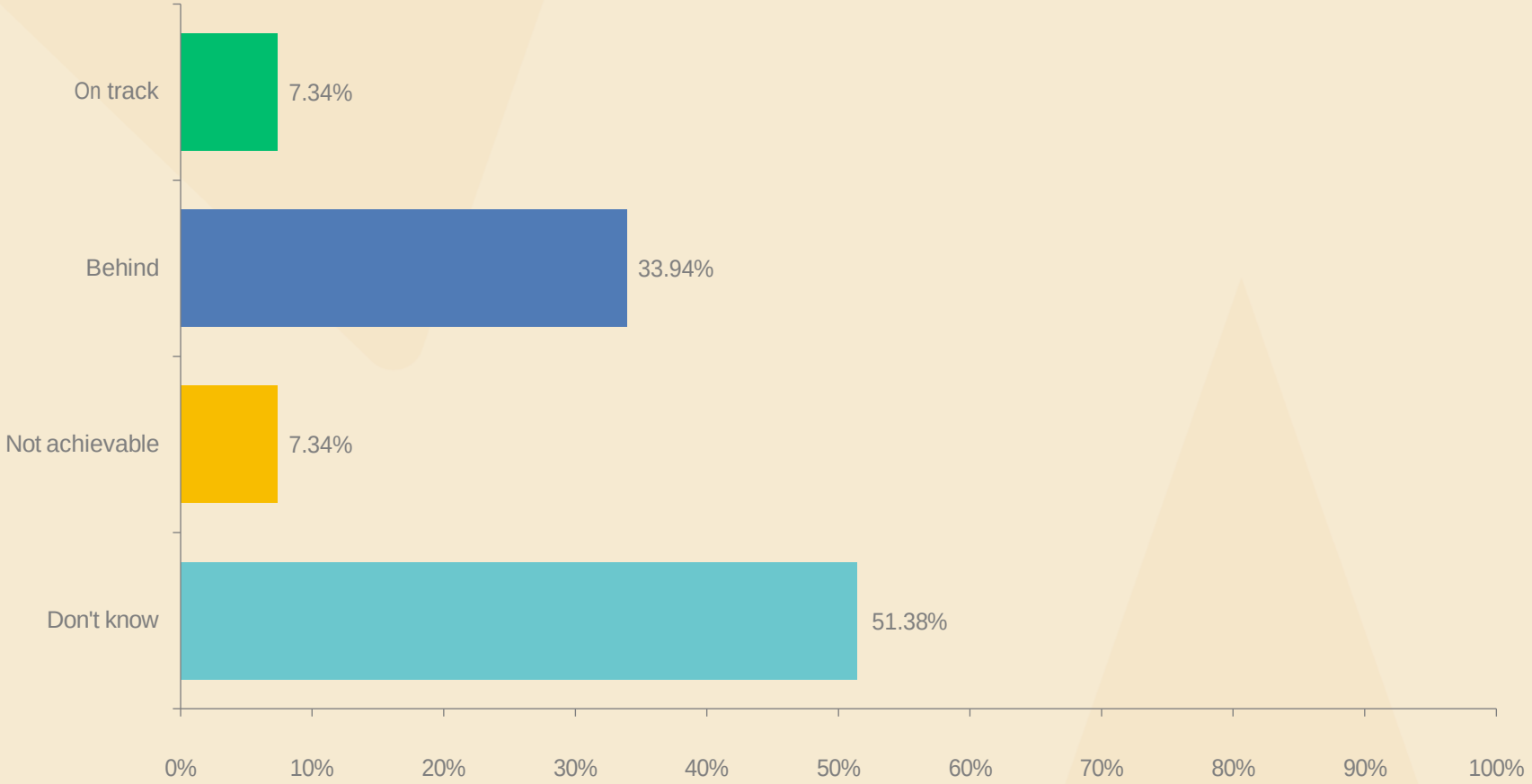
The targets are too low and have to be exceeded to avoid excessive costs of the transition.

Proper surveys are needed first. Too many unwilling owners if you can find them all. Too many properties in un-factored blocks of flats.

If date are being set back then the message is not being received, need more awareness to all landlords and homeowners

Skills shortage, supply chain maturity, product development etc.

Q8: Do you believe previous EPC targets set by EESSH legislation for social housing (to achieve min SAP scores between C and D by 2020 at point of let) to be:



BE—ST

Q8: Comments on EPC targets

Don't know anything about the EESSH legislation

Industry could deliver better standards now

Majority met standard by deadline

No budget available

Too complicated too much red tape

SAP also a flawed system - not enough focus on fabric performance

As per the above, I don't think these targets are ambitious enough. On another note, from observation of retrofit measures on social housing around Dundee, poor retrofit design and strategy has caused huge thermal bridges around external wall insulation. It appears a complete lack of understanding if thermal bridging and retrofitted insulation pervades many current contractors. Poor choice of vapour-closed insulation materials will invariably cause long-term problems with moisture in the building fabric and also occupants. This is extremely frustrating given that there is plenty of evidence on how to retrofit properly (ref. AECB Carbonlite and Passivhaus Designer/Contractor courses).

There is too much variation within EPC bands for this to be useful.

A number of landlords are reliant on exemptions to achieve compliance but these should be challenged - social housing has the opportunity to lead by example and help stimulate the retrofit market.

Lack of awareness. It must become compulsory by law to happen. But then again there is not enough labour workforce to implement.

The data might suggest "achieved" but in reality they are behind

If this was SMART proven we would have been much closer to targets set. We have proved that we need to look in more detail on what we can/ need to provide to achieve the next target range.

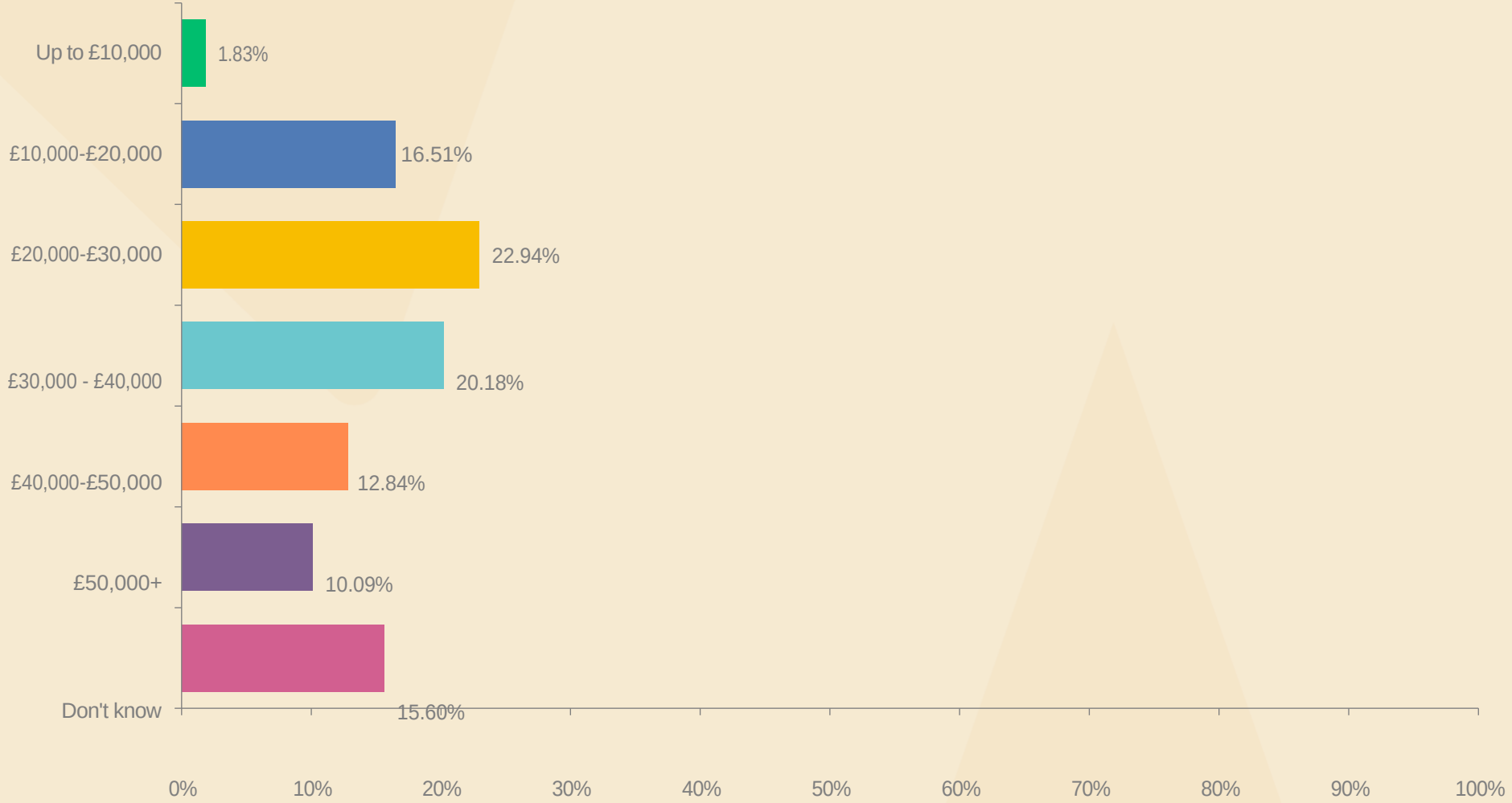
Do not know enough about the topic

Scottish social housing is good, not so private landlords

Some providers are on track. Not sure on a national level.

It is now 2023

Q9: What do you believe is the average cost of a domestic retrofit per home?



BE—ST

Q9: What do you believe is the average cost of a domestic retrofit per home?

Whole house retrofit is a very labour intensive process of careful evaluation of proposed measures and addressing building defects and lack of maintenance prior to any works commencing. Testing and monitoring should form part of the budget allowance. Step by step long term retrofit can be achieved and form more realistic benchmarks for private owners. Retrofit plans aligned with PAS2035 will be required.

Completely depends on the state of the house and what you're aiming for but more often the projects we are involved with are 30k+

External wall insulation + New windows + ventilation unit + ASHP

Dependent on extents

Scale of work involved and specification of technology or products - particularly emerging tech (ASHP) and historic buildings (listed or traditionally built)

Halving of heat demand of typical archetype for ~£18k including heat pump.

Dependent on too many factors

Depends on the products, standards of installer and type of property

Stick to improving the fabric simple things first

It's a guess

At least - to do it properly

Answer is a guess, as this is a "how long is a piece of string" question. House/flat? detached/not/top floor/middle floor? It all matters.

Most existing houses require significant repair work to be carried out in advance of retrofit

This is what it costs us, anyway. You can do it for under £20k but it will be poor quality and use cheaper, fossil fuel derived products,

30-40k per 80sqm at scale is possible from our studies

The cost will vary hugely depending on building shape, size, location, exposure to wind and rain, type (flat, bungalow, semi etc.) and efficiency target. I guess most homes could be retrofitted within £50,000.

It depends. If it's just a heat pump it's much more likely to be in a lower bracket but if you believe that all homes should have substantial fabric upgrades (which, incidentally, at Nesta we don't believe this) then the cost will be higher

If it is to be heading towards net zero, it will be in the region of £80k

Basic package of better windows, wall insulation and a heat pump

Q9: What do you believe is the average cost of a domestic retrofit per home?

It will vary on the level of retrofit, I believe enerphit standard can cost between £800/ m2 to £1000/m2.

I believe it is currently low, because not enough is being done - there needs to be a deep retrofit, whole building approach - fabric first including air tightness and appropriate insulation, and less focus on technical heating solutions. A well insulated airtight building needs hardly any heating at all.

For basic upgrade of loft insulation, EWI, more energy efficient boiler and solar panels I think the costs would be in the region of £20-30k.

We produce the National Schedule of Rates pricing tool and Retrofit Schedule

For a deep retrofit that also achieves net-zero carbon emissions right now, it can't be anything less than £50k per unit - however if we can create demand and aggregation with sufficient skills and capability at a regional/local level this will help drive economies of scale.

Minimum measure would include insulation, windows and ventilation. An expert should be involved which adds professional services fee. That gets easily to £40000

This varies a lot, depending on the measures. A whole 80sqm house in London for a whole retrofit starts at £100K, fully insulated, ASHP and new windows.

To reach net zero carbon, we are spending £100k+, more general retrofits which do not achieve net zero are closer to £30-40k

Dependant on house type, size, location - but insulation to all external walls and roofs, replacement of external windows with double glazed units

Light retrofit ~ £10k. Medium retrofit ~ £20k. Deep retrofit ~ £50k

There needs to be a better understanding of the level of retrofit, again measured against a more robust standard such as Passivhaus - with that in mind, in order to meet future targets, not only do practically all the existing housing stock need to be upgraded, but also the vast majority of those currently in development. The cost to strip back to insulation component level and reinstate is substantial.

but depends on level of retrofit required

This is only to EPC C (approx). To do a proper deep retrofit, we're seeing costs of £1000+/m2

Based on reported costs

For a deep retrofit upgrade to achieve compatibility with a net zero future requires significant investment. Under ambition may save money in the short term but it is likely to lead to work being revisited and expensive remediation. Deep retrofit alongside quality assurance (such as PAS 2035) is required to meet goals

Q9: What do you believe is the average cost of a domestic retrofit per home?

We have been involved in 70 SHDF bids.

To achieve better EPC ratings, two key aspects are improvements in insulation and installation of new boilers. There is often a government subsidy that is available to help with this.

Unsure as it depends on the level of retofit required and do not know enough about the EPC targets

Far infrared heating would cost around £4K and a SunAmp water battery unit around £4k also per home to supply and install within a day or two. This would be with minimum distribution to the owner or tenant. Compared to ASPH where the refurbishment alone could potentially be £10k where radiators are replaced with larger units, water pipes are replaced under flooring - all to accommodate the required 40deg water flow. Not to mention the equipment storage and space required to install units. Then there is the ongoing maintenance costs to consider.

This is really dependant on the size and nature of the retro fit needed

Would depend on how many measures

Insulation & Heating, closer to £30K really depends on measures

It depends on the extent of what is being retrofitted. eg. Windows, solar, insulation (roof, EWI, etc.) heating.

Heating and wall insulation costs are relatively high to include install costs

Difficult to answer! Economies of scale skills help to bring down costs.

It depends upon the level of intervention needed and whether carried out as a standalone project or as part of a refurb

If whole house

Depends on the type of building. Depends on what you think is needed to optimise costs of generation capacity (e.g. offshore wind), cost of grid upgrades, cost of demand reduction, and acceptable levels of disruption for households.

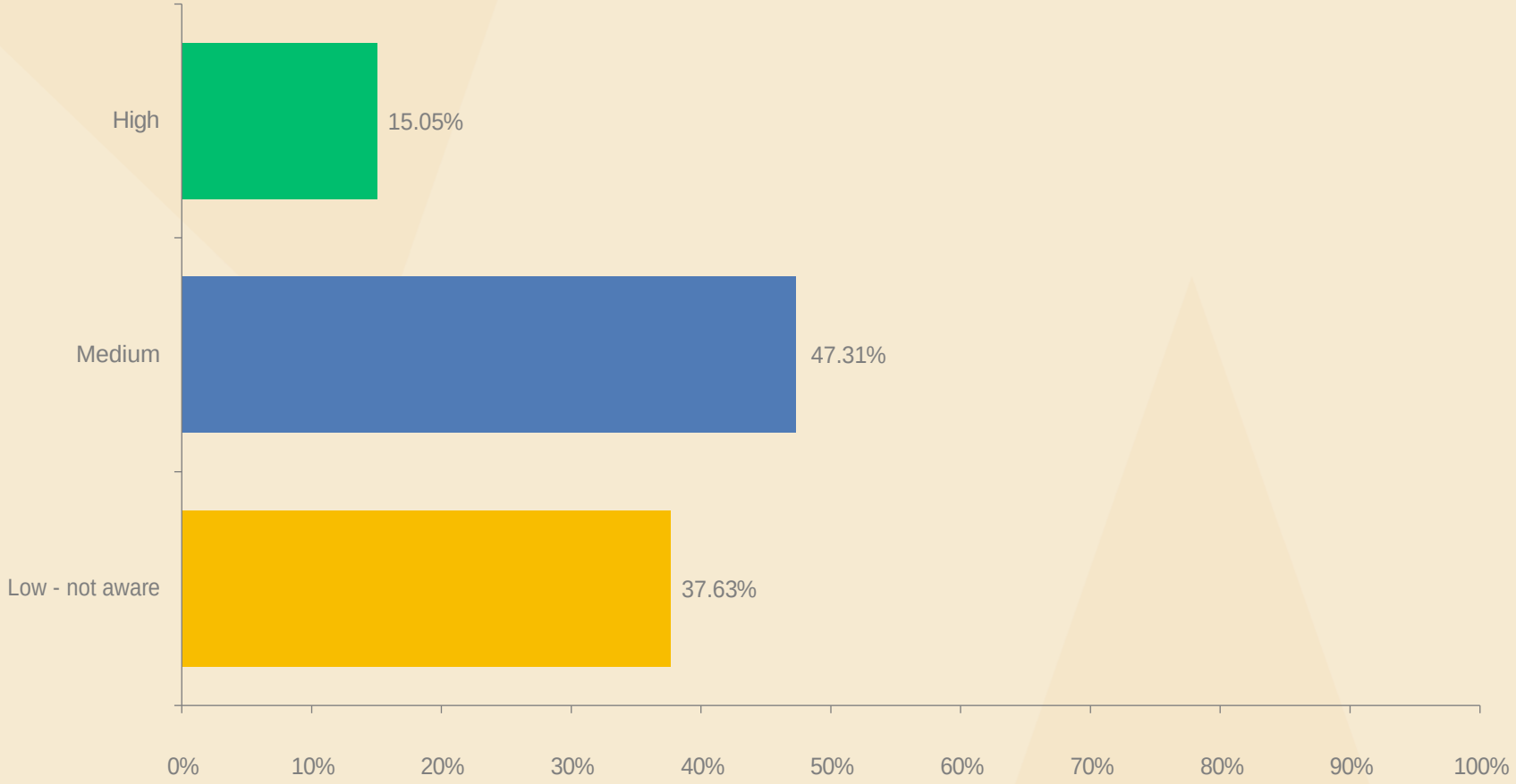
Should we carry out work to current regs or plan for the future and Net Zero targets? Going to Passivhaus would be best but it's disruptive and expensive.

I've heard that this is about what you're able to get in loans/grants in Scotland.

material costs have risen

Change in heating system, building fabric upgrade, H&S requirements, logistics etc.

Q10: What is your understanding or knowledge of current public sector funding availability in domestic retrofit?



BE—ST

Q10: What is your understanding or knowledge of current public sector funding availability in domestic retrofit?

Some funding available for social housing providers (SHDF), private owner occupiers (HUG, ECO) but largely targeting only those on low income

Piecemeal approach with no wholistic overview or quality control

Not aware of significant funding availability

Social Housing Net Zero Heat Fund , SHDF, Welsh ORP, etc

I know of the LAD schemes, ECO, Home Energy Scotland, Warmer Homes Scotland etc

Very difficult to navigate through

Research suggested there is very little and it has reduced over the years

We retrofit empty homes, sourcing funding from the local authority, charitable trusts and borrowing from supportive lenders.

As far as I know, the support is aimed at low level retrofit measures, e.g. very moderate wall insulation where much thicker insulation should actually be applied and to a much higher degree of detail (to avoid thermal bridges).

I'm aware of heat pump retrofit and ECO schemes, I'm not personally aware of either Scottish or locality specific schemes

There is not much here.

Funding is always changing and it is hard to keep up to date

Aware of various ScotGov and UK Gov funding available for energy efficiency measures and retrofit works.

I am aware of the founding but have not applied for any due to clients not meeting the requirements or wrong timing.

Until it hits them on the face, institutions won't look into it.

It would be nice to know more

Funding is currently based on single measures. To achieve results funding needs to be refocused to fund a whole house approach.

As a company - high, me personally medium

Q10: What is your understanding or knowledge of current public sector funding availability in domestic retrofit?

There has never been funding for Far Infrared heating in Scotland. This had been swerved in favour of the more expensive, and potentially useless ASHP in retrofits. It’s time the government spoke to the UK Far Infrared experts at Flexel to get a better understanding of our solution and why it’s the perfect fit for the current housing heating crisis.

Changes, so constantly keeping up to date

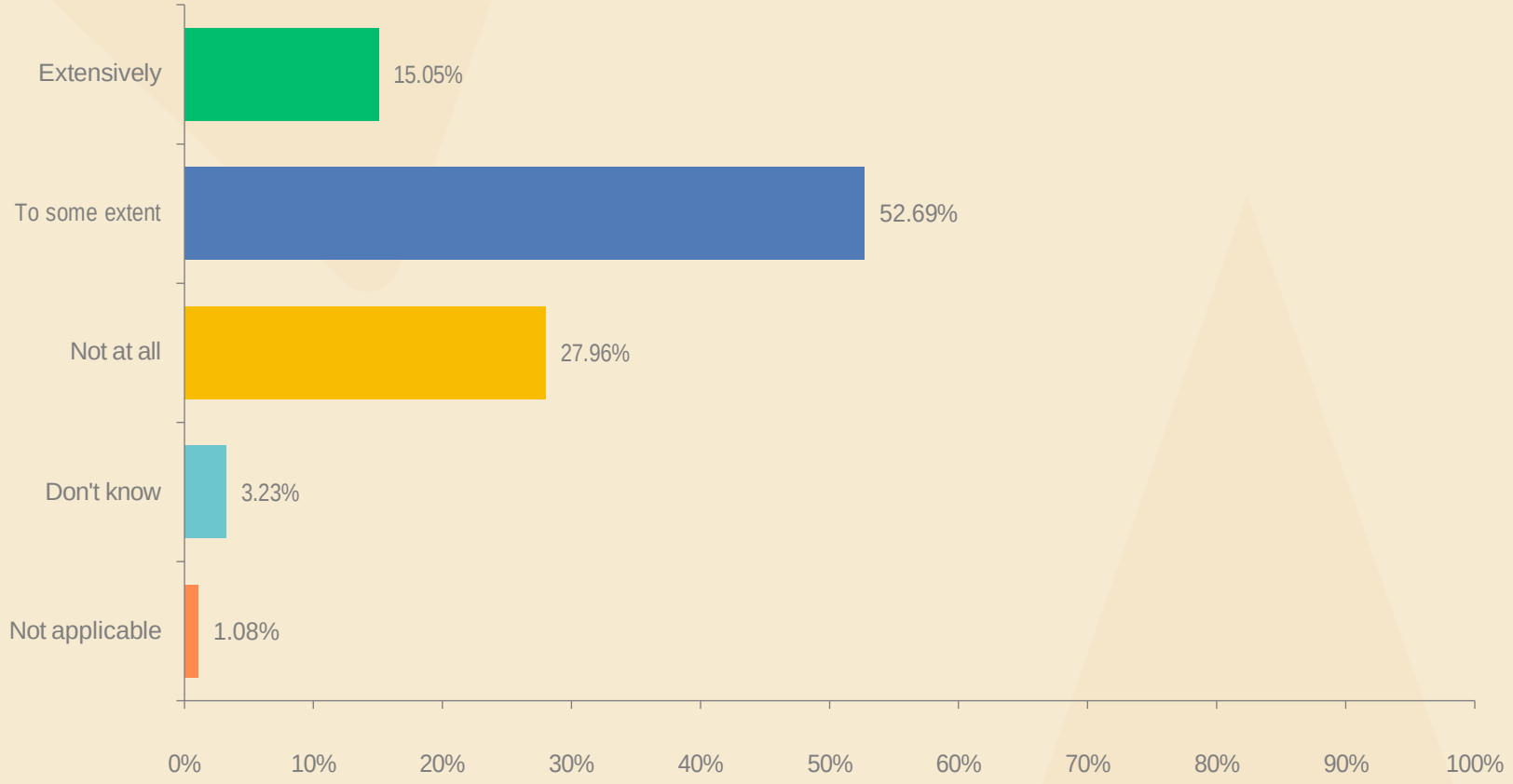
I've recently completed domestic retrofit - insulation and ASHP, although the funding and rules do regularly change

Home Energy Scotland

work with the council to support this

Didn't think there was anything directly available for home owners, aside from reduced heat pump costs.

Q11: To what level have you engaged with retrofit resources and support? (both public and private)? eg. business networks to promote awareness/uptake, industry working groups informing building standards, financial incentives and funding mechanisms.



BE—ST

Q11: To what level have you engaged with retrofit resources and support? (both public and private)? eg. business networks to promote awareness/uptake, industry working groups informing building standards, financial incentives and funding mechanisms.

I am developing a regional retrofit programme for West Yorkshire Combined Authority and have been doing extensive research into the work of other LAs and Combined Authority's.

Involved in local FABA seminars

Local networking and CPD led by various organisations and professional bodies (CIOB)

LETI (Low Energy Transformation Initiative) www.leti.uk

TiG used to run a scheme in the OH but this has now stopped - not sure about wider Scotland funding that is available for clients

We found the only option was VAT reduction, and that has been further constrained

We're not directly involved in this, but have provided some householder focused resources for heat pump retrofit and commented on government documents

From personal experience, there was very little financial support and lack of technical retrofit knowledge available in past years

Try and attend as many events as possible

Part of a Scottish working group for retrofit and PAS2035 professionals.

Would like more info

I engage with anybody that will listen about Far Infrared. SE, HeatSource, Architects, Building firms, College Lecturers, Modular companies, BE-ST to name a few but without the Green Party or SNP backing we are struggling to bring Far Infrared into the main stream of topic as it is in Europe where Gas is generally imported. Therefore Far Infrared has been the norm for heating for decades.

i have a level 2 understanding of domestic retro fit and over 25 years experience in construction

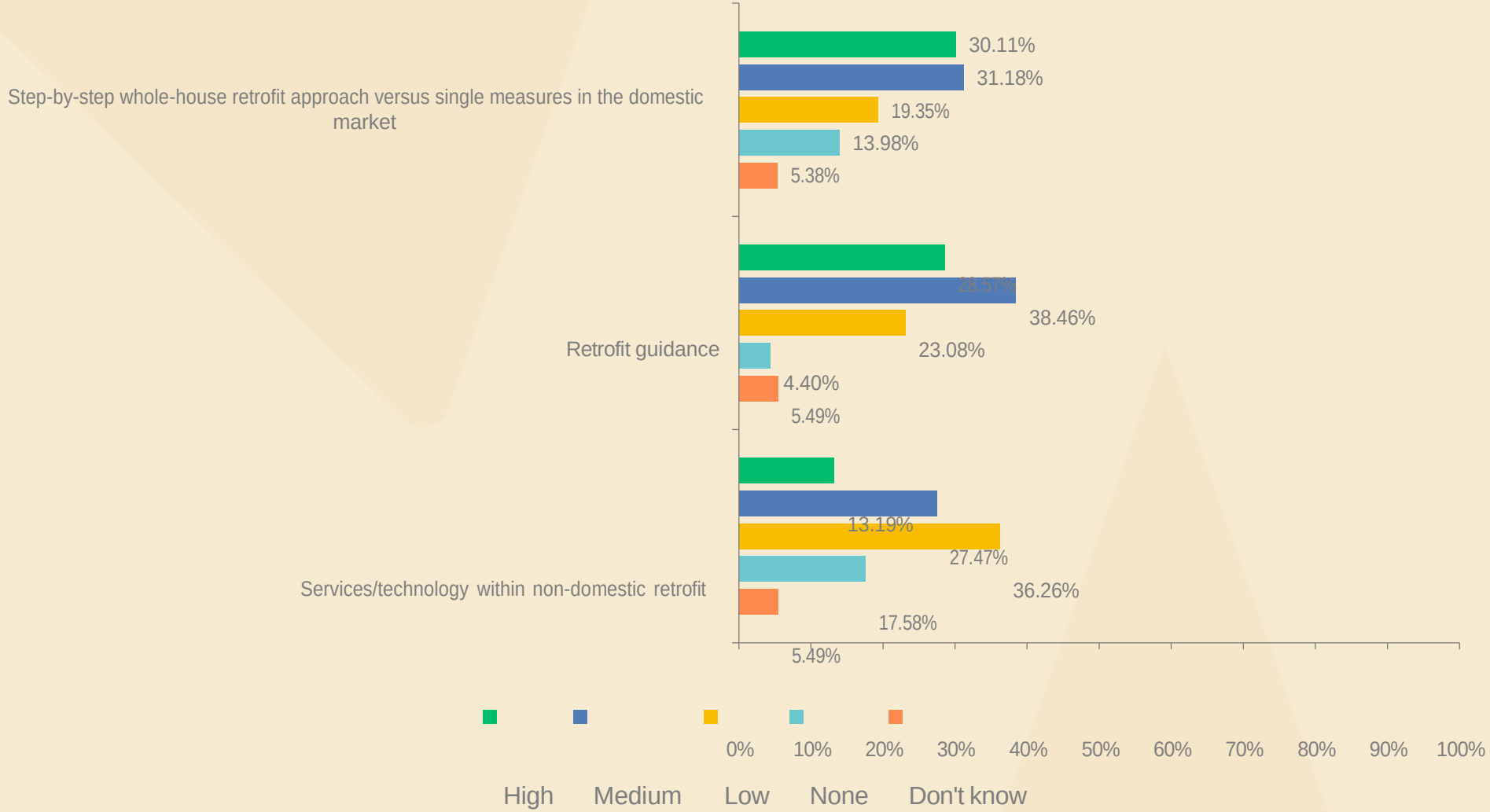
Only public sector. I feel the private sector not fully engaged yet.

Completed own home retrofit (grant funding, new insulation and ASHP) and as part of certain projects as Quantity Surveyor working with public and private sector clients

online courses for self development also hosting upskilling sessions to contractors

Colleagues lead in this space and update team

Q12: What level or knowledge or experience do you have in the following areas:



BE—ST

Q12: What level of knowledge or experience do you have in the following areas:

We specialize in domestic market

LETI has published guidance www.leti.uk/retrofit. New publication shortly on housing covering 'how many, how deep, at what cost'

I'm a DEA of 10 years, Retrofit assessor and run a pas2030 insulation company and have insulated thousands of houses personally so have a decent understanding of domestic retrofit

As far as building fabric improvements are concerned, I expect non-domestic buildings can benefit from similar retrofit measures originally developed for domestic buildings. So experience should be transferable whilst treating every building on its own merits - same as for every domestic retrofit project.

Our focus is on heat decarbonisation only

Myself and our team are technical retrofit specialists who also supply insulation on scale

Architects by trade, but studying to become a retrofit coordinator.

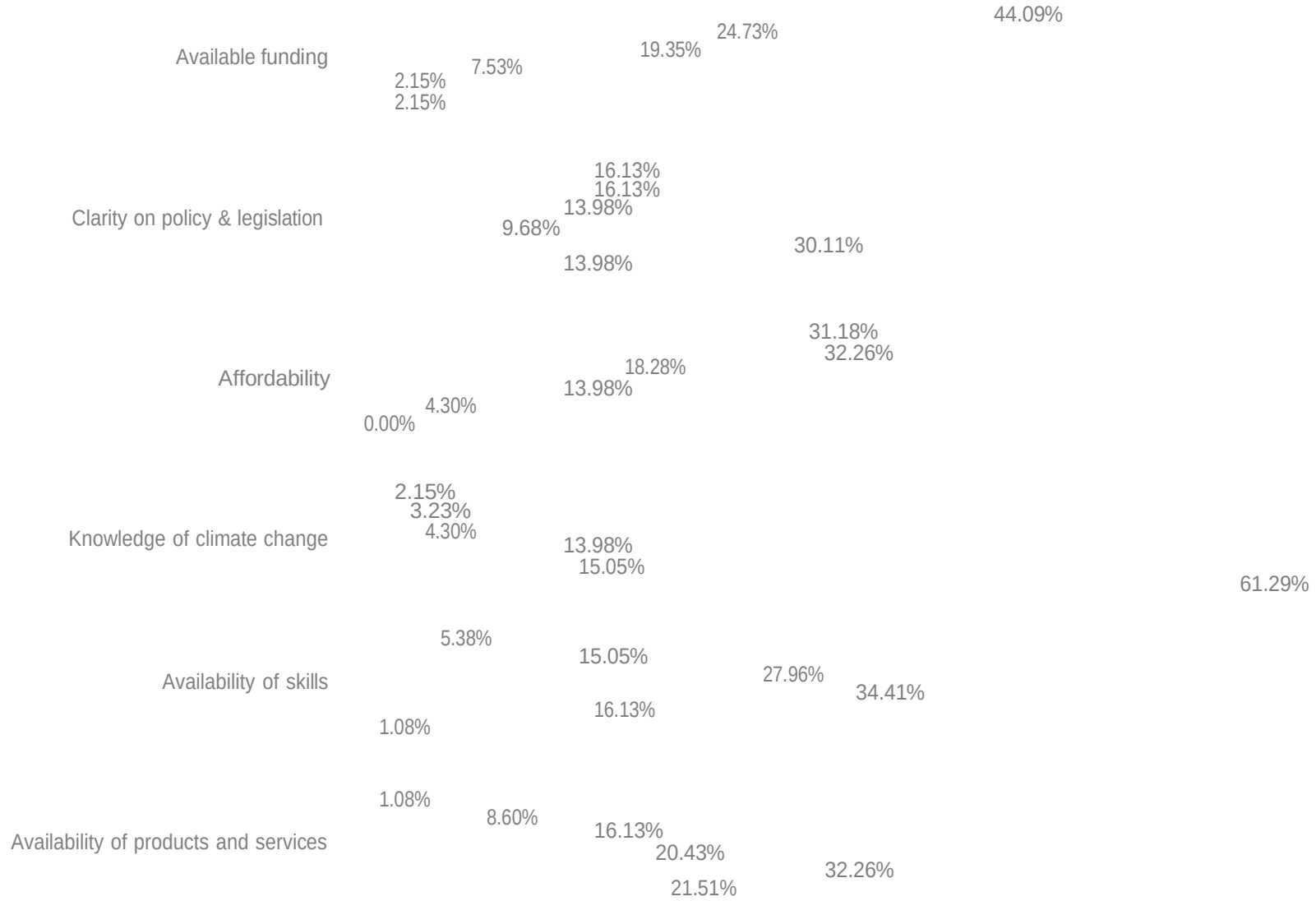
Would like more info

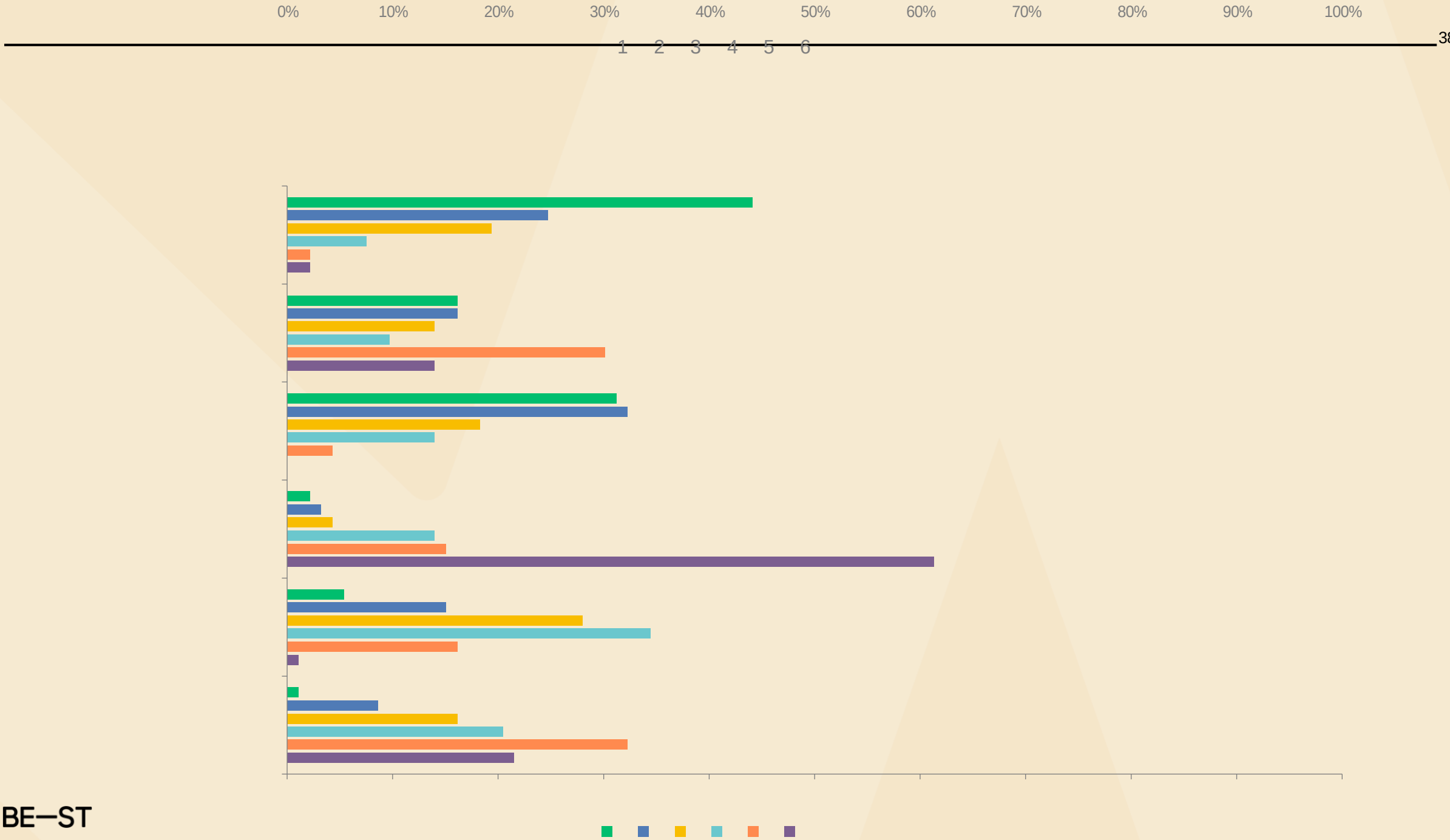
We are not asked to discuss testing our products against other - and of course we would be delighted to do so. There are several current tests going on such as Energy House 2. We as manufacturers provide non-domestic solutions so are currently seeing an increase in commercial and industrial premises moving away from Gas air blowers in favour of high output, low energy EcoSun S+ far infrared units. Sales are bolstered in Scotland by the recent changes to EPC and SAP for this type of building especially where the owner rents.

Passivhaus contractor, extensive retrofit cpd with Aecb, green register. Academic study of building physics and sustainability

level 2 retrofit coordinator, part of the retrofit team to help domestic homes

Q13: What are the main enablers for the adoption of domestic retrofit? Rank in order of importance.

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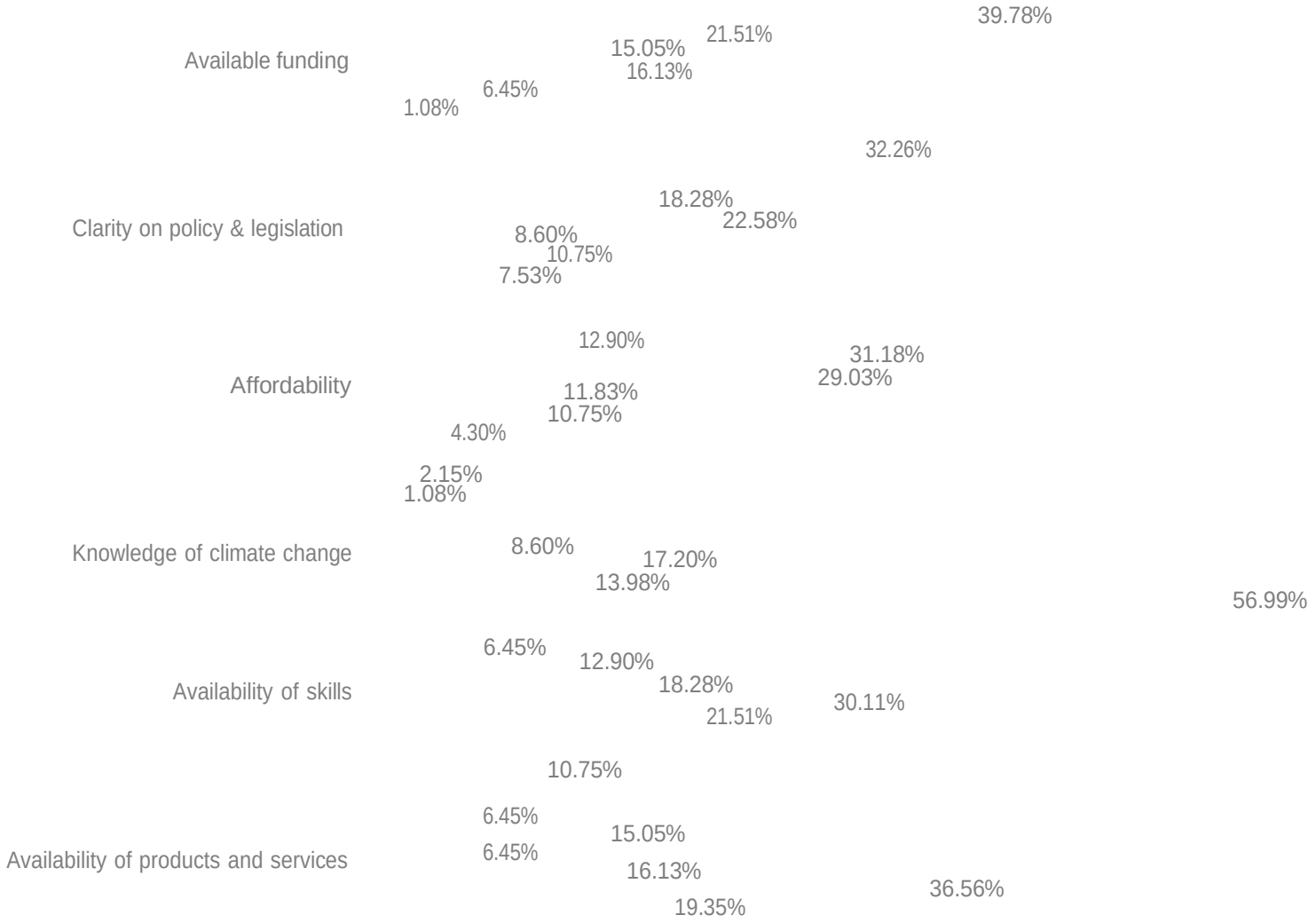
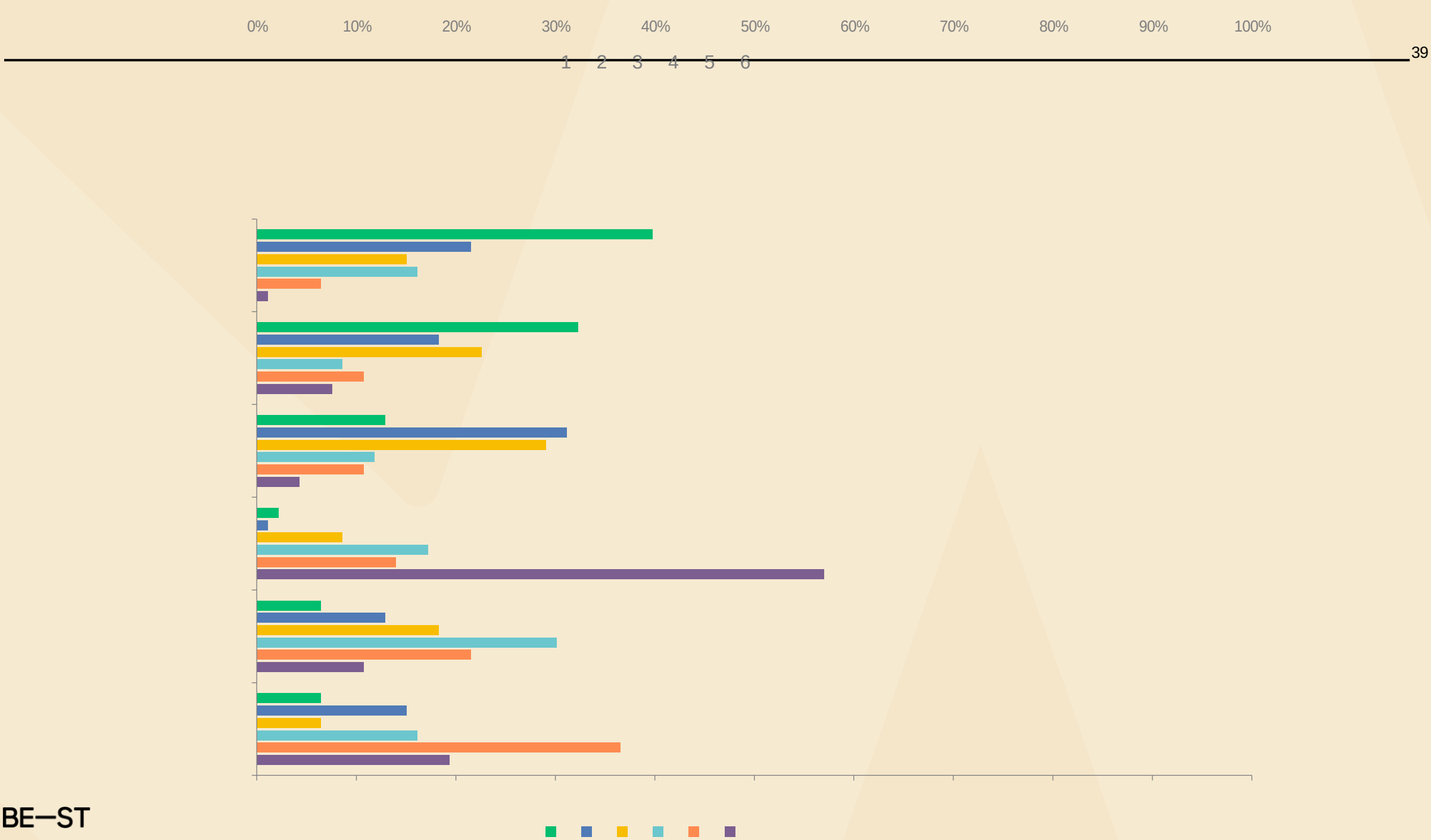
Q14: What are the main enablers for the adoption of non-domestic retrofit? Rank in order of importance.

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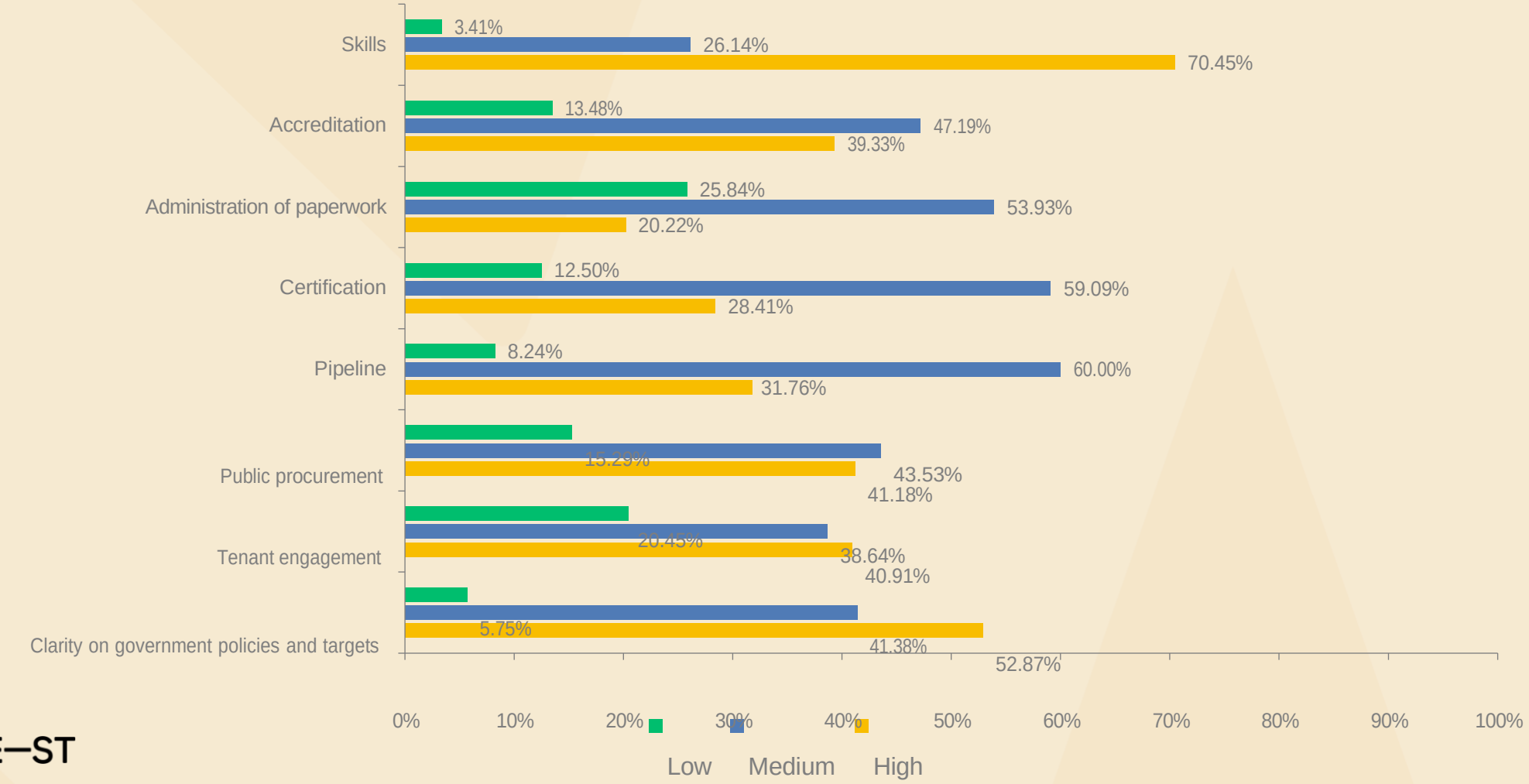
Q15: In regards to the supply chain, to what extent are the following factors a barrier to accessing the retrofit market?



BE—ST

Q15: In regards to the supply chain, to what extent are the following factors a barrier to accessing the retrofit market?

Process / products / productivity improvements

Home Energy Scotland taking 3 months to process an insulation grant doesn't help things move quickly.

I am not sure about his to interpret this question. Key problem at present is the availability of suitably trained builders. In my very own experience, I will likely be doing almost all my home retrofit (to EnerPHit level) work myself as I am unable to find builders with suitable training, experience and skills.

Main obstacle to retrofit private property: VAT on new build vs VAT on retrofit. Planning requirements to prove lower carbon footprint on new built can be easily manipulated to make new build look more sustainable. Planners need to be trained and be able to read documentation submitted to spot false information.

Government policy is under review which is discouraging investment in the public sector until intentions are clarified. The uncertainty on quality assurance (PAS 2035) is also impacting on momentum to upskill the workforce.

Lots of opportunities, hard to find local skills

Support is needed to enable contractors to gain accreditation especially in rural areas. Level of trust in retrofit is needed for engagement.

Q16: What support could help stimulate further adoption and implementation of energy efficiency measures for domestic and non-domestic retrofit?

Cost benefit analysis of different technologies (£ and carbon). Whole life cost versus capital cost understanding.

Need a clear retrofit strategy from Central Government, with appropriate carrot / stick to encourage behaviour change. Local Authority's need more funding and resources to implement projects. Grant funding needs to be more flexible, allowing area-based schemes and longer delivery windows are needed. Long term pipeline of projects needed to give supply chain / skills providers confidence to invest.

Policy backed by structured framework for delivery including grant funding and public information campaign.

There needs to be incentives for people to upskill. Awareness needs to be stimulated in the public area as to what retrofit is and what it can achieve

Establishment of minimum compliance standards enforced through technical building standards

Needs holistic approach to be effective - not piecemeal property owners therefore need designers with fully rounded skills as this is the first step, funding towards design would stimulate the right kind of retrofit

Financial incentives for domestic clients

Better understanding and desire to improve on the current building stock especially around financial cost and payback periods. Understanding the fiscal cost against the carbon cost of poor energy efficiency.

Single point of contact integrated whole-house offering, cost optimised solutions, for delivering guarenteed in-use performance, backed up with 3rd part verification.

Increase and continuation of 'energy efficiency' theme of Social Housing Net Zero Heat Fund

Better processing times at Home Energy Scotland. The issue is that the more funding and quicker/easier implementation of Energy efficiency measures means the more crap work gets done by companies purely out to extract as much money as they can from government schemes. I would suggest scaling up Installers isn't the best approach. There should be more support for the small companies with 5-10 employees who do qualify work rather than the companies with 50+ who aren't able to monitor their staff properly and do all the crap work that we have seen over the past 2 decades. How many installations did the Mark Group do that were funded by the government that are now being ripped out and replaced? Millions

Q16: What support could help stimulate further adoption and implementation of energy efficiency measures for domestic and non-domestic retrofit?

Simple information on basic improvements

Consistent sensible UK Government policy. Carefully targeted seed money

Rather than piecemeal policies for just insulated internal lining for example - whole house approaches need to be adopted, it's more expensive though.

Clear investment pipelines for sectors, not companies, to express scale of purchasing requirements to the market.

Simple, clear and consistent grant and loan funding arrangements. Sufficient technical knowledge of decision makers.

Financial support, by VAT reduction or grant funding

Clear policy on the ending of all fossil fuels in domestic and commercial buildings

There is a distinct lack of clear guidance and support for households seeking to retrofit outside of managed and funded schemes (like Warmer Homes Scotland and EES ABS). There needs to be more in-depth support for households to navigate the complexity and have the confidence to take action.

Far more meet the buyer meetings with "real" opportunities discussed from all with true requirement

1. Availability of training, e.g. there is no suitable training on Domestic ventilation available in the UK at the moment. 2. Mandatory training for installers, e.g. Domestic ventilation

A massive increase in the number of people trained in the installation of low carbon retrofit solutions; adequate funding to make it happen; and incentives to encourage people to undergo the significant upheaval they must ensure whilst the work is ongoing.

1. Certification scheme based on nationally recognised standards (e.g. EnerPHit) with verified performance to give people confidence in spending money on retrofit or buying a retrofitted property. 2. Support schemes to train retrofit workforce from consultants/advisors to builders. 3. Financial support to make it more affordable to retrofit a building to many more home owners.

Skills and capacity of the sector need to increase. This means not just training but facilitation of those who wish to make a business in the sector to do so. This means long-termist policy, and also support for those who wish to pivot their business that's more complex than simply a short training course in the relevant technical skill. (Speaking from experience specifically in heat pumps in domestic retrofit settings)

Q16: What support could help stimulate further adoption and implementation of energy efficiency measures for domestic and non-domestic retrofit?

Better Access to competent/knowledgeable trades Funding Support

Interest free loans with a PAYS repayment scheme.

Be good to reflect what some European countries are doing to fund fabric first approaches for homeowners - some even offer uplifts for lower embodied carbon insulations

Education on how retrofit can help climate change

To paraphrase Hemingway, these energy efficient changes will happen in two ways: gradually, then suddenly. I suspect we will see every house in Scotland have some sort of PV panels within the next 10-15 years. Just like driveways or extensions or a new car, monkey-see monkey-do will be the crest of the wave.

The use of a National Schedule of Rates NSR would allow works to be scaled up and called off with speed, as well as give a transparent consistent way to having a predetermined cost.

A blend of public and private financing models to achieve affordability and incentivize the "able to pay" sector who can ultimately drive this at the scale needed over the next 20+ years.

In private residential sector VAT is our main issue to proceed with retrofit rather than new build. On projects £1m+ there is no funds that could be better than VAT reduction.

Clarity of strategy and adoption of the correct materials to be use. To avoid green washing and problematic retrofits, some product should literally forbidden.

Education and skills training, starting at high school/a-levels, up skilling current supply chain

Awareness of what is on the market ie hydro genie systems

Grants / funding, clarity on regulations and enforcement of regulations, easy access to skills and products

Financial support. Education to customers to ensure participation and uptake.

A “national retrofit timetable” perhaps where householders can see when their property will be dealt with, all other properties having been triaged for impact, urgency and suitability

An increase in the availability of funding, both public and private.

Q16: What support could help stimulate further adoption and implementation of energy efficiency measures for domestic and non-domestic retrofit?

Low cost finance mechanisms that are easy to understand, easy to apply for and not changed to suit election cycles.

Education, training, awareness

Government funding for whole house retrofit rather than single measures. Clear position on the adoption of PAS 2035 and the implementation of a Scottish trustmark. Standards based on energy use rather than cost to promote fabric first and zero direct emissions heating

Ring fenced funding and clarity for the expected EPC rating for EESSH2

A simplification on the entire process. Esp. funding

Regulatory certainty

1 singular policy with a centralised body providing guidance on a centralised single pot of money

Better awareness through media and additional financial support. Then when people do engage make it achievable and supported.

legislation?

Education on the product's availability in Scotland. Why ship in ASHP and rely of replacement parts from abroad when we have an alternative low cost, zero carbon solution right hear on our doorstep? It's a balancing act to hit target for Scotland that appears to be 90% weighted on ASHP as the only solution to the problem when clearly this is wrong.

Financial incentives

Not enough knowledge to comment

Guaranteed long term funding so that public sector clients can guarantee a pipeline of work and engage in partnering type contracts. This in turn will give contractors and their supply chains some security and more likely to invest in skills training and any new technology.

Not sure

Investment in skills and labor

Better encouragement from central government

Availability of funding for the changes that have the greatest effect on energy usage/ wastage

Public funding

Q16: What support could help stimulate further adoption and implementation of energy efficiency measures for domestic and non-domestic retrofit?

In the private domestic market do not need support, they need there to be a problem before they react. In the non-domestic market, these retrofitting needs to be the best option for cost and improvement of the building.

Domestic and non domestic rates relief or another form of offset to aid affordability

Knowledge, out with the industry, apprentice schemes and funding. Ability to create local jobs is attractive to larger projects

Legal requirements and government funding

further input to reduce costs and also ability to re train personell without so many obstacles in gaining accreditation etc

Consistent policy and grant funding to owner occupiers with poor access to capital. An alternative or mechanism within PAS2035 to enable DIY publicly funded works.

Clear government policy partnered with funding/grant assistance/incentives

Public Awareness

Training for all designers/contractors/RSL required.

First, we need much better, expert advice for homeowners as well as quality assurance hand-holding through the project. Second, we need much easier access to funding for homeowners. e.g. Funding for which the installer/ adviser/ intermediary can apply, instead of the homeowner. Home Energy Scotland is extremely difficult to access. Its a middle class pursuit - you need to be able to take extensive amounts of time during work hours to repeatedly call them up. And you need the cash flow to be able to pay the installer while you wait for HES to pay out - this can mean using savings, borrowing from family or borrowing from bank/ credit card.

Set targets for all buildings to have a retrofit plan in place. With EPC's being required when a property is sold a Retrofit Plan should also be prepared including for New Build's as they are built to current standards and will still need to be improved.

Training for the skills needed and boosting the supply chain.

Greater leadership on making decisions, legislation allowing a tax break on those who are retrofitting.

Public funding should be moved from poor/under-performing schemes into more relevant grants and incentives to increase uptake and adoption of innovative technologies.

Q17: How do you see demand for your products/services evolving over the next 5 years to meet opportunities created by retrofit? Please provide any information on capital investment required to expand your business.

Definite growth. We have invested heavily in low risk futureproof low carbon and low energy windows and door systems. As a group we have the capital to expand capacity and production while also looking to further reduce the embodied carbon on operational energy of our products.

As landlord the only ‘opportunity’ is to have accommodation with lower fuel costs.

I think demand will increase, I am a sole trader so its hard to run a business on your own, and there doesn't seem to be any financial help.

Massive levels of interest. Specialist knowledge required. Support to take on new graduates to train up. Better integrated support packages for business and projects

increasing greater demand for embodied carbon in addition to performance data

Demand will rise with more early engagement around project feasibility and cost planning in respect to capital vs operational costs of building assets. Unfortunately Tier 1 contractors can only model the costs and there is often not enough information available at early stages which can be relied upon. This may be passed to PQS's but in reality it needs to be a more joined up approach as both bring different skills to the table.

LETI provide zero carbon Guidance as a non-aligned volunteer organisation. Our aim is to develop and disseminate innovative knowledge and methods for the UK to deliver on its zero carbon targets.

Expanding my business is the last thing I would want to do. If I wanted to make more money then sure I'd hire another 10 staff, let standards slip and cream millions in a year but I believe in doing a quality job for the customer and I believe the bigger the company the worse the quality of work.

it already is getting much busier

Patchily at best, given the current policy environment

High - we want to look at retrofit products in line with our prefabricated construction system but haven't the time to invest atm.

Q17: How do you see demand for your products/services evolving over the next 5 years to meet opportunities created by retrofit? Please provide any information on capital investment required to expand your business.

It is increasing, it is getting more natural materials based and it will not need major capital outlay for our practice

Increasing rapidly. Capital bring spent

Increasing significantly, held back by lack of skilled personnel. Capital investment not required.

See demand increasing significantly driven by a number of factors - energy costs, climate change and government regulation.

Increasing

Massive growth is expected. We would need £1-2 mio. and funding for new retrofit products.

Increase in demand provided we can continue taking on new trainees (at around £20K per year) and expand into carrying out Retrofits for other, less experienced organisations.

Huge demand increases as deadlines become closer - capital investment in skills, facilities and products will also increase in line with demand.

Huge demand. At present, I am supplying only my own retrofit consultancy services with limited scope to expand (the are only so many hours in the day). I may join forces with other suitably trained retrofit consultants in the future, also to develop systems to make retrofit analysis faster without compromising on quality.

Lots of poor quality entrants to the market

Rising

We anticipate our local insulation manufacturing in Scotland to be at capacity quickly due to increasing demand - we would need to expand within 5 years. Cost c. £6M+

I see demand for our services increasing exponentially over next 5 years

Clients will seek more robust design solutions and costings for retro-fits. We will need to upskill the workforce to understand the implications of retro-fit so that costings are accurate and realistic.

We have already invested heavily to be ready to scale and produced the Retrofit pricing Schedule

Q17: How do you see demand for your products/services evolving over the next 5 years to meet opportunities created by retrofit? Please provide any information on capital investment required to expand your business.

We're currently delivering a lot of programme management and project management in the retrofit space which is showing no sign of slowing down as more funding opportunities become available. We are also heavily involved in supporting social landlords in the development of their asset management, sustainability and retrofit strategies to build a pathway towards achieving a greater level of performance across their portfolios.

Definitely to increase. Most my clients who want a house retrofitted are young and educated, and prefer to have a warmer comfortable home over a leaky extension.

As a Borough with a 2030 climate commitment, finding affordable, skilled installers who can manage whole house retrofits is imperative. We have funding and houses, but not enough supply chain to deliver at scale.

Exponential growth in the next 5 years I have been doing all of this with no investors up until now and have grown with demand.

I'm currently supporting several large scale public sector organisations in retrofitting big (sometimes listed) buildings to an achieve net zero. The energy modelling is revolving quickly and the advice we can offer clients is extensive - but I don't think that this can be easily accessed by your regular single home owners who may struggle to know where to start in retrofitting their own home. Some easy step by step guidance - which is advertised widely - with pointers to what they need to consider / comply with - and what funding is available - would be very very helpful!

Everyone will want a heat pump, a battery and the comfort of knowing they will work. However, not everyone knows they will need specific insulation, airtightness tape, MVHR, filter change schedules etc! A government backed document much like those from the Passive House Trust describing the components of a healthy home, and the steps required to get there would be helpful. This could link directly to the specialists who can enable the works.

Increased demand, which by extension will necessitate more skilled labour (i.e. engineers).

We see demand growing. We will need to continue to invest in staff training to meet demand and to deliver the best possible service.

Q17: How do you see demand for your products/services evolving over the next 5 years to meet opportunities created by retrofit? Please provide any information on capital investment required to expand your business.

Would like to think it will increase turnover by 50%. Limited capital investment with generic growth

They will grow exponentially. Capital investment is required to support the development local retrofit strategy to deliver on scale.

All depends on the EESSH2 standard. Major investment will be required and issues of skills and funding will be issues if fully implemented.

We were acquired last year by a Tier 1 contractor for exactly this reason. The future is very exciting in this sector.

Increasing significantly. Availability of skills and resources are key. In capital investment terms, design modelling tools.

I see a large upscaling of everything in the retrofit space

definitely an increase in refurbishing existing building stock rather than building new

Growing. We will require investment for growth required.

This will depend on financial reward rather than environmental impact.

I feel demand will increase once owners see the full benefits and if the cost are commensurate with the benefits

It is likely that demand will increase as people strive to reuse existing building stock.

We are seeing an increasing demand in our space - non-domestic building retrofitting

I believe demand will be high, district heating is being given a lot of focus, and is starting to be understood. Heat as a service could become more important to larger housing suppliers

Depends on legal requirements and government funding

Huge demand for renewable heating systems and need for upgrading insulation the demand for skilled personnel

Would like to develop retrofit design and Co ordination services. Currently pipeline of work dies not warrant investment in training and accreditation. Would also like to offer digital services - Energy modelling, moisture risk. Market is still developing. Looking to invest in software and training

Q17: How do you see demand for your products/services evolving over the next 5 years to meet opportunities created by retrofit? Please provide any information on capital investment required to expand your business.

There will be a greater focus on retrofit and a need for increased skills and awareness in the industry. A clearer understanding of products and processes and of the challenges encountered during different forms of retrofit and how to manage them and the costs involved

Demand will increase for insulation and ventilation products.

increased demand as SHDF gets underway

Increasing. We need revenue funding to develop our team, our services and our business model. Don't need capital funding. Scottish Enterprise has a huge focus on manufacturing but that is not a major constraint to progress now.

Hopefully it will grow to include more properties.

Already seeing a rapid increase in demand for our services.

Funding to expand and have a bigger reach to market to the correct audience

Q17: How do you see demand for your products/services evolving over the next 5 years to meet opportunities created by retrofit? Please provide any information on capital investment required to expand your business.

Flexel response:

Flexel manufacture innovating heating solutions that work with both sustainable renewable energy and energy that is still currently generated using fossil fuels. However at source our product produce zero emotions and are zero carbon heating solutions for all types of premises. In order to evaluate the carbon saving against current products that they will replace we would need to know all the details of what is being produced currently in each product, so the simple answer is the realistic one – that using our products will save 100% of the current carbon production using these inefficient and ineffective high cost heating options.

So if we look more at our security to supply larger volumes going forward as I have already mentioned Flexel are the UK arm of Fenix – one, if not now the largest manufacturers of radiant far infrared heaters in Europe. Our two main product as stated are EcoFilm (manufactured in Glenrothes) and EcoSun heaters (manufactured in Czech). We have to date fortunately not had any issues with supply from both factories and indeed Far Infrared sales to Demark last year increased to 45,000 panel sales without any dent or supply issues. We are potentially the best places company outside of the Far East to supply all of the UK retrofit market from our two existing factories without any major new investment requirements. In Glenrothes we have already purchased a large factory with one quarter 25,000 square foot of space currently on short-term rent but ready for expansion going forward. Flexel are a Scottish company that has been sitting patiently waiting on the UK government to catch up with us and now we are the best placed and best priced solutions ready to roll out to assist with going zero-net for retrofits throughout the UK. We would of course increase our warehouse capacity locally if required when the volumes dictate to ensure we have sufficient stock to keep up with demands. We have a surplus of land around our premised with flexibility to build more storage We currently hold around £2m in stock in our existing warehouse as an example of our current trading levels.

Appendix B - Interview analysis

Interview Summary – Further Analysis

Products

The interviewees offered different perspectives on which products will need to scale up to meet demand. Overall, the interviewees were less concerned about the availability of products and more about the lack of knowledge and expertise of how to use them. Insulation and ventilation products were identified as the main product opportunities by those who didn't cite skills as the main barrier.

Some interviewees highlighted the lack of internal wall insulation products. Others noted that products for 'non-traditional' and harder-to-treat homes are lagging behind. There are fewer products on the market for those building types, and the high cost of the products are limiting the demand.

In general, though, interviewees felt product availability was not the main issue. Rather, the challenge is to scale up the delivery of products and develop the expertise to deploy them in more challenging buildings.

One interviewee offered a different perspective and problematised the reliance on product imports, resulting in higher costs. A suggested solution would be enabling more local production, especially of high-quality doors and triple glazed windows, natural insulation, and air tightness products and ventilation systems.

Services

Overall, there was a strong recognition that more in-depth support is needed through the retrofit process, and that the current services does not exist at an adequate scale.
One interviewee said that more care and attention is needed in the design phase, with a need for wider understanding of the importance of retrofit design across the sector. They noted that this will avoid retrofit failures where, for example, ventilation has not been adequately considered. This was echoed by an interviewee who felt that the end goal of affordable warmth was sometimes lost when retrofitting became a box-ticking exercise without an adequate understanding of how different measures work together.
Two interviewees called for more oversight of the whole retrofit process, either in the form of a third-party to sign-off at all stages, or through the involvement of a building specialist or retrofit coordinator in the project. This can help ensure that the right retrofit standards are being met.

Interviewees felt that more support will also be needed in the post-installation phases. Retrofit technologies require behaviour changes on the side of the householders, and there is a risk that they will be unable to maximise the usefulness of the new technology.

Interviewees also noted that many householders are not eligible for grants, and that further support needs to be developed for these people, especially in terms of guidance of how to undertake the retrofit journey.

All interviewees in the interview process highlighted public awareness as a major barrier to retrofit at scale.

Quality and trust

Interviewees highlighted the importance of 'getting it right' to build up trust in the retrofit technologies and market. It was felt that many householders had lost faith due to past

mistakes in the sector, such as retrofits made under the ECO schemes which had not been of high enough quality. It was felt that any missteps now could make irreparable damage to the retrofit sector. One interviewee shared,

"*Quality must be central to any mass retrofit programme otherwise the mistakes made in the last decade are likely to be repeated and any remaining trust lost.'*

Skills, training, supply chain

Interviewees spoke of the need for both expanding the workforce as well as upskilling the existing supply chain. All interviewees agreed that there are not enough people currently available and qualified to deliver retrofit at the scale required to meet the targets.

They also mentioned the issue of retraining the existing workforce and how this could be achieved. As argued by one interviewee, there needs to be the right incentive and benefits to get people to retrain. This is partially about profit margins, but it is also about having certainty and security that the market is there.

"*We have established businesses in the heat provision and energy markets that have very little interest in moving towards net zero technologies and training and skills*. "
One interviewee identified a barrier in the lack of clarity around what future investments will look like and called for the Scottish Government to be clear about what standards would need to be met.

"*We need a position where manufacturers have confidence that buyers will buy their products on scale. And from buyers' side, that the market is fit for purpose, good value for money, and there is confidence in the scale it can be delivered to. It's two sides of the same coin.'*

A recurring comment was that the nature of retrofit work is different from existing trades in that it is not clearly delineated and covers multiple skillsets. A consequence of this, according to multiple interviewees, is that retrofit skills will need incorporated into existing trades, but it can also make it harder to educate through apprenticeships.
One interviewee suggested that the retrofit sector would either need to align itself with existing accreditation schemes, such as the Construction Skills Certification Scheme, or create its own.

Interviewees also recognised the importance of colleges. One challenge is the urgent timeline of retrofit market developments compared to the slower developments in changing or upgrading curriculums.

Demand

When asked how they thought retrofit demand will develop in the next five years, the interviewees expressed a clear difference between the social housing sector and the private sector. Most interviewees simply stated that the social housing sector would need to scale up. Though this was described as a challenge, the specific requirements set out by the Scottish Government in EESSH2 were perceived to push this development. One interviewee expressed concern about EESSH2 being 'on hold' and the risk of target deadlines being pushed back, as this is seen as directly impacting the pace of energy efficiency delivery.

Interviewees were less optimistic regarding the owner-occupied and privately rented market. The main reasoning for this was the lack of commitments and requirements in Scottish Government policy. Current standards were seen as too vague, not strict enough, and too easily achieved with single measures that do not address the overall energy efficiency of the building.

Drawing comparison to developments in the renewables sector, an interviewee highlighted how investing in support like the Feed-In-Tariff led to a growth in the market, arguing that similar actions would be necessary to develop the retrofit market.

Cost

The interviewees imagined different trajectories in the cost development. One pointed out that the prices have increased in the past few years but expected these to even out before eventually falling. Another interviewee hoped that net zero technologies would reach a 'tipping point of profitability' once they moved away from being niche, non-standard options. No interviewees confidently expected a fall in costs in the next five years, as this would require significant changes in the market.

Interviewees could not estimate an 'average cost' of future retrofits as this depends on the heat demand reduction required by the chosen retrofit standard. One interviewee described how the cost differences between, for example, a 50%, a 70%, and a 90% heat demand reduction isn't linear, and certain threshold measures are more costly than others. They noted that it will be necessary to confidently predict energy demand reductions to fund the necessary investments, and these figures are important to building a business case. This was echoed by another interviewee who made the point that 'it's quite a big ask of innovators to invest in the scale that is required' without having articulated the costs per home, including lifecycle and other associated costs. To accurately answer these questions, would require more clarity on what standards need to be achieved and how they are measured.

Appendix C - Cost case studies

107 Niddrie Road

Traditional Glasgow tenement net zero retrofit

Key facts

Client:
Southside Housing Association

Project architect:
John Gilbert Architects

QS:
NBM Construction Cost Consultants

Structural Engineer:
Design Engineering Workshop

Passivhaus consultant:
Graham Drummond

Passivhaus certifier:
WARM

Contractor:
CCG Construction

Partners:
CaCHE, University of Strathclyde & Glasgow City Council

Timeframe
Completed March 2022

Retrofit Standards
EnerPHit target

Cost
Construction cost per flat: £88K (of which £37K is for energy efficiency measures)

Project description

107 Niddrie Road is a pre-1919 red sandstone tenement in Govanhill in the south side of Glasgow owned by Southside Housing Association. It consists of eight one-bedroom flats and a communal close and back court.

This project was designed to the EnerPHit methodology (Passivhaus for retrofit) and features ultra high levels of insulation and airtightness combined with new heating and ventilation systems. These measures will drastically reduce energy bills for the tenants while providing them with a comfortable and healthy internal environment.

Measures being introduced as part of the project include:

- Maintenance and repair of the building fabric, including vital structural repairs 450mm of loft insulation
- Combination of internal wall and external wall insulation, utilising natural and vapour-open materials for IWI
- Ground floor insulation
- Triple glazed windows and doors
- Mechanical ventilation with heat recovery
- Exceptional levels of air-tightness
- Wastewater heat recovery to baths and showers
- Layout altered to provide better flexibility and accessibility
- Air Source Heat pumps installed to four flats, to test future decarbonisation strategies

Westmoreland Street

Traditional Glasgow tenement
Whole House Retrofit

Key facts

Client:
Govanhill Housing Association

Project architect:
John Gilbert Architects

Timeframe
2022-23

Retrofit Standards
AECB retrofit standard

Project description

Refurbishment of a corner tenement block, one of the first purchased by the client under the groundbreaking Enhanced Enforcement Area status granted to compulsorily purchase sub-standard properties owned by rogue landlords.

Westmoreland Street block will be a pinnacle of this project and aims to be the first in Scotland completed to AECB retrofit standard. This project includes the preparation of a AECB retrofit strategy for close of traditional tenement properties located in the Southside of Glasgow.

The Whole House Retrofit methodology to shape our approach to this project and its deliverables. We implemented the PHPP energy modelling tool, to shape the retrofit designs and to proof AECB compliance. In early stages of the projects, we used Design PH to optimise resources and to analyse AECB feasibility for a wider range of retrofit measures, which was later modelled in more detail in PHPP.

The key outcomes:

- collate accurate in-situ information on the condition of the properties
- maximise the long-term value from investment in tenement properties over the
- next 30 years
- establish a viable route to meeting key targets for stock condition and energy
- efficiency
- AECB compliance, using PHPP modelling tool

We are leading the establishment of a strategy for decarbonising pre-1919 tenements by implementing AECB standards.

Glentrool Hive

Conversion of a 1954 primary school building into a community centre

Key facts

Client:
Glentrool & Bargrennan Community Trust

Project architect:
John Gilbert Architects

Contractor:
Broatch Construction

Cost Consultant:
Reids Associates

Structural Engineer:
David Narro Associates

Timeframe
April 2021 - April 2022

Retrofit Standards
N/A

Project description

The Glentrool Hive is a community retrofit project situated in the village of Glentrool in Dumfries and Galloway. This conversion of a 1954 primary school building into a fit for purpose community centre. It includes a multi function community hall, gallery, meeting spaces with associated ancillary spaces as well as a dedicated self catered accommodation wing.

The existing building was upgraded considerably to improve the energy efficiency. External walls are cavity masonry construction and these were filled with EPS insulation beads and insulated externally with mineral wool insulation prior to the timber cladding being installed. There are a mixture of ground floor types but all have been insulated from beneath.

To complete the improved insulation envelope there was considerable loft level insulation applied. New energy efficient double glazing was installed throughout which was fully taped for improved airtightness and insulated to minimise thermal bridging at openings. By reusing the existing building we have removed the embodied carbon that would be associated with demolition and new build option.

External wall u-values were improved from 1.93W/m2K to 0.29W/m2K using EPS bead cavity fill insulation plus 50mm mineral wool insulation fixed externally. This build up was then protected using the timber rainscreen cladding. Loft level insulation u-values were improved from 1.07W/m2K to 0.09W/m2K by checking the existing loft insulation and supplementing this was a further 340mm mineral wool while maintaining eaves ventilation into the roof space. Existing suspended concrete and timber floors were uninsulated. These were either insulated from above or below where possible using mineral wool.

Renfrewshire Council

Retrofit of 100 residential archetypes of over 1,800 properties

Key facts

Client:
Renfrewshire Council

Project architect:
John Gilbert Architects

Contractor:
Procast

Retrofit Designer:
John Gilbert Architects

Timeframe:
2020-22

Retrofit Standards:
PAS 2035, EnerPHit or AECB standard

Project description

PAS 2035 Retrofit design and Retrofit co-ordination of 100 residential archetypes including over 1,800 properties owned and managed by Renfrewshire Council.

The project aims to deliver a fabric-first retrofit strategy of external works for the housing stock in question. The majority of the houses are council owned but there is still a large number of privately owned houses. This project includes the preparation of retrofit assessments, the preparation of a retrofit strategy and retrofit designs & specification of non traditional BISF properties, Swedish homes dwellings, no-fines building blocks, precast concrete terraced houses, four in a block solid brick walls, etc.

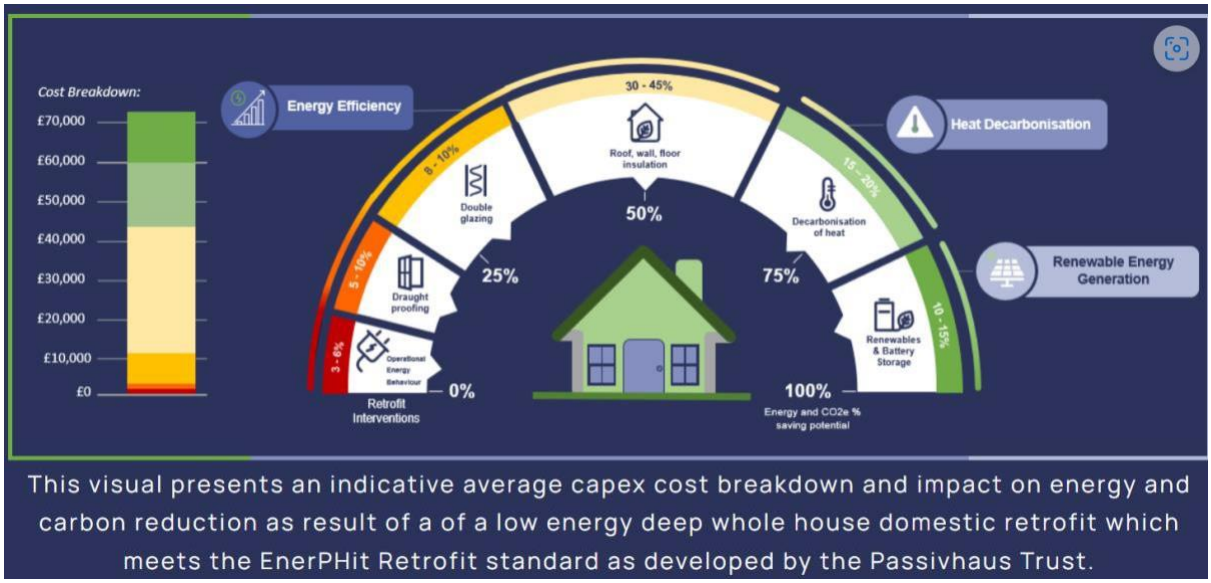
The retrofit design stage developed a PAS 2035 risk-based approach to include a set of proposed details and specifications in concert with the Council.

This project aims to meet EESSH 2032 targets and comply with PAS 2035:2019 standards.

The proposed energy retrofit measures include high performance external wall insulation system, airtightness improvement measures, ventilation and renewable energy systems with minimal intrusion on tenants, designed carefully to meet moisture balance, structural and performance requirements of the non-traditional construction.

3 Cities

The 3Cities collaboration model between Wolverhampton, Birmingham and Coventry seeks created a retrofit plan at scale, they have used a partnership approach to overcome barriers, build capacity, and develop a range of funding. They have created a unique cost versus energy efficiency measure and carbon reduction model.



This visual presents an indicative average capex cost breakdown and impact on energy and carbon reduction as result of a of a low energy deep whole house domestic retrofit which meets the EnerPHit Retrofit standard as developed by the Passivhaus Trust.

Appendix D – Supply Chain (confidential)

Appendix E – Existing Homes Alliance Case Study

Solutions

Public Awareness - Existing Homes Alliance Case Study

Making Retrofit Work, Customer Journey, Nov 2022

Appendix F – Skills Research

“Using data from the Climate Change Committee (CCC)’s balanced scenario, our modelling suggests that an additional 22,500 FTE workers will be needed in Scotland by 2028, to be involved in delivering improvements to existing buildings that will reduce energy demand. That represents an increase of around 9% of the current size of the workforce, based on current technologies and ways of working.
Scotland, March 21, CITB Building Skills for Net Zero in Scotland.

“An additional 50,000 retrofit co-ordinators are required by 2030 (domestic) and an additional 86,500 project managers with an understanding of the retrofit process (non-domestic) by 2028. Existing installers will need to be upskilled under PAS 2035 guidance to be accredited. An increase in digital skills is also required for example installing digitalised electrical engineering controls for smart components. Regional demand for jobs will be localised in the area where manufacturers core operations are but also dependant on the supply chain’s ability to install the technology.” UK, November 2021, CITB,

“In the UK retrofit market, 12,000 upskilled workers will be needed every year over the first four years, increasing to 30,000 per year up to ten years, culminating in an increase in the trained workforce of 230,000 by 2030. By 2050, the heat network sector could create between 20,000 and 35,000 new direct jobs. Growing UK manufacturing and the supply of heat pumps to 300,000 units a year by 2025 could create over 10,000 jobs in manufacturing.”
Green Alliance Policy Insight, Jan 2022

“Embedding of the Energy Efficiency Skills Matrix that sets out requirements for installers, designers and retrofit coordinators that links with MCS, PAS 2030 and PAS 2035 standards. The college network is currently developing additional provision to meet anticipated demand for upskilling. There will be a requirement for the development of specialist knowledge and skills round retrofit, zero emissions heating systems and heat networks for professional, technical and craft roles, as well as data and smart systems skills for delivering energy management in buildings services. Upskilling of existing roles and adaption of training will be needed across new build and retrofit to embed best practice and ensure performance gaps are addressed.”
Skills Development Scotland: Climate Emergency Skills Action Plan 2020-2025

Energy Efficiency Market Analysis and Economic Opportunity Assessment

July 2023