

Bridging the gap: integrating energy measures into mainstream home repairs, maintenance and improvements

Catrin Maby
Welsh School of Architecture
Cardiff University
United Kingdom
cmaby@outlook.com

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Abstract

One of the many complex challenges in tackling climate change is the pressing need to achieve a major reduction in carbon emissions from existing buildings. Making the necessary improvements to the domestic sector presents particular problems around consumer awareness and priorities, disruption and inconvenience, cost and availability of finance, duration of tenure, and availability of appropriate (and trusted) contractors.

While work has been done to try to understand better the views and needs of the households and homeowners, a perspective that tends to be missing in policy debate is that of the contractors themselves. As the first point of contact for many homeowners who want building work done, these key market actors have a great deal of potential to influence such customers, and a wealth of knowledge to bring to retrofit. They could be the frontline in communicating, selling and implementing energy improvements.

Research carried out in the UK sought to complement existing knowledge with views from different standpoints, across a range of building trades, merchants and suppliers. The aim was to develop a better understanding of standard practice within the local supply chain in relation to home energy improvements, as a basis for seeking solutions to some of the barriers that exist. The results are presented as a series of gaps: gaps in communications at many levels; gaps in construction educa-

tion, training and qualifications; gaps between trades and between building professions; gaps in advice and information for homeowners and the building trades; gaps in quality assurance, transparency and accountability; gaps in business offering, and ultimately gaps in policy.

Introduction

There is a body of research on the issue of 'retrofit' of energy improvements, set against the context of the need for a step change in the energy efficiency of existing homes. Such research tends to focus either on detailed technical issues around the buildings and the application of retrofit technologies, or on the user, the household and how they choose to retrofit, what retrofit is undertaken, and how they use their homes before and after retrofit. At a policy level, the focus is primarily on how to achieve scale through national or area based schemes.

Relatively little research appears to have been carried out with regard to the opportunities for the mainstream building trades to deliver home energy improvements. Focus on the supply chain has instead largely concentrated on the development of a parallel 'green' industry, delivering to popular policy targets around new job creation. While there may be an argument for the development of low energy, low carbon or otherwise 'green' renovation as a specialism, a lack of integration with the mainstream trades carries the risk that if and when such new businesses fail (such as if policy support is withdrawn before the market is established securely enough to survive independently), the skills and knowledge may disappear with them. Another significant potential risk of a lack of integration is that the opportunity is missed to include energy improvements

when homeowners get repairs and maintenance done on their homes, such as including thermal insulation when a wall or roof is renovated, or when they invest in improvements such as extensions, attic conversions, or new kitchens and bathrooms.

The home repair, maintenance and improvement (RMI) market in the UK is generally consumer-led, in that it is work that homeowners want or need, and seek to have done – rather than responding to government incentives. It is a sizeable market, estimated at more than £11 billion per annum (€12.4 billion) in private housing alone in the UK in 2013 (Maby and Owen, 2015). This market provides practical opportunities for the inclusion of energy improvements alongside other works, as well as the potential for offering stand-alone energy improvements as part of the tradesperson's portfolio. As the first point of contact for many homeowners who want building work done, RMI building tradespeople have the potential to influence these customers, and a wealth of knowledge to bring to retrofit. They could be the frontline in communicating, selling and implementing energy improvements.

In the UK, the RMI market is a highly fragmented industry, dominated by SMEs and in particular micro-enterprises, which are mainly active at a local level, and tend not to be members of particular associations or membership bodies, apart from those specifically required to enable them to carry out their trades. As such, an understanding of their views and working practice can be difficult for policy-makers to access.

Against this background, qualitative research was carried out to fill the gap in knowledge. The research focused particularly on the views and experience of micro-enterprise building trades and those that they connect with in their everyday work, to build a picture from the ground up of how the industry could be enabled to deliver the home energy improvements needed to deliver national policy goals. Building trades do not operate in isolation, and in order to complete the picture, a small sample was included of other key actors with whom tradespeople connect in the course of their work, such as builders' merchants and suppliers, trade associations and building control professionals.

This research was done within the framework of a part time doctoral study at the Welsh School of Architecture, Cardiff University, with fieldwork carried out during 2014–18.

Research Aims and Methodology

The overarching aim of the work was to research the opportunities and barriers to the integration of home energy improvements into mainstream repair, maintenance, renovation and home improvement practice in the UK. A primary objective towards achieving this aim was to develop an understanding of standard practice within local supply chains in relation to home energy improvements, through researching the views of key market actors from different standpoints, across a range of building trades, merchants and suppliers. A second objective was to identify recommendations for change which would enable an increase in the quantity and quality of application of energy improvement measures by the building trades engaged in the RMI market. The measures considered were across the full range of those that might be carried out as building or building services work, including thermal insulation, heating and cooling, hot water provision, lighting and microgeneration.

The research was entirely qualitative, and data was analysed using coding. The main source of data was 57 semi-structured interviews, carried out in two phases, the first in 2014–15 and the second in 2017. Additional data was obtained through two discussion groups, in 2015 and 2017, engaging a further 21 participants. The total number of research participants was 78, of which 40 were building tradespeople. A breakdown of the research participants is provided in Table 1.

The first phase of research focussed on developing an understanding of standard practice for RMI building tradespeople, the kind of work they do, how they find their customers and how decisions are made about the work that will be done. This led on to asking about whether they included energy improvements in what they offered, whether they would advise the customer on this issue, and what kind of response they would typically get. They were also asked about any barriers encountered in delivering energy improvements, and where they would find help and information if they needed it. At the end of the interview they were asked about what changes they would like to see at a policy level to make it easier to deliver home energy improvements.

A second phase of semi-structured interviews built on the findings of the first phase, with a particular focus on the role of the general builder in specifying home energy improvements within RMI work and managing their delivery in practice – and how they learn to do this. These interviews targeted general builders again, but also suppliers of energy efficiency materials and construction training professionals.

Gaining access to building tradespeople to interview was achieved largely through the use of neighbourhood and social contacts, and by asking them to suggest others to interview. This use of 'social capital' was found to be necessary as busy tradespeople were generally unreceptive to interview requests from a stranger, without any kind of introduction. From the initial contacts with tradespeople it became evident that it would be difficult to set up appointments for interviews during the working week, rather it was necessary to be flexible and to fit in with the availability of the interviewee, which could change at short notice. Working within very small companies, they tended to be out on site a great deal and to work to variable schedules. The majority of interviews took place in the home of the researcher or the interviewee, in an informal setting, such as at a kitchen table.

This approach to sampling had an advantage for the research in that it ensured that the sample was mainly relatively mainstream and without a specialist bias towards 'green' technologies (although a degree of bias exists in that the research was introduced as being about energy improvements). It also meant that the geographical scope was relatively limited, with the majority of the interviewees based in the same region as the researcher, on the English/Welsh borders in the counties of Monmouthshire, Herefordshire and Gloucestershire. A small additional sample (5) from West Yorkshire was provided through a collaboration with a researcher at Leeds University (Maby & Owen, 2015). The risk of a rural/small town or other geographical bias to the results was mitigated by checking against a scattering of 18 further interviews from further afield, such as London and Birmingham, enabled through networks such as the Federation of Master Builders and the Association for Environmentally Conscious Building. 11 interviews were

Table 1. Research participants

Category	Interviewees	Group discussions	Total participants
general builder	20	3	24
plumber/heating engineer	7		7
Electrician	2		2
carpenter/joiner	3		3
Bricklayer	1		1
painter/decorator	1		1
roofer	1		1
insulation installer	1		1
air tightness specialist		1	1
trade association	4		4
planning/building control personnel	3		3
architect	1	2	3
self-build homeowner		1	1
training professional	4		4
merchant/supplier/manufacture	8	1	9
research academic/consultant		8	8
public sector policy professional		3	3
energy efficiency programme manager		2	2
total	57	21	78

with organisations with a wider geographical remit such as trade associations, manufacturers and training colleges. The second round table discussion, held in 2017, provided an opportunity to discuss results with other researchers, programme managers and policy professionals.

Results

INSIGHTS INTO STANDARD PRACTICE

Some of the key insights identified are set out below: firstly into standard practice in running RMI businesses and managing work, and secondly in relation to proposing energy efficiency improvements alongside RMI works.

Preference for working locally

The building tradespeople that were interviewed indicated that they generally worked at a very local level, and preferred to do so, for several reasons – economic, practical, and personal.

A key issue raised was the time and cost of travelling to different locations for work – and that this makes it difficult to offer a price that is competitive with a business already based in that location. Family responsibilities were also highlighted, such as taking children to school or being there when they get home. A few of those interviewed also mentioned the environmental impact of travelling a long way, and were conscious of the inherent contradiction in doing this to undertake ‘green’ work.

An important practical point was access to known suppliers and other trades to work with. For a builder involved in several jobs at the same time, where they may be coordinating or

sub-contracting to others, keeping an eye on the different jobs makes distance even more crucial. There was a strong preference for using known (local) suppliers who can be relied upon for reasonable prices, deliveries and follow-through in the case of problems.

Local reputation matters

Working locally was seen as important to build reputation and trust, both with customers and with other trades. A positive local reputation is important for developing a stream of local work with good customers – getting work through personal recommendation helps the tradesperson to avoid potentially difficult customers and bad payers. The costs of a single building project can be very high relative to annual turnover and microenterprises may not be able to build up reserve capital to fall back on if cash flow problems arise.

Another consideration is that a personal recommendation starts the tradesperson on a better footing with the customer, and helps to reduce the number of quotations they have to do to get work – as opposed to the ‘one of three quotations’ situation, which can be very time consuming for small businesses. A good reputation can put a business in a better position to get confirmed work early in the design process, and to influence the detail of the project. This can also potentially increase the energy benefits of the project, allowing good practice and existing knowledge to be incorporated through recommending measures such as thermal insulation, more energy efficient lighting, or identifying opportunities for microgeneration.

We don’t advertise ... if your work is good enough you don’t have to [general builder]

Many of the tradespeople interviewed said that they get most or all of their work through word of mouth recommendations. Advertising their business, if it is done at all, is highly localised, such as through parish newsletters or local free sheets. Work on a building that is well known in the community, such as the church, pub, village hall, sports centre or school, has the potential to cascade into other opportunities.

Don't market myself at all, I prefer to get word of mouth jobs – people who like my work pass on my information to others [general builder]

They found us in the village newsletter and we did some work to the local pub, and from that the phone for about 3 weeks was inundated ... [heating engineer]

Influencing customers

Research participants reported that while there is a knowledgeable type of customer who researches and decides on the details of retrofit for themselves, in many cases, the tradesperson needs to suggest what and how things could be done. In practice there can be quite an extended dialogue around the detail of the work before it is finally agreed, and there can be changes during the course of the work. The builder can have a great deal of influence on whether and to what level the energy performance standards are improved as part of the work – from spotting the opportunities through to detailing, and encouraging take-up.

The tradespeople interviewed were generally aware that improving energy efficiency can save on running costs, as well as being positive for the environment and delivering co-benefits, such as improved comfort and health due to staying warm enough in winter and reducing the risk of damp. The level of customer interest in different potential benefits was reported to vary widely, however. Cost in particular, was indicated as an important issue, but investigating what this meant brought out a wide variation in how cost was perceived by different customers. Some are worried about future running costs, and willing to spend now to save later, at least with encouragement to do so – while others (including some wealthy customers) are apparently unconcerned about running costs, and unconvinced about the value of spending money on energy efficiency.

... when I do my quotes, I try to explain that the energy efficiency measures I have included will decrease people's heating bills and so on and increase their comfort – but I am aware that other builders won't be quoting for quite so much insulation and therefore I may not get the job as a result [general builder]

In practice, an initial interest in energy improvements might not be carried through to a decision to invest in them. Money that could be spent on energy improvements comes from a finite pot from the homeowner's point of view, and may have to compete with other wants and needs, such as a holiday.

Well, they wanted insulation in the floor, and then I said well there's no point in having insulation in the floor and not in the sides or the roof, and they were just shocked by the cost then ... yeah, I did work them out a price, and I never heard any more ... [general builder]

People only have a certain amount of money to spend, and if it's ... more insulation or go on a Spanish holiday ... [general builder]

In trying to communicate the potential benefits of retrofit, tradespeople noted that being able to quantify savings against costs in a credible and consistent way would help their case, but said that they did not know how to access this information. There was general awareness of the existence of Energy Performance Certificates (EPCs), and that these can be useful in bringing attention to energy efficiency - but there was also the view that they can be inaccurate and are of limited use (for example because the assessor has not collected data accurately, or the EPC assessment process does not allow a detailed enough consideration of a particular property).

How receptive a customer will be to recommendations, and therefore how ambitious the tradesperson can be in their advice, varies with the situation and the relationship. Having worked for the customer before, or being personally recommended, establishes a basic level of trust which puts the tradesperson in a stronger position to make recommendations. This is particularly important if the recommendations incur additional cost, perhaps because it's for a higher quality product or for something extra to the customer's original enquiry, for example additional thermal insulation within a general RMI job such as re-plastering a wall or fitting a new kitchen.

I am in quite a good place generally because I am recommended ... I will tell them what I feel should be done and I am pretty sure they are fairly comfortable that I am not doing it just so that I can make as much money as I can [carpenter/joiner]

Customers often cannot afford to do everything at once, however, or are limited by the need to continue to live in the house while work is being done. They may only be able to consider one room or part of the building at a time. Compromises need to be made in practice, to deliver what is possible on energy efficiency within this limited scope.

But in a lot of other cases, people want great outcomes with hardly any money to spend, and there's always these tricky conversations about ... I mean I always want to get the conversation about how much it will cost in fairly early because people have expectations [general builder]

Building Regulations driving energy improvements

Research participants placed high value on Building Regulations as a driver for higher energy efficiency standards – emphasising that if the Regulations stipulate something then the customer will have to agree to it, and cannot choose a cheaper option. It was emphasised that this only works, however, if Regulations are effectively enforced – and concern was raised with regard both to the reduction in Building Control capacity (with cuts in this provision within local authorities in recent years) and the privatisation of the function, with the risk that the independence of Inspectors is compromised by the commercialisation of this service.¹

1. Building Regulations in the UK are enforced by Building Control Bodies which are either within Local Authorities or private approved Inspectors.

A local authority Building Control officer pointed out that the inclusion of sustainability in regulations is more difficult to enforce than matters which are more directly related to health and safety – no one wants to be responsible for causing death or serious injury, but climate change is seen as a more remote risk. Regulations concerning sustainability can also be more difficult to understand. Regulation or incentives that are too complicated could have a negative effect, because people may not understand how to comply, or be frightened off by the paperwork involved.

... where the Building Regulations started out with keeping people safe ... this is a different direction for the Regulations – because nobody is going to die because there is not enough insulation in the walls [Building Control Officer]

A builder's merchant stressed that Building Regulations drive the market for insulation (and potentially other products) in that they will stock what the Regulations require – and hence what is easily available to builders.

Building trades cooperating through informal local networks

The majority (23) of the building tradespeople interviewed were either sole traders or had formed companies without any other direct employees. 9 were in companies with more than one but less than 5 employees, and only 2 were in bigger companies of 7 and 16 respectively. Some of the interviewees had worked in larger SME building companies until they were disbanded a few years ago, citing 2008 as the economic 'crash' year, since when there has not been the confidence to rebuild companies to that scale.²

Where jobs require more than one trade, it appeared to be common practice in the domestic RMI market for these independent tradespeople to link up with others on an informal basis, bringing in other tradespeople that they know from within their locality. This is seen as a relatively low risk way of working compared to having a team of employees, given the economic uncertainties of the time. In some cases a lead builder will subcontract to the others, but in others the customer pays each tradesperson separately. Sometimes the customer also pays directly to the supplier for the materials. This reduces the financial burden on the tradesperson, in having to pay large sums out before being paid themselves. For the customer there is the benefit of greater transparency – they can see exactly where their money is going – however under this arrangement, they cannot entirely pass over the burden of managing the costs of the overall project to the builder.

We have employed people in the past, but it's too uncompetitive to employ people – the costs of employing people are massive, and you are having to compete against people who haven't got employees [general builder]

I work with a plumber who's brilliant and he knows his stuff, and then very often perhaps there's a brickie or a carpenter, and everybody knows each other ... because back in the 70s or 80s there used to be one big company and they used to employ everybody, right up to the finishing and painters

and decorators, and they all used to look after each other [electrician]

We have a little sort of almost cooperative thing going ... there's a couple of us builders, specific carpenters when you are getting into the intricate stuff, plumbers, electricians, plasterers ... and I guess a lot of people work in the same way ... [general builder]

The multiple roles of the general builder – from design through to completion

This discovery led to discussion with interviewees about how the work is designed, specified and coordinated on site, and by who. In large or commercial projects where there is an architect and wider design team, there is normally a clearly defined process to make sure that design objectives are implemented, as set out for example in the Royal Institute of British Architects 'Plan of Work' 2013 (RIBA, 2013) – but in talking to building tradespeople engaged in domestic RMI work, it emerged that there is no standard way in which this is managed. In the wide range of RMI jobs considered, only some of the more major ones (such as an extension) typically involved architects, and even then the architect might be engaged only for the overall design, and not necessarily for the detailed specification or the oversight of the work on site. In this situation, it is typically the general builder who fills the gap, coordinating the work on site and even in many cases designing and specifying the whole job. Even where an architect has drawn up a detailed specification, some builders reported mistakes, omissions or lack of clarity, and that some construction details or problems may only become evident once work has begun, and so need to be resolved on site. If this happens then the builder will typically lead on developing a solution, sometimes in consultation with the customer and the architect.

This latter point highlighted the need for effective communications at all levels, including on site, so that solutions to difficult details and problems that may arise in working on an existing building can be developed between the tradespeople with their different specialisms, and understood by all involved. Such details can be particularly sensitive in low carbon renovation, such as around ventilation, or avoiding cold bridges in applying thermal insulation. Experienced builders emphasised the trouble-shooting aspect of the skill-set they had developed, as well as general knowledge of the range of building characteristics in their region.

Discussion with tradespeople identified the generalised stages illustrated in Figure 1 in a 'typical' RMI job, and that the relationship with the customer can involve considerable dialogue and ongoing decision-making, particularly, but not exclusively at the initial stages.

There is no specific qualification to be a general builder in the UK

The research indicated that a tradesperson offering general building services plays a key role in domestic renovations, from design and specification, discussion of options with the homeowner, through to on-site coordination and decisions throughout the process. Further investigation revealed that while there is a clear demand from homeowners for general building services, there is no clear definition of this as a trade in the UK – and hence no specific qualification or educational pathway. Quali-

2. The global financial crisis of 2007–8, which erupted within financial institutions and was followed by widespread economic downturn, affecting construction along with many other industries.

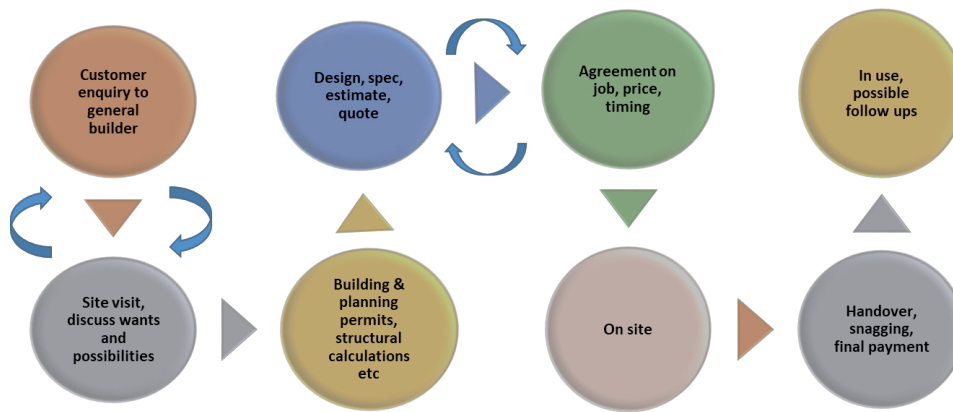


Figure 1. The stages of a typical RMI job.

cations and college courses are specific to individual trades, such as carpentry, joinery, bricklaying, electrical services and so on. There is no licensing system for building work in the UK, and only specific building services – electrical and gas work – carry a legal requirement for a qualification.

So how had those offering the general building services learned to do their job in practice? Some of those interviewed had trained initially as carpenter/joiners; others had done several separate trade qualifications over time; or worked for their father's building company and gained a wider knowledge base by working with different skilled people. Practical, on-site experience and working with skilled teachers or mentors was seen by many as the most valuable training.

I did 5 years as an apprentice but I started work for my father ... when he employed people he put me with someone, two years with one trade and then he put me with another one [general builder]

Others had gained some of the necessary skills and knowledge through renovating their own homes (and then in some cases being asked by neighbours to do something similar for them), and moved into building work from another profession, such as engineering or project management. As one interviewee put it:

You kind of transition to become a general builder by virtue of the market [general builder]

The lack of a standardised educational route to becoming a general builder has implications as regards the ability to take responsibility for the 'whole house', including its energy performance, and closely associated issues such as internal air quality and the movement of moisture within a building.

One participant raised as a concern the fact that trade apprenticeships are much shorter than they used to be. While this may be in part due to a reduction in the need to develop specific manual skills, due to modern machinery, it raises concerns about the status of the building trades in society, which is already felt to be very low and could be reduced further by cutting back on training.

Before the First World War, probably even before the Second World War, you used to do a 7 year apprenticeship. Well, my dad did his apprenticeship as a decorator in the 60s and he did 5 years ... and I did my apprenticeship starting 1989 and I did 3 years [carpenter/joiner]

No one seems to think that doing a job with your hands is a worthy thing, that you must be stupid, that it's something you do if you're thick [general builder]

A corollary to this low status is that the fees that builders charge may not reflect the importance of their work to people's lives, homes and the value of the property they work on.

People will pay a solicitor £120 for an hour and they will say it takes a long time to become a solicitor, and doctors will get £120,000 a year because it takes 7 years to qualify ... as far as I can see it takes at least as long as that to become a true craftsman, but it's not recognised as a profession and something needs to change in my opinion ... [carpenter/joiner]

The need for wide ranging skills and resources for ongoing learning and information

It was noted that building tradespeople working as sole traders or in very small companies tend to develop wider business and technical skills, out of necessity, than in the more defined roles in big companies. Working on domestic renovation projects, where someone needs to take a lead in coordinating jobs with other trades involved and to plan, cost and coordinate complex building projects, helps to explain perhaps how a capable carpenter, for example, may find themselves on a path which leads to becoming a general builder.

The need for ongoing learning was seen as an essential part of RMI work, with every new project bringing new challenges. Knowledge exchange between tradespeople is key, especially between the different trades grouping together in their informal local networks. Tradespeople realise that they take responsibility for the choice of products and materials, but may have to spend a lot of time sourcing it, and cannot always be sure of their sources. Product suppliers are seen as a valuable source of information and advice, but with limitations when it comes to selecting technologies and looking at the integration of services within the whole house – not least because of the obvious risk of commercial bias.

The trouble is with all the information you get now, is at the end of it they are trying to sell a product ... and won't look across the broad spectrum with the amount of options you have [general builder]

Given the value placed on Building Regulations as a way of ensuring standards, there was some frustration that Building Control does not give more information and advice on how best to comply with requirements.

You should be able to speak to building control and get information ... You can't just chat to someone ... everyone is trying to cover their own backs. They will not say 'yes you can do that' just in case. [general builder]

DISCUSSION – BRIDGING THE GAPS

The discovery of a gap in construction education with regard to the role of the general builder led to investigation of a number of other gaps, in construction training and qualifications more broadly, and in the related educational approach and philosophy, in communications, advice and information, quality control, the business 'offer' available to consumers to support home energy improvements, and ultimately in policy itself.

These issues are reflected to a greater or lesser extent in academic and policy literature, some of which is referenced in the discussion below.

Gaps in construction education

The gaps in construction education can be broken down into several categories:

A qualification for general house building and renovation

The research indicated that the lack of a specific qualification for general building services to the domestic sector in the UK is a significant gap to be addressed. Discussion with construction training professionals identified the closest existing fit to be the Higher National Certificate (HNC) in Building Con-

struction, but that this tends in practice to be tailored to larger and commercial sites. None of the builders interviewed had taken this qualification. At a much lower level, a multi trade qualification had been developed aimed at maintenance work for social housing. The need for a general builder qualification has recently been adopted as a campaign objective by the UK's Federation of Master Builders, along with that of establishing a licensing scheme for builders (Federation of Master Builders, 2018).

An educational pathway to becoming a general builder is needed as a basis, in order to ensure that the necessary elements to enable good quality low carbon renovation are included – and that all the many skills required of the general builder are covered. Taking into account the views of research participants, an outline of the educational requirements for a 'low-carbon-renovation-ready' domestic general builder is suggested in Table 2.

Sustainability/sustainable energy education across all trades

The specific gap in terms of sustainability education, and the issues of sustainable energy and low carbon in particular, is a matter for concern across the professions and key actors involved in buildings management and renovation – architects, building trades, planning and building control, merchants, housing providers and developers. In relation to the building trades, to ensure maximum impact and consistency, sustainable energy must be embedded into training for each trade, rather than as an optional extra, but this is not enough on its own. There is also a need for education on the interaction between trades with respect to energy efficiency and low carbon, and awareness of the energy performance of the building as an integrated whole (Green Construction Board, 2017; Clarke et al, 2017).

Table 2. Outline educational requirements for a low-carbon-renovation-ready domestic general builder.

Foundation/Core	<ul style="list-style-type: none"> • Literacy and numeracy • Researching information and materials • Producing written estimates and quotations
Cross-cutting/transversal	<ul style="list-style-type: none"> • Project management • People management and coordinating work on site, working with multiple trades • Communication skills, ability to manage effective dialogue with customers, including explaining technical terms • Business management and marketing • Problem-solving and trouble-shooting • Health and safety, fire safety
Technical	<ul style="list-style-type: none"> • Good general knowledge of main construction and building services trades, including carpentry/joinery, bricklaying, roofing, groundworks, and drainage, plumbing, heating and electrical services • Good general knowledge of microgeneration and household scale renewable heat technologies • Heat loss and energy demand, and associated carbon emission calculations • Reading and interpreting technical drawings • Renovation design and specification, including sourcing materials and products, accurate measurements and quantity calculations • Knowledge of moisture movement in buildings, and causes and remedies for damp • Knowledge of ventilation requirements and provision, and building details for low air infiltration and passive buildings
Scope	<ul style="list-style-type: none"> • Practical (including on site) and theoretical • Urban and rural • New build and existing buildings • Modern and traditional, including sensitive built heritage conservation

Level of achievement required to undertake building work

An issue that emerged was a concern regarding the *level* of qualification seen as sufficient for delivery – and the tendency for this to be driven down by the commercial interests of the larger employers dominating the current system for employer-led apprenticeships. One aspect of this is the cost of having apprentices at college instead of on site learning – but another is that the larger employers are more likely to run larger programmes where labour is divided by function and task, resulting in the need for a narrower set of skill requirements than are likely to be needed more widely in the domestic self-employed or microbusiness employment they may find themselves in after qualifying. An example quoted by an interviewee was that a large employer might want an apprentice carpenter to fit 200 factory-made identical skirting boards, door architraves and factory made staircases, while the small business may need them to be able to make these from scratch for different situations.

Investigating vocational education and training for heat pump installations, Gleeson identifies a trend towards deskilling within the UK heating market, due to packaging of products and an increased use of ‘rule of thumb’ for specification. He points out the negative consequences for the effective introduction of low carbon technologies, reminding us that the energy performance of heat pump systems is heavily dependent not only on the product and its installation, but also on the design, installation and commissioning of the whole system. Describing the change in the UK heating and plumbing market from the 1950s when central heating first started to become the norm in new heating installation, to the present day, he describes the shift from the expectation that the heating engineer would calculate heat loss, radiator, pump and pipe sizes to a ‘combi culture’ where specifications are done by rule of thumb and systems are bought as a package of equipment by the installer (Gleeson, 2015).

Pushing trainees out into the market at too low a level of qualification risks undermining the quality of work that can be achieved, with particular concerns as regards the increased sensitivities of low carbon technologies and building fabric renovation. The tendency for construction (including building services) trainees to leave education at too low a level is noted with concern in academic studies, (Clarke et al, 2017; Brockmann et al, 2010) and was reflected in comments by training professionals interviewed.

Range of practical and on-site experience

Interviewees highlighted the importance of the range of practical experience needed, and the mismatch between the narrow range of tasks learned in apprenticeships with large employers (often working on new build projects) and the reality of work available after qualifying, much of which is in the domestic RMI market, and in micro-businesses. A 2016 review of technical education in England recognised as a critical issue the need to enable the development of the ‘knowledge, skills and behaviours required to perform successfully in specific occupations, not just the narrower job role-focused needs of individual employers’ (Sainsbury, 2016). Many of these concerns were echoed in a recent review of construction education in Wales (Qualifications Wales, 2018) – education being devolved in the UK, with differences between England, Northern Ireland, Scot-

land and Wales. A Welsh third sector initiative, Cyfle Building Skills, has developed a shared apprenticeship scheme, with trainees moving around different employers, to address two of the practical problems identified: that apprentices need experience of the wider skill set and experience involved in working in small businesses, and to help small businesses for whom it is difficult and expensive to take on apprentices alone (www.cyflebuilding.co.uk).

Gaps between trades and between building professions

The ‘gap-identification’ approach might be similarly applied to the gaps in formal coverage of the many tasks required to fulfil an effective low carbon refurbishment – design, specification, on-site coordination and so on. It could also be applied to the communications between different building professions – architects, surveyors, builders, building inspectors and planning control. This is particularly highlighted by the lack of clarity as to who is responsible for design, specification and coordination on site in the typical domestic renovation project.

Reference was made by an interviewee to the development of industry or trade ‘silos’, the breaking down of which can threaten the commercial interests of different trade bodies and service organisations which have grown up over time to support them. Change initiatives which rely on leadership by ‘the market’ can founder on the barriers to change thrown up by these interests.

Gaps in quality assurance, transparency and accountability

The ‘performance gap’ is a term used to describe an installation not meeting expectations in some way. This might be for a number of reasons, including not only potential inadequacies in the product itself, but the choice of product, the details of the way it is installed, other aspects of design and interaction with the building and building services, and the way the product and the building are used and maintained.

Quality control in building can be seen as a jigsaw of issues: product, installation, design, user advice and behaviour, maintenance. It involves setting the right standards, backed up by qualifications and certification, and regulating to ensure they are achieved. Getting this right has been emphasised as an issue in UK policy discussions around buildings in recent years (Bonfield, 2016), in relation both to renovation and new build. In an era in which reducing public intervention is a core political paradigm, the maintenance (and improvement) of quality assurance is a complex and often confusing issue, and the lack of public knowledge and understanding of the frameworks that exist and how they should function makes their effective functioning even more questionable. A report into the potential for licensing of building work for Welsh Government concluded that the key issue ‘with the plethora of existing schemes is the potential for confusion among consumers, a belief that certain schemes are a mark of proven quality where no such assessment takes place, and the lack of muscle to take any kind of direct enforcement action where adverse consequences occur or where inspections have found building work or other installations to be sub-standard’ (Pye Tait Consulting, 2014).

The issues of quality control, and of accountability have been highlighted recently in relation to the tragic fire at Grenfell Tower in London in 2016, in which many residents died. The spread of the fire was linked to the renovation of the building

(which included external wall insulation). The review following the fire concluded not only that ‘the current system of building regulations and fire safety is not fit for purpose and that a culture change is required to support the delivery of buildings that are safe’, but also that the roles and responsibilities of those procuring, designing, constructing and maintaining buildings are unclear (Hackitt, 2018), a point which chimes with the findings of this research. The gap analogy can be applied yet again – in amongst the multiple factors which appear to have contributed to the spread of the fire and its appalling consequences, can be found distinct gaps in both communications and accountability within the renovation process.

Gaps in communications

The importance of communications (and the lack of it) was raised by a number of interviewees, in different aspects with regard to home energy improvements. This was highlighted at all levels, not only at high level from government, but also at project level: between builder and customer, between designer/architect (where one is involved) and builder, and between different trades on site. Working together to find solutions to problems can be critical to achieving the aims of very low carbon renovation, where everyone involved may be on a relatively steep learning curve. In purely technical terms, the problems in low carbon renovation often occur at the physical interface, such as the joints between different building elements and materials (Rickaby, 2015). It could be argued that this is reflected in the need for effective communication to bridge the ‘interface’ between trades, to ensure that no gaps in quality can occur. An obvious example is where a fabric seal is broken or compartmentalisation compromised by building services added at a later stage.

There is a need for more effective government communications to the industry and the public setting out the strategic direction of travel in low carbon renovation, and backing it up with regulations and marketing messages. A specifically relevant point raised by one interviewee was the lack of communications about changes to Building Regulations, and the reasons for these – this seems critical for the industry to be able to keep up to date, and to have a clear picture of the progressive shift in regulation towards low carbon that would give confidence to invest in the skills and knowledge development required.

Gaps in advice and information

Another aspect of communications highlighted was that while there was awareness of both the potential for, and the benefits of, energy improvements within RMI amongst the building tradespeople interviewed, they lacked confidence in their ability to convince the homeowner, unless supported by credible independent advice. The Countdown to Low Carbon Homes research (Charalambous et al, 2014) concluded that homeowner advice needs were multi-stage, and that impartial bespoke advice and support throughout the ‘retrofit journey’ are instrumental in overcoming many of the barriers to domestic retrofit, with advice needed at each of the stages identified in Figure 2.

A good quality and detailed technical energy assessment is an important tool for advice provision, and one that sets out a practical path to low carbon for a building, even if it is only achieved step by step, would be a useful addition, such as in the ‘Building Energy Passport’ concept (Fabbri et al, 2016).

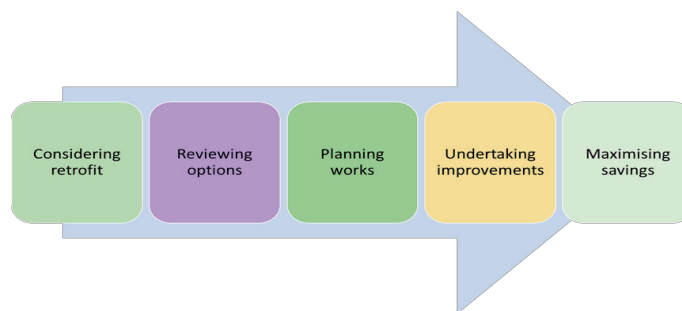


Figure 2. The customer journey through a home energy renovation project.

This might be provided and communicated to a homeowner, alongside support on deciding what to do, finding contractors, financing the work, and adapting user behaviour to maximise the benefits.

Building tradespeople interviewed indicated that they would also value access to expert but commercially impartial advice on low carbon renovation, including site-specific. Discussion around how this might best be provided highlighted suppliers as one source, but with the limitation that this would not be commercially independent. Another option is a local Building Control function with the capacity to offer advice, with the added benefit of being able to point to local examples and experience.

Energy advice provision has been cut back to the bare minimum in much of the UK in recent years, with the notable exception of Scotland – leaving a significant gap in provision.

Gaps in business offering

Building further on the concept of the advisory service, which supports both homeowners and builders through the process of low carbon renovation, is the concept of the ‘one-stop-shop’ for building energy renovations – which can be broadly defined as a business model which offers more than one of the relevant services to the consumer, encompassing for example the advice and technical energy assessment of a building, the products and installation, financing the works, and facilitating or coordinating the process and/or the work on site (Erwin et al, 2016). A range of local and regional examples offer variations on this theme, such as Retrofit Works in London, BetterHome in Denmark, Super Homes in Ireland, and Picardie Pass Renovation in France, providing models that could be built upon (BPIE, 2018).

Looked at from the perspective of the individual building business, to achieve the level and scale of energy renovation demanded by policy requires business models that extend beyond single technologies or services and can provide a more comprehensive service (Cré et al, 2012), either within the same business or in collaboration with others, as in the informal networking indicated as the norm in the UK RMI market.

Gaps in policy

The yawning gap that is apparent is a coherent long term renovation strategy, to achieve carbon and fuel poverty targets for UK housing, including consistent interim targets and a realistic but ambitious action plan. Interviewees cited problems in relation to short term subsidies, seen as destabilising to the in-

dustry and creating an unsustainable dependence and ‘boom-bust’ effect. A consistent, long-term policy, on the other hand, would help to build capacity in the mainstream RMI industry, and enable companies to plan and invest in the right skills and training. Underpinning this is the need to modernise and improve consistency in the construction training sector, as indicated above. It is also crucial that housing energy policy is part of a coherent housing policy, which ensures that all sectors of the population are able to access affordable and good quality housing – the energy transition must be one that adds to, not detracts from social justice.

Conclusions

The research provided several key insights into standard practice within the mainstream UK market for home repairs, maintenance and improvements, in relation to the potential for promoting home energy improvements. As a substantial, demand-led market, this offers multiple opportunities on a daily basis to take forward policy goals for reducing carbon emissions from housing. The general builder, working at local level, is well-placed to promote and deliver energy improvements to homes, with a crucial role in assisting and influencing the decisions of homeowners, developing the details, and coordinating the work on site. This kind of work requires the development of skills in trouble-shooting and a ‘whole-house’ perspective. Working with other trades in informal local networks enables the building trade microbusinesses that typify the current market to adapt to projects of different scales and to bring in the specialisms that are needed in each situation.

The research highlighted significant gaps in the system, limiting the ability of this sector to deliver. A key gap is the lack of a coherent long-term strategy, supported by clear and well-communicated Building Regulations, underpinned by an adequately resourced Building Control function. An overhaul of construction education is required to embed sustainability and enhance multi-trade awareness across the trades, to address the de-skilling tendency and raise the minimum level of qualification at which trade training is considered complete, and to create an effective educational pathway for the general builder carrying out domestic RMI works. Finally, access to independent expert advice is highlighted, to support homeowners through the retrofit process, and building tradespeople to promote and deliver quality in low energy renovation. To address these gaps requires an integrated approach which steps away from traditional silos and embraces a 21st century energy transition.

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