

4 Building and Retrofit Sub-System: Findings from Data Analysis

4.1 Factors affecting Bristol's building and retrofit sub-system

Drawing on the interview data analysis, we have formulated the causal model of the building and retrofit sub-system in Bristol, as shown in Figure 3¹⁰, and is briefly explained below.

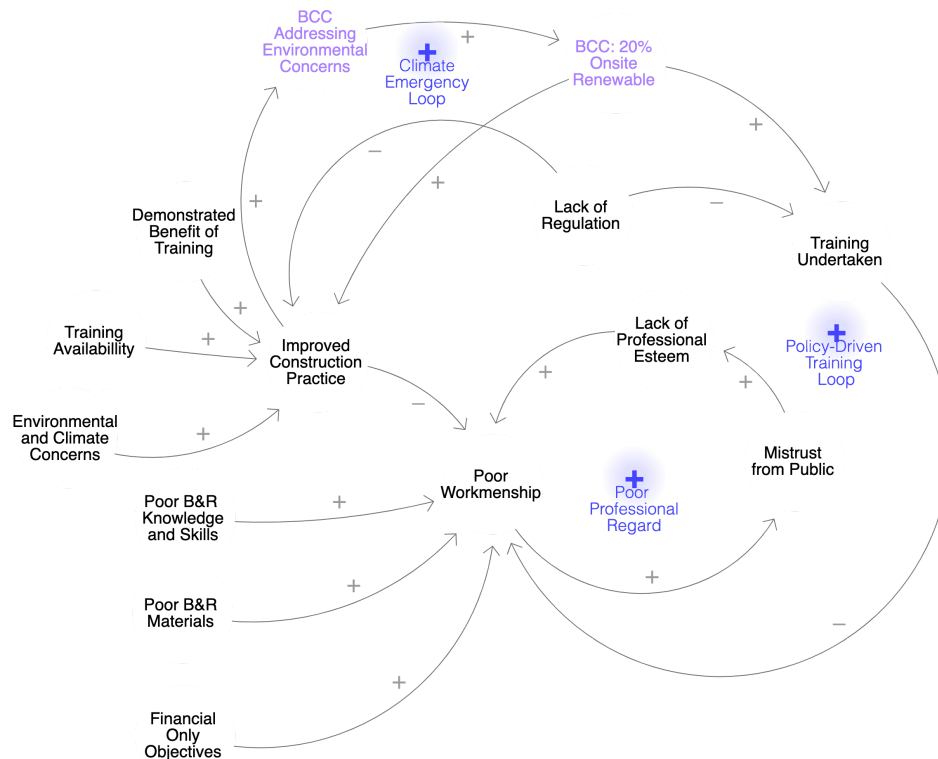


Figure 3: Causal model of Bristol's Building and Retrofit Sub-system (factors local and specific to Bristol are presented in purple).

The Building and Retrofit sector in Bristol has flagged two key factors of influence:

- (a) the ethos of the UK building and retrofit industry, of which Bristol is a part, and
- (b) the climate emergency challenge driven by national agenda and reinforced by the local city council.

The study participants describe the UK's Building and Retrofit sector as very **conservative and lagging behind modern building knowledge in materials and methods**. As stated by P11: "We seem very bad in this country about learning lessons about it from other countries. We're often trailing behind in terms of materials specification technologies. ...we seem incredibly resistant to perhaps stopping and looking and learning, and we plough on with our almost unique way of building ...". This is exacerbated by **money-driven priorities**, especially within the large building companies. This culture of building to the **minimum specifications, and as cheaply and quickly as possible**, leads to a poor quality of workmanship where the "...let's build quick and deal with

¹⁰This model can be simulated through this url: <https://energysystems.blogs.bristol.ac.uk/2021/03/08/retrofit/>

the problems later” (P11) attitude results in storing up problems in the new build. Thus, “because things don’t get built properly,” (P14) “...in 20 years’ time we’ll be retrofitting houses that were built ...today.” (P11).

This culture of poor workmanship leads to mistrust by the public towards the builders and retrofit providers “...a lot of the construction industry is not particularly well perceived by the general public. There are major trust issues around who you want to do work on your house ...” (P7). This reinforcing of poor practices also results in a poor view of the profession in that it is “...not seen as being glamorous or interesting or well paid enough ...” (P14).

However, the **climate emergency challenge** is a positive factor in driving change in the building and retrofit industry. In Bristol, the city council has introduced rules such as 20% of energy to be generated locally from renewable sources for each new build property and a ban on gas boiler installations in Bristol from 2030. Similarly, as part of the City Leap project, BCC will set up a joint venture for scaling up project delivery with qualified delivery providers. All these factors, along with the funding available from the central government for energy efficiency measures are encouraging training, the uptake of new technologies, and modernisation of work practices in the local building and retrofit industry.

To **support training** delivery, the Green Register [27] and Futureproof [28] projects have initiated training delivery activities in Bristol, although much still remains to be done.

4.2 What Skills are Needed for the Building and Retrofit Sub-System Currently and in the Future?

The skills deemed relevant by our interviewees to each of the areas of Bristol’s Building and Retrofit ecosystem are summarised in Figure 4 and detailed below, while also being aggregated into generic types.

4.2.1 Engineering and design skills for the Building and Retrofit sub-system

- *Architects with current retrofit knowledge:* while we have not observed a shortage of architects per se, several of the study participants noted that the architects lack knowledge of, and experience in, undertaking retrofit projects. As noted by P14, “the architect I chose, ...is about one of two accredited building biologists in the whole of the UK”. Furthermore, while builders can undertake much of the retrofit work, the architect should be involved with the quality assurance, as noted by P23: “...internal insulation would be undertaken by the general builder, and their workmanship would be inspected by the architect”. Furthermore, P11 suggested that a new role should be considered for an *architectural technician*, who would fill the “...space [between] builder and the architect. There’s a space in the middle ...to fill ...because, going back to the building science, building physics side of it, if you’re a brick-layer, clearly you don’t need to understand building software that’s going to thermally model a house, for instance.”
- *Heating and Ventilation Engineering* (also referred to as Mechanical and Electrical, or M&E) is a skill set which “will play a bigger part in housing in the next few years ...” (P11), and relates to the integrated design of heat pump sizing and integration of heat recovery and ventilation systems. While the installation of these systems could be considered to be a trade skill, an integrated design for these is more of an engineering endeavour: “need to know where all

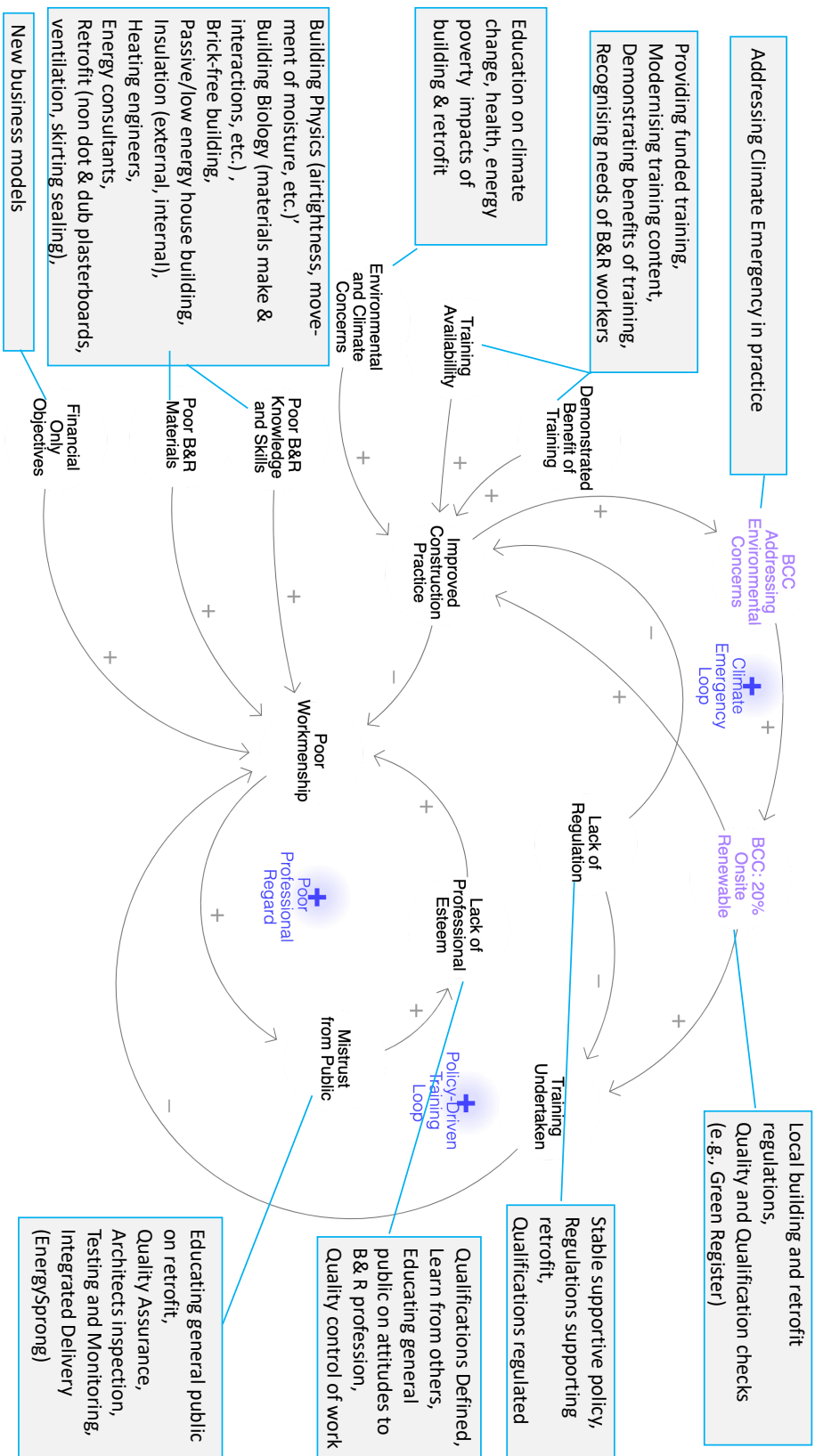


Figure 4: Skills in the Causal model of Bristol's Building and Retrofit Sub-system.

the kit is going to go. It's all very well designing it and then ready to go and then you think, 'Well I haven't got a big enough room to put all of the kit and we haven't allowed for cabling or duct work.'" (P11).

- *Software: smart buildings and controls* are expected to take a more central role with the automation of energy systems, "...to guarantee the performance, you need much more detailed monitoring and controls than are typical." (P12).

4.2.2 Trades Skills for Building and Retrofit sub-system

The most notable lack of skills and knowledge within the Building and Retrofit trades seems to originate around the lack of desire to modernise the techniques and processes, and the materials used. The UK B&R industry is said to cling to traditional building methods which are incompatible with both the carbon neutrality objectives and the SLE transition.

- *Building Physics* skills (i.e. "...the knowledge of how buildings operate" (P7), such as an understanding of how to make a building airtight, yet providing a sufficient movement of moisture, regulating airflow and temperature across various areas of the building, etc.) are reported to be severely lacking. "That's the education around the difference between traditional construction and modern construction and the fact that they should be treated differently." (P7)
- *Building Biology* skills, (i.e. knowledge of building and retrofit materials, their make, interactions and impact on those living around these materials) is noted to be very poor. While building biology is "...long established in Germany" it is still "...a very niche thing in this country" (P14). As a result, "some builders that don't really understand are maybe specifying inappropriate products for the purposes ..." (P7).

Importantly, skilled use of building biology affects both the quality of the building (e.g. due to "...absorption and desorption of moisture" (P14)), as well as the health of their inhabitants (e.g. "...it's quite shocking how much stuff is toxic that people use. Most carpets have got all sorts of horrible chemicals in for fire retardant. And there's lots of people that are allergic to that and they get really ill." (P14))

- *Installations of Alternative Heat Sources* is the area of largest trades skills needs in Bristol (and elsewhere), as " ...the government are saying that no new houses will have a gas boiler from 2025. So they're going to have to all have *heat pumps* in them" (P18), and technologies such as *solar water heaters* and *district heating projects* are also growing.
- *Gas boilers decommissioning* must go along with the new heat source installation (noted above), as we " ...need to rip out those gas boilers, and the scale and the pace that we need to move at to get to 2030" [is very rapid] (P6).
- *Brick-free building* works with "...clay blocks and they don't have a mortar course as such; they've got an adhesive course. And so it's not traditional bricklaying by any stretch ...it has to be laser perfect" (P14). While this technology is well used regularly in the continental Europe, and is both faster and much more energy efficient, the UK builders so far, have so far, resisted from adopting it.

- *Retrofit* skills, while available, substantially vary in the quality of delivery. Thus, simple *draught proofing* could often address sealing the gaps around windows, doors and letter-boxes, yet leave out sealing around skirting boards. Installation of *internal wall insulation* often results in interstitial condensation and dampness due to a *lack of ventilation* and the *use of non-breathable materials*, as well as *thermal bridging* problems. The current use of “dot and dub plasterboarding” leads to cold air enveloping the rooms just outside of the plastering layer, and slipping in from under the skirting. Therefore, though retrofit skills are generally available, there is a lack of *well qualified retrofit delivery professionals*, or “retrofit consultants” (P23) which would “...be one-stop shops that ...are able to explain, survey, analyse, liaise with the customers as part of a firm that’s also able to deliver” (P23). This kind of approach looks at the whole house rather than individual measures.
- *Quality Assurance* skill is said to be completely lacking in construction and retrofit: “the whole kind of quality assurance bit during installation, through the whole process but installation in particular, which the construction industry doesn’t really do.” (P12). While managers could address this by setting up testing procedures and the tradespeople themselves could also upskill, there still needs to be a mechanism for checking the quality of the installation. In addition, architects could inspect the workmanship (P23) (which is sometimes done in construction, yet rarely in retrofit).
- Although *passive/low energy house building* is not a new method or process, it is still an under-represented skill in the UK building and retrofit industry (P23).

4.2.3 Managerial Skills for Building and Retrofit sub-system

Given that construction and retrofit projects work with large teams, and in the UK, these teams are often made up from individual builders who act as subcontractors, project management skills are particularly important. Within this context, the most relevant noted skills are:

- *Building a core trusted team of tradespeople* who are “...signed up to ... the whole idea of saving energy and the importance of trying to stabilise the climate and prevent global warming” (P14). When the managers were successful in this, the subcontractors, “...even though they were self-employed, it was all but in name, they were essentially [company name] employees” (P11), preferring to work for a company that shared their approach and where their values and skills were recognised.
- *Delivering Quality Assurance* in an environment where the “supply chain is all split into architects, contractors and main contractors ...” (P12). For this, the manager needs to ensure that tests and checks are carried out, e.g. “...the usual kind of co-heating and air tightness tests ...” (P12).
- *Sourcing modern materials for the right price* should not really be a specific skill; it should be as simple as “...phone in an order” (P7). However, modern materials are often not available at local building merchants, “...delivery costs quite often make it non profitable” (P7) to order these materials from afar, and “...SMEs they don’t have storage facilities to order in the bulk that they need, and keep in storage”. Thus, “...if other products aren’t readily accessible, then most builders ...just ...fall back on what they know” (P7). Thus, this skill of *sourcing*,

or *proprietary supply chain set up* is considered to be a relevant and in-shortage managerial skill.

4.2.4 Energy Skills for Building and Retrofit sub-system

- *Energy Surveyor* role is often conflated with the building surveyor's. Furthermore, though general advice on roof insulation and draught proofing around windows is easy to give, the specialist energy surveyors who are able to use dedicated survey tools (such as thermal imaging) are still in short supply. As noted by P13, "There are one or two people in the country who are doing thermal imaging with pressure reduction" which is the most up-to-date energy surveying technology.

4.2.5 Finance Skills for Building and Retrofit sub-system

- Ability to work with *new business models* is considered as particularly relevant, if property owners are to be voluntarily committed to retrofit. As noted by P12, "...landlords need more re-skilling internally around kind of business model really, and what needs to be done to the properties to make them fit for purpose ...". This means being able to take a longer term view of costs and savings relating to retrofit measures.

4.2.6 Policy Skills for Building and Retrofit sub-system

While building and retrofit providers are not expected to follow the delivery policy and regulation directly, the policy concerns below were noted as being directly relevant to the industry:

- *Delivery of Clearer Regulations*: while Bristol City Council has declared a climate emergency and aims to transition to carbon neutrality by 2030, some parts of BCC act inconsistently, e.g. the Planning team prohibits certain PV installations (P7), or only allows for external wall insulation to be done at the back of the buildings to preserve the front decorations (P23).
- *Stable supportive policy* is necessary, as shown by the recent policy changes "I think ...the degree of retrofit going on has dropped by 80% since 2012. ...That's because the plug was pulled by Cameron on all sorts of what he called 'the green crap'." (P13).
- *Quality and Qualification regulations* would ensure that building and retrofit providers undertake the relevant training and get "Some sort of certification that they can go: 'Look, I've got this certificate.'" (P7). This "...pushing government to be stricter on the regulations ..." (P12) will improve the quality of the delivered workmanship as well.

4.2.7 Legal Skills for Building and Retrofit sub-system

While the building and retrofit providers are not expected to deliver the legal skills directly, the legal concerns below were noted as being directly relevant to the industry:

- *Legal interpretation* skills are very relevant when undertaking retrofit activities, because contradictions must be resolved at certain times, as noted by P7: "...they've declared a climate emergency and we must do this," yet later going on to say, "No, you can't put solar panels

on your roof because you're in a conservation area, even though that's not what the planning guidance says. The planning guidance says you're not allowed to put it on your wall, and yet Bristol City Council interpret it as your roof."

- Furthermore, to help resolve most of the above-mentioned contradictions, P7 suggested that the UK must *Legislate for Energy Efficiency of all Building and Retrofit work*.
- Finally, a new *legal requirement for an Energy Report for each house* was suggested: "...everybody having a really good quality energy report on their house that needs to stay with the house? Yes, I know you need to change legislation in order to do this, but if everybody could get a good quality energy audit which provides a roadmap for achieving zero carbon, and the order that you would do it in to avoid doing something and then having to change it assuming that no extensions take place etc., and that gets passed onto the next occupants. Still have the EPC to determine what has changed since the last time it was sold, but that's your roadmap ..." (P7). Such a report would prevent made-up claims by "cowboy builders" on the work needed for energy efficiency improvement of a house, and would help the house owners in planning and realising the necessary improvements.

4.2.8 Soft Skills Shortage in Building and Retrofit sub-system

- *Willingness to learn from others* is a key missing skill, as noted by P11: "We seem very bad in this country about learning lessons about it from other countries. We're often trailing behind in terms of materials specification technologies." Similarly, the compulsory licensing of building and retrofit providers prior to giving them access to the work is mandatory, e.g. in Portugal, although UK still persists in "...not looking abroad and seeing how it's done differently and trying to learn from that." (P11).
- The skill of *Valuing Own Work and Profession* is said to be underdeveloped in building and retrofit professionals. This also leads to a low motivation to improve. Thus, building and retrofit professionals must learn that "...they're doing something quite important" (P11) by themselves, and they also need to communicate this message to the general public.
- *Educating general public on:*
 - retrofit,
 - attitudes to building and retrofit profession and its link to
 - Climate change, health and energy poverty

is another key missing skill. Such an education would help the uptake of the retrofit activities, and would also help the general public to value the professionals who deliver these services.

4.3 Training Needs for Building and Retrofit Sub-System

4.3.1 Areas of Training Needs

The key areas in B&R where training is considered to be particularly necessary are:

- *Building Physics*, i.e. the understanding of the movement of heat and moisture in buildings, so that the resultant (retrofitted) buildings are more comfortable, energy efficient and healthy.
- *Building Biology*, i.e. the understanding of health hazards in the built environment: from chemicals in building materials, to allergens, mould and so on. This will help the B&R professionals to choose the right materials and deliver healthy dwellings.
- *Delivery of retrofit*, including insulation (ensuring the avoidance of condensation and mould), thermal bridging, non-dot-and-dub plastering, sealing the edges of insulation and seams around joists, and alike. This includes an overview of the whole house in relation to a number of retrofit measures and their likely benefits and sequencing.
- *Heat Pump and Heat Technology Installation*, such as solar water heaters, ground and air-source heat pumps, district heating, etc.
- *Maintenance* “...to turn up in somebody’s house that’s got some dodgy wiring and weird plumbing ...and how you remove ...a lead pipe or some nasty lime scaled thing off the wall without destroying it.” (P7) This is a particularly relevant skill as all fossil-fuel-based infrastructure (e.g. gas and diesel) must be decommissioned at scale.
- *Building with new methods*, such as brick-free building, passive and low energy house building.
- *Work Ethic*, i.e. conscientious approach to work, with respect to their own occupation (which has a paramount impact on energy efficiency, health and the environment), as well as those who will use the resultant buildings.

4.3.2 Modes of Training

When discussing how training should be delivered, the respondents noted that a variety of training modes will be relevant:

- *Higher education* for theoretical and science-based professions (such as architectural engineers or data analysts);
- *Further education colleges*: while “NVQs and HNDs in building services are generally focused on new build” (P7) and these skills need updating, trainees also need to learn about retrofitting older buildings;
- *Internal Training at a Company* where the innovation delivered is new and specific, such as thermal imaging with air pressure use for energy surveying at CHEESE [29]: “...nobody else is doing what we’re doing so we’re training people. We run at least one training course a year” (P13); this might also include training delivered by the manufacturer of a particular product to ensure correct installation;
- *Learning-by-doing* where the content “...is not complicated but it does require patience. And it does require you to want to learn and not to rush it” (P11), such as laying insulation or learning to be a “draught buster” (P13);

- *Online Courses*, such as those from the Association for Environment Conscious Building (AECB) [30] on retrofit are available, yet are limited in content, and new material (e.g. on building Physics and Biology). Green Register [27] has also set up online training, in addition to its in-house provision. This mode, however, is less suited for practical skills development, although AECB uses photographic evidence of completed practical tasks as part of its assessment.
- *Peer-Learning*, i.e. learning from colleagues, either from within the same company, or from peers outside of one's own organisation, is another well-established method. The *Toolbox Talks* programme was recently started by Green Register through the Futureproof project, whereby if "...builder would like an hour's training on site from another builder about a particular area ..." a Futureproof qualified (FAB: Futureproof Associate Builder) peer will be invited to deliver the training.
- *In Community Training* is delivered by local community organisations and for the community benefit "...skilling up of local people who might be unemployed" (P13). It is aimed at developing the sense of ownership and engagement within the local community, as well as upskilling the local residents "...it's not a company coming in and just doing it and leaving again. But you can have that ownership ..." (P18).

4.4 Insights and Recommendations on Bristol's Building and Retrofit Sub-System

The key challenges faced by Bristol's B&R sector in support of the transition to smart local energy systems arrive when:

1. Motivating the current workforce to a) take up the available training and b) adopt modern building and retrofit practices;
2. Attracting young people to the sector;
3. Navigating the transition path equitably, i.e. avoiding obsolescence of the sector workers.

4.4.1 Motivating the current workforce to take up the available training and adopt modern building and retrofit practices

Knowledge of modern building and retrofit techniques as well as training providers are readily available in Bristol (including through two universities, several FE colleges, online training delivery organisations (such as AECB [30]), as well as local professional development initiatives (such as Futureproof [28] with Green Register [27] and CHEESE [29])). As it is, the challenges are in:

- a) motivating the current workforce to take up this training, and
- b) applying the said training into their remaining practice.

We suggest that both of these challenges need to be addressed simultaneously by, on the one hand, **removing the barriers**, and, on the other, **creating demand** for the upskilled, modern building and retrofit services.

1.4.1.1 Overcoming Barriers to Training Uptake

Barriers to training uptake are both economic, cultural and personal, and so the means for overcoming them must be of a similar nature:

- *Paid-for Training* is necessary, as many of the B&R workers are “one man bands” (P14) and cannot afford to take time off work. However, where the worker is employed by an SME, payment of the salary to the worker is insufficient, and the overheads (e.g. costs of the company’s bookkeeper, warehouse, manager, etc.) to the SME also need to be accommodated.
- *Difficulty of New Methods Uptake* is due to the inertia against change: “people are so used to doing something for so long that it’s quite a struggle to introduce something new even though it’s really simple/straightforward” (P14). Thus, when introducing new methods, the B&R professionals would require additional support, such as a trainer, or a peer network to help out.
- *Providing Funding for Trainers* is necessary for both enabling the training organisations to continue to function as a training provider (e.g. “FE colleges ...are absolutely strapped for cash and ...sometimes they don’t have enough money to run the courses” (P7)), nor for the development and delivery of modern (hands-on practical) and relevant training content. When funding is limited, the training providers could be forced to work with what they have: “Kingfisher and Knauss give FE colleges free products. Well, if you go and learn how to put Kingspan in ...you go into a shop and you see Kingspan, oh, I used that in school so that’ll be fine. But what you don’t know about is the twenty other different insulant types that might be fine or even better for the purposes you use them.” (P7)
- *Professionalise Vocational Education*: given that the present regulations do not require any qualifications for the B&R trade, there are not many incentives for those already in the profession to undertake additional training. This could be mitigated if there is “...some certification element attached to it that makes those people that have made the effort stand out in some way” (P7). This certification can then be used to signal to customers the skill levels of various B&R workers.

1.4.1.2 On Supply and Demand for Building and Retrofit Training at Bristol

While removing obstacles to training uptake makes training accessible, it does not really motivate the already busy builders to upskill themselves. This is the challenge that a Bristol-based CSE has advocated to target through “*locally focused market orchestration*” [31].

The locally focused market orchestration approach observes that the technology adoption curve (see Fig.5) is led by innovators who take risks. These risk takers have already been adopting the new methods and practices, both as builders and as homeowners. The innovators are followed by the “early adopters”, who would not take the risk of trying the unknown, but would look for examples and references from the innovators. The early adopter home owners “...won’t take ‘innovator’ risks so need to get recommendations for builders and to see homes like theirs already done completed before taking action” [31]. Once the early adopters take up the new technology, the early and late majority will follow (under the right financial conditions). However:

- the *early adopter homeowners* (the demand for skills) will not invest into extensive energy efficiency measures (beyond the easy draught proofing and roof insulation), unless they are confident that they can find a good builder and have seen what the end result would be. Meanwhile,

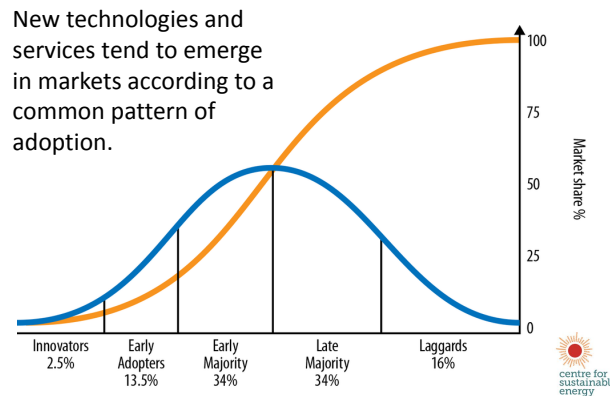


Figure 5: Technology Adoption Curve [31]

- the *early adopter builders* (supply of skills) will not invest in skills development if they don't think that there is a local demand which will give better margins than their current skills.

The **locally focused market orchestration approach** addresses this by stimulating demand on the one hand, and supply on the other.

CSE, in collaboration with other partners, have already started this process in Bristol:

- The Green Open Homes project [32] (active in Bristol since 2010 as 'Bristol Green Doors', and now a national network) provides an opportunity for people who have completed retrofit activities to open their homes to interested peer-homeowners, who may wish to do a similar upgrade. This gives the early adopters a chance to see the end products and to hear about builder recommendations.
- The Green Register [27] organisation (founded in 2000 and based in Bristol) provides a register of qualified building and retrofit professionals for each locality. This allows for the early adopters to find a local builder to employ.
- Bristol Energy Network (BEN) provides training in understanding the energy efficiency opportunities for Bristol's communities, which on the one hand, creates more demand. On the other hand, BEN works with the Futureproof project in the identification and engagement of builders and retrofit providers with the training programmes, thus boosting the supply side.
- At the same time, the demand is stimulated further through the nationwide Green Homes Grant funding [33].
- The Futureproof project [28] (which has been active in Bristol since 2019): a) provides funded training on modern technologies and techniques for building professionals, and b) provides an opportunity for building retrofit professionals to build peer networks for mutual learning and support.
- The CHEESE project [29] provides comprehensive energy audits for citizens as well as training community members in undertaking energy audits with cutting edge proprietary technology solutions which use thermal imaging to identify heat loss in buildings.

While all of the above are supporting the uptake of both training and retrofit, the local authorities (and, in particular, Bristol City Council) can take a proactive role in amplifying their positive impact. The following aspects would strengthen this approach further:

- *Formal regulation to make specific qualifications a required pre-requisite* for access to building and retrofit work (similar to the prerequisites of qualifications to work as an electrician) would be particularly useful. This can be both a local policy and a national regulation. For instance, Bristol City Council could contract only those registered with the Green Register, or qualified to the minimum of Futureproof's Level 1 for work within city-owned properties, strengthening the reputation of these qualifications. Such a regulation seems to be currently on the way with the Retrofit Academy's PAS 2035 accreditation expected to be a mandatory requirement "...for all projects in the long-term" [34]. However, BCC does not need to wait for the 'long-term' to act locally.
- *Support with local supply chain provision* is particularly relevant for the SMEs and sole traders who wish to build to the Passive House standard, and with modern materials and processes:
 - The vast majority of the energy efficient components and natural materials (such as triple glazed windows and clay building blocks) are imported from Europe: "...the supply chain is all from Europe, we just don't make this stuff" (P14). This, already fragile, supply chain can be easily broken down with changes in trade rules and tariffs due to Brexit. Thus, we suggest that BCC sets up a *Building and Retrofit Suppliers Network or Conference* that meets up regularly to facilitate supply chain and relationships building between the EU and Bristol companies. Moreover, an *investment into distribution service set up* (either funded through contributions from SMEs, or privately with agreement of SMEs to trade with the given distributors for the specified items) would be very desirable.
 - *Competitions for Supply Chain Development* is another avenue available for facilitating the transition of the sector. Such competitions have previously been funded, e.g. through the EU "...we did a design competition back in October and so we got some of our prospective landlords to submit buildings which they're thinking about retrofitting. And the design competition, we had some funding so we offered that to consortia of supply chain companies to deliver [specialised retrofit] design for those case study buildings." (P12).
 - *Supply Chain Development per Design Archetype*: given that there are many landlords that own properties of the similar design, i.e. "same housing archetypes" (P12), a solution "...that is designed is also suitable for other landlords down the line so that they benefit from the cost reduction rather than having dozens of separate pilots ..." (P12). Here, the 'solution' refers to both of the retrofit designs, and also to the supply chain drawn upon to implement the said designs. Here too, BCC could draw together the landlords of the archetypal properties from across Bristol and orchestrate a common solution for each type (e.g. through a pilot competition/tender, where the winner, or most successful pilot, is awarded the contract for the archetype).

4.4.2 Attracting young people

As previously noted, the B&R sector currently has a poor image and is mistrusted by the general public. However, the scale and pace of the required transition necessitates attracting new building

and retrofit professionals. A number of directions to tackle this challenge have already been noted and are briefly summarised below. Much of this can be carried out by the professional bodies, as well as by the local authorities:

- The training providers and employers can *improve the image of the profession within the current workforce* by demonstrating the value of the work and its impact on the environmental as well as public well-being (e.g. through Building Biology and Physics, Valuing Own Work and Work Ethics modules).
- Local and national authorities *can increase the confidence of the public in the profession through certification* of qualifications and quality assurance clauses for post-delivery of the work.
- The training providers and employers can engage with young people at schools to demonstrate the value of the profession and create an early interest (e.g. through acting as guest speakers at lessons, such as on Building Biology as part of the Biology curriculum, or Building Physics for Physics sessions, or Architecture in Product Design, etc.): “...go into my old school in Bristol and give a talk or two to the sixth form. I mean, it’s a major issue we have to deal with.” (P14)

4.4.3 Navigating the transition path equitably

Given the scale and pace of the necessary change to meet Bristol’s agenda of becoming a carbon neutral city by 2030, the city needs to train up a number of tradespeople to take on the immediately relevant jobs, such as at-scale gas boiler decommissioning and property retrofit. Unfortunately, these jobs will not have a long-term future in that, once the city is carbon neutral, the gas system decommissioning professionals will be obsolete. This poses a challenge of, on the one hand, training up the tradesmen in large numbers for such jobs while, on the other hand, planning for their post-2030 transition into other specialisms or jobs.

In order to avoid mass redundancies and joblessness in Bristol’s B&R workforce in the post-carbon neutrality future, we advocate:

- avoiding a single-skill professionalisation/training provision. For instance, gas decommissioning tradesmen can also be trained to undertake heat pump installations. Thus, should the demand for work on decommissioning reduce, the installation skills could continue to remain relevant.
- maintain the continuous professional development and ensure that training in a new, mid-to-long-term relevant skill is made available to the B&R workers, as the demand for one of their previously relevant skills declines.