

2020-11-25

Opportunities and barriers to business engagement in the UK domestic retrofit sector: An industry perspective

Butt, B

<http://hdl.handle.net/10026.1/16692>

10.1177/0143624420975640

Building Services Engineering Research and Technology

SAGE Publications

All content in PEARL is protected by copyright law. Author manuscripts are made available in accordance with publisher policies. Please cite only the published version using the details provided on the item record or document. In the absence of an open licence (e.g. Creative Commons), permissions for further reuse of content should be sought from the publisher or author.

Opportunities and barriers to business engagement in the UK domestic retrofit sector: An industry perspective

Ben Butt¹, Rory V. Jones², Alba Fuentes²

¹ SDS Engineering Consultants, 6 Kew Court, Rydon Lane, Pynes Hill, Exeter, EX2 5AZ, UK.

² Department of Built Environment, University of Plymouth, Drake Circus, Plymouth, Devon, PL4 8AA, UK.

Corresponding author: Ben Butt, SDS Engineering Consultants, 6 Kew Court, Rydon Lane, Pynes Hill, Exeter, EX2 5AZ, UK.

Email: ben.butt@sdsolution.co.uk

Abstract

This paper investigates the opportunities and barriers to business engagement in the UK domestic retrofit sector. There are approximately 28 million UK dwellings accounting for 30% of UK total energy consumption. Almost all of the existing housing stock will require some form of retrofit in order to meet the UK Government's Net Zero emissions target by 2050. However, adoption has been much lower than required. Semi-structured interviews were undertaken with industry professionals to investigate the key barriers and opportunities for businesses in the retrofit market. The results suggest that there is significant opportunity for businesses, but engagement has been suppressed by three main categories of barriers: (1) Those that cause lack of consumer demand; (2) Those that constrain retrofit projects, limiting their volume and scalability; (3) Those resulting from a lack of government will or direction. Business opportunity for retrofit was seen to extend globally, with substantial market growth possible. The paper suggests potential roles and solutions key stakeholders could take to achieve the volume of retrofit required. The findings should be of interest to all stakeholders who wish to overcome the multitude of barriers to business engagement in the retrofit sector and realise the potential opportunities.

Keywords:

Domestic retrofit, Existing housing stock, Energy saving measures, Barriers, Opportunities

Practical Application

This study aims to understand the barriers preventing the large-scale adoption of domestic retrofit in the UK in order to identify avenues for increasing business engagement in the sector. Potential areas believed to present significant opportunity for businesses when engaging in, developing and upscaling the retrofit process and solutions are highlighted. This paper should be of interest to building industry professionals already or wanting to undertake domestic retrofit works in future. The paper also gathers the views of current building industry professionals through semi-structured interviews providing an industry centric assessment of the sector's challenges and possible solutions.

1. Introduction

The UK government is legally bound to deliver a 100% reduction in greenhouse-gas (GHG) emissions from 1990 levels by 2050¹ (Net Zero). The domestic sector accounts for 30% of UK total energy consumption², with space heating accounting for 60%³. Over 20% of the Existing Housing Stock (EHS) exceeds 100 years making it one of the oldest in Europe⁴. There are approximately 28 million UK dwellings, with an annual replacement rate of just 1%⁵. Consequently, it would take 100 years to replace the EHS with new-build dwellings that meet current energy standards. Therefore, retrofitting the EHS is essential to reduce emissions and meet government targets.

Fuel poverty, is another significant concern in the UK, affecting an estimated 10% of households⁶. Fuel poverty is the result of a combination of three factors: low household incomes, high energy costs and the inefficient housing stock⁷. The inefficient housing stock can be addressed through retrofitting and therefore has significant potential to reduce the extent of fuel poor households. However, despite the necessity for retrofits being reported for over 20 years⁸, uptake has been lower than expected⁹⁻¹¹. Previous research found the key barriers to business engagement in the sector are: industry structure and culture^{10,12-15}; lack of consumer demand¹⁶⁻²⁰ technical challenges^{12,14,21}; capital cost and finance²¹⁻²³ and a lack of will from, and trust in the UK government^{14, 24-27}.

It is clear that a large business opportunity exists from upscaling the retrofit process²⁸. The zero-carbon transition will affect every household as almost all homes will require some form of retrofit, resulting in an extensive market for designers, engineers, contractors and supply chains to capitalise upon^{29,30}. There are also clear environmental, social and economic benefits for all stakeholders, including large potential profits³¹.

This paper aims to investigate the potential opportunities and barriers for business engagement in the UK domestic retrofit sector. Whilst some knowledge of the barriers already exist, currently, there is limited research discussing the opportunities. This paper also analyses the beliefs of building industry professionals, rather than homeowners, whom have been the predominant sample investigated in previous research on barriers to domestic retrofit. The findings from this study should be of interest to all stakeholders who wish to overcome the multitude of barriers to business engagement in the retrofit sector and realise the potential benefits.

2. Method

Semi-structured interviews were conducted with 15 professionals from the built environment sector: 5 face-to-face and 10 by telephone. Participants were from a diverse range of professions (Table 1); both with and without previous experience in retrofit projects. Each were targeted due to their influence on their business and/or experience within the retrofit sector. Eight participants operated within the South West of the UK, with the remainder geographically dispersed. Many represented businesses that operated nationally or globally. Therefore, the sample provided a multifaceted, reasonably holistic representation of the industry³².

Table 1. Details of interview participants

Participant	No. of company employees	Operating Region	Job Role Additional company/personal background relevant to the retrofit market	Years of construction Industry Experience
P1	206	National	Director of Property Services Business Focused directly on retrofitting the existing housing stock. A front-runner in the market.	20+
P2	5	South West	Director of Sustainable Property Developer Sole purpose is to deliver sustainable property developments.	20+
P3	1	North West	CEO of Low Energy Consultant Aim to make houses warmer, improve sustainability and tackle climate change.	20+
P4	5	Midlands	Technical Director of Housebuilder and Retrofit Contractor Main business focus is transforming the existing housing stock into energy efficient, comfortable and healthy homes. A front-runner in the market.	20+
P5	87,000	Global	Associate Director at an Infrastructure and Engineering Firm with specialisms in a Varied Array of Disciplines Personal interest and experience in retrofit, including author of industry guidance and research.	15+
P6	22	National	Safety, Health & Environmental Officer at a National Trade Association	15+
P7	800	Global	Partner of Engineering Consultancy	20+
P8	408	National	National Planning Director of a Housebuilder	20+
P9	6	National	CEO of a Housebuilder Utilising only Modern Methods of Construction/Modular homes with a focus on sustainability and outstanding performance	6
P10	55	South West	Regional Director of Engineering Consultancy	15+
P11	6,376	Global	Senior Project Manager at a Consultancy and Construction Firm	15+
P12	1,200	National	Group Research and Development Manager at a Housebuilder	20+
P13	1	South West	Managing Director of a Housebuilder Focus on developing Nearly-Zero Energy Buildings and Modern Methods of Construction for housing systems.	20+
P14	850	National	Regional Manager of Mechanical and Electrical Contractor	20+
P15	500	South West	Senior Building Control Officer at Local Authority	20+

The interviews took between 30-60 minutes to complete, including open-ended and focused questions to gather participants' beliefs, experience and knowledge^{33,34}, whilst providing sufficient scope for wider discussion of new ideas. Table 2 presents the questions asked and their order. The interviews were audio recorded and transcribed. The interview data was analysed using the thematic analysis framework³⁵, an influential and flexible approach to qualitative data analysis³⁶. Key ideas cited by participants were coded and then organised into wider themes^{37,38}.

Table 2. Semi-structured interview questions asked to participants

Order	Question
1	In the last 12 months, how many retrofit projects have you/your business been involved in? What proportion of your total projects are they? How many of these are domestic?
2	Is energy performance a key consideration in the refurbishment projects you have been a part of?
3	Is a whole-house approach to energy performance utilised and at what stage is this generally considered?
4	The Building Research Establishment (BRE) state that between now and 2050, a dwelling must be retrofitted every 45 seconds. It seems a widely known and accepted problem, yet very minimal progress has been made. What are the reasons you feel are behind this?
5	To what extent do you feel the above is achievable for the industry?
6	What do you see as the main challenge to your business engaging in retrofit projects?
7	Are there any other challenges you feel that the sector as a whole are facing to engage in retrofit projects?
8	Are you seeing an increase in the number of retrofit projects?
9	Arguably, this could be seen as a huge opportunity for businesses to upscale the process. What are your thoughts on this and do you see a particularly suitable business model/approach?
10	What role do you feel government legislation, policy and incentives have to play in future progress?
11	How can the adoption of a whole-house approach to retrofit be accelerated to achieve the required levels?

3. Results

3.1. Barriers to business engagement

3.1.1. Industry structure and culture

Fourteen participants cited the construction industry itself as a barrier to business engagement. Retrofits were generally regarded as *“piecemeal solutions, often done in isolation”* (P1), undertaken by *“small enterprises doing one/two measures”* (P14). This *“fragmented nature”* (P6) was believed to inhibit market growth as scale is difficult to achieve. Furthermore, the current predominant procurement method, door-to-door salespersons was considered a barrier as they *“use false facts to sell, creating consumer uncertainty and lack of trust in industry as energy saving measures rarely achieve stipulated savings”* (P3).

60% of participants stated insufficient knowledge and understanding within the industry, including *“a lack of understanding of properties worked upon”, “their limitations”* and *“how to overcome issues properly”* (P6, P10, P13). It was also raised that *“the industry has a longstanding culture of doing things badly”* (P5) and *“lack the understanding for the need to do high quality work”* (P14). It was suggested that tradespeople do not see the bigger picture and are traditionally trained without qualifications. P5 said there is *“an attitude problem, people think stuff can be hidden”* and do not act *“in a way to achieve required performance”*. P15 furthered this concern *“they don’t worry about impacts on others – not my job, so not my problem”* and *“everyone is a subcontractor who are money driven and don’t consider wider implications”*. For retrofits, *“workmanship is vital”* or *“you fail to achieve specified performance – it’s only as strong as its weakest link”* (P6). It was evident this creates a performance gap³⁹, generating a lack of trust in industry and reducing demand. P5 said *“benefits aren’t as quoted because of poor workmanship, creating perceptions work isn’t worth doing”*.

A third of participants believed there to be a negative culture within construction. P11 mentioned a *“culture of meeting minimum standards”* and *“never looking beyond”*. P8 supported this *“most businesses don’t do anything unless forced by legislation”*. P11 added *“decisions are often based upon profitability”* and *“everyone is squeezed down by tight margins”*. P15 agreed *“competition drives each*

other down to win work, resulting in cost cutting and poor/non-compliant projects". It was clear this had a detrimental impact on the sector and *"drains consumer confidence, leading to non-adoption"* (P6).

The industry was generally considered risk adverse. P5 stated *"the industry is very conservative, doing only what they know"*. Subsequently, few businesses are involved in retrofits, P4 said *"not many businesses or trades people offer or discuss it"*. P14 suggested this was due to the *"risk adverse nature"*, reinforced by P2 *"you don't know what you are getting into until you start hacking things off"*.

3.1.2. Labour and skills shortage

The construction industry is and will continue to face a large skills shortage⁴⁰. Retrofits are labour intensive, requiring specialist knowledge and skills. 50% of participants stated a severe lack of people with the skills, knowledge and experience to carry out retrofit work correctly. The existing workforce is *"dwindling and traditionally trained, of which, around 30% will retire over next 10 years"* (P1). Worsening this situation is that construction is viewed as an *"undesirable occupation"* (P13), there *"are not enough professionals coming into the industry, creating a massive shortfall"* (P15). Consequently, *"volume and projects have and will continue to be constrained"* (P1), *"we don't have the people, training or skills to achieve the quantities required"* (P3).

3.1.3 Clients, homeowners and occupants

There is a lack of demand from clients, homeowners and occupants for dwellings to be retrofitted, which was associated with lack of will, understanding, and simply many do not know it is an option. P1 cited *"denial, apathy, inertia and ignorance around considering this a problem"*. 10 participants mentioned that energy performance was not a key consideration for homeowners, who *"prefer spending money on other things, such as cars or holidays"* (P10) and there is no perceived added value – homeowners *"don't want to spend money on something unseen, such as insulation over a new kitchen"* (P14). Retrofits were considered *"an undesirable product, there isn't demand as benefits are only environmental"* (P9). Additionally, many mentioned lack of understanding of its importance, benefits, what is required, or how to achieve it – *"people don't know what to do about it"* (P7).

Furthermore, undergoing whole house retrofit causes huge disruption to owners/occupants, which is a large deterrent. P8 and P12 agreed *"it is such a disruptive process, alternative accommodation must be found, raising cost"*, whilst *"people don't want to leave their house, or it to be changed/ruined"* (P13). Moreover, *"homeowners usually purchase houses they like the look of, hence don't want to change the appearance"* (P5), further reducing demand and creating *"classic market failure"* (P4).

Overall, the retrofit market is limited due to lack of demand. P4 stated *"retrofit is currently an enthusiast's marketplace, very early adopters are the only people in the space"*. Therefore, businesses will not invest as there are few people to buy their product.

3.1.4. Technical challenges with the existing housing stock

Diversity of the existing housing stock is seen as a significant barrier to meeting the required volume. There are a *"myriad of property types, so one solution does not fit all"* (P4). Consequently, this drastically increases time required to perform works and vastly inhibits scalability of solutions, as each must be *"bespoke"* (P10, P13).

Additionally, insulation was viewed as a large technical challenge. Installing cavity (CWI), internal (IWI) or external wall insulation (EWI) can create thermal bridging issues and cause condensation. P6 said *"CWI blocks the cavity, a route for moisture escape, and stops continuous airflow, vastly increasing"*

condensation risk". Additionally, *"EWI requires changing/adapting soffits, boiler flues and rainwater pipes"* (P12), which *"is not possible with old/listed buildings where architectural heritage must be retained, and architectural features increase difficulty"* (P6). Moreover, if *"critical details are ignored and improperly addressed, it undermines the entire job and causes more problems than are solved"* (P15). Accordingly, technical implications limit the possibility and suitability of solutions for dwellings, thus restraining business engagement.

P6 and P11 agreed some buildings *"simply cannot be retrofitted"* due to their condition. Furthermore, P14 said *"buildings do not lend themselves to retrofit without massive expenditure and little return"*. P15 highlighted the high probability of *"uncovering unexpected issues – creating a high level of risk and uncertainty"*. This generates vast hidden costs, so it is *"difficult to find contractors to support this"* (P2). P15 added *"it is difficult to estimate and tender projects as you can uncover things you don't expect"*, which deters businesses. Consequently, the potentially large contingencies placed on retrofit projects, due to possible unforeseen problems, can push them over budget. This can be a deterrent to undertaking the project at all or sacrifices subsequently have to be made to the performance to remain within budget.

3.1.5. Finance and cost

Eight participants mentioned cost as the greatest barrier to uptake, due to the upfront cost to homeowners/clients, which many simply do not have to invest. P1 and P4 who undertake 'whole-house' retrofit schemes estimated costs at *"between £80–90,000"*. P6 mentioned *"financial benefits are disproportionate to the cost"* therefore return on investment (ROI) is very long. It was also highlighted *"people often move house before achieving the financial returns, so don't carry out major works"* (P14).

It was evident the cost of retrofit is not then reflected in dwelling sale prices; thereby, it is hard to obtain finance. P12 said *"ROI is unachievable, it isn't reflected in sale prices"*, P4 added *"householders do not pay more for better performing dwellings"*. Many participants believed there was *"little reason to act beyond loft, cavity wall insulation (CWI) and low energy lightbulbs"* (P4). The cost of energy was seen as too cheap and/or retrofit measures too expensive to make investments more palatable, so people are consequently *"willing to bear the cost of their existing energy bills"* (P9).

From a business perspective, retrofit was seen as a sector with little financial reward due to its resource intensive nature and potential hidden costs. P13 expressed *"there must be money to be made, but margins are tight, if any profit at all"* and P12 stated *"nobody will do it for free, there must be profit"*. Due to this, businesses typically avoided engagement with the sector, focusing on more profitable works such as new build – *"it is easier, cheaper and less risky, to look at a greenfield site than retrofit"* (P2).

3.1.6. Government, legislation and policy

The role of government was noted as a key barrier by all participants. Four believed politicians make empty promises and proposals to appease but go no further. P2 and P12 agreed *"Politicians need votes and say things to win them, it costs nothing but sounds fantastic. They are totally vacuous, ill-considered statements"* and *"soon retracted"*. Likewise, *"they make flippant remarks but don't have the understanding or fundamental practices in place to deliver"* (P13). When considering 2050 emissions targets, four participants questioned whether zero carbon is achievable with the EHS, feeling it is *"unrealistic"*. Conversely, P1 stated *"it can and has to be done but is extremely expensive and cost prohibitive"*.

A lack of government will was also found to be a barrier inhibiting business engagement due to uncertainty and lack of direction. P15, who had attended a Ministry of Housing, Communities and Local Government (MHCLG) building regulations conference, stated it is unlikely to change soon: *"government will not introduce controversial policy – it is a vote loser. They do not want to introduce it as it would be unpopular, and risk being voted out"*. P1 and P9 exclaimed, *"there is commitment to*

remove gas by 2050, yet still homes are being built with gas boilers". There is *"no halt on the implementation of inefficient systems into new builds – feeding into the belly of the beast. We still are building homes that need retrofitting"*. This shows contradiction and lack of direction from government, causing uncertainty. Furthermore, *"there are tremendously large barriers in policy prohibiting retrofit, including three competing interests; conservation, demanding buildings remain unaltered; energy regulations requiring insulating to reduce energy consumption; and building regulations require elements be replaced with fireproof materials"* (P2). Balancing the competing interest *"is nearly impossible"*, there *"is no policy steer to say which is most important"* (P2). P12 added *"if there is no clear path, nobody will invest, industry and finance won't come along and there will be no opportunity"*, which is the current situation being faced.

Seven participants voiced concern over lack of government support to clients/homeowners and businesses. P2 expressed *"there are no incentives to do this work, which we deliver at greater time, cost and expertise than new builds, yet are clobbered by the same rules"*. Likewise, six participants mentioned lack of support from government in grants and incentives for homeowners. For example, there is *"support to purchase dwellings through help-to-buy¹, yet owners are expected to retrofit dwellings without help"* (P9). Participants acknowledged a previous attempt, the green deal², yet signified *"interest rates were too high, it failed, and a huge number of businesses developed but shrunk as quickly when funding was removed"* (P12). This caused uncertainty and a lack of trust in government.

P10 voiced *"a lack of clarity what 'zero carbon' means"* and P12 stated *"there is little trust in what the government say due to previous U-turns, on diesel cars for example"*, eluding to the implementation of 'tax-breaks', encouraging diesel car purchases, which were later retracted and taxed with potential bans due in the future⁴. A further example is where wood burners scored highly in Standard Assessment Procedure (SAP) assessments³. Yet increased use led to pollution and subsequently scoring was reduced. P15 stated *"this is just one example where government shot themselves in the foot"*. Moreover, six participants mentioned renewable energy Feed-in Tariffs⁴ (FIT) made a *"mess of the marketplace with boom and bust, as companies were sucked in to make money, then collapsed"* (P4) as the FIT was cut, and uptake reduced. This led to a lack of investment from all stakeholders – P12 stated *"U-turns create uncertainty. Without a clear path, nobody will invest"*.

3.2. Opportunities for business engagement

The majority of participants believed there was vast business opportunity within the retrofit sector. Only a single participant opposed this view, stating *"I don't see it as an opportunity, as money, skill and will isn't there. It needs to be done, but it is a zap on resources"* (P13).

3.2.1 Scale

Participants who believed there was opportunity, largely attributed this to the scale of works required. P1 identified *"24 million homes need retrofitting"*, and from a meeting they had with the Welsh government it was recognised *"250,000 social housing properties require retrofitting over the next 10*

¹ Help to Buy is a government scheme to help first time buyers who struggle to save a deposit to purchase a property. The government lends first time buyers money in the form of an equity loan.

² The green deal was a government initiative aiming to encourage consumers to improve their dwelling's energy performance. A loan could be obtained to spread the cost of Energy Saving Measures over a 10 to 25 year period.

³ The Standard Assessment Procedure is a government used methodology used to assess/compare the energy and environmental performance of a dwelling. The aim is to provide accurate and reliable assessments required to support policy initiatives.

⁴ Feed-in Tariffs are a government programme designed to promote uptake of renewable and low-carbon electricity generation products. Payments are made by the energy supplier for the electricity an installation generates.

years”, nearly 50% more than the largest UK housebuilder, Barratt Homes, achieved in 2018-19⁴². P9 expanded “*it is the entire built environment across the world, not just the UK*”, which presents expansion opportunity into overseas markets and “*it could become an export to help other countries*” (P3).

3.2.2. Increasing awareness of the retrofit market

Whilst awareness of retrofit was identified as a barrier to slow growth in projects, P1, P3 and P12 suggested, “*awareness is increasing*” as “*people wake up to the problem*”. It was evident participants could only see the industry growing – “*retrofit will only continue to grow*” (P5), while P1 “*saw it as a growth market, so changed business strategy to maximise opportunity*”. Moreover, “*repurposing is another growth opportunity, turning unused commercial buildings into residential schemes, incorporating Energy Saving Measures*” (P7).

3.2.3. Opportunity for all construction related businesses through varying approaches

It was clear there is no single method suitable to address the retrofit challenge, and many solutions will be required. The challenge “*is so varied, different approaches can solve different elements. That is how it must be done and it would not be exclusive – small/large, existing and new businesses could benefit*” (P4). P3 explained a community-led business model could be a solution to “*stimulate local supply chains and create hundreds of thousands of long-term jobs*”. A third of participants believed incorporating offsite modern methods of construction (MMC) was a solution to increase scalability and volume. Approaches such as Energiesprong “*seem a good way to achieve scale, speed and quality required*”, but “*it won’t suit everything*” (P5). P6 reinforced, “*there is need for both current and new approaches*”.

4. Discussion

The results presented in this study should be of interest to all stakeholders engaged in the retrofit sector in order to help address the multitude of barriers to business engagement. Each stakeholder must take an active role in solutions, from government to financiers and consumers²¹. This section suggests potential roles and solutions stakeholders could take to achieve the volume of retrofit required. No single solution will solve the market failure, yet each could begin to address it¹⁵.

4.2.1 Role of government

The results of this study clearly emphasised the important role for government. A clear and consistent policy is required, promoting the importance of retrofits, and a national strategy planned and phased to achieve the required targets⁴³. The findings suggested that initial focus could be placed upon social housing to stimulate early demand, allowing industry to develop solutions and establish supply chains⁴⁴. Subsequently, the private sector will follow as volume reduces cost⁴³.

Many participants highlighted nothing will progress unless retrofits are subsidised and/or incentivised. Capital cost was established as a leading barrier curtailing consumer demand. A suggestion from the interviews was tax could be introduced to housebuilders, similar to the Community Infrastructure Levy⁵ (CIL) and section 106 agreement⁶, that would require contributing to or funding retrofitting on nearby

⁵ The CIL is a charge that can be imposed upon new developments by local authorities to help provide the infrastructure required to support the development in the local area.

⁶ A section 106 agreement, under the Town and Country Planning Act 1990, is a mechanism to ensure a planned development proposal suitably satisfies planning requirements, with a focus upon site specific mitigation of the development.

dwellings. It should be noted that finance will likely only be an enabler, rather than drive demand⁴⁵. Therefore, further incentives in parallel will also be required to encourage uptake, for example, adjusting stamp duty and council tax according to dwelling performance has been suggested⁴⁶. The cost benefit case can be strengthened by including indirect benefits, such as occupant health and comfort⁴⁷, which has potential to reduce NHS spending by 42p on every £1 spent⁴⁸.

Furthermore, participants stated regulations are too lenient so should be improved, enforcement increased and penalties for non-performance/compliance issued. Previous research has suggested the government to introduce a quality assurance/certification scheme with aspirational targets to encourage homeowners to exceed minimum requirements¹⁵. The Institution of Engineering and Technology (IET) have stated that current conflicting policy should be reviewed to ensure retrofits are permitted, and difficulty reduced⁴³. It has also been highlighted that government should fund research and development to encourage innovation in the retrofit sector. Additionally, increased advertisement, marketing and communications has been suggested to raise general awareness⁴⁶.

4.2.2 Role of industry and education

The study established lack of knowledge, education and training across the industry. It is vital government, industry and training providers ensure all stakeholders are appropriately skilled and educated from suppliers to installers. Increased knowledge improves workmanship and hence performance, which increases consumer satisfaction and raises demand¹⁷. Additionally, educating consumers increases awareness and hence demand. The interviews established that working together, sharing data, information and resources would be key to establish the market and feasible solutions⁴⁹.

The social housing sector was seen as an area to initially concentrate on as it is reasonably homogenous and so solutions can be developed, supply chains established, knowledge advanced, lessons learned, data generated, progress achieved and costs reduced^{50,51}. Therefore, greatest efforts should be concentrated upon this as there is no ownership problem, hence it is the simplest and quickest way to achieve volume⁴³. Following development of social housing retrofits, reliable and accurate performance data can be obtained and can be used to provide and communicate more accurate estimates of potential energy savings for individual households⁵². Additionally, once solutions are developed, they can be refined and improved with innovation of materials and technologies to make products more desirable.

The adoption of MMC was viewed as vital to achieve volume required⁵³. Approaches, such as Energiesprong, utilising an industrialised offsite, prefabricated approach to deliver high performing retrofits, hinging on economies of scale²⁰. Industry must embrace such approaches and encourage increased innovation of materials, solutions and business models in the sector. Innovation is required to provide materials that are cheaper, safer and easier to work with, perform better and deliverable at scale.

Interviews mentioned that retrofit with solely environmental benefits is not appealing. Comfort and smart home technologies have been suggested as methods to make solutions more appealing and beneficial to consumers and accelerate adoption⁴⁸. Increased focus could be placed on building occupants and integrating them into the retrofit process, as they determine over than 50% of potential energy efficiency⁵⁴. Linking works to key trigger points, such as renovations, repairs, maintenance or when property changes ownership/occupants are methods to minimise disruption, which was a large deterrent^{55,56}.

It was evident the workforce is declining due to an ageing workforce and shortfall of people entering construction. This could constrain the entire industry, not only the retrofit sector. Therefore, more must be done to increase the desirability of occupations. Industry, government, educators, bodies, such as the construction industry training board (CITB) and chartered institutions must work collaboratively to

promote the industry to the younger generation, via the most appropriate communication methods for relevant age groups⁴⁹. Investment is required to promote through education streams, and marketing could use mainstream and social media. Integration of education into the construction industry will be vital in achieving this.

The vast number of retrofits required presents businesses with significant market opportunity, resulting in increased job opportunities and investment⁵⁷. As discussed in the interviews, an array of approaches is required to address the EHS, providing an opening to establish a market position and differentiate from others.

4.2.3 Role of financiers

Cost of Energy Saving Measures was determined as the leading barrier to retrofit uptake. Finance provision is required as most homeowners lack the capital required upfront, yet current mechanisms are considered lacking¹⁴. Interest rates are typically high, as investments are seen as illiquid and ROI is based on predicted, not guaranteed savings^{58,59}. Improving finance methods for long-term strategies could encourage sector activity and improve economies of scale¹⁷. As policy is introduced, the market expands, reliable data obtained, and demand increased, ROI will become more assured and properties not retrofitted will decrease in value. As a result, finance should become more obtainable as finance providers must offer affordable rates of finance for owners to employ.

6. Conclusions

There is significant opportunity within the UK domestic retrofit sector, yet business engagement has been suppressed due to an array of multifaceted barriers. Such barriers can be consigned in 3 categories. Firstly, those that cause lack of consumer demand which instigates a classic market failure. Secondly, those that constrain retrofit projects, which limits the volume and scalability achievable by businesses. Finally, those as a result of no government will or direction in relation legislation and policy, which creates uncertainty in the consumer and both construction and finance industries, curtailing willingness to invest.

Whilst this research has identified a broad range of barriers and opportunities to business engagement in the domestic retrofit market, due to the limited sample size, it is important to note that they may not be comprehensive. For example, higher VAT rates for retrofit than new-build projects was not mentioned by any of the participants in this study, but is known to be a potential barrier⁶⁰. Further research into the barriers and opportunities, as well as possible solutions are therefore required. Nevertheless, the insights delivered in this paper should be valuable to stimulate further discussion.

The key barriers to business engagement identified are:

- Significant capital cost of retrofit, lack of funding options and poor ROI.
- Lack of clear, consistent government direction with legislation and policy, plus a lack of will to enforce retrofit.
- Current fragmented, risk adverse nature of the industry, typified by poor workmanship, lack of knowledge, and a traditionally trained, dwindling workforce with no improvement culture.
- Lack of understanding and awareness.
- The myriad of property types and their associated technical challenges, the lack of available solutions and innovations.

The key opportunities for business engagement identified are:

- Approximately 22 million homes within the UK must be retrofitted.
- The opportunity extends beyond the UK, to the global built environment. UK business could lead change and expand worldwide.
- Consumer awareness is and will only continue to grow.
- A myriad of solutions is required to address the issues, in which all businesses could capitalise.

Acknowledgements

We would like to declare our sincere appreciation to all who permitted this research to take place, by thanking all participants who were able to spare time out of their day and strenuous schedules to share their thoughts, and impart such invaluable knowledge on the topic, which made this research paper possible.

References

- ¹ Climate Change Act 2008 (2050 Target Amendment) Order 2019 (SI 2019/1056), www.legislation.gov.uk/ukxi/2019/1056/made (2019, accessed 25 June 2020).
- ² Department for Business, Energy & Industrial Strategy. Energy consumption in the UK, <https://www.gov.uk/government/statistics/energy-consumption-in-the-uk> (2019, accessed 25 June 2020).
- ³ Hardy A. Glew, D. Gorse, C. et al. Validating solid wall insulation retrofits with in-use data. *Energy Buildings* 2018; 165: 200-205.
- ⁴ National House Building Council. *40 Facts – Homes, housing & house building today*. Milton Keynes: NHBC Foundation. 2018.
- ⁵ Myers D. *Construction Economics – A new approach*. 4th ed. Abingdon: Routledge, 2019.
- ⁶ BEIS, Annual Fuel Poverty Statistics Report, 2020, Department for Business, Energy & Industrial Strategy, 2020 (Accessed 29 October 2020), <https://www.gov.uk/government/statistics/annual-fuel-poverty-statistics-report-2020>
- ⁷ B. Atanasiu, E. Kontonasiou, F. Mariottini, Alleviating Fuel Poverty in the EU: Investing in Home Renovation, A Sustainable and Inclusive Solution, Buildings Performance Institute Europe (BPIE), Brussels, Belgium, 2014.
- ⁸ Boden M. Paradigm shift and building services. *The Service Industries Journal* 1966; 16 (4): 491-510.
- ⁹ Friege J. and Chappin E. Modelling decisions on energy-efficient renovations; a review. *Renew Sust Energy Rev* 2014; 39: 196-208.
- ¹⁰ Murto P, Jalas M, Jouni J, et al. The difficult process of adopting a comprehensive energy retrofit in housing companies: Barriers posed by nascent markets and complicated calculability. *Energy Policy* 2019; 132: 955-964.
- ¹¹ Committee on Climate Change. Reducing UK emissions – 2019 Progress Report to Parliament, <https://www.theccc.org.uk/publication/reducing-uk-emissions-2019-progress-report-to-parliament/> (2019, accessed 15 November 2019).
- ¹² Gooding L. and Gul M. Enabling a self-sufficient energy efficient retrofit services sector future: A Qualitative Study. *Energy Policy* 2017; 156: 306-314.
- ¹³ De Wilde M. and Spaargaren G. Designing trust: how strategic intermediaries choreograph homeowners' low carbon retrofit experience. *Build Res Inf* 2019; 47: 362-374.
- ¹⁴ Brouwer J. van Deelen K. and van Engelenburg B. Value creation in Retrofitting Housing Stock: an analysis of business opportunities. Report no. R10904, TNO The Netherlands, August 2017.
- ¹⁵ Bonfield P. *Each Home Counts – An Independent Review of Consumer Advice, Protection, Standards and Enforcement for Energy Efficiency and Renewable Energy*. London: Department for Business, Energy and Industrial Strategy (BEIS) and Department for Communities and Local Government, 2016.
- ¹⁶ Ince R and Marvin S. Constructing domestic retrofit as a new urban infrastructure: experimentation, equitability and contested priorities. *Local Environment* 2019; 24 (9): 825-842.

-
- ¹⁷ Gooding L. and Gul M. 'Achieving growth within the UK's Domestic Energy Efficiency Retrofitting Services sector, practitioner experiences and strategies moving forward. *Energ Policy* 2017; 105: 173-182.
- ¹⁸ Kangas HL. Lazarevic D. and Kivimaa P. Technical skills, disinterest and non-functional regulation: Barriers to building energy efficiency in Finland viewed by energy service companies. *Energ Policy* 2018; 114: 63-76.
- ¹⁹ Mahzouni A. The institutional challenges of scaling-up housing retrofit; the Swiss cities of Basel and Sio. *Facilities* 2019; 37 (11/12): 780-798.
- ²⁰ Brown D. *Whole-house retrofit: the role of new business models, finance mechanisms, and their implications for policy*. Brighton: Science Policy Research Unit, 2019
- ²¹ Jagarajan R. Asmoni M, Mohammed A, et al. Green retrofitting – a review of current status, implementations and challenges. *Renew Sust Energ Rev* 2017, 67, 1360-1368.
- ²² Chan A. Darko A. Effah E, et al. Barriers Affecting the Adoption of Green Building Technologies. *J Manage Eng* 201; 33:1-12.
- ²³ Pardo-Boscho F, Cervera C. and Ysa T. Key aspects of building retrofitting: Strategizing sustainable cities, *J Environ Manage* 2019; 248: 1-14.
- ²⁴ Committee on Climate Change. Sectoral Scenarios for the Fifth Carbon Budget, www.theccc.org.uk/wp-content/uploads/2015/11/Sectoral-scenarios-for-the-fifth-carbon-budget-Committee-on-Climate-Change.pdf (2015, accessed 12 November 2019).
- ²⁵ Guertler P and Rosenow J. Buildings and the 5th Carbon Budget, <https://www.raponline.org/knowledge-center/buildings-fifth-carbon-budget/> (2016, accessed 22 November 2019).
- ²⁶ Rosenow J and Eyre N. Residential energy efficiency programmes in the UK: a roadmap for recovery, <http://www.biee.org/wpcms/wp-content/uploads/Rosenow-Eyre-Residential-energy-efficiency-programmes-in-the-UK.pdf> (2016, accessed 22 November 2019).
- ²⁷ Brown D. Business models for residential retrofit in the UK: a critical assessment of five key archetypes. *Energ Effic* 2018; 11 (6): 1497-1517.
- ²⁸ Miller, R. Deep retrofit of 26 million homes is a great business opportunity, www.businessgreen.com/bg/opinion/3066224/deep-retrofit-of-26-million-homes-is-a-great-business-opportunity (2018, accessed 25 June 2020).
- ²⁹ Committee on Climate Change. UK Housing: Fit for the future?, www.theccc.org.uk/publication/uk-housing-fit-for-the-future/ (2019, accessed 25 June 2020).
- ³⁰ Gillich, A. Mahmoudi, E. Mohreb, E. Limits and uncertainty for energy efficiency in the UK housing stock. *Energ Policy* 2019; 133: 1-8.
- ³¹ The American Institute of Architects. Deep energy retrofits: An Emerging Opportunity, content.aia.org/sites/default/files/2016-04/Deep-Energy-Retrofits-EmergingOpportunity.pdf (2013, accessed 25 June 2020)
- ³² Creswell J and Poth C. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. 4th ed. London: Sage, 2018.
- ³³ Pathak V, Jena B and Kalra S. Qualitative research. *Perspectives in Clinical Research* 2013; 4 (3): 192
- ³⁴ Silverman D. *Doing qualitative research*. 5th ed. London: Sage Publications, 2017.
- ³⁵ Braun V and Clarke V. Using thematic analysis in psychology. *Qual Res Psychol* 2006; 3 (2): 77-101.
- ³⁶ Maguire M and Delahunt B. Doing a Thematic Analysis: A Practical, Step-by-Step Guide for Learning and Teaching Scholars. *All Ireland Journal of Teaching and Learning in Higher Education* 2017; 8 (3): 3351-33514.
- ³⁷ Brooks J and King N. (2014) Doing Template Analysis: Evaluating an End-of-Life Care Service. <http://methods.sagepub.com/case/doing-template-analysis-evaluating-an-end-of-life-care-service> (2014, accessed 20 November 2019).
- ³⁸ Kuckartz U. Qualitative Text Analysis: A Systematic Approach. In: Kaiser G and Presmeg N (eds) *Compendium for Early Career Researchers in Mathematics Education*. Cham: Springer, 2019, pp. 181-197.
- ³⁹ Fylan F, Glew D, Smith M, et al. Reflections on retrofits: Overcoming barriers to energy efficiency among the fuel poor in the United Kingdom. *Energy Research and Social Science* 2016; 21: 190-198.
- ⁴⁰ Chartered Institute of Building. Shortage occupations in construction. Report, Chartered Institute of Building, UK, January 2019.
- ⁴¹ Leggett T. Diesel cars: Your questions answered. <https://www.bbc.co.uk/news/business-42621112> (2018, accessed 23 March 2020).
- ⁴² Hammond G. UK's largest housebuilder Barratt on course for record profits. <https://www.ft.com/content/54f4cf96-a2d6-11e9-974c-ad1c6ab5efd1> (2019, accessed 31 March 2020).

-
- ⁴³ Ellsworth-Krebs K, Reid L and Hunter C. Home-ing in on domestic energy research: “House,” “home,” and the importance of ontology. *Energy Research & Social Science* 2015; 6: 100–108.
- ⁴⁴ Transition Zero. Make Net Zero Energy Refurbishments for Houses a Mass Market Reality – Report on Market Assessment and Bottlenecks. <http://transition-zero.eu/wp-content/uploads/2018/03/TransitionZero-D8.4-Market-assessmentbottlenecks.pdf> (2018, accessed 30 March 2020).
- ⁴⁵ Zimring M, Borgeson M and Todd A. Getting the Biggest Bang for the Buck Exploring the Rationales and Design Options for Energy Efficiency Financing Programs. <https://emp.lbl.gov/publications/getting-biggest-bang-buck-exploring> (2013, accessed 08 April 20).
- ⁴⁶ Jankel, Z. Delivering and Funding Housing Retrofit: A Review of Community Models. <https://www.arup.com/news-and-events/arup-launches-housing-retrofit-report> (2013, accessed 06 November 2019).
- ⁴⁷ Poortinga W, Jiang S, Grey C, et al. Impacts of energy-efficiency investments on internal conditions in low-income households. *Build Res Inf* 2017; 46: 653-667.
- ⁴⁸ United Kingdom Green Building Council. Regeneration and Retrofit – Task group report. <https://www.ukgbc.org/ukgbc-work/retrofit-led-regeneration/> (2017, accessed 08 April 2020).
- ⁴⁹ Ofcom. Techie teens are shaping how we communicate. <https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2014/cmr-uk-2014> (2014, accessed 09 April 2020).
- ⁵⁰ Gupta R and Gregg M. Do deep low carbon domestic retrofits actually work?. *Energy Buildings* 2016; 129: 330-343.
- ⁵¹ Swan W, Fitton R, Smith L, et al. Adoption of sustainable retrofit in UK social housing 2010-2015. *International Journal of Building Pathology and Adaptation* 2017; 35 (5): 456-469.
- ⁵² Hamilton G, Summerfield A, Shipworth B, et al. Energy efficiency uptake and energy savings in English houses: A cohort study. *Energy Buildings* 2016; 118: 259-276.
- ⁵³ Nadim W and Goulding J. Offsite Production in the UK: The Construction Industry and Academia. *Architectural Engineering and Design Management* 2009; 5: 136-152.
- ⁵⁴ Trota G. The determinants of energy efficient retrofit investments in the English residential sector. *Energy Policy* 2018; 120: 175-182.
- ⁵⁵ Wilson C, Crane L and Chryssochoidis, D. Why do homeowners renovate energy efficiently? Contrasting perspectives and implications for policy. *Energy Research & Social Science* 2015; 7: 12-22.
- ⁵⁶ Maby C. and Owen A. Installer Power – The Key to Unlocking Low Carbon Retrofit in Private Housing. <http://ukace.org/wp-content/uploads/2015/12/Installer-Power-report-2015.pdf> (2015, accessed 19 November 2019).
- ⁵⁷ Energiesprong. Energiesprong Leaflet. <https://energiesprong.org/publication/> (2018, accessed: 09 April 2020).
- ⁵⁸ Boardman B. *Achieving Zero: Delivering Future-friendly Buildings*. Oxford: Environmental Change Institute, 2012.
- ⁵⁹ Pettifor H, Wilson C and Chryssochoidis G. The appeal of the green deal: empirical evidence for the influence of energy efficiency policy on renovating homeowners. *Energy Policy* 2015; 79: 161-176.
- ⁶⁰ Kaminski, I. VAT chance: Can tax reforms spur a retrofit renaissance? *Architects Journal*, <https://www.architectsjournal.co.uk/news/vat-chance-can-tax-reforms-spur-a-retrofit-renaissance> (2020, accessed 29 October 2020).