



Scaling Up Better Homes Yorkshire

executive summary

This report examines the actions needed to support an ambitious programme of domestic energy retrofits. The Combined Authority has overseen delivery through the Better Homes Yorkshire partnership since 2015. However, the contracts with partners come to an end in 2023, so the ambition is to build on its success and scale-up the market. Although considerable progress has been made on energy efficiency in homes, delivery has stalled owing to the limitations of funding, the cost and complexity of renovating the housing stock and the willingness of homeowners to upgrade their property. It is also widely recognised that to reduce bills and make homes net-zero carbon, will take a 'whole house' approach to reduce energy demand and supply low carbon energy.

A climate emergency was declared in June 2019 by the West Yorkshire Combined Authority and the Leeds City Region Local Enterprise Partnership. This had led to the creation of science based targets to reach zero carbon by 2038 based on reducing emissions by 14.5% each year. This report shows how housing can play its part in delivering this. Modelling shows how 1.8MTCO₂ per year can be removed from the CO₂ emissions of the region's homes by 2030 - equivalent to the interim target of every home achieving an energy performance certificate C - in a way that enables the final part of the journey to zero carbon homes to be achieved. While the CO₂ emissions to produce electricity have halved in the last decade, to remove the emissions entirely will involve using radically less energy than currently.

Whole house retrofit is an opportunity to bring the energy consumption and comfort of all the regions homes up to a 21st century level, no matter which century they were built in. While the improvements involved do not have to be done at one time, they need to be planned to avoid having to redo work already done. This involves going beyond simple energy efficiency to a whole house retrofit approach to nearly a million homes over the next 18 years. This can also enable the region to be free of fuel poverty within a decade and create 30,000 sustainable, rewarding, well paid jobs.

This study carried out a review of energy efficiency schemes to examine what has worked well and what has not worked well. They also carried out interviews with expert individuals to validate the findings and offer critical perspectives. Importantly, the findings do not point toward a single scheme that has already delivered such an extensive retrofit programme. Five key elements emerged for successful delivery :

trusted offer

The creation of a truly trusted offer is the key starting point. This sets the new approach as clearly better than what has gone before, that has learnt from previous mistakes with quality and suitability of work to make sure they are not repeated.

building the market

There are close to a million houses in the region: each is slightly different, the desires of the occupants differ again. As with any new idea, but especially with climate change, there will be those wanting to take action now, others who will wait. Market segmentation is crucial.

fit for purpose

The way retrofit is done needs to be fit for purpose - from how it is specified to how it works on the building. it needs to work for the whole house, its occupants and the wider environment.

paying for it

Credible means of paying for the work need establishing, which is going to require the mobilisation of massive amounts of capital. In the opening years of the program this will need to be cheap and patient enough to enable the market to scale up without penalising early adopters. Different ways of providing that money for different household situations and tenures can be provided to ensure the opportunity is accessible to all. Bill savings can be combined with other incomes such as selling energy to the grid.

delivery

A critical missing factor to date has been a long term pipeline of retrofit work that gives confidence in investment in training and business development rather than the boom and bust experience resulting from short term, short deadline pilots and programmes that have delivered millions of installed measures but not a comprehensive approach to whole house retrofit. This sits alongside the ability to then scale this up at high speed requiring different models.

results of analysis

A detailed analysis of the issues around funding in Section IV shows the different funding sources by household types and proposes a loan fund, to offer low interest long term loans. Skills and supply chain development issues are discussed in Section V, with key issues identified as the need to shorten and co-ordinate supply chains, stop the damage done by short term programmes and develop a long term strategy to encourage retraining and investment, reduce shortages of skilled labour and improve the quality of work done.

Investigating the complex and interlocking reasons behind the successes and failures of previous retrofit schemes led to the development of a ten point list of the necessary components for a long term holistic retrofit programme. Section VI explains these components in detail, with proposals for best practice delivery.

1. customer journey:
Starts with knowledge of what needs improving in each home, informs independent advice to occupants and owners which they can trust, putting them on a path to a retrofit that retains that trust.
2. assessment and calculation:
The initial home energy use assessment must be able to accurately predict the most effective Whole House Retrofit both in terms of cost and performance.
3. monitoring and data:
More information is needed on where energy is wasted in homes, with records of building improvements and the difference they made, to enable rapid development and deployment of best practice.
4. IT and software:
Whole House Retrofit currently needs a lot of property-specific assessment and design work which cannot deliver cost effective scale: how retrofit proposals are created and delivered needs software solutions to improve efficiency, accuracy and deliver mass customisation.
5. specification and detailing:
The materials chosen for a retrofit and how they go together in buildings need radical improvement.
6. contacting and guarantees:
The contracts used for retrofit work need to better reflect the realities of this new industry, alongside better guarantees of performance.
7. additional revenues
Bill savings cannot meet the needs of cost recovery alone, other revenues (especially ones available to large scale programmes) need to be identified so that property owners are at least no worse off than they are now. The radical changes in the energy market and the concurrent roll out of renewables offers an opportunity for further CO₂ savings alongside access to incomes from aggregating the energy storage.
8. finance vehicle
Access to cheap, patient, flexible borrowing is important to creating an attractive offer to all forms of customer, other than those who can use their own savings. Providing an attractive finance offer enables quality control by specifying approved contractors. If the interest rate is kept low this could create a margin to pay for delivery costs.
9. scalability
Care needs to be taken in increasing the scale of retrofit work to avoid overtaking the development of the rest of the components required. Short term, high demand programmes damage the industry, mistakes must be avoided and costs kept under control. The ability to expand capacity exists but cannot be done without certainty of future work and concurrent development of the supply chain and delivery mechanisms.

10. workforce development & skills

All of this requires a trained workforce. The opportunity for retrofit to assist in the region's recovery from COVID19 is enormous, but requires action on all fronts to develop a skilled workforce across a wide range of roles at all skills levels.

component list

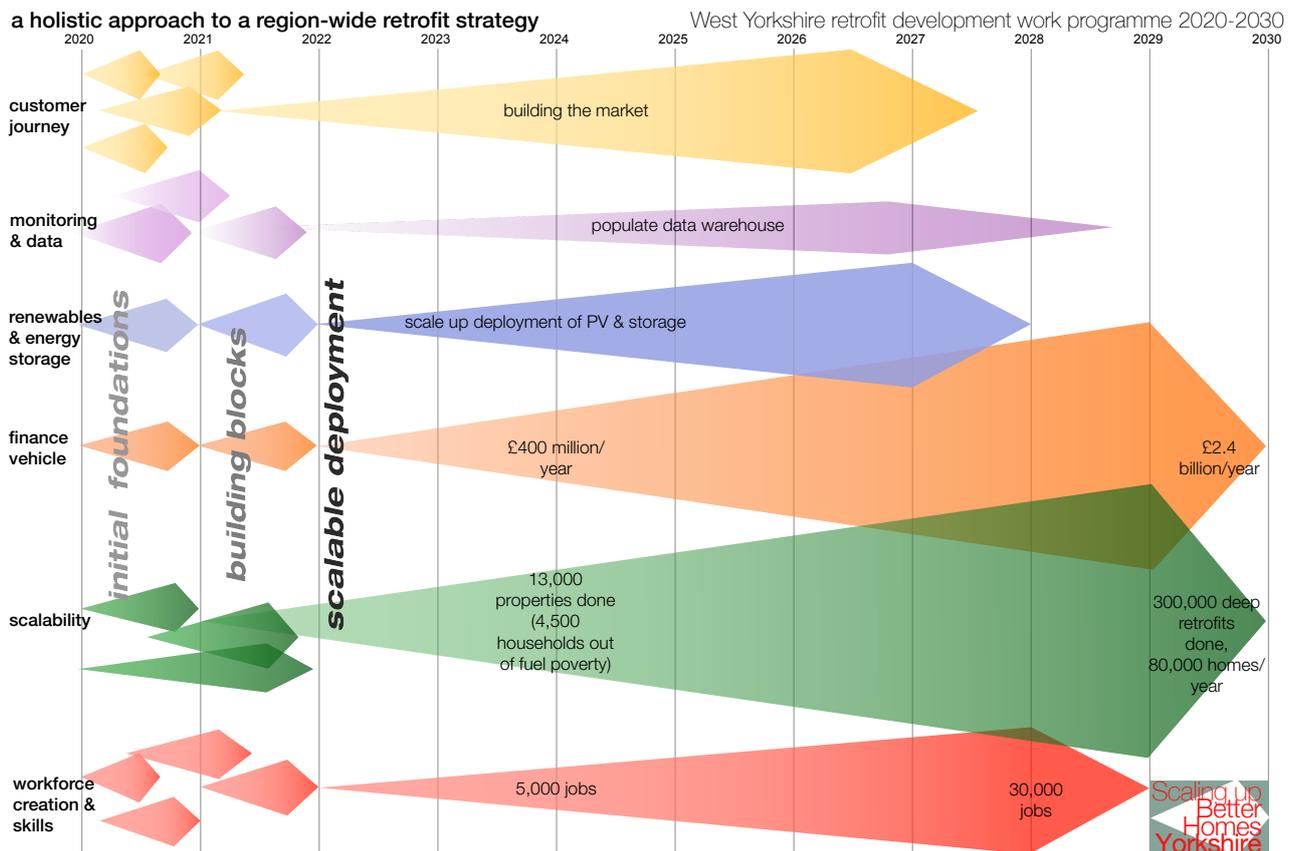
		local	federal	national	trusted offer	building the market	fit for purpose	paying for it	delivery
1	customer journey	a consistent independent advice							
		b knowledge of status of every home							
		c market intelligence							
		d show homes							
2	assessment & calculation	a accurate whole house assessment							
		b cost benefit							
		c accurate costing works							
3	monitoring & data	a pre- & post-works monitoring							
		b identify & quantify best practice							
		c user & contractor feedback							
		d data repository							
4	IT & software	a interoperable software development							
		b mass customisation							
		c site management							
		d on site works remote monitoring							
5	specification & detailing	a specification improvement							
		b retrofit pattern book							
6	contracting & guarantees	a contract models							
		b warranties							
		c performance guarantee							
		d quality control							
7	additional revenues	a roof top PV							
		b domestic or street scale energy storage							
		c energy production & storage aggregation							
		d carbon sales?							
		e rented housing cost recovery methods							
8	finance vehicle	a multiple sources of finance							
		b policy driven lending							
		c multiple bottom lines on surpluses							
9	scalability	a develop delivery infrastructure							
		b demonstrators to increase scale							
		c competitions							
		d pipeline development							
		e supply chain development							
		f connect new & existing delivery infrastructure							
10	workforce development & skills	a audit of skills, providers & methods							
		b training provision study							
		c awareness raising							
		d schools introductions							
		e apprenticeship dev't							
		f college & university engagement							
		g DLO & TU engagement							
		h industry participation							
		i work with LA's on COVID recovery plans							

delivery

The key message of this report is that action is needed to develop all of the ten components - the lack of any one of them will undermine the ability to deliver on these challenging targets.

The report makes 20 recommendations for next steps to assemble the full set of components for a successful retrofit programme. Some components require national government action, some need a wider community of interest, others need local involvement. We have focused on the actions across six elements which are best driven forward at regional level to support The West Yorkshire Combined Authority regional priorities.

These include :

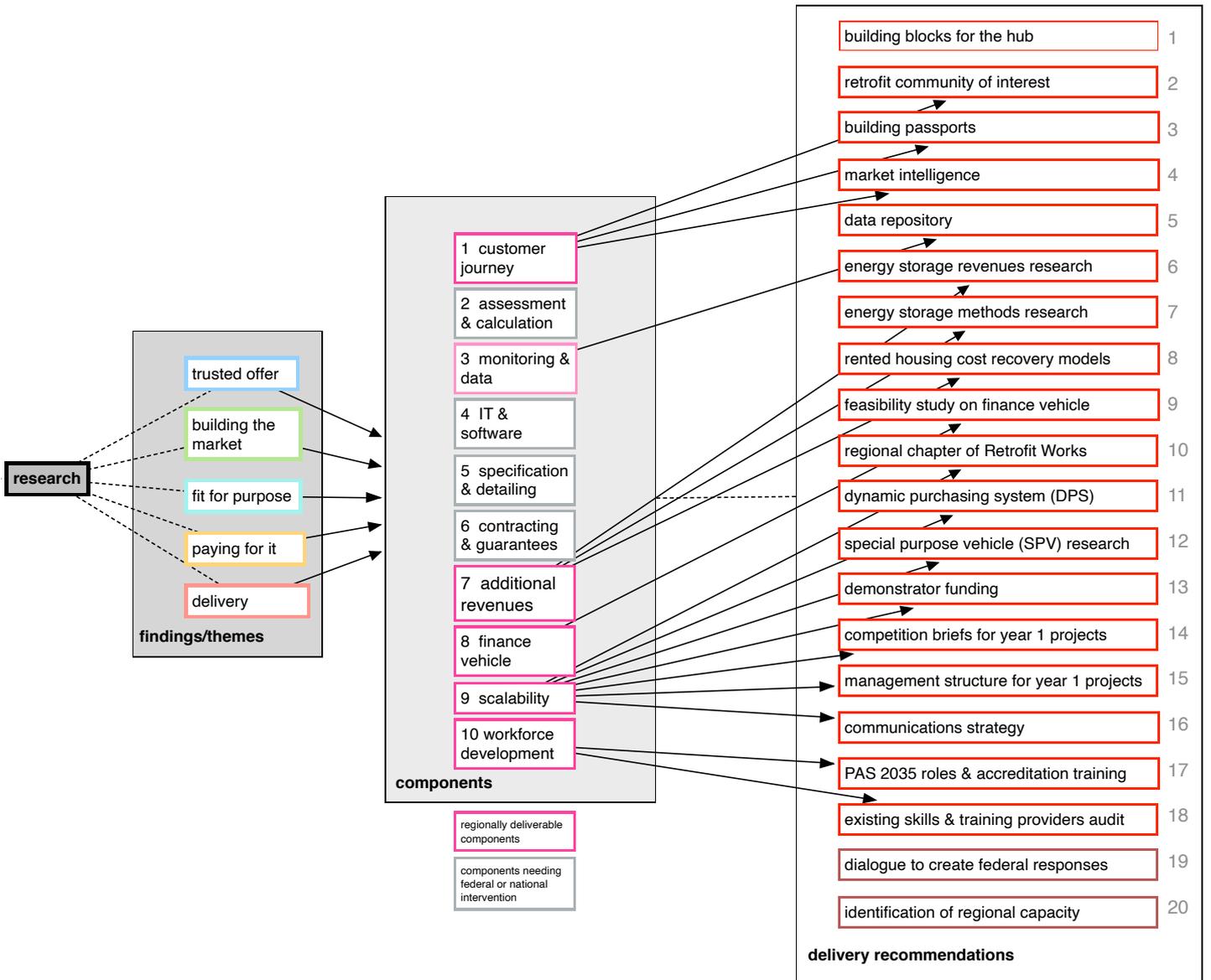


This diagram shows how the 20 recommendations made feed into the main elements of the retrofit programme and their growth in scale over the first ten years.

- the development of a Retrofit Hub to co-ordinate the work,
- the development of a model for installation of solar PV/battery systems to create an income stream from sales to the electricity grid,
- development of a finance vehicle able to create a finance package suitable for any household income level, combining available grants with low interest loans
- steady growth in the number of retrofits to enable manageable growth in the supply chain and skilled workforce, with a year one programme of 300 deep retrofits to test and refine the process

The recommendations suggested in this document are all steps that will work individually but together will deliver the initial building blocks of this huge undertaking. The recommendations will set the region on the path of building scale to meet the regional net-zero pathways and climate emergency goals, building the evidence base for further action. This maximises ‘No Regrets’ activities (which work towards the net zero carbon goal) and the flexibility for the path taken, rather than trying to prescribe it now without the necessary evidence.

recommendations	page
retrofit hub	56
<ul style="list-style-type: none"> 1. identify staff resources to create building blocks for the hub 2. community of interest: create a retrofit network made up of a variety of stakeholders (contractors, clients, supply chain and intermediaries) facilitated by a cross Combined Authority working group 	
component 1 customer journey	58
<ul style="list-style-type: none"> 3. commission work to create building passports to generate high quality data to help with planning programmes and retrofits 4. commission an updatable model of market intelligence 	
component 3 monitoring & data	58
<ul style="list-style-type: none"> 5. develop relationships to build common program interfaces for a data repository - as part of that partnership, develop the regional data repository 	
component 7 additional revenues	58
<ul style="list-style-type: none"> 6. commission research on the accessibility and reliability of energy sales revenues and the steps necessary to realise them 7. analyse the best deployment, adoption and efficiency characteristics of the storage form required 8. create a task group of rented housing experts and representatives to create a delivery plan for viable cost recovery models 	
component 8 finance vehicle	59
<ul style="list-style-type: none"> 9. commission a feasibility study on the next steps to creating a finance vehicle 	
component 9 scalability & pipeline	60
<ul style="list-style-type: none"> 10.set up a regional sub-group of Retrofit Works to encourage collaborative working in the supply chain 11.set up a Dynamic Purchasing System (DPS) 12.commission further research on Special Purpose Vehicle (SPV) options and whether they offer a credible scalable pathway 13.identify a loan stream to fund the first year's demonstrator programme 14.develop briefs for competitions for the first year programme 15.create a management structure for those projects 16.develop and resource a communications strategy 	
component 10 workforce development & skills	60
<ul style="list-style-type: none"> 17.use stimulus funding to support training for PAS 2035 and PAS 2030:2019 roles and accreditation to be ready for Green Homes Grants response 18.carry out an audit of existing skills and training providers 	
remaining components	61
<ul style="list-style-type: none"> 19.start dialogue with other Combined Authorities and Local Authorities about how to create more federal responses to delivery of the retrofit components list 20.identify capacity regionally to be able to seize first mover advantage on delivery of the components 	



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I. introduction:

The goal of this report is to deliver recommendations to enable scaling up home retrofit in the West Yorkshire region. While the region has historic engagement with retrofit, issues such as climate emergency and post-COVID recovery identify that this needs to be undertaken on an unprecedented scale.

The study has three main elements:

- An **appraisal of existing schemes** to scale up whole house retrofit in both the UK and overseas, identifying best practice and innovation in customer journey, delivery structures, business models and governance
- A review of the different private and public **funding models** for deep retrofit and incremental steps to whole house retrofit.
- A **skills and supply chain capacity study** mapping skills gaps, skills demand and skills/training provision for retrofit delivery for the whole supply chain from client/budget holders to surveyors, suppliers, installers and maintenance contractors.

The ultimate goal is to identify a number of actions and potential models to address two issues

- The scaling up of retrofit in West Yorkshire – finance models, pipeline/ market development, supply chain
- The delivery of a quality “trusted offer” – quality systems (PAS2035), skills, data and verification

This will address the details of business models, supply chain issues, financing models and policy issue. The study focuses on domestic retrofit: the owner occupier, private rented and social housing sector.

The delivery of sustainable retrofit to achieve the West Yorkshire Combined Authority's goals of net zero carbon by 2038

it is recognised that there will need to be major changes to the carbon intensity of the energy supply and the energy demand from homes, particularly for heating¹.

West Yorkshire's carbon emissions are 11.1MTCO₂ per year, of which housing is 2.9MTCO₂. The key goal of a retrofit programme is to reduce carbon emissions by 1.8MTCO₂ per year, equivalent to every home achieving EPC of C, consistent with the region's available carbon budget as defined by the Tyndall Centre.

It must be recognised that sustainable domestic retrofit creates a number of benefits beyond the decarbonisation goal.

- The potential creation of 30,000 jobs²
- A reduction in fuel poverty
- An improvement in the housing stock with related health benefits.
- Regeneration improvements in local areas

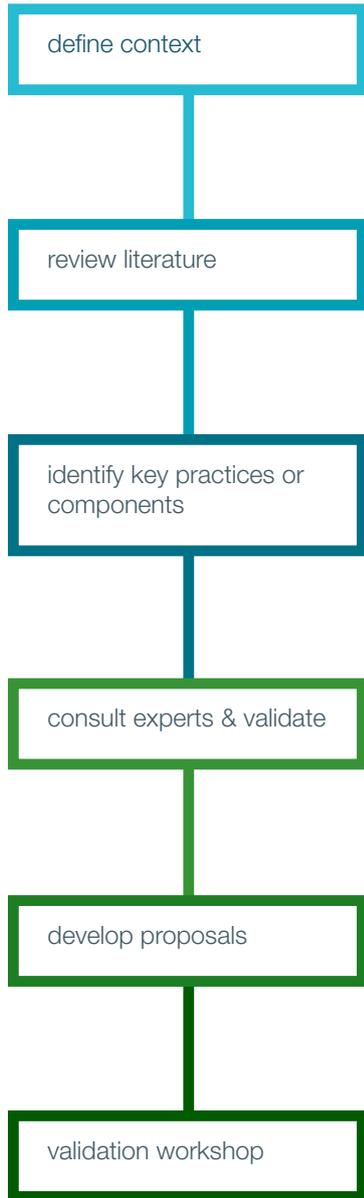
This report recognises that there have been considerable issues in scaling up retrofit across the UK. The scale at which retrofit is demanded by the decarbonisation targets is without precedent.

1.1 Overview of Methodology

The study aimed to take a review of the available evidence from both existing projects and by consulting with recognised experts in the field. The objective was to build a series of related practices, or components, that could be applied by the Combined Authority to deliver their retrofit aspirations.

¹ www.westyorks-ca.gov.uk/media/4247/tackling-the-climate-emergency-emission-reduction-pathways-report.pdf

² see Component 10 for modelling basis



STEP 1 - Contextual review

This stage identified the scale of the issue, including the carbon reduction target, high level understanding of the stock, key stakeholders and delivery mechanisms for retrofit, related skills and relevant networks. This identified and extended the research themes from the proposal.

STEP 2 - Literature review

Review of publicly available information on our research themes. There was an internal group assessment for quality and relevance; identification of practices, innovations and issues leading to development of a questioning framework. The literature reviewed was a mix of publicly available reports and academic literature. All research was cross referenced against the LIS (unpublished), the Energy Strategy and Delivery Plan and other relevant Combined Authority and national strategy, policy and programmes.

STEP 3 - Development of component model

The innovations, issues and practices were categorised and presented as a components list based around a project/ programme delivery process. These are show in Appendix V.

STEP 4 - 1:1 interviews

A set of interviews developed themes identified in the literature review and validated their relevance to West Yorkshire and the current economic climate. Interviewees were carefully selected for relevance from a set of candidates identified by the research team through the literature review and their own networks, as well as contacts identified by interviewees and the Combined Authority . The sample represented sectors including economic policy, planning, supply chain, skills and education.

STEP 5 - Outline Proposals

The outline proposals to scale up home retrofit activity were compiled into a report combining the literature review and interviews.

STEP 6 - Report and summary workshop

Report written for the audience confirmed by The West Yorkshire Combined Authority and workshop invitations issued by the Combined Authority.

II. contextual review

This section of the report provides backgrounds to the relevant policy and assumptions that have informed the report. This is not undertaken to a high level of detail due to time constraints, but provides the necessary framework to inform the later stages of the study.

The scale of the challenge of massively upscaling retrofit is daunting, eventually needing work to over a thousand properties every week. As implied by the Climate Emergency declared, business as usual is not enough and responding to this challenge requires a ‘systems’ approach whereby all the elements of a delivery programme are strengthened within a long-term planned programme of energy efficiency retrofit.

This work also contributes to a number of policies and strategies that exist within the region, including:

- **Leeds City Region Enterprise Partnership Strategic Economic Plan 2106-2036** – four economic policies of Boosting productivity, Supporting clean growth, Enabling inclusive growth and Delivering 21st century transport.
- **Inclusive Growth** – potential to create flexible jobs in a number of roles.
- **Tackling the Climate Emergency** – investment in clean growth.
- **Leeds City Region Energy Delivery Plan** – five strategic priorities of Resource efficient business and industry, New energy generation, Energy efficiency and empowering consumers, Smart grid systems integration, and Efficient and integrated transport.
- **West Yorkshire Carbon Emissions Reduction Pathways Report 2020** – supporting retrofit of the region’s homes with energy efficiency measures.
- **Leeds City Region Enterprise Partnership Local Industrial Strategy** – future-proofing existing and future housing stock to reduce fuel poverty and create healthy, sustainable communities.
- **West Yorkshire Economic Recovery Plan** – contributing to the creation of 30,000 new jobs.
- **WYCA Digital Skills Partnership** – enabling a highly skilled, diverse and flexible workforce.
- **WYCA Devolution deal** – includes control of the £63m annual Adult Education Budget for West Yorkshire to closer align spending on skills to the opportunities and needs in the local economy.

These are covered in more detail in the table on page 62.

2.1 Developing a Pathway

We have considered a possible approach to modelling targets and retrofit delivery that meets the requirements of the West Yorkshire Carbon Emission Reduction Pathways (CERP) report³. The approach outlined here is high-level and does have flexibility. This level of detail has been required in order to identify which elements of the component list (see Section VI) could deliver the required outcomes.

The Tyndall Centre were commissioned to develop a science based emissions reduction trajectory that would enable the region to keep within its remaining carbon budget. They arrived at an annual reduction of 14.5% per year, arriving at zero carbon by 2038.

The share of this goal for housing is to reach zero by 2038 with an intermediate target of every home achieving and EPC of C by 2030. The closest scenario in the CERP to the Tyndall trajectory is the Max Ambition one.

It is possible that the renewable energy capacity will be such that decarbonisation of the grid will be able to deliver the amounts of energy needed in homes with lower targets of demand reduction, however other sectors of society are going to have their own difficulties meeting the zero carbon target so it will be beneficial if the housing sector can achieve higher demand reduction.

Many zero carbon pathways rely on carbon capture and storage (CCS) to make up the shortfall in emissions reduction. This at an early stage of development and has not yet proved that it can work at the scale assumed in many models. So the precautionary principle argues this should not be relied on.

³ www.westyorks-ca.gov.uk/media/4247/tackling-the-climate-emergency-emission-reduction-pathways-report.pdf

There are hopes that changing the natural gas grid to hydrogen will mean much lower levels of energy demand reduction will be needed through retrofit⁴. However, this is also still at an early stage. The journey from hydrogen made from natural gas (referred to as blue hydrogen) to hydrogen made from water (green hydrogen) relies on CCS, pilots are being carried out on the technicalities of the fuel change.

Therefore we have assumed that ambitious targets of demand reduction are the most appropriate 'no regrets' pathway. Experience of deep retrofits and the modelling that has been carried out establish that viable combinations of measures can get most of the region's housing to zero net carbon with the rest not far behind.

A zero carbon retrofit strategy is a low regret option as there are other positive outcomes:

- Healthier homes
- Better indoor air quality
- Warmer homes with greater stability of internal temperatures
- Better energy security
- Economic development and employment
- Fuel Poverty alleviation
- Regeneration opportunities

2.2 Carbon Budget

The current capacity of the retrofit industry and the infrastructure required to enable it to grow argues for a programme of whole house retrofit that starts at a smaller scale while the supply chain is developed and workforce created (see Section VI for detail). This approach means housing takes time to make its contribution to keeping within the carbon budget available. This is examined in more detail in appendix II.

To look at ways of accelerating this contribution, we have modelled early deployment of PV and storage. This delivers rapid early reductions in emissions alongside the potential income that will enable financial assistance for both cost recovery on the early, more expensive retrofits and the running costs of the programme. These issues are further explored in Section IV (Finance) and VI (Components)

There is a risk of embedding underperformance in properties retrofitted to lower targets of energy demand reduction, with reduced opportunity upgrade performance later. This is examined in more detail in appendix III. To avoid this, the modelling is based on a 2030 target of the total CO₂ savings achieved if every homes was upgraded to a C rather than the EPC target itself. The regional average EPC is 53 (D). Aiming for 75 (a high C) on 1 million homes would save around 1.7 million TCO₂ - 43% of the total.

With an accelerated deployment of PV & storage as shown in fig 2.1 there is a potential to produce a

fig 2.1 retrofits & PV + storage installs/year

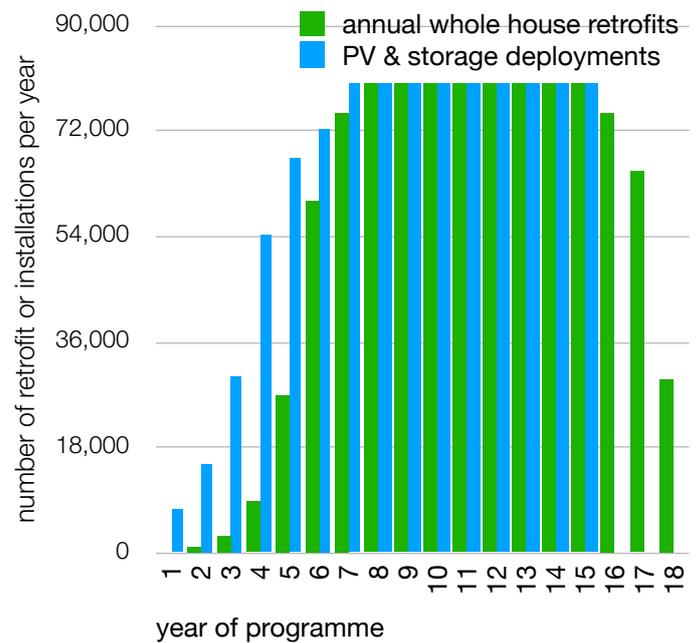
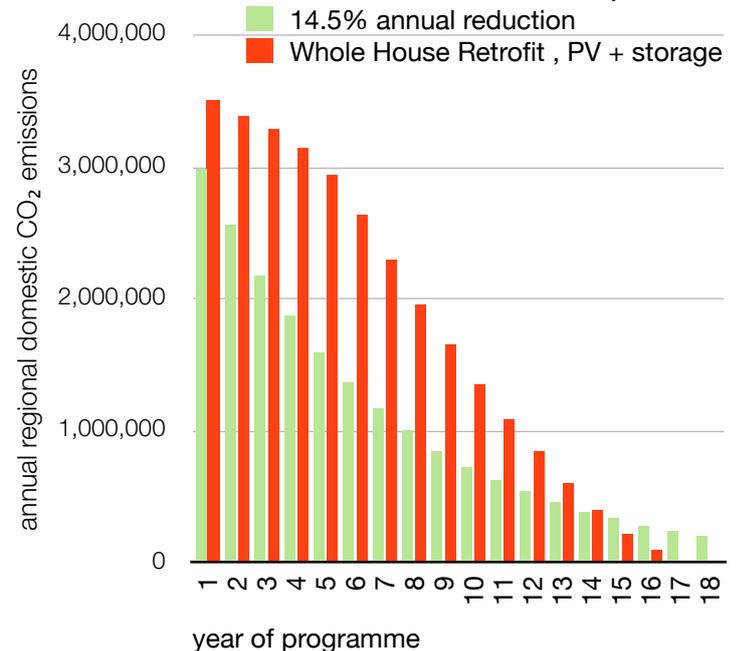


fig 2.2 annual domestic CO₂ emissions trajectories



⁴ <https://cadentgas.com/nggdwsdev/media/media/documents/Greater-Manchester-decarbonisation-pathway-report.pdf>

saving by 2030 of 1.8 million TCO₂ per year with 80,000 properties a year being retrofitted to at or near zero emissions, together with an additional income stream to assist with the programme. The early deployment also helps deliver emissions reductions in the early years while the fabric works programme is scaling up as shown in fig 2.2.

2.3 Modelling the Proposition

Red Co-operative has developed a financial model for large scale retrofit which has been adapted for this analysis. The purpose of this modelling work is to provide some high-level working assumptions that can indicate the scale of the need for large scale domestic energy efficiency retrofit. By establishing the required reduction pathways, it is possible to identify approaches, finance and skills requirements to shape the Combined Authority’s strategy.

We present a simplified model of the region’s housing stock, together with figures for the other main parameters for large-scale delivery of retrofit.

A key assumption in our modelling is that **we are aiming at a proposition to property owners that is cost neutral - expected financial savings are equal to or greater than cost** - known as the **Golden Rule**⁵. To maximise the robustness of the model we have not assumed grant but progressive lending instead. The model demonstrates that the work could be done free from government subsidy. When grants are available these could be used to accelerate the programme but it would not be vulnerable to short term boom and bust cycles.

The modelling assumes that a local retrofit loan fund could be established, to enable retrofit works to be funded by loans with an element of progressive lending (loan costs and terms based on household income). It proposes that additional income from solar panel/battery storage installations can be used to make increased retrofit spending affordable.

The relationship between emissions/energy demand reduction and the cost of works to achieve them is central to achieving the Golden Rule. If the cost of retrofit is to be recovered by a loan, then there is a point where the bill savings line equals the loan repayment costs, making it financially viable for the occupant.

The model considers:

- Cost of finance
- Cost of works

Exploring the cost of finance, we need to establish a baseline for the cost of works. Figure 2.3 indicates the potential costs for a single property in achieving various levels of carbon reduction and the current related costs. This shows the last 20% of carbon emissions reduction through retrofit can be highly costly.

Figure 2.4 demonstrates the principle that emissions reductions in the region of 40-50% would cover the

fig 2.3 – approx retrofit costs for level of emissions reduction

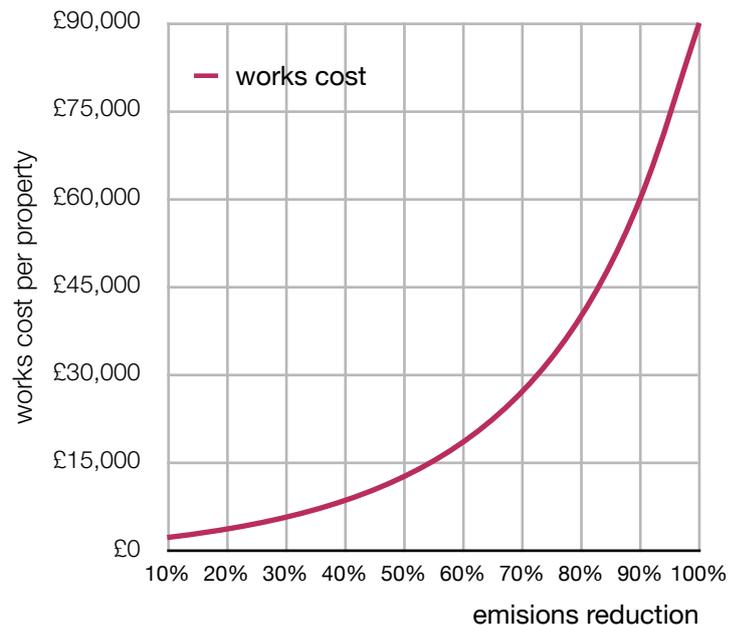
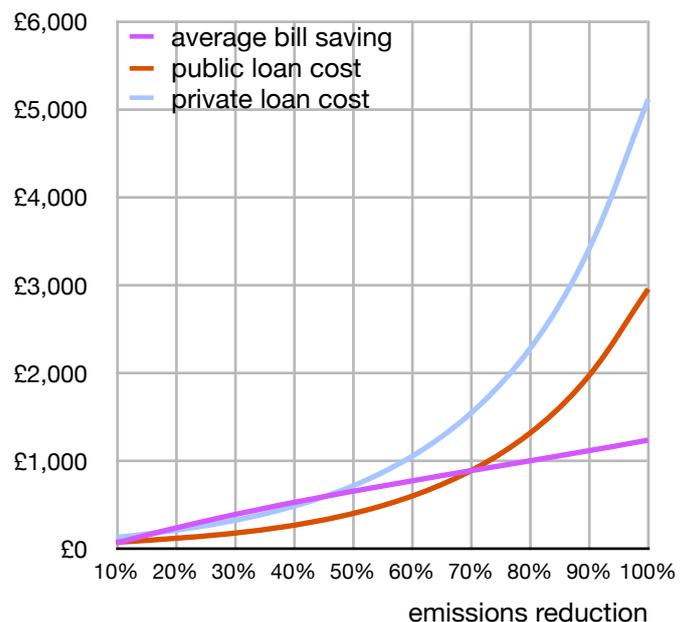


fig 2.4 – annual loan costs (public & private) v potential energy savings for specific emissions reduction levels



⁵ Department of Energy & Climate Change 2010

repayment costs of a high street mortgage (3.3% over 25 years), but public sector borrowing costs (2.5% over 40 years) would move the crossover to around 70% emissions reduction. This shows that the lower the cost of finance applied to the retrofit, a greater depth of emissions will be achievable whilst leaving the occupier no worse off in terms of bill savings or household spending for warmth and energy.

The pink line is based on a fabric only retrofit.

The rest of decarbonisation can be driven through renewable heating, energy generation and storage. This also enables the household's electrical appliance energy use and subsequent emissions to be tackled, as there is limited scope for demand reduction in this area.

The financial savings from using self generated electricity stored in a battery do not move the Golden Rule point very far on an individual property, as shown by the lower pale green line in Figure 2.5. There are additional revenues that are possible once roll out of energy storage has been scaled up to the point that participation in the National Grid Balancing Services and the wider energy market enables other incomes, as discussed in Section VI.7 Additional Revenues. These potential income streams are included in the top line for energy savings in Figure 2.6 and suggest 90% emissions saving using public loan costs could potentially be cost neutral for the occupier.

The model for these 3 graphs has a static retrofit cost to explore potential models for financing. BEIS has an identified trajectory for cost reductions for retrofit⁶, which are shown in Figure 2.6.

These figures show the potential reductions in cost of

fig 2.5 – energy savings against annual loans costs for 3 scenarios

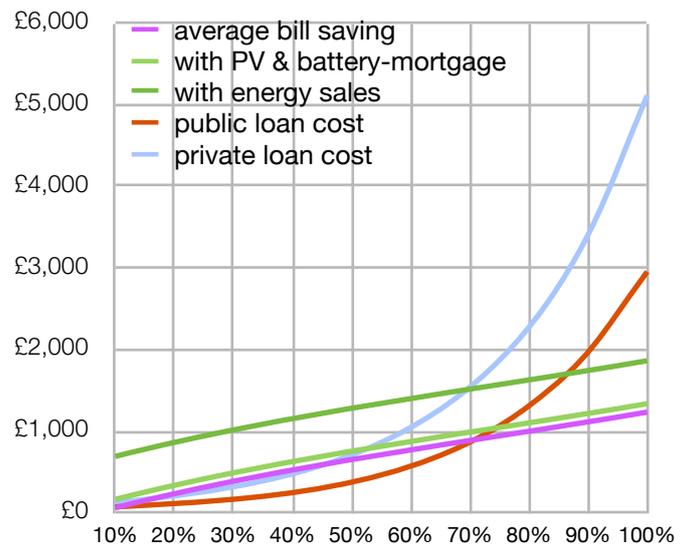


fig 2.6 – decline in average retrofit costs over 25-year period

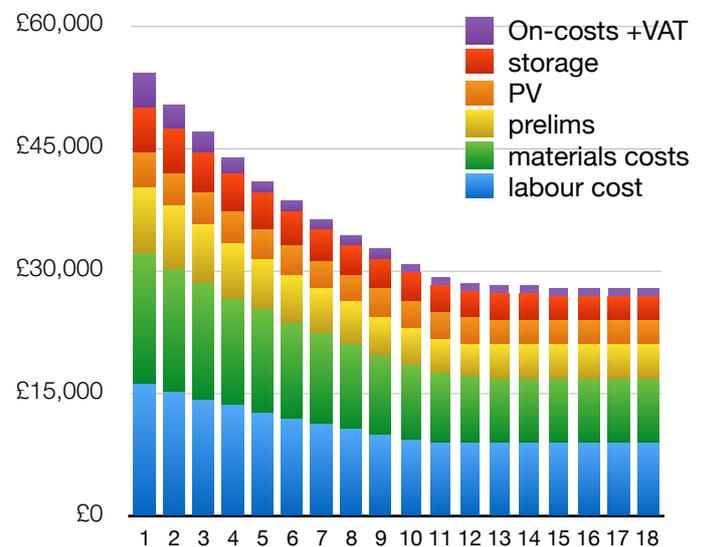
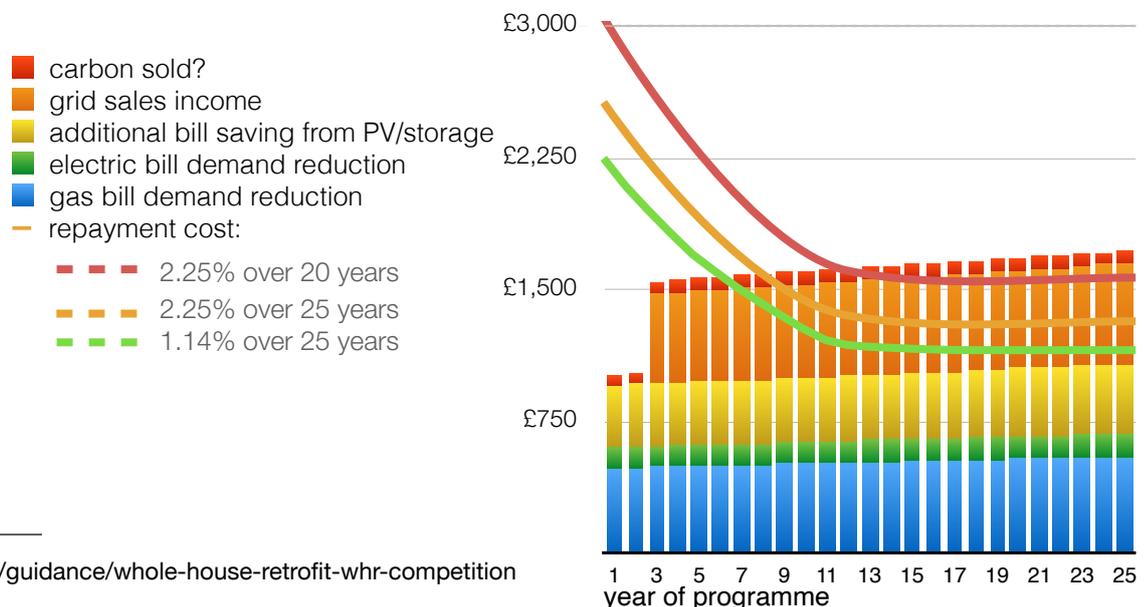


fig 2.7 – 3 different annual costs of loans for retrofit starting that year against potential savings and revenues



⁶ <https://www.gov.uk/guidance/whole-house-retrofit-whr-competition>
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labour, materials, management and on costs over 25 years. The reductions in the different categories of cost over the period are driven by lower risk, innovation and scale. These potential reductions in costs further improve the potential depth of decarbonisation.

Figure 2.7 shows the relationship between costs and savings that may be generated by a retrofit. The bars show the bill savings and income opportunities. The lines show the annual retrofit loan repayments, at different interest rates and terms. This cost declines as retrofit costs reduce. The diagram indicates that lower loan costs enable deeper retrofit to become affordable quicker, especially in the early years before costs have reduced.

2.4 Scaling Up

The experience of large-scale programmes, such as Green Deal Communities, indicates that scaling up can create quality control risks around delivery. A more managed scaling up minimises this. While this means a slower start, there is also a requirement to develop supply chains and up skill the workforce, which can take time.

This supports a strategy of starting small and growing at a managed rate to be able to optimise innovation and the most effective measures, while developing supply chain efficiencies and workforce creation alongside greater expertise both at corporate and individual tradesperson level.

Figure 2.8 outlines the number of projected retrofit required annually to meet the emissions pathway, whilst taking into account the requirement to mobilise the skills and supply chain, as discussed in more detail in Section VI. The number of retrofits completed peaks at 80,000 per year, with almost a million homes completed by 2038.

This needs more detailed analysis to identify potential growth scenarios in terms of meeting demand for a high quality affordable home retrofit, as well as a clearer understanding of the potential for cost reductions.

2.5 Financial Viability

The lack of supply chain development means higher costs which creates a financial viability gap for occupiers in the opening years of this programme (fig 2.6). In the early years, the cost of a retrofit loan exceeds the bill savings and other income. This gap reduces and by year 7 provides the occupiers with bill savings that balance loan costs (Figure 2.9)

There is a paradox in this viability gap: in order to develop the industry’s capacity to deliver retrofits at the level needed, it needs to actually deliver a number at a sufficient scale for that market development to take place. This argues against setting up a programme that delivers lower performing retrofits, as they will be less likely to meet the targets unless packages of work can be developed that enable second visits in later years. The issue of staged retrofit is not currently well understood.

fig 2.8 – number of projected retrofit has per year

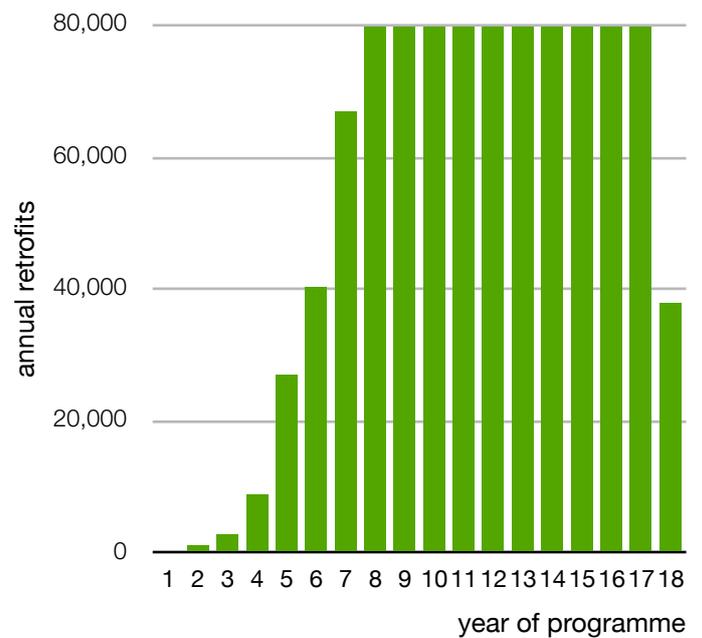
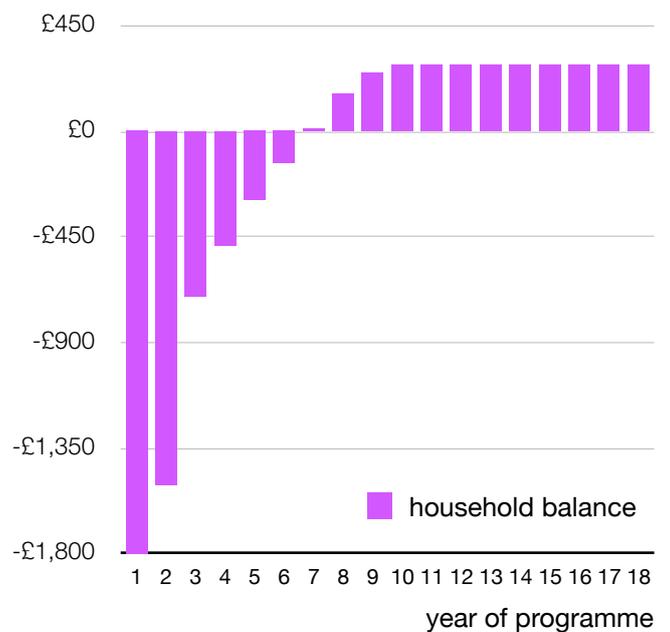


fig 2.9 – annual cost of retrofit financing for household by year from 2020



The early gap between retrofit costs and utility bill savings for occupiers can be minimised in different ways, two key ones being through reducing the cost of finance or accelerating the roll out of PV and energy storage and associated revenue benefits. These are not yet available directly to domestic users but the systems needed are already in place for commercial users. Two key regulatory changes are going through over the next 18 months which will then enable these revenues to be available for business models to be created to federate domestic storage. This is discussed in more detail in section IV.7 .

We have modelled for every property having solar panels having assumed that where suitable rooftops are not available on a property other locations will be available (see appendix II).

We have modelled the PV & storage proposition as it is currently available technology. However other revenue generating opportunities may come forward.

The difference between the original bills is compared to the new loan costs and remaining bills, less the income from the energy exported. The early years are challenging, as expected, but not prohibitively so compared to future opportunities: figures 2.10 and 2.11 suggest the maximum deficit even on high street lending and not PV deployment acceleration is less than £25 million and is repaid easily in later years. If the opening years (Figure 2.10) are subsidised by an accelerated roll out of PV and storage, as suggested earlier, that deficit drops below £1 million, repaid as soon as the larger scale aggregation income comes on stream. If those early homes were able to benefit from finance from public lending the deficit is also less than £1 million.

This would argue for low cost borrowing to finance PV & storage deployment and the first two years of the retrofit programme to allow for more financial room for manoeuvre so that property owners could be offered an incentive to take part.

Extending this out towards the zero-carbon in 2038 (Figure 2.11), we can see the energy savings and potential additional revenues create an opportunity to support major investment in retrofit.

What this section has set out to demonstrate is that retrofit at scale could be delivered with no cost to the Treasury. It represents an opportunity to give the Combined Authority & Local Authorities the opportunity to develop independent income which could then support the wider delivery of meeting the zero-carbon target.

It should be noted that this is high-level modelling and, as such would require further detailed financial modelling to confirm these assumptions. Assumptions include on costs for retrofit work & loans but not organisational set up costs.

fig 2.11 – accumulated surplus/ deficits from retrofit in 3 scenarios to 2030

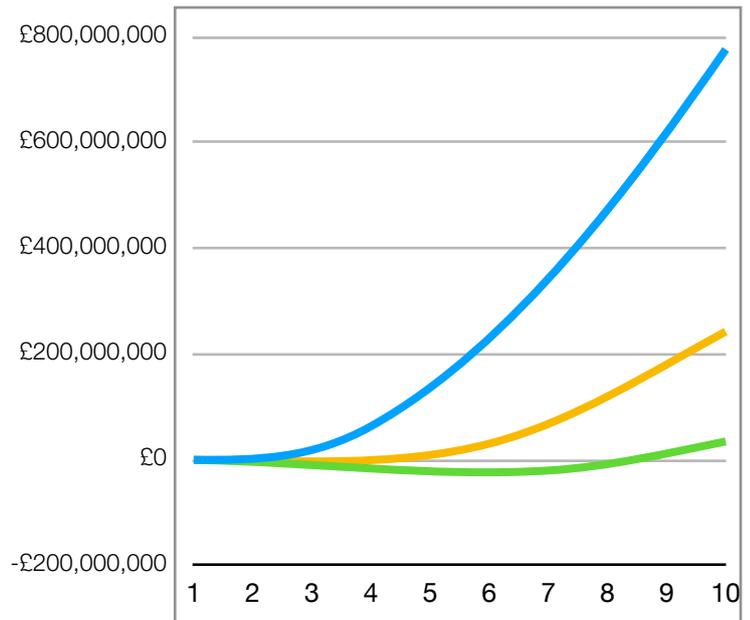
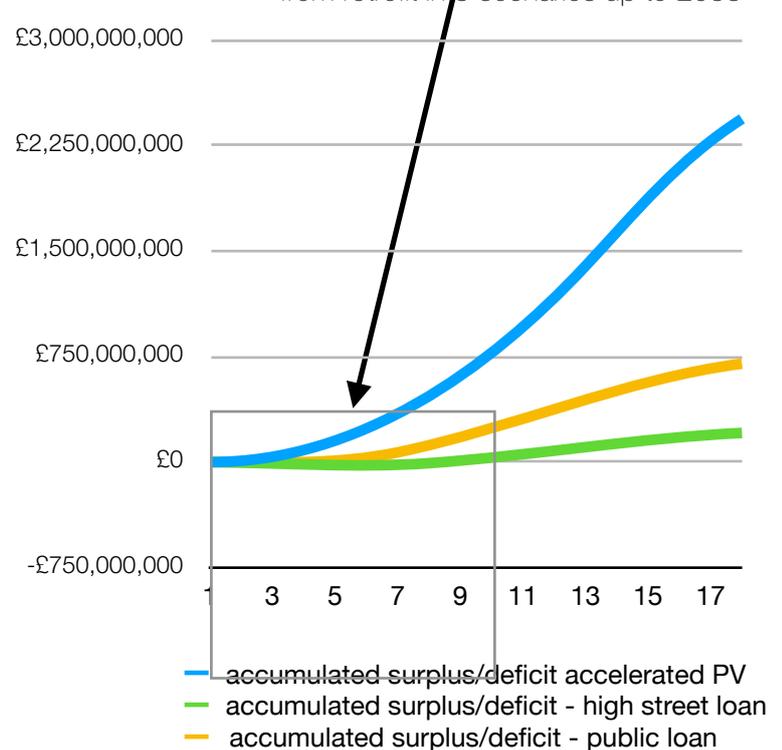
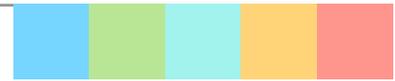


fig 2.12 - accumulated surplus/ deficits from retrofit in 3 scenarios up to 2038



III. retrofit schemes



This section reviews the approach taken in Step 2. We have reviewed 37 individual UK retrofit programmes, 10 overseas retrofit programmes, 7 non-retrofit construction programmes, 72 reports and guidance documents and carried out 30 formal interviews as well as other informal discussions. A number of the schemes are familiar to the team through direct participation or linkages, which provides a good opportunity to reality check the claims. A full list of research material is available in Appendix VII.

The broad themes we were seeking to see addressed focused on the two core issues of scaling up and delivering quality retrofit. These themes are strongly interconnected: there is not a critical path through as they all need to be addressed at the same time. These themes form the framework for the initial data collection looked at both holistic solutions, where there was a beginning to end model such as Energiesprong, or individual good practices that could potentially be combined into a wider “kit of parts” addressed in Section VI Components.

develop a trusted offer

How to ensure that the retrofit is delivered to a high standard that inspires consumer confidence? Key sub-themes are:

- developing the customer journey
- application and enforcement of quality systems such as PAS2035
- ensuring high quality of work is delivered
- models of verification and assessment into the long-term, inc warranties and liabilities.

building the market

How to create a market within the 3 different tenures that can operated at scale? Key themes are:

- demonstrator projects to improve confidence
- pipeline development within social housing
- engagement with the private rented sector
- keeping track of progress and mapping over policy
- scalability

fit for purpose

How to ensure the solutions that are provided fit the desired pathways and connect with wider opportunities? Key sub-themes are:

- products for the right situation and maximising the cost benefit
- no regrets measures - retrofit measures that will not preclude attainment of deep reduction reductions in energy use.
- retrofit design tools that reduce the performance gap
- retrofit methods and details that take a whole house approach
- specification methods with a firm scientific basis.

paying for it

What financial models are required for customers? How can capital be mobilised to support the delivery at scale? Is there a governance model sitting over this? Key sub-themes are:

- The need to radically reduce the cost of retrofits and how they are financed so that the customer can afford that offer
- Financial models for customers/ consumer market

- Mobilisation of capital markets
- Financial models for social housing



How to establish means of delivery and the supply chains that go with them that can meet the level of demand required to meet our carbon reduction targets? Key sub-themes are:

- Development of effective supply chains
- Delivery structures, partnerships and business models – procurement etc,
- Capacity of skills and training infrastructure and labour markets

Using these themes, we address the wider brief by examining the detail in the following sections. Section VI Components explores the wider findings from the literature review and interviews, with additional exploration on the issues of Funding and Finance (section IV), Regional Supply Chain, and Skills and Training (Section V).

Review of schemes

An increased body of evidence⁷ on domestic energy retrofits suggests a range of viable technical solutions are available. Meanwhile, improved standards have also been developed to overcome poor quality building work; going some way to gain consumer trust (PAS 20135 / Trustmark). However, the market for well-coordinated whole-house retrofit solutions and supporting services is not well established.⁸

The research found that there is no single approach to scaling up retrofit that can provide a model for West Yorkshire to follow to meet the target of bringing its housing stock up to meet 2038 net zero carbon targets with substantial progress by 2030. However there are many examples of what has been learnt from pilots, demonstrators and short term programmes and these have informed the development of our recommendations.

The headline findings are:

- There is no single one size fits all model for scaling up retrofit⁹ as different tenures and sub groups within each tenure require a range of support and finance offers backed up by regulation and incentivisation¹⁰.
- The complexity of a largescale retrofit programme and all its components means many aspects have to be addressed at the same time within a systems approach which underpins PAS2035 recommendations. “the new approach looks at the home, environment, occupancy and the householders' improvement objectives when determining suitable measures to install.”¹¹
- There is national focus on the need for scaling up retrofit and BEIS is currently running a number of pilots to investigate known issues including behaviours, lack of private rented sector (PRS) investment in retrofit and lack of stock condition data. There are opportunities for West Yorkshire to collaborate on creation of the building blocks for a largescale programme. The Combined Authority, Leeds City Council and Otley Energy and Leeds Climate Commission are already involved in the UKGBC Accelerator Cities project.¹²

⁷ Buildings energy efficiency technical research. BEIS 2019. <https://www.gov.uk/government/collections/buildings-energy-efficiency-technical-research>

⁸ Invitation to Quote ‘Scaling up Better Homes Yorkshire’ West Yorkshire Combined Authority 2020

⁹ <https://www.ciob.org/sites/default/files/The%20Retrofit%20Challenge%20-%20Delivering%20Low%20Carbon%20Buildings.pdf>

¹⁰ <https://www.ukgbc.org/ukgbc-work/accelerator-cities/>

¹¹ <https://www.elmhurstenergy.co.uk/accreditation/pas-2035-retrofit-schemes>

¹² <https://www.ukgbc.org/ukgbc-work/accelerator-cities/>

- Stop start initiatives do not lead to the creation of a high quality, robust supply chain or retrofit industry. A view repeated in the research interviews.

Programme Frameworks

Home Energy Efficiency Programme for Scotland (HEEPS)

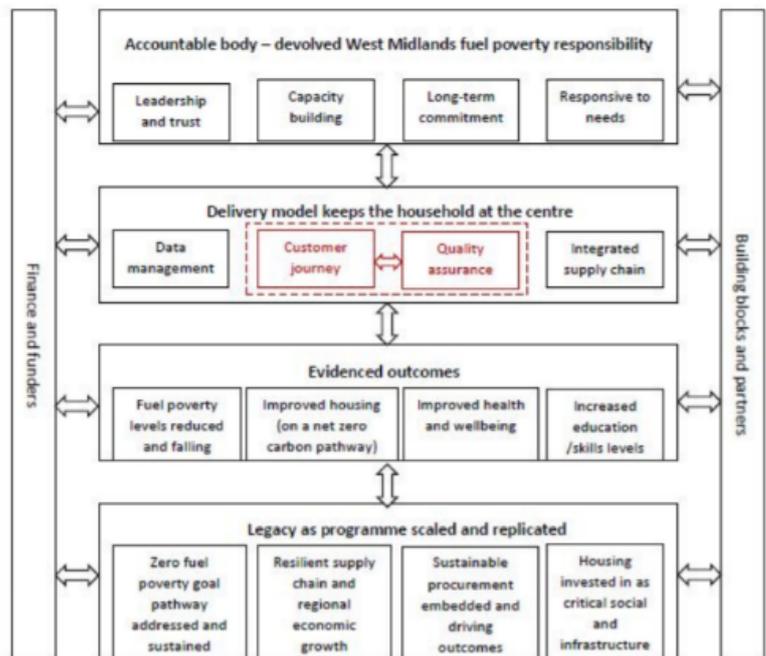
The Home Energy Efficiency Programme for Scotland (HEEPS) is the strongest example of a retrofit programme. It is the Scottish Government's flagship delivery vehicle for tackling fuel poverty and improving the energy efficiency of the domestic housing stock. Launched in April 2013, HEEPS provides an offer of support to all households across Scotland. The 2017/18 Programme had a total budget of £116.85m which funded a number of schemes, including advice and support.¹³ Important aspects include a commitment to long term funding to provide supply chain confidence, high targets for delivery standards, a strong audit process to ensure “right first time” and a free impartial advice service guiding customers to work appropriate to their circumstances (2017/18 Advice and Support budget £10.075m)

Warm Homes Save Lives

The Warm Homes Save Lives¹⁴ report prepared for the West Midland Combined Authority proposes a governance structure putting the customer at the centre with delivery through a number of building blocks developed in SHAP reports including Community Green Deal 2010¹⁵. There is an opportunity for regional authorities to act as sponsors for development of the building blocks.

Procurement

Procurement is a powerful element of successful projects. The Construction Leadership Council (CLC) Procuring for Value¹⁶ report demonstrates how a new approach to procurement can produce better value for money, based on a strong client led process requiring continuous improvement and feedback against long term outcomes. This addresses the ‘performance gap’ and delivers opportunities for innovation but require a strong vision, building of capacity at procurement stage and a long term relationship between client and contractor.¹⁷ A toolkit to support decision making has now been launched by the CLC.¹⁸



Trust and End to End Customer Journey

Warmworks Scotland

Good examples of management of the customer journey were found including Warmworks Scotland, which delivers the Scottish Government’s nationwide energy efficiency scheme. The scheme provides

¹³ <https://www.gov.scot/publications/home-energy-efficiency-programmes-scotland-delivery-report-2017-18/>

¹⁴ Warm Homes Save Lives_proposals document PDF

¹⁵ <https://shap.uk.com/resources/resources-pre-2018/>

¹⁶ <http://www.constructionleadershipcouncil.co.uk/wp-content/uploads/2018/07/RLB-Procuring-for-Value-18-July-.pdf#:~:text=Procuring%20for%20Value%20is%20a%20key%20theme%20of,be%20defined%20which%20are%20broader%20than%20capital%20cost.>

¹⁷ <https://www.energiesprong.uk/>

¹⁸ <https://constructioninnovationhub.org.uk/new-toolkit-signals-shift-towards-value-based-decision-model/>

insulation, efficient heating and renewable technologies to households struggling with the cost of high energy bills. Warmworks receives referrals to the Warmer Homes Scotland scheme from Home Energy Scotland. Warmworks Scotland act as the key point of contact and make sure everything is clear, helpful and easy to understand from the moment the application is submitted through to the installation and inspection of completed work.¹⁹

Warmworks Scotland has to meet a customer satisfaction target of 98% and does this by providing as much phone support as each customer needs, with the offer of home visits if they are needed. Discretionary funding is also available to help with barriers such as clearing lofts, moving furniture and more so that insulation and other works can take place. Through an incentivisation approach of reward and penalty, Warmworks work with their supply chain to make sure work is done within deadlines to a high quality and to a high customer satisfaction.

RetrofitWorks

RetrofitWorks has a different model of bringing clients and contractors together and managing the end to end process.²⁰ RetrofitWorks is a 'not for private profit' multi-stakeholder co-operative run by the members for the members and their local communities benefits. Trust is created by bringing the demand and supply chain together.

Two main member types are RetrofitWorks Advocates – organisations representing a constituency of potential customers, acting as trusted advisers on their behalf such as community groups, Local Authorities and other local stakeholders. Advocate members have a say on quality control. RetrofitWorks Practitioners – certified SME companies wishing to carry out retrofit advice, assessment, design, coordination, and installation work. All Practitioners are vetted and fully trained. Practitioners have a say on logistics of delivery. Retrofit quality is ensured by the appointment of a Retrofit Coordinator to every job, supported by job management software issued to all site staff – live GPS linked photos and evidence uploads.

Paying for Quality

There is a clear issue with targets set for decarbonisation programmes where the delivery of installations at lowest cost met the programme goals. This is evidenced by the understandable focus on the 'low hanging fruit' of a series of obligations on energy companies and deemed scores for installations. However, there is a well documented case study of how a CESP²¹ funded project could go disastrously wrong.²² With poor workmanship being blamed for many of the problems partly due to a rush to meet obligated deadlines and exclusion of many items which were not 'required' but which were necessary in a properly designed project. "The installers wouldn't extend the roofs out over the insulation because they said they were not being paid to do so." The performance gap is a concern, including unfamiliarity with materials/technologies and steep learning curves.²³

Relationship with fuel poverty

Programmes to address fuel poverty and retrofit have common aspects but responding to the energy needs of people in crisis may require immediate action not directly on a zero carbon pathway. Basic retrofit measures only enable people to heat their homes better with existing fuel use - there is no reduction in carbon emissions, which will be achieved with a higher level of works. This is recognised in our recommendations that fuel poverty responses should be informed by a whole house retrofit pathway to avoid abortive works. Nottingham City Homes are on a third iteration of external wall insulation for tower blocks, having installed and

¹⁹ <https://www.warmworks.co.uk/>

²⁰ <https://retrofitworks.co.uk/>

²¹ https://www.ofgem.gov.uk/sites/default/files/docs/2013/05/cesp-final-report-2013_final-300413_0.pdf

²² <https://passivehouseplus.ie/news/health/disastrous-preston-retrofit-scheme-remains-unresolved>

²³ <https://www.cibsejournal.com/general/home-truths-innovate-uk-building-performance-evaluation-programme-report/#:~:text=Findings%20from%20Innovate%20UK%E2%80%99s%20four-year%20Building%20Performance%20Evaluation,a%20yawning%20gap%20in%20performance%20for%20the%20majority.>

removed 2 previous insulation layers to increase the depth to meet current requirements.²⁴ This therefore makes the investment costs very high compared to a single step installation of insulation to meet a deep retrofit fabric specification.

Behaviour Change/Lifestyle Choices

Accord Housing ERDF Smart Grids and Retrofit Project undertook monitoring and analysis of tenant behaviour.²⁵ They found that as long as insulation and ventilation issues are properly undertaken with robust coordinated building details, householder lifestyle is unlikely to impact the energy savings achievable.

Business Models

New business models are emerging that take a long term approach to recovering investment costs to reach low carbon and net zero accommodation. Common factors include innovative energy systems, partnerships that run from design, through construction to long term maintenance and mechanisms through rent and other finance packages that pay a return on investment. Energiesprong UK is testing this model for retrofit in the UK and has just won new funding for additional pilot/demonstrator projects.²⁶ Legislation allows tenant contributions towards the fabric and energy efficiency works to be captured, although maintenance of the new systems cannot be recovered through a service charge.

Other examples of long term partnerships delivering zero carbon accommodation are found in the Hertfordshire University zero carbon BREEAM outstanding student accommodation²⁷ where common factors with the Energiesprong approach include a public private partnership (Uliving) which took on responsibility for the design, construction and financing of the University's new accommodation complex, and its maintenance and management for 50 years.

The Warmer Homes ERDF project being delivered by Connexus is developing the business case for investment in its stock over a 30 year asset management plan cycle to reach Enerphit standard for a rural portfolio including non traditional and off gas properties.²⁸ The project has not started capital works delivery yet.

Creating Demand

DECC funded a number of schemes to drive consumer demand for energy efficiency and reduced energy bills.²⁹ There are different drivers and opportunities in different sectors.

Wrap Up Leeds³⁰ has been a great example of a Council, local social enterprise and the private sector working together to make the most of different skills.

Cosy Homes Oxfordshire³¹ is a new service run by Low Carbon Hub, Retrofit Works and National Energy Foundation offering quick fix heating scheme, simple measures that are quick to install such as loft insulation, cavity wall insulation, ventilation with access to a handyman scheme, advice for people who are doing works and could maximise the property's energy efficiency at the same time, a two week program of works (e.g. for moving or holidays and Whole house retrofits.

²⁴ personal communication

²⁵ <https://shapuk.files.wordpress.com/2018/07/maximising-outcomes-from-investment-in-domestic-retrofit.pdf>

²⁶ <https://www.energiesprong.uk/newspage/energiesprong-uk-wins-twice-in-whole-house-retrofit-competition-beis>

²⁷ <https://fulcruminfrastructuremanagement.co.uk/wp-content/uploads/2018/12/CS3-Meridiam-UoH-breeam-outstanding.pdf>

²⁸ <https://connexus-group.co.uk/news/connexus-warmer-homes-project>

²⁹ <https://shapuk.files.wordpress.com/2017/10/2013-evaluation-of-decc-funded-projects-report.pdf>

³⁰ <https://yesenergysolutions.co.uk/schemes/wrap-up-leeds>

³¹ https://www.oxford.gov.uk/directory_record/11938/cosy_homes_oxfordshire

Information and Advice

In addition to examples of end to end provision such as RetrofitWorks and WarmWorks Scotland there are a number of other models of high quality advice provision.

The Green Doctor service supported retrofit in West Yorkshire and found that post installation visits were important in making sure occupants could operate new heating systems and understand the installation work completed.³²

Superhomes, run by NEF has had success in promoting deep energy retrofit through peer to peer demonstrator network.³³ 3 in 5 visitors reported it was very likely they would improve the energy efficiency of their home. 86% said it was very likely or likely they would investigate a product recommended by a SuperHome. Visitors planned to spend on average £5770 on energy saving measures over the year after their visit to a Superhome.

Cornwall Home Works

Other sources of information and advice were tested in Cornwall 'Home Works' project, providing tradespeople with information, skills and incentives to play their part in the transition to Net Zero, by talking about the benefits of domestic energy efficiency to the homeowners that they visit.³⁴

Interview comments - successful schemes

Interviewees from the supply chain expressed a need for clarity over directions of retrofit. There was some concern that the sector is not clear on the relationship between fabric and technology and the balance between these in effective retrofit. This related in part to uncertainty around specific technologies, such as heat pumps and hydrogen, and the extent to which retrofit needs to be at the deepest level if grid decarbonisation will in any case lower the impact of housing energy. A house can be understood as a system, and placed within the energy system as whole. From a practical point of view, interviewees considered whether a full EPC A deep retrofit approach would be necessary in the context of new technology and a decarbonising grid: partly a financial decision in terms of how local authorities are seen to invest their money and also a practical consideration in the sense that fabric measures are more likely to be expensive, disruptive and difficult to sell to the public. The importance of retrofit was not in doubt, and it was recognised that better insulation opened up more options for heating technologies. This also related to specific cases, such as houses that would be prohibitively difficult to retrofit to EPC A such as stone houses in Bradford and rural and remote homes. Some areas may also have distinct opportunities for low-carbon energy and heat approaches – an example given was post-mining areas, where former mine shafts can provide opportunities for district heating. In relation to specific technologies, there was some uncertainty about which 'horse to back'.

EPC as a target

Whilst there was some discussion about the suitability of EPC as a target, interviewees generally recognised its value as an established and accepted measures despite its shortcomings. Some newer technologies such as smart air bricks are not recognised in SAP/RdSAP and houses with the same EPC rating can have very different energy consumption. EPCs are more appropriate for modelled energy consumption than actual energy consumption. One interviewee noted that fixing broken heating systems has no effect on EPC – since the heating system was in place, if not working, and that this is a limitation in its role in fuel poverty programmes.

Relationship with fuel poverty

Many of the interviewees commented on the relationship between fuel poverty and carbon reduction. In some cases, programme funding was specifically related to fuel poverty and this tended to shape their direction in terms of which houses to help and what approaches to adopt. Tensions were observed here. The most

³² <https://www.groundwork.org.uk/services/green-doctor/>

³³ <http://www.superhomes.org.uk/resources/superhomes-research-report-2014/>

³⁴ <https://www.homeworksretrofit.com/>

effective way to help someone out of fuel poverty, for example, is to give someone a new gas boiler but this is not necessarily the best approach for decarbonisation. A focus on fuel poverty could therefore mean going in the wrong direction when action is urgently needed on reducing emissions. Equally, rolling out new electric heating technologies could result in houses having higher bills in the medium term and push households further into fuel poverty.

Social rented sector

Interviewees discussed the extent to which challenges in retrofit vary across the owner-occupied, privately rented and social rented sectors. To some extent social housing has an advantage. Housing associations are more likely to manage their stock as an asset and know what they are looking for when setting up contracts and to be in ongoing communication with their tenants. Although to some extent they can insist that improvements are made to their homes, they still need to convince tenants to engage, particularly when it comes to retrofit. A challenge is the cycle of works, which tend to be split over decades as part of long-term plans – doors one year, windows after five years, heating system after 10 years, and so on. This can mitigate against whole-house retrofit at a single stage but, if plans are modified, can be the vehicle through which to manage a coordinated approach over a longer term. Interviewees saw this as challenging though, in terms of being able to adapt business plans – perhaps an internal struggle for the sustainability officer in the housing association. Social housing also has particular opportunities to influence the supply chain through procurement and training, such as apprenticeship programmes. They can take the opportunity to retrofit properties when they are void and one interviewee suggested they could be enabled to buy up surrounding stock to retrofit and then return to the market.

Owner-occupied sector

The key issue with the owner-occupied sector was seen to be creating householder demand for deep retrofit. Householder decision making was seen as a priority for research and there is a need to understand not only what financial schemes can help, but also what motivates people. Owner occupiers are not a homogenous group and there is a need to subsegment and understand how people at different stages and with different priorities can be engaged with retrofit. Whilst for some fuel poverty may be an incentive, there are affluent consumers for whom entirely different messaging will be needed and the government cannot be seen to be subsidising their investment in their house. There was a general feeling that financial incentives are insufficient and that there also needs to be a stronger effort to make retrofit a desirable consumer product while also not leaving the fuel poor behind. The sector needs to accept that for most people retrofit is not ‘on their radar’ and that getting people to accept even basic measures is a challenge, and much more so for more substantial and disruptive approaches.

In ‘selling’ retrofit there is a need to work closely with communities, potentially finding local representatives and ambassadors. New BEIS-funded projects like People Powered Retrofit in Manchester are working with householders to integrate supply chain with demand, to some extent ‘holding hands’ with the occupants through the journey. Another part of the relationship with occupants is ensuring that they can get the best out of systems, and therefore that energy savings are achieved. Examples of difficulties include residents turning off a heat pump as it was noisy, elderly people refusing PV as they do not know how to use it, and tenants saying they would rather avoid the disruption as they do not know if they are going to be living there in the following year. Community champions can help ready to recruit people to install retrofit.

Privately rented sector

The private rented sector was seen to be a significant challenge, with landlords often uninterested and sometimes not located in the area or the country. Whilst it can be argued that private landlords operate as a business and can release capital to generate finance, there are differences by area. Whilst in areas like the Southeast, rents can be high and landlords can recoup costs of energy investment through increased rents, in many areas of the country the market is different and landlords are often losing money or not breaking even, sometimes on properties they cannot sell. Despite this challenge there are landlords who want to ‘do the right thing’ and some areas have been successful in attracting landlords to seminars to learn about energy efficiency – admittedly this is likely to be a self-selecting community. Loan schemes such as Lendology have been used to enable small landlords to meet regulatory targets for energy performance.

IV. funding & finance

Stern's analysis (2007) showed that the cost of not dealing with climate change would be up to 20 times higher than the cost of doing the work to minimise its impact. Working out how to engage the levels of finance needed in retrofit is an urgent need, being addressed by finance sector leaders notably through the Green Finance Initiative and Place-Based Climate Action Network. Mainstream banks including Barclays and HSBC are facilitating the issue of Green Bonds for investment in carbon saving projects.³⁵

While an attractive funding package alone will not stimulate demand for retrofit, lack of funding is the most commonly quoted barrier to retrofit in social housing³⁶ and in owner occupiers³⁷. Assuming that other issues discussed in this report have been dealt with, ensuring that all households and landlords can access a funding package to carry out retrofit work on their property is vital.

The majority of UK retrofit programmes we reviewed were funded by government grants or green charges on energy bills. Some projects had used government grant to trial very low interest loans (such as Carbon Co-op Green Deal Go Early). Registered providers had used their maintenance funds in combination with grants to carry out high levels of retrofit, notably Radian Homes. Individual property owners have used savings and mortgage extensions to carry out retrofit work. Across Europe retrofit programmes combine low interest loans issued through retail banks with grants, depending on income levels, leveraging in a higher level of private contributions (examples include KfW (German state bank) and Octave in France).

High interest rates will reduce the amount of retrofit work that can be funded if repayments are to be linked to bill savings, leaving the household not worse off. This is a debatable target - some home owners are willing to pay more for the health improvements, comfort and certainty of future costs (fixed loan costs instead of rising fuel prices).

While governments have provided low cost measures free of charge, deep retrofit is assumed to be too expensive to be state funded. Energy efficiency programmes have often been focussed on the fuel poor : now improvements must be made to homes at all income levels. We have therefore modelled how to achieve net zero carbon emission level retrofit using loans rather than grant funding. The shortage of grant funding makes it necessary to encourage the immediate beneficiaries of the work to repay the costs over time. However, there are barriers to overcome for different household types, as set out in table 4.1 below. This will make it necessary to tailor the loan terms to the household's ability to pay.

Establishing an advice and financing hub for retrofit makes this achievable. "One stop shops" offer a single point of contact for a thermal audit and work plan which then inform the development of a finance package. A trusted advice service can guide households and landlords to the most appropriate source of finance, including any available grant funding, taking into account their ability to pay including the savings/income from a retrofit project. An example is Picardie Pass Rénovation : their typical financial package consists of 13% subsidies, 17% self-financing by the homeowner, and 70% loan. The service provides low interest loans at 2.5% over 15-20 years, with the risk carried by Picardie Region using a European Investment Bank loan (no longer available to UK projects). Work has been completed on 1721 properties.

The wider economic benefits of facilitating investment in energy efficiency are substantial. Analysis of the Secure Warm Modern programme in Nottingham showed that every £1 invested through the programme generates local spend of £1.46 through orders to local tradespeople and suppliers³⁸. Extended economic multipliers will come from improved health and job creation. Studies show that the multiplier effect of home energy efficiency is significantly higher than other forms of investment such as road, rail or electricity generation infrastructure, with economic benefits likely to be felt in every community³⁹.

³⁵ Financing climate action with positive social impact Robbins 2020

³⁶ "What are the Barriers to Retrofit in Social Housing?", Palmer et al 2018

³⁷ Barriers to domestic retrofit—learning from past home improvement experiences, Mallaband et al 2012; also Breaking Barriers, National Energy Foundation 2014

³⁸ The Effects of Secure Warm Modern Homes in Nottingham, Decent Homes Impact Study, Nottingham City Homes, 2016

³⁹ A Green Stimulus for Housing : The Macroeconomic impacts of a UK Whole House Retrofit Programme, New Economics Foundation 2020

In July 2020 UK100 called for the government to establish a Net Zero Bank, blending private (including social impact investment funds) and local authority (pension funds, municipal bonds) finance to create patient capital for projects moving towards the net zero goal, in a model similar to the Canada Infrastructure Bank⁴⁰. In the absence of national action, more local solutions are required and have the potential to create a stronger local ownership of returns, both financial and social benefits such as ability to target health outcomes.

fig 4.1 - financing by household type

		Owner Occupiers				Private Landlord	Social Landlord	
		Able to pay : substantial savings	Able to pay : borrowing ability	Able to pay : income but no asset cover	Struggling to pay	Unable to pay		
Personal finances		Fund retrofit from savings					savings / reserves	reserves maintenance funds
barriers		risk aversion - uncertainty about achieving cost reductions to rebuild savings, loss of savings income					no benefits from bill reductions unless rents can be increased	limited liquid assets repair planning without long term energy goals
Borrowing against property		mortgage extension (including Green Additional Mortgages) equity release		equity release loan			mortgage extension "green buy to let" mortgage	secured bank loans
barriers		wish to leave assets to family affordability/age barriers future interest rate changes changes in credit rating make borrowing difficult high existing mortgage competes with other investments/purchases		reduces household assets if work done not reflected in property value repayments when affordable could be allowed to reduce impact on property asset loan agreement needs to be fair to avoid taking excessive share of property value rises			high existing mortgage using rental income to fund personal expenses so cannot afford loan payments no benefit from bill reductions unless retrofit increases rent level	requires a strong credit rating competes with other priorities including building new homes
Unsecured borrowing				Credit Union low interest loan				green equipment lease green bond issue
barriers		Intention to move house before loan is repaid - concerns about whether the value of the work will be reflected in the sale price	high interest rates, Term too short for the long payback of energy efficiency works	unable to pass credit checks for loans Low availability of affordable unsecured loans	unable to pass credit checks for loans Bill savings will be small in underheated homes			Interest rates need to relate to savings green bond issue requires strong credit rating
Grants			renewable heat incentive green homes grants				green homes grants	Social Housing Decarbonisation Fund
barriers			short term programmes prevent planning insufficient funding available for deep retrofit high demand for grants RHI requires high up front investment some evidence of suppliers increasing prices for grant funded programme, due to extra demand or to cover administration		Unable to fund contribution required or up front investment		need funding for one third contribution	limited funds & short deadlines create risk of badly planned programmes - needs clarity on continued work

⁴⁰ Accelerating the Rate of Investment in Local Energy Projects, Billington/Smith/Ball, 2020

A Local Retrofit Loan Fund

Revolving loan funds for retrofit have been under discussion for some time. In the public and further education sector, Salix has successfully helped over 3,100 clients to commit over 18,700 projects valued at £971 million, forecast to save over 867,000 tonnes of CO₂e annually. This suggests an average spend of £31,322 per client, so the scale is comparable with whole house retrofit.

Gouldson's report finds that the using revolving loan funds the "entire retrofit programme could be made cost-neutral over an extended period"⁴¹. To achieve a major public interest goal with limited cost to public funds is an attractive target worthy of its set up costs.

Lending for energy efficiency may be a high quality market : the Bank of England concludes that, even after taking into account income levels and loan to value ratios, energy-efficient properties are less frequently in payment arrears.⁴²

Establishing a Retrofit Loan Fund would allow property owners (residents or landlords) to borrow money to carry out retrofit works at affordable interest rates. Money repaid to the fund would be recycled to lend again. Securing loans against the property would allow interest rates to be kept low, as money would not be lost from the fund.

Local authorities could use these loans to support retrofit as well as wider objectives such as area regeneration. The UK Green Building Council⁴³ suggests that the funds can be obtained from Local authority borrowing and reserves, Local Enterprise Partnerships, central government borrowing and private sector investment.

Local authorities have offered loan funds with a variety of payback options suited to the owners income level, from WarmUp Bristol and West Midlands Kickstart equity release loans (with repayment as a percentage of sales price) to Manchester's Care & Repair interest free Home Energy Loan Plan for home energy improvements (up to £10,000 over ten years)⁴⁴. Home Energy Scotland is offering 12 year interest free loans of up to £15,000 for energy efficiency plus £17,500 for renewable energy generation, interest free and repaid over ten years : the loan budget for 2017/18 was £30m.

A particularly successful example of this is Lendology, a social enterprise working with 18 councils. Established in 2005, this fund has recycled £7.5m of funding and continues to lend between £1k-£50k to households and landlords for essential home improvement projects, with loan forms tailored to the individual needs and incomes including deferred payment, interest only or equity models as well as standard repayment loans at 4% interest. They have a very low default rate (5 loans in 15 years) because they work supportively with borrowers. They are expert in working in line with FCA regulatory requirements, complexity of which can be a barrier to the creation of new lending schemes.

Some local authorities provide home energy loans through the Yorkshire and Humber Loan Scheme. Currently available to those in high levels of need, loans are administered by Sheffield City Council. These loans are between £300 and £2000, interest free and repayable over 1-5 years at a rate of 25% of disposable income. These are funded by repayments of equity loans known as Home Appreciation Loans. These are loans of up to £30,000 which are not repaid until the property is sold. The repayment is an agreed percentage of the property, based on the value at the time the loan was issued. This means that the council benefits from an uplift in property values. Over the long term this can have a high impact on the asset remaining, which will deter some people from taking out this type of loan.

Leeds City Region also has a Revolving Investment Fund offering short term (up to 5 years) commercial loans to projects delivering economic growth and job creation. This has been funded by local authorities in the region. The target is asset based infrastructure and construction, including housing.

⁴¹ "Innovative financing models for low carbon transitions: Exploring the case for revolving funds for domestic energy efficiency programmes" Gouldson et al 2015

⁴² Does energy efficiency predict mortgage performance? Bank of England Working Paper 2020

⁴³ Regeneration and Retrofit : Task Group Report, UKGBC, 2017

⁴⁴ <https://www.careandrepair-manchester.org.uk/manchester-services/hrst/the-home-energy-loan-plan/>

A revolving loan fund can support an ongoing pipeline of work - our review of projects found that good retrofit programmes came to a halt because the funding ran out before a financial structure to support long term work was established (for example, Carbon Co-op Go Early retrofits).

Several loan funds have experienced low take-up - some interviewees felt the bureaucracy around certain loan schemes was a disincentive, suggesting that the application process needs to be streamlined and supported. In many the amount available or the term will not fit the savings payback for whole house retrofit which requires a long term (25 year) low interest loan if the household is going to be able to use energy savings to fund loan payments. Lendology reported no problems allocating their low interest loans to households as long as councils trusted them to deliver loans for agreed work types. Other loan funds are very hard to find details of or only offer loans to people referred by local authorities or other agencies and appear to have (either accidentally or deliberately) limited the number of applicants. Further research is needed to match the loan term, interest rate to the package of works needed to meet energy use reduction targets.

The recommendations in Section VIII propose that a feasibility study should be commissioned, to provide more detailed analysis of how the retrofit loan fund would function, including the balance between different loan types suggested in Fig 4.1 and detailed costing of management overheads. Incorporation of additional incomes from energy generation are discussed in Component 7.

PACE : Property Assessed Clean Energy Finance

This type of programme funds 100% of upfront retrofit costs, secured against the property (and transferred with it if ownership changes) and repaid through an additional property tax (such as a council tax charge) over a long timescale (15-25 years). In the US this mechanism has mobilised over \$5 billion of home retrofit at an average cost of \$25,000⁴⁵. A detailed design is required, the costs of which are included. The building owner keeps the benefits of lower energy costs (assuming they are the bill payer). The payments do not affect the borrowing capacity of the building owner and outstanding payments do not have to be repaid on sale.⁴⁶ In the US programmes vary from public bodies providing funding and administration, to privately funded and managed.

There is a clear logic to attaching future payments to the building as some retrofit measures have a long payback period which would otherwise deter people who feel that they may move before receiving the benefits. This may prove to be a barrier to selling the property if buyers are deterred. The other option is to make a loan which is repayable on sale, but this will only be attractive if property owners believe that the value of their investment in retrofit works will be reflected in the sale price, evidence for which is currently conflicted.

This model has similarities with the Green Deal programme, 2013-2015, which allowed building owners to repay the cost of retrofit through their energy bills. A framework of accredited assessors and installers was intended to increase trust in retrofit products. Less than 1% of qualifying works were funded using this loan scheme. The National Audit Office found the loan process was too complex, the interest rates too expensive at 7-10% (where programmes with interest free finance had high levels of demand), the Golden Rule (savings to match borrowing costs) at this rate meant that financial contributions were required to top up the loan and the scheme was too narrowly focussed on financial returns where consumers valued wider benefits.⁴⁷ There were also reports that households in urgent need of retrofit work were not able to pass credit checks for the Green Deal loans⁴⁸.

EuroPACE pilot projects are starting in Belgium, Portugal, Spain and the Netherlands. A Retrofit Loan Fund could offer loans on this basis, mitigating the concerns of households who expect to move on before their retrofit costs are repaid and landlords who are not the beneficiary of energy savings. This would require legislative changes to allow additional council tax charges.

⁴⁵"Financing Energy Efficient Buildings" Green Finance Institute 2020

⁴⁶ "PACE financing - A primer for real estate investment management professionals", Johnson 2015

⁴⁷ "Green Deal and Energy Company Obligation " National Audit Office 2016

⁴⁸ "Introduction of Energy Repayment Loans " Chris Galley, Sheffield City Council 2016

Under an Energy Service agreement a third party pays for the work and is repaid using bill savings. A low interest loan scheme would work in this way, using data from an assessment method that is as accurate as possible in predicting bill savings to inform lending choices.

Interview data on finance

The interviews included stakeholders who have experience with bidding for or managing finance for retrofit and construction activities. Upscaling retrofit activities will require additional finance including new ways of generating funds at the scale intended in West Yorkshire.

There was an overwhelming view from the interviews that successful retrofit needs long-term financial commitments that allow a sustainable retrofit industry to develop based on delivering householder needs and quality work. Long-term finance was seen as an enabler to successful retrofit scaling up whereas short-term funding, even when quite large levels, was seen as damaging to a sustainable retrofit industry. There was some scepticism about the ability of the government to provide sufficient funding at a sufficiently long-term level and therefore a recognition of the need for a mixture of funding options.

Interviewees emphasised the importance of understanding financial barriers in context: the right financial model can nudge people towards retrofit choices, but are unlikely on their own to be able to create the desire for it. Related to this were also concerns about the efficacy of focusing on financial mechanisms as this could push people towards evaluating retrofit on purely financial grounds and downplaying the wider benefits. Whilst some interviewees were focused on getting the payback period of retrofit to a level that would be attractive to householders, implying that take up would then rise, another commented that the sector is gradually realising that this is insufficient in the context of barriers such as disruption and lack of trust in contractors.

Whilst the Green Deal left programmes in a challenging context, in terms of householder and supply chain perceptions about funding mechanisms and quality of work, others noted that few householders have heard of the Green Deal or looked into retrofit finance options. The Green Homes Grant is a current example. On the face of it this looked like a step in the right direction but interviewees expressed concerns about the short-term nature of the scheme and advised that the money should go to local authorities or the installer to allow them to coordinate measures and avoid the overheads in terms of securing the payment from the householder. It was also noted that the Green Homes Grant meant organisations and the sector as a whole having to react quickly, and that this does not encourage high quality work. Such schemes can also prompt a short term 'gold rush' and price inflation if not managed carefully.

Interviewees spoke of the need for different financial models for different housing tenures, reflecting the diverse needs and drivers of owner-occupied, private rented and social housing. There were views that financial incentives were needed alongside deterrents to provide a 'carrot and stick' approach. It was recognised that giving people a range of finance and funding options is beneficial and that it is important to balance this with relatively simple models. Financial offers do not have to focus solely on energy efficiency, successful schemes such as KfW in Germany allowed householders to carry out general renovation as long as energy efficiency was a component. Some incentives mentioned included:

- Green loans/mortgages
- Loans against assets
- Grants when moving house
- Lifetime ISAs for home improvements
- Equity release
- Very low interest loans focused on retrofit (for example, provided by Energy Action Scotland)

Targeting specific groups and considering the subsets of likely householders, particularly owner occupiers is important. Those in fuel poverty are unlikely to be able to afford capital expenditure of down payments even if a loan is attractive.

Interviewees identified financial approaches to provide 'sticks' to push householders towards retrofit:

- Taxation on energy inefficient properties (but it was recognised it is important not to penalise those most at risk of fuel poverty)
- Taxation on stamp duty
- Minimum EPC ratings at point of sale
- Improved building regulations
- Minimum Energy Efficiency Standards
- Council tax based on energy efficiency

An interviewee had looked into using council tax to encourage energy efficiency but had found in focus groups that the householders 'hated it'.

Particular local finance models that could work:

- PACE
- Green Rental Agreements in the private rented sector
- Insurance backed comfort plan (social housing)
- Community municipal investment

The idea of comfort as a service was discussed in many of the interviews and people were interested in this approach, particularly in the reliability of payments and noting increasing acceptance of subscription models for communication and entertainment and therefore that buying an outcome, rather than a product, could be an effective way to engage with people on energy efficiency. If energy companies are selling comfort rather than energy, one interviewee noted, then models like EnergieSprong and Passivhaus start to make more economic sense. Bristol Energy are trialled billing for 'warm hours' and research has shown that people are prepared to pay more for healthy buildings. There are challenges though, particularly in terms of cultural differences around perceptions of ownership and control of living environments as well as practical challenges such as the arrangements when people move house.

Social housing providers require funding for substantial roll outs of energy efficiency. There are opportunities for them to take creative approaches, and changes in legislation could allow them up to do this. In social housing, there are particular opportunities such as placing an energy charge on the rent to cover some of the cost of energy efficiency installation, since the occupant would still be better off. Interviewees from social housing also emphasised the importance of ongoing work with tenants to ensure they get the best out of retrofitted homes and new technologies, and that this would also require capacity and therefore revenue funding.

The structure of finance can shape the quality of the work. In the case of ECO, companies wanted the cheapest measures for the greatest lifetime savings, incentivising easy work. Some lenders, such as the Ecology Building Society, are able to use the conditions of loans to ensure standards of retrofit work.

There are opportunities for lenders to be proactive in encouraging energy efficiency. Mortgage lenders are working together to develop approaches to encouraging energy efficiency something described by an interviewee with a focus on green finance as 'latent demand in the finance sector'. This has come about partly because the sector is under pressure to disclose its climate related activities since the publication of the Taskforce for Climate Related Financial Disclosure. They also see opportunities through 'build back better' post-Covid-19, in particular following the Green Homes Grant scheme. There is still some conservatism and risk averseness in relation to more ambitious or unconventional retrofits.

How to capitalise a revolving loan fund

Investors are increasingly interested in triple bottom line products (combining economic value, environmental impact and social responsibility)⁴⁹. Interview comments suggest that there is increasing interest in supporting home retrofit from banks, building societies and pension funds, with dedicated teams supporting this, partly due to climate related reporting requirements. The fund needs to attract considerable capital as the programme grows to meet the region's zero carbon target. Using an at or near net zero level of retrofit endeavour the current forecast is for £2.4 billion a year by 2029 for the West Yorkshire region's residential

⁴⁹ "Sustainable Reality: Analyzing Risk and Returns of Sustainable Funds," Morgan Stanley 2019

sector. Outline modelling suggests that in 8 years time it is feasible that the market for whole house retrofit could be developed so that finance demands would be attractive to private sector funders, including institutions such as pensions funds. Further detailed study needs to be done to more precisely assess the effect on capital availability and cost of the combined efforts of greater performance certainty, uplifts in property value, revenues from carbon, energy demand side response (DSR), renewable energy and storage alongside those works cost reductions.

Low Carbon Hub in Oxfordshire raised £1.5m through Ethex⁵⁰ in March 2020, taking their total invested to £6m. The funds are used to create renewable energy projects, the profits from which are used to support community action on climate change. Over £500,000 has been donated to this work since 2011. Energise Barnsley raised £800,000 in 2016 using 5 year bonds to fund solar panels, offering a return of 5%.

Municipal Bonds are a well established funding mechanism in other countries such as Sweden. The UK form (also known as Community Mutual Investments) has been developed by social impact investors Abundance, currently being tested by local authorities. These are currently very focussed projects (West Berkshire and Warrington both raising £1m to fund solar panels on council buildings/solar park, five year term bonds from £5 investment with a 1.2% interest rate)⁵¹. The programme to be funded would need to be clear and easily understood to attract investors but 73% of people polled would be interested in investing in a CMI (Abundance, 2020). The bond structure gives investors the opportunity to support wider outcomes and social impacts. Research has shown an unmet demand for place based investments to support the net zero economy⁵² which could be tapped into by a West Yorkshire green bond for retrofit, to be used to capitalise a loan fund.

It would be possible to offer varying interest rates to investors - experience of organisations such as Radical Routes demonstrates that some people want to invest in a project for non-financial reasons and do not require a return (for example Glendale Gateway Trust raised £128,000 in community bonds at zero interest rate to facilitate a community led affordable housing project as part of a wider finance package).

A model worthy of further testing is one that has tiered shares. Founding funders have tier1 shares, tier 2 community shares bought by means such as crowd sourcing, providing a buffer of patient funds, then be supplemented by the ordinary tier 3 shares. The preferential benefits of Tier 1 & 2 shares would need to be sufficiently attractive to fund until the model is self sustaining at more commercial finance rates in future years. This model would also enable the process of shortening the paths of finance, so that money from the region is deployed in the creation of the region's future. This would both reduce cost and encourage greater community engagement, while obtaining longer term investment than the five years of recent municipal bonds.

It may be possible for investors to benefit from tax incentives rather than project returns. Enterprise Investment Scheme can be used to attract up to £5m a year of equity investments (such as community shares) for the first seven years of trading. Investors receive 30% income tax credit, as long as shares are held for three years. The organisation's non-trading income must not exceed 20% of the total. The organisation must be independent, with less than 250 employees. For example, Low Carbon Hub investors can expect 30% Enterprise Investment Scheme, or 50% for those qualifying for Seed Enterprise Investment Scheme. Social Investment Tax Relief is allowable on unsecured loan investments. It gives investors 30% income tax relief. Social enterprises can use this scheme to raise up to £300,000 in any three year period, with a lifetime limit of £1.5m. However these schemes can no longer be used for energy generation activities.

It would also be possible to vary the interest rates charged to borrowers, to help those in fuel poverty or to encourage early adopters.

The retrofit loan fund could be operated through existing arrangements with Sheffield City Council, or other social enterprise such as Lendology CIC.

The fund would be able to respond to regulatory changes to start offering PACE type loans, use payment on the bill mechanisms and to blend loans with any grant funding available from time to time as well as signposting to mainstream loan products, to create a finance package to suit all property ownership models.

Recommendations for establishing a finance vehicle can be found in Component 8, page 45.

⁵⁰ https://www.ethex.org.uk/low-carbon-hub-raise-15-million-on-ethex-for-a-better-energy-future_2697.html

⁵¹ <https://www.abundanceinvestment.com/invest-now/municipal-investments>

⁵² Financing inclusive climate action in the UK Robbins et al 2019

V. supply chain, skills & training

Supply chain study

30 interviews were undertaken with organisations involved with delivering retrofit improvements through direct installation, co-ordination, advice or finance. This included:

- Local authorities
- Social housing providers
- Organisations providing advice to the retrofit sector (accreditation, certification, sector representation)
- Finance providers
- Large companies delivering construction and retrofit works
- SMEs delivering construction and retrofit works
- NGOs
- Construction skills college.

The interviews aimed to understand the challenges and opportunities that a huge scaling up of retrofit was likely to present, and included the investigation of views around the materials supply chain, skills, finance, delivery models, standards and monitoring.

Primary challenge facing the retrofit sector when scaling up

There were seven primary challenges that emerged and were mentioned in many interviews regardless of roles of the interviewees:

- A significant lack of skilled labour, both in terms of skills and labour.
- The history of retrofit being subject to short-term start/stop initiatives that encourages low quality work, price inflation and ultimately damages the reputation and value of retrofit.
- The need to move away from disparate trades working on uncoordinated improvements to planned measures that improve properties in the longer-term.
- The need to move away from a stretched vertical supply chain focussed on short-term targets rather than quality improvements.
- Low levels of demand from householders, and therefore an associated reliance on national government 'boom and bust' cycles of policy interest and support.
- The general level of readiness of the supply chain to scale up to the types of throughput required by climate change targets.
- A fragmented supply chain.

There were differing views from interviewees that an 80-fold increase in retrofit improvement works would be feasible, although there was also a sizeable view that the primary challenges could be addressed through long-term planning and adopting some significantly different approaches. One interviewee reflected this concern with the comment that the retrofit sector is not really a 'sector' currently, arguing that there are now opportunities to help it develop into a stronger sector and it make it something attractive to people looking to train for a career.

These are discussed in the individual sections below.

Skills

Skill shortages were seen as one of the key barriers to enabling a significant scaling up in retrofit activity. These shortages were seen in depth of skill requirements (such as requirements for general construction skills as well as high quality, technical skills) and range of skills. Skill shortages were identified in planning, surveyors, product specifiers, administration, finance, modern methods of construction, renewable technologies, ventilation, business planning, project management, customer engagement and onsite

inspection. Mapping skills in the local area is therefore a good place to start to understand the overall skill needs for the sector. It was also noted that trades often did not have a good understanding of how they fit with others into the bigger picture of retrofit delivery, having companies able to focus on the whole process is therefore important, as is the development of multi-skills installers.

There is also a need for some general education in building physics, and it was suggested this be included in PAS2035. Poor understanding of building physics has ended up with many unintended consequences such as mould, moisture and therefore impacts on health, e.g. asthma. An example is ventilation, which is not well understood and not on 'people's radar', even for experienced builders.

Renewables and energy storage skills are important but these are further down the line – improving a building's fabric should be the priority.

Interviewees related much of the skill shortage to the difficulties of stop/start retrofit initiatives that discourage companies from taking a long-term view on investing in staff skills and provide little incentive for individuals to pursue apprenticeships or courses in relevant skills. In this regard there is a certain amount of sector memory and this affects confidence in the market. This also damages the reputation of the retrofit sector meaning that it is difficult to attract both high quality, experienced staff as well as young people starting their career. Apprenticeships in the car sector are seen as highly valuable, as compared to apprenticeships with retrofit trades (when available).

Fluctuating financial support also related to a loss of institutional memory in the public sector in Yorkshire in relation to how to deliver the schemes and to shape strategic direction so there is a need for capacity in local authorities to coordinate and deliver schemes. Several interviewees alluded to the potential for government investment and clear policy signals to unlock capacity in local authorities, to for example, coordinate retrofit and manage contract issues, commenting in one specific case that the council would not be likely to invest in this agenda unless it could see big changes across the specific city.

There were views that training retrofit staff has been made difficult by policies and standards that encourage deeper skills improvements in single trades (such as electrical skills or plumbing) while retrofit work would benefit from both deep and broad skills. For example, how is a plumber incentivised to learn about air tightness or thermal bridging when fitting pipework? There were some comments that upscaling retrofit activities might require Occupational Industry Standards and CITB training routes to be revised.

There was a recognition that coordination and design roles, such as the Retrofit Coordinator role in PAS2035, will be increasingly important, if not essential, reflecting the need to make sure that quality is maintained at the intersection of different systems within the house, and different trades within the sector and that individual trades are unlikely to effectively engage with each other and the householder in delivering retrofit. This is currently not well enough understood across the sector, although some organisations and actors understand the importance of it. This level of coordination needs to transcend individual measures so that installations are carried out as part of whole house retrofit or as part of a long term plan. A whole house retrofit does not need to be completed in one go, as long as there is a plan to get there.

Some commonly stated success factors of large retrofit programmes included the need for skills in whole-house retrofit designer/co-ordination, customer engagement and significantly increased levels of onsite clerk of works roles to ensure high levels of quality. One interviewee estimated that around 1,000 Retrofit Coordinators would be required for a scaled-up programme and another spoke of the long lead-in time required to establish enough training centres to develop retrofit skills to this level. The level of training needed will require substantial investment in facilities such as workshop training, classrooms, trainers, time to train the trainers and supplementary skills.

While this is challenging, it also provides considerable scope for job opportunities for new sector entrants, experienced workers changing trades and people requiring retraining after the impact of Covid-19. Interviewees spoke about the need to coordinate training at a regional level, with coordination provided by industry, learning providers and colleges, local authorities and manufacturers. One interviewee spoke of his personal appreciation of training led by manufacturers of retrofit equipment when they had a high level of quality assurance. An example given was the Heat Academies run by Nordic Energy. One interviewee was responsible for providing CPD to their customers, mostly architects. There are opportunities to run skills and training events at a programme level. Good practice may for example involve getting supply chain partners together to share good practice stories amidst some friendly competition for awards for good service.

Organisations like SHAP are also important in this regard, as are UKBGC. There are also opportunities to do this at regional level, and this is something West Midlands Combined Authority are developing. The Retrofit Academy also has a prominent role in providing training to retrofit professionals. Higher and Further Education establishments have an important role, although one interviewee expressed scepticism of their ability to develop new resources and scale up quickly.

Some interviewees also highlighted skills in occupant engagement, relating to knowledge about energy efficiency and practices that enable them to better manage a home and get the best out of new technologies, therefore helping to minimise the performance gap. The adoption of heat pumps has been a challenging process, and there has been a need for staff skills and capacity to engage with social housing tenants to deal with issues as they arise.

Material supply chain

The interviews took place while many construction companies were in lockdown due to Covid-19, had furloughed staff or were just returning to a level of reduced working. When returning to work, many companies had suffered difficulties with sourcing materials, or were only able to source materials at substantially increased costs. Some interviewees commented that the material supply chain did not appear robust (although Covid-19 was an extreme challenge to the supply chain) and that they had experienced similar price inflation during retrofit programmes with high outputs in short timescales.

Many interviewees regarded a long-term approach would allow both construction companies and the materials supply chain to work together more closely and plan needs and resources collectively. There was a degree of confidence in the ability of the supply chain to scale up and match demand. It would, it was felt, need security, but need less intervention than the labour supply chain.

When asked what impact a scaled-up retrofit programme would have on material supply chain costs, most interviewees stated that they expected long-term planning and confidence would lead to reduced retrofit costs.

There are opportunities for the UK to develop economies around this, for example for Wales to become a wood economy. For this, a degree of certainty from the government would be valuable.

Standards

Retrofit, generally, has a poor reputation from industry and householders, due to previous programmes not achieving universally high-quality outcomes and a poor approach to engaging, informing and responding to customers' needs effectively. When government support takes the form of short-term bursts of funding, the companies that rush to pick this up are not necessarily those best able to deliver quality, and this can further damage householder trust in the sector. An interviewee commented on low levels of competence and noted that work to date has generally been low skilled, commenting that the sector knows that expectations of higher standards are coming but that it is a journey that will take time. There were points about cultures of work, with one interviewee commenting that there is a mentality that people can get away with poor performance.

Whilst points were made about the importance of maintaining standards through regulations and inspections regimes, interviewees also highlighted approaches centred around encouraging pride in the work. There is value, for example, in getting staff to understand their role in retrofit, the overall goal of it and to be able to communicate this to others. This means moving beyond the current culture, with a tendency for companies to come into the market with small margins and do the 'absolute minimum'. There is therefore a role for 'retrofit coaching', helping businesses and contractors see the bigger picture and the importance of high-quality work. In general, the sector is very traditional and needs to move away from doing things because that is how they always done them. The interviewee gave an example of a Passivhaus standard retrofit in which project site managers were handpicked for attitude and quality, and a process was followed to engage with staff about their role and what they were trying to achieve through the project. Related to this is the value of encouraging a culture of learning amongst the trades. One interviewee observed that the opposite is generally true: that builders have been told they are not good at understanding science and concepts and therefore tend to 'shy away from education on new things'.

The public sector has a role, if limited, in ensuring quality. It cannot promote one manufacturer over another, but it can work to make sure that a company's responsibility to provide warranty on performance, work and materials over a reasonably long timescale. It can involve quality companies in its own frameworks: this is something Better Homes Yorkshire has been able to do.

Having social housing in the portfolio and framework can result in higher standards 'spreading' to the general housing stock, and this was the experience in Better Homes Yorkshire. In Leeds, council ownership is 18% of the housing stock and this gives the council some influence over the supply chain. In Scotland, they have seen standards rise generally across companies and the sector as a whole when they have imposed high standards on their specific programmes.

There was a very strong view from many interviewees that a very different approach towards standards is needed for future retrofit works. Retrofit work is disruptive; deep retrofit probably requires alternative accommodation for occupiers while work is being carried out. For retrofit to be willingly accepted at a considerably scaled-up level, interviewees spoke of the need of:

- An initial high-quality, whole-house retrofit design, required to a national, recognised standard, such as PAS 2035.
- A vastly improved approach to working with the occupiers, informing them of the need for retrofit works, benefits, changes to the management of their property, energy bill changes and following up after improvements have been carried out to check implementation.
- An adopted standard for contractors appropriate to the level of work carried out – this could be PAS 2030 for larger installers or a simplified version for small contractors. Standards were viewed as very important but also bureaucratic and costly to maintain, which in turn adds costs for customers. Finding the most appropriate balance between quality and standards was seen as a necessary challenge.
- A level of consistency in methodology for contractors, to allow deeper training in the more common retrofit tasks. This would not restrict the range of works available for households but allow the more common tasks to be consistently delivered at a dependable quality.
- Checking the quality of work at every stage by experienced clerks. While this could appear to increase costs, many interviewees spoke of failure of retrofit works that damaged the fabric of the building (such as failed EWI, cold spots through thermal bridging, damp caused by reduced ventilation or poorly installed IWI) causing sizeable costs for installers or local authorities, and additional upheaval and inconvenience for occupiers.
- Guarantees and warranties that give occupiers confidence in the installed works. These could be insurance backed for long-term security.
- A much more joined up approach. Bow Tie Construction in London was mentioned as an example: the same team goes from house to house so that the process is more integrated.
- Independent monitoring, on the principle that you get what you measure. This has worked well in Scotland - work can be audited at any time, so there is 'no hiding place' for poor work.

Follow-up visits were regarded as very important to ensure the retrofit works were giving the expected performance improvements as well as ensuring the householder understood different heating or ventilation requirements. Maintenance visits are also often an essential part of ensuring manufacturers guarantees are valid.

Data was something that many interviews identified as a barrier to improving standards. This relates to data on the housing stock as whole and at a more detailed level on individual properties. Higher quality, and granularity, would help in planning programmes and house retrofits respectively. EPCs are limited in that they are often not updated and can be full of fabric assumptions or defaults such as 'as built'. There were suggestions for a publicly available database that would include items such as record of works, guarantees, gas certification and other factors for houses in a central place. A building passporting system was suggested as one way of operationalising this.

Partnerships and delivery models

Many interviewees regarded previous retrofit programmes as having stretched vertical supply chains, with contractual rather than collaborative relationships along the chain. These appeared mostly at times of

demanding retrofit delivery, requiring large numbers of outputs and a high level of subcontractors being employed. The consequences of this approach caused little long-term investment potential for contractors, limited checking of work in progress and resulted in some poor-quality work being installed.

Approaches that cut across tenure can be advantageous in terms of efficiency and cost-effectiveness as well as increasing take up in streets, with people seeing the benefits to their neighbours' houses. Approaches like 'green streets' could help to package this concept and lead to area-based transformations. Leeds City Council have seen evidence of renovation schemes bring streets back to life from streets of void properties to areas in which it is once again possible to rent out houses.

Many interviewees stated that better collaborative partnerships could support a longer-term approach and increase incentives for investment, increasing skills, creating a long pipeline of work for business confidence and ultimately reducing the chance of low-quality work being installed. Diversity in frameworks was seen to be important, widening the offer and allowing companies to compete for work and display their strengths.

Local authorities were seen as the most appropriate drivers of delivery partnerships as trusted organisations with the potential to target improvements to those most at need as well as securing additional external resources when available. It was noted that this depends on the reputation of the specific authority and that some will be more positive than others. Local authorities have financial processes such as using call-off contracts (and other financial mechanisms) that can allow a flexible composition of improvements to be installed in properties while maintaining quality and transparency. Regional level approaches can help to develop local supply chains and make beneficial partnerships with colleges and other education and training providers. Better Homes Yorkshire, for example, has a social value team that makes connections with training organisations, schools and apprenticeship providers.

It was also felt that local authorities can develop partnerships where members would be willing to share skills and expertise, which could help reduce the risk-averse nature of some sectors. Local authorities are also likely to share experience and learning across the public sector. This could also apply for social housing providers to work together on installations, sharing learning and economies of scale.

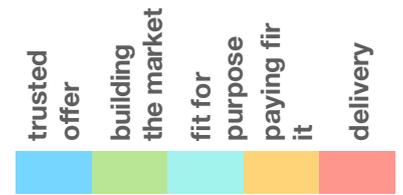
RetrofitWorks can provide an independent body standing between the household and the contractor and a level of continuity irrespective of current Government policy. It can bring smaller businesses together that can deliver works in the right way and it can create an upswell of interest in a community.

Recommendations for supply chain can be found in Component 9, page 48.

fig 6.1 components

subject	components	
1 customer journey	a consistent independent advice	
	b knowledge of status of every home	
	c market intelligence	
	d show homes	
2 assessment & calculation	a accurate whole house assessment	
	b cost benefit to property owners/occupant/	
	c accurate costing works	
3 monitoring & data	a pre- & post-works monitoring	
	b identify & quantify best practice	
	c user & contractor feedback	
	d data repository	
4 IT & software	a interoperable software development	
	b mass customisation	
	c site management	
	d on site works remote monitoring	
5 specification & detailing	a specification improvement	
	b retrofit pattern book	
6 contracting & guarantees	a contract models	
	b warranties	
	c performance guarantee	
	d quality control	
7 additional revenues	a roof top PV	
	b domestic or street scale energy storage	
	c energy production & storage aggregation	
	d carbon sales?	
	e rented housing cost recovery methods	
8 finance vehicle	a multiple sources of finance public sector borrowing crowdfunding institutions	
	b policy driven lending	
	9 scalability	a develop delivery infrastructure
		b demonstrators to increase scale
c competitions		
d pipeline development		
e supply chain development		
f connect new & existing delivery		
10 workforce development & skills	a audit of skills, providers & methods	
	b training provision study	
	c awareness raising	
	d schools introductions	
	e apprenticeship dev't	
	f college & university engagement	
	g DLO & TU engagement	
	h industry participation	
	f local authorities COVID recovery plans	

VI. component list



The component model has been developed based on the data collection identified in Section III, where current practices and innovations have been gathered from literature and interview sources to create a component list, from which the delivery of retrofit programmes and projects could be developed.

The findings from Section III have been constructed into a structured “kit of parts” or components. A simplified version is shown in fig 6.1 while a more detailed version is included in Appendix VI. The full version addresses 10 categories of activity designed to deliver retrofit. This identifies each category against a number of different issues:

- At what level it may best be implemented, either locally, regionally or nationally.
- Which drivers does the component address?
- Examples from the evidence.
- Potential mode of delivery.

The following sections describe the components in more detail.

component 1 Customer Journey

The complexity of whole house retrofit requires that there are multiple stages to the customer journey: from the initial interest through assessment of the property, proposals, decisions, through to post-works.

The customer journey has been used to frame this element of the component list to guide through the potential experience of the customer. This is of particular importance given the difficulty in reaching private sector customers.

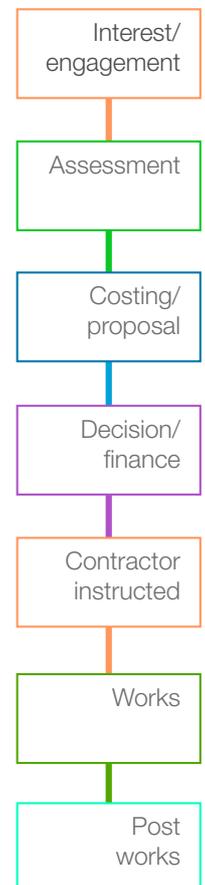


fig 6.2 customer journey

1.a Trusted Advice

A key starting point in generating interest is trusted advice. In some cases this can come from trusted one stop operations. The customer needs access to consistent independent advice⁵³.

Advisors need to be qualified to give technical opinion, to give customers confidence that they are not simply being sold a product convenient to the contractor but are getting the most appropriate for their home⁵⁴. In the Green Deal that customers were unable to either get more detail on the products that were offered to them or negotiate with the suppliers for different products based on their own choices, such as more sustainable or better performing materials.

1.b Building Stock Data

In terms of assessing properties, there is a developing argument for city-regions to have access to high level stock models⁵⁵, whilst individuals have access to data about their homes, using models such as Building Passports⁵⁶.

Stock Models - One of the problems identified by Manchester: A Certain Future was that the original goals were in line with the climate science, but they were unable to plan from year to year as they had no data as to help them track progress. Information needs to be gathered about the status of every home reducing the reliance on cloned data. This will give confidence to people unaware how much is happening or give impetus to those with agency to do more when targets are unmet. Resource allocation and political accountability can be easier and clearer when backed up by information. The form of this information needs consideration as there are many potential interested parties in creating and managing it. Trustmark are creating a data warehouse⁵⁷, others have talked of a 'building passport'.

Building Level Data – Individual's homeowners may need access to their own data, which may be accessible from the overarching stock models, in the form of Building Passports. Information should be available to contractors to be able to plan work, supply chain to be able to supply the right materials at the project or programme level. Some areas are working on data requirements, such as Climate Action Readiness Assessment (CARA) in Leeds⁵⁸.

1.c Market Intelligence

Crucial to planning for a large-scale rapid rollout retrofit program is knowledge of who you are trying to engage with⁵⁹. A more granular market intelligence is needed around market segmentation and current trigger points. Some of this will be available nationally⁶⁰, but there may be a need for a regional geographically specific body of information in terms of how to encourage customer demand.

As highlighted earlier in the report, the interdependencies between potential demand, finance, and supply chain mean these issues would need to be managed thoughtfully. A potential trajectory for adoption based around the Rogers Adoption/Innovation curve (fig 6.3) for adoption of new technologies as below would suit the development timescale of the rest of the infrastructure needed such as large scale finance (Section IV), develop expertise and product in the supply chain and a large enough workforce (Section V).

Following this model, the West Yorkshire Region may have 25,000 people interested in going for a zero-carbon retrofit now. Understanding this latent demand is needed in order to be able to justify the levels of investment

⁵³ "Designing trust: how strategic intermediaries choreograph homeowners' low-carbon retrofit experience", de Wilde and Spaargaren 2019

⁵⁴ "Homes fit for the Future : Retrofit - Towards a Sector Wide Roadmap" Catapult 2020

⁵⁵ "Retrofit 2050: Critical Challenges for Urban Transitions" Eames et al 2014

⁵⁶ "Building Renovation Passports : Customised Roadmaps towards deep renovation and better homes" Buildings Performance Institute Europe 2016

⁵⁷ <https://www.trustmark.org.uk/ourservices/data-warehouse>

⁵⁸ Leading a Climate Smart Strategy Gouldson 2020

⁵⁹ "Private household investment in home energy retrofit: reviewing the evidence and designing effective public policy" Climate XChange 2018

⁶⁰ <https://www.gov.uk/government/collections/english-housing-survey>

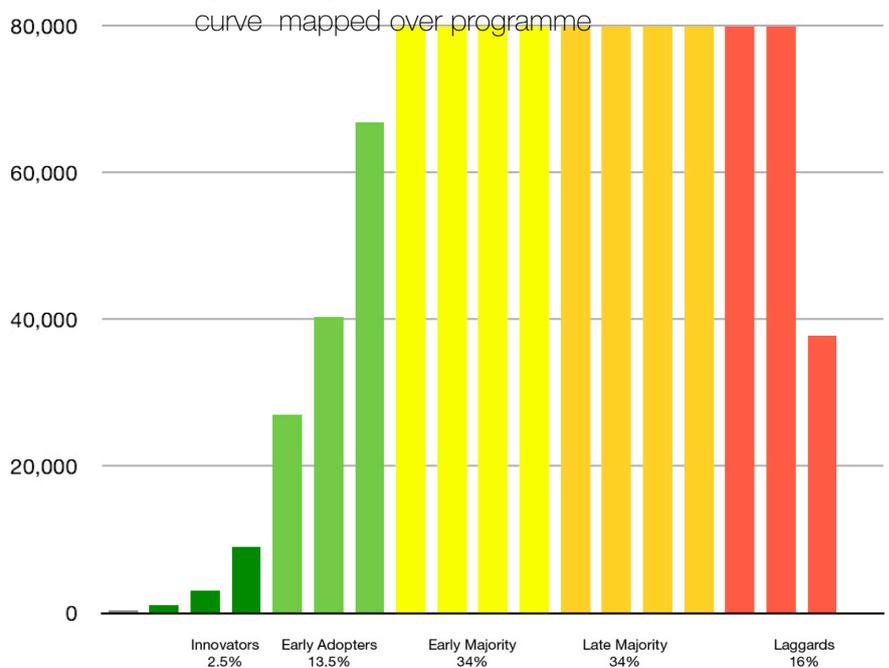
required to get started at scale. Market intelligence work should be carried out. This research would also equip delivery teams with information on how to attract a wider demographic, as well as a variety of tenures.

Given the number of different outcomes that individual households may experience from a retrofit such as asset improvement, carbon saving, comfort, fuel poverty etc. it may be important to understand households at a more granular level⁶¹. For this it is necessary to segment the market then work out optimal offers to those segments.

Consideration should also be given to the social housing sector, which takes an asset management approach, and the private rented sector, which ranges from the large portfolio holders to accidental, single unit, landlords. In both cases, the issues of split incentives, where the benefit is not experienced by the investor directly, will need to be addressed. This may need new rental business models for the private sector or new regulatory frameworks for social housing. Approaches such as warmth as a service⁶², where comfort rather than energy is purchased, may be able to address some of these issues.

It is important to recognise that customer preferences are dynamic. This work should be revisited over time to reflect changing consumer preferences.

fig 6.3 Rogers Adoption/Innovation



1.d Show Homes



People respond better to seeing the real thing and talking to households with whom they can identify, as evidence from show home programmes has indicated. This can help demonstrate value of whole house retrofit. Early adopters can make ideal ambassadors for future phases, making it easier to get neighbours to see the benefits of change and enabling recruitment of future households by widening the base of advice and support. The Superhome Network⁶³ and CSE's Open Green Homes⁶⁴ have demonstrated this and proved to be invaluable in creating a link between theory and reality for both decision makers and potential early adopters.

component 2 Assessment

2.a More Accurate Whole House Assessment



Currently the process of working out many retrofit assessments is done using the same model that creates Energy Performance Certificates (EPC). There is research that suggests that while adequate for single measures at lower levels of demand reduction, this does not create the most accurate outcomes for deep retrofits, as it does not take into account key aspects of building performance such as cold bridging and airtightness. This software is actually a reduced data version of the Standard Assessment Procedure (SAP)

⁶¹ "Financing energy efficient buildings: the path to retrofit at scale" Green Finance Institute 2020

⁶² "Heat as a Service" Energy Systems Catapult 2019

⁶³ "Show Homes : An Effective Force for Inspiring Domestic Retrofit" NEF 2017

⁶⁴ https://www.cse.org.uk/downloads/file/GOH_end_of_project_summary.pdf

which is able to produce a greater level of accuracy⁶⁵. Additionally, there is the Passivhaus Planning Package (PHPP) which is used to benefit retrofits as well as newbuild passive houses⁶⁶.

A crucial component of building a trusted offer is reliable methods of assessment and calculation of measures to be developed/adopted so that the risk of underperformance or future defects is minimised.

2.b Assessing Cost Benefit of Retrofit



More accurate models can be used to give more accurate predictions of running costs of homes post-works to inform much more reliable value propositions to property owners⁶⁷. This is critical to landlords and those homes owners with less robust financial situations.

CROHM Live from Parity Projects does offer a more accurate mass stock assessment system. There is a growing understanding and acceptance among those commissioning work of the importance of detailed whole house systems like SAP and PHPP, which can now include a carbon footprint assessment.

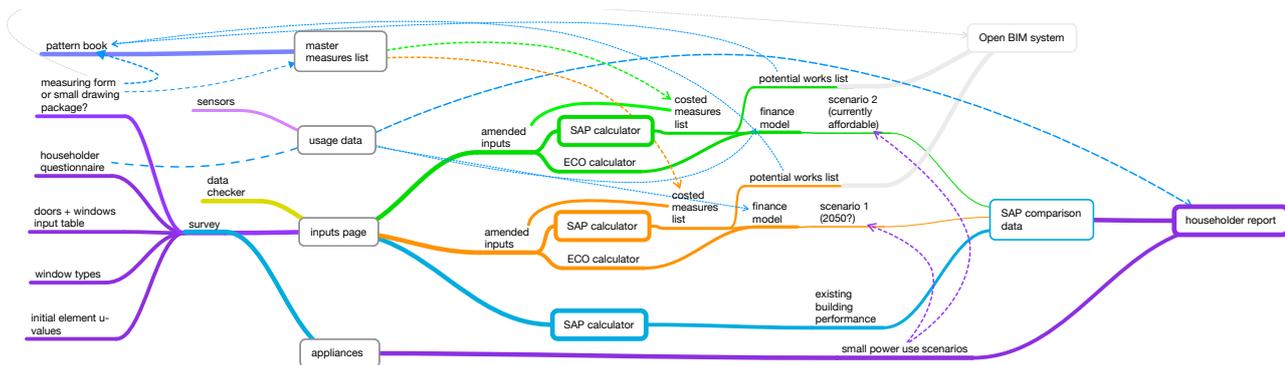


fig. 6.4 outlines a potential customer assessment journey that takes measured and modelled data to deliver a detailed homeowner report for a retrofit, based on a robust modelling approach, in this example SAP.

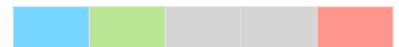


2.c accurate costing of works



It would radically improve cost outcomes if this software was able to take those energy models and build property-specific detailed cost models. There is also an increasing need to monitor the carbon cost of those works too.

component 3 Monitoring and Data



3.a Pre- and Post-Works Monitoring

Retrofit projects and programmes have often suffered from a lack of detailed performance data⁶⁸. There is a lack of data for building performance on an existing house by house level, relying on EPC data and its modelled prediction instead⁶⁹. A trusted offer means it is necessary to know what works, but also be able to identify problems as they happen rather than wait until the problems become serious and expensive to resolve. The Energiesprong model in Netherlands has shown that monitoring of buildings post-works also enables engagement with occupants to further improve performance of the buildings and reduce energy use⁷⁰.

⁶⁵ “Simulation Models and Energy Efficiency in Historic Buildings” Historic England 2019

⁶⁶ https://passivehouse.com/04_phpp/04_phpp.htm

⁶⁷ “Powering Down Together Community Green Deal Case Study Summary” De Selincourt 2017

⁶⁸ “Scaling up retrofit 2050” Nottingham Trent University 2020

⁶⁹ <https://www.gov.scot/publications/consultation-analysis-energy-efficient-scotland-making-homes-buildings-warmer-greener-more-efficient/pages/7/>

⁷⁰ <https://energiesprong.org/about/>

3.b Identify and Quantify Best Practice



Given the scale of the required retrofit and the speed at which it needs to be delivered, there is a need to know what works best. This makes it easier to identify the optimal measures to roll out and avoid implementing measures that turn out to be sub-optimal. This requires an evidence base of real-life performance of retrofit measures across as wide a spectrum of property archetypes and measures as possible. There are a number of examples of retrofit monitoring in the evidence base⁷¹. However, this can be hard to access and interpret for lay people. This needs to link to a more structured data set. If this were combined with software development it would also enable algorithms to be developed that would enable greater levels of automation of retrofit design.

3.c User and Contractor Feedback



Householder and occupant feedback is critical⁷². It is not consistently collected or collated, the opportunity to analyse and optimise methods and measures is reduced. This could lead to downstream costs that could be avoided if knowledge collection and analysis was improved. National models such as Constructing Excellence KPIs, have previously been applied in housing as part of Rethinking Construction, have relevance here.

In terms of contractor feedback, there are very few feedback loops that enable those that fit materials and measures to respond to the manufacturer⁷³, except through whether they decide to buy a specific product. A data collection and analysis system, with the engagement of key parts of the supply chain, would enable the right products to be developed, their usability and cost optimised.

3.d Data Repository



The accessibility and availability of data through systems such as the smart meter infrastructure and home automation represents an opportunity to better understand the performance of our homes. When combined with stock and building data, this presents a number of opportunities.

Data collection could potentially be centralised physically or virtually through alignment of databases held by different parties. It is possible that these programmes would start at a national scale, or alternatively link through integration technologies such as the commonly used Application Programming Interface (API), which allows data sharing and integration between different applications⁷⁴. It should be noted that issues of GDPR and privacy will need to be addressed.

The home automation market has moved into monitoring a range of environmental and energy consumption measures, such as indoor air quality (Netatmo⁷⁵) and extending their systems (Loxone⁷⁶). The heating control system market is moving into levels of home automation (Nest). There are also then new players looking at the value of data (Switchee⁷⁷). The arrival of smart meters and heat pumps alongside issues of demand side response (DSR) has then created new opportunities for very new market entrants (Homely⁷⁸).

⁷¹ eg “Monitoring of the Community Energy Saving Programme” BRE 2016, “Core cities Green Deal monitoring project” Leeds Beckett University

⁷² “Each Home Counts” Bonfield 2016

⁷³ “Exploring the practices and roles of UK construction manufacturers and merchants in relation to housing energy retrofit” Killip at all 2019

⁷⁴ <https://www.redhat.com/en/topics/api/what-are-application-programming-interfaces>

⁷⁵ <https://www.netatmo.com/en-gb/energy>

⁷⁶ <https://www.loxone.com/enen/products/heating/>

⁷⁷ <https://www.switchee.co/retrofit-validation/>

⁷⁸ <https://www.homelyenergy.com>

component 4 IT & Software

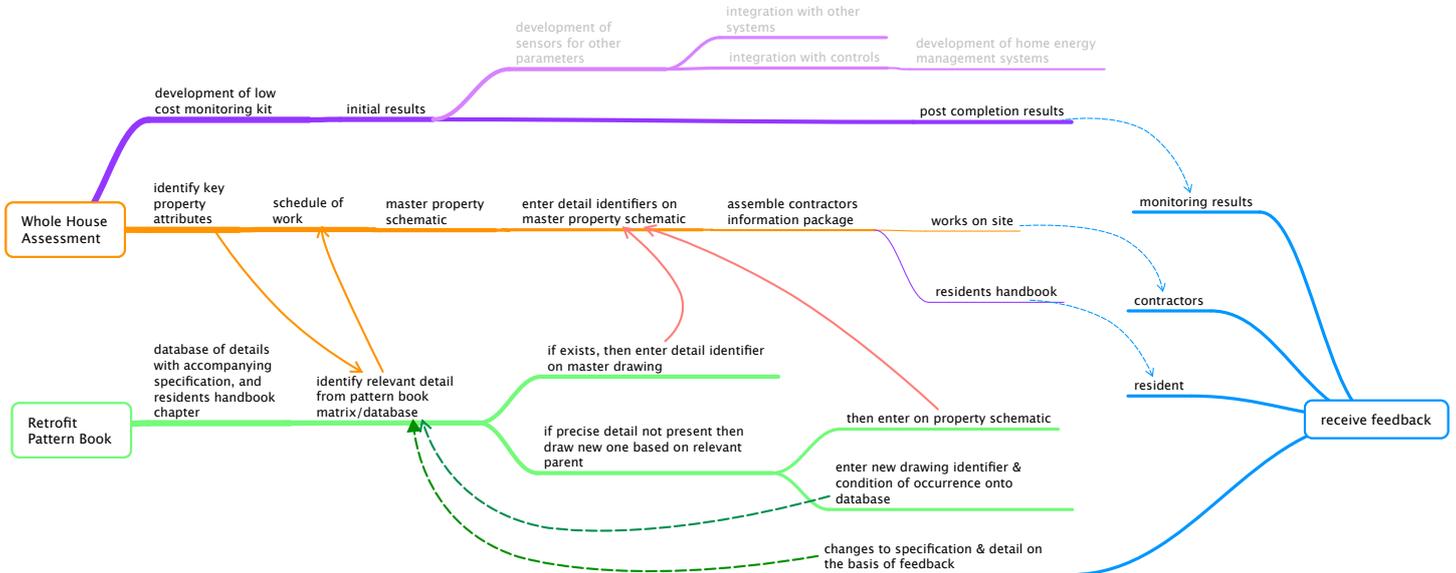
4.a Interoperable Software Development

IT systems & interoperable software offer a substantial opportunity to improve speed and accuracy, reduce on-costs and streamline design, and improve cost estimating and control.

There are applications already on the market for many of the stages in a retrofit from assessment onwards, such as Crohm⁷⁹ and Refurbify⁸⁰. However, few of them have been enabled to work together. Many providers are already making the application programming interfaces (API) accessible, which allows applications to work with each other. Working this way allows multiple parties to retain their own products and attendant intellectual property while enabling an approach that delivers a much greater and finer grained response accessible to smaller players, delivering many of the parts of the retrofit process that will improve the outcomes on all fronts.

The stages where software could or does play a role and where there are clear benefits to interoperability: pre-works building performance, survey, energy assessment, choice of measures, selection of construction details, cost estimating, cost benefit analysis, contract documents, schedules of quantities, materials ordering and site supervision.

fig. 6.5 – Linkages between assessment and design database



For example, figure 6.5, shows the existing process relationship between two existing approaches, the Whole House Assessment Method⁸¹ and the Retrofit Pattern Book⁸². The WHA develops the retrofit solution, while the Pattern Book provides a database of design solutions at the detail level that have previously been applied in a specific property type, to begin to create a more detailed schedule of works.

If cost models were aligned to databases of construction details or suppliers systems then automation of contracts documents or procurement might be possible, reducing the time from assessment to start on site and on-costs. It would enable working with suppliers and merchants on schedules of materials and their delivery to site improving efficiency and reducing wastage.

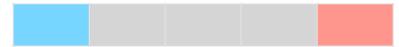
⁷⁹ <https://parityprojects.com>

⁸⁰ <https://www.vrmtech.co.uk/refurbify-1>

⁸¹ <http://red.coop/wham>

⁸² www.retrofit.support

4.b Mass Customisation



Domestic buildings incorporate centuries of individual decisions about maintenance and upgrades to a property. The retrofit market needs to be able to accommodate these if it is to be able to create an attractive customer proposition. This means that archetype approaches are often not appropriate when it comes to designing a retrofit for an individual home. While many details are the same in homes, there are often individual idiosyncrasies that make a blanket approach impossible⁸³. This means the principle of mass customisation⁸⁴, where there are minor differences around a core design, may be applicable in domestic retrofit.

This does require a complex understanding of available options, and is likely it would require support through software to allow the decision making process to be automated.

4.c Site Management



Retrofit is complex in terms of site management, leading to higher management costs. Even large programmes are essentially a number of small sites, with the added complication of disrupting people's homes⁸⁵. New systems for site management are required to reduce this overhead.

Systems that are able to more accurately predict the amount of **materials** needed on site and when would reduce materials overhead while also improving on site efficiency, reducing wastage, and limit onsite storage. There is also room for applications that assist in **scheduling of trades**.

In many cases previous owners or occupiers' decisions on changes or maintenance do not become apparent until they are uncovered at work stage, on-site the systems need to be able to deal with the unforeseen developments that are a characteristic of retrofit project. Principles of lean or agile construction would be beneficial (being developed by RezBuild⁸⁶).

Retrofit Works uses a system for allocation of work to sub-contractors through a smart phone application that requires them to take regular photographs of their work so that the retrofit co-ordinator can monitor what is being installed without having to attend site as often⁸⁷. There are opportunities for further development of this for coordinating trades. This is a crucial area contributing to building a trusted offer, reducing the cost of retrofit while improving the speed and efficiency of delivery.

Red's Whole House Assessment has proved the concept of current site costs feeding into the modelling so that costing related to forecast energy demand reductions can be tuned with the customer to achieve the best fit. Parity's CROHM Live is very close to making this available in a full platform. Opportunities to build more interoperability area being looked at with teams involving Q-Bot and the Retrofit Academy.

component 5 Specification & Detailing

5.a Specification Improvement



There is much research that shows that improper specification of materials such as insulation can lead to unintended consequences such as increased damp, mould growth, and poor air quality⁸⁸. In the deep retrofit this problem is multiplied as so much of the building is treated in some way. The nature of the funding regimes for much retrofit to date has been based on number of square metres which has led to pressure to use the cheapest insulation materials and a failure to address junctions at the design stage.

More scientific data is needed to guide designers and specifiers on the best materials to use so that all buildings can be treated and so that the risks of underperformance, defects and health effects are reduced.

⁸³ Red Co-operative experience from Retrofit for the Future, Go Early and Homes as Energy Systems projects

⁸⁴ "A Guide into renovation package concepts for mass retrofit of different types of buildings" Rovers 2018

⁸⁵ "Retrofitting social housing : reflections by tenants on adopting and living with retrofit technology" University of Salford 2015

⁸⁶ <https://rezbuildproject.eu>

⁸⁷ <https://www.vrmtech.co.uk/refurbify-1>

⁸⁸ eg "Planning for Responsible Retrofit of Traditional Buildings" Heath 2015

5.b Details for Retrofit



The availability of tested and modelled details for new build, through approaches such as Enhanced Construction Details⁸⁹, have the benefit of de-risking certain elements of the specification. Models for retrofit are available, but as yet have to be fully developed.

The Retrofit Pattern Book (retrofit.support) was developed 5 years ago as a proof of concept to show how good practice on construction details could be made both more available and more accessible. With over 600 users it has proved that it is worth further development to make it interoperable with other software.

component 6 Contracting and Guarantees

The introduction of new contract forms, warranties and guarantees are required to ensure that work is delivered in a robust way that protects all parties involved, particularly the non-expert consumer. Examples of where potential benefits are:

- Better contract models and delivery structures
- Reduce chains of sub-contracting
- Partnering contracts that reduce adversarial issues on variations
- Stimulate innovation e.g. energy performance guarantees

6.a Contract Forms



Construction contracts are based on the designer having worked out everything up front then let a contract to a contractor who knows exactly what they have to do. Whole house retrofit almost always has unforeseen issues, as it is not possible to identify many of them until finishes are removed and slates or floorboards lifted. This frequently leads to substantial cost issues, as well as a straining of contractual relationships. Figure 6.6 shows two different approaches to solving problems as they arise on site. The process in red follows a traditional contract model, while the process in green follows a design and build approach. The traditional approach is more complex.

New contractual forms may be required to better reflect the reality of skill sets on the ground, including the role of the Retrofit Co-ordinator⁹⁰.

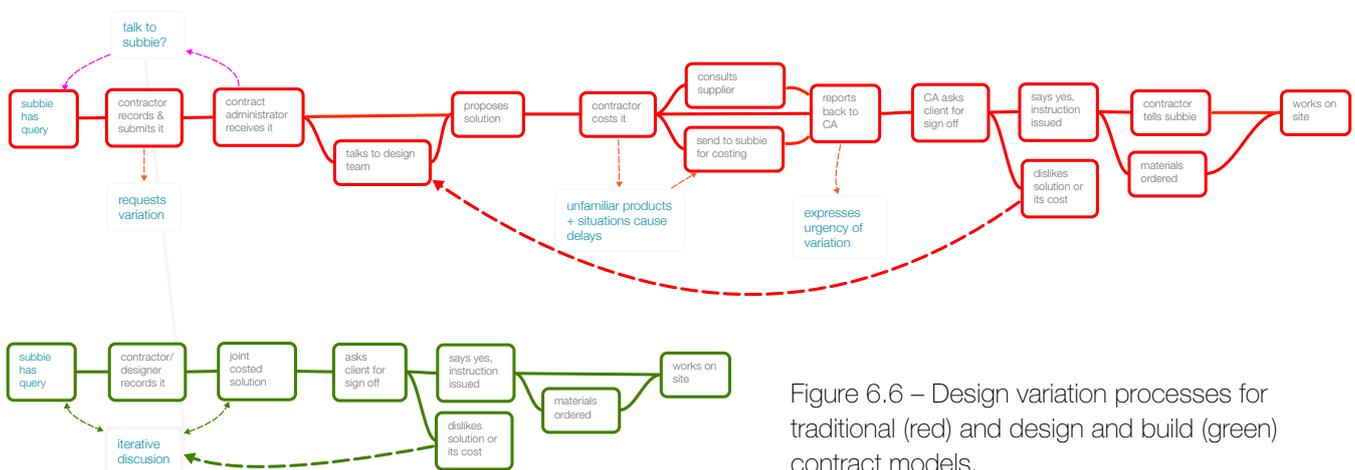


Figure 6.6 – Design variation processes for traditional (red) and design and build (green) contract models.

6.b Warranties



If trust in the retrofit industry is sufficient to enable the industry to grow, work needs to be done on warranties and the protection they afford consumers. While this varies from local authority to local authority, some building inspectors still insist on British Board of Agrément (BBA) approval for new materials. BBA approval costs between £10,000 and £30,000. In order to qualify for ECO and Green Deal related funding, a bond

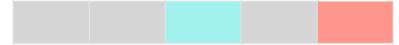
⁸⁹ Enhanced Construction Details: Thermal bridging and airtightness, Energy Saving Trust

⁹⁰ <https://www.retrofitacademy.org/retrofit-coordinator/>

backed warranty had to be provided and BBA approval was one of the only ways of making this achievable and the only cost-free option⁹¹.

Another route to warranties was identified as part of the ECO in 2014. A one-off technical assessment through an insurance intermediary, such as Kinnell, but these were only viable with some other form of approval such as one from the European Technical Advisory Group (ETAG) and still cost a minimum of £600.

6.c Performance Guarantee



There has been a lot of attention paid to poor performance in UK retrofit measures⁹². Regulatory frameworks such as PAS2030 and 2035⁹³ have been the main attempt to push up delivery standards, but have yet to become well established⁹⁴. There have been recent developments in the idea of making the contractor responsible for the energy performance. Currently making the best progress within the Energiesprong project⁹⁵. This has had a positive effect on standards of work, calculation methods and cost. It has also created a climate that encourages innovation. This responsibility is realised through an Energy Performance Guarantee lasting for 30 years. This together with assistance during the research phase from the Dutch government has enabled them to create whole house retrofits producing zero energy bills for 60,000€.

The UK could benefit from the effectiveness of this approach - however an Energy Performance Guarantee would not be effective by itself if the contractor giving it was at risk of not being around for that 30 years. It is proposed that the guarantee may need to be either backed by a bond from the contractor, or via an insurer. It is likely SME contractors would need to rely on insurer backed warranties.

component 7 additional revenues

Combining savings and income

7.a Renewable Energy



Renewable generation is critical to meeting the zero carbon target. The removal of the Feed In Tariff (FIT) has meant that PV installation needs to pay for itself. This is possible if high levels of self-consumption can be achieved⁹⁶. The Export Guarantee Scheme⁹⁷ provides some additional support, but the payments are low compared to FIT. Energy storage using a battery is one way of achieving that self-consumption, but adds more capital cost to the overall proposal.

7.b Domestic Level Storage



A move to energy generation that is not matched to periods of demand requires energy storage. Larger units of storage are more efficient, but it is easier to make the value proposition to householders if the charge and discharge of the storage is solely for their own benefit. Battery storage allows a household to change their energy tariff to one that is charged at different prices for different times of day such as Octopus' Agile tariff⁹⁸. This assists in repaying the capital cost of the battery, as charging take place when electricity is very cheap (usually overnight) allowing this stored energy to be used when grid rates are expensive.

There are already control systems available that will learn household energy consumption patterns⁹⁹ and match these with fluctuating energy costs to charge the battery at the cheapest cost. This combined with solar panel power generation matches costs with savings for the installation of solar panels and battery storage.

⁹¹ "Research into quality assurance in energy efficiency and low carbon schemes in the domestic market" Pye Tait 2015

⁹² "Each Home Counts" Bonfield 2016

⁹³ PAS 2035:2019 Specification for the energy retrofit of domestic buildings) BEIS

⁹⁴ <https://www.trustmark.org.uk/ourservices/pas-2035>

⁹⁵ :Reinventing retrofit: How to scale up home energy efficiency in the UK" Green Alliance 2019

⁹⁶ <https://www.cse.org.uk/advice/renewable-energy/battery-storage>

⁹⁷ <https://www.ofgem.gov.uk/environmental-programmes/smart-export-guarantee-seg/about-smart-export-guarantee-seg>

⁹⁸ <https://octopus.energy/agile/>

⁹⁹ <https://www.homelyenergy.com>

7.c Energy Production and Storage Aggregation

Changes in the energy market will soon make it possible to gain income by selling power from groups of batteries to the grid in a variety of ways.

Additional income is available from battery storage and PV installations when they are aggregated under single points of control in arrangements, sometimes referred to as a virtual power plants (VPP)¹⁰⁰. These software services allow for sub-second control of the batteries remotely so that they can be set to discharge on instruction. With enough of these aggregated together through a single point of control, batteries can provide services to the National Grid's Balancing Services. This process also enables sales to energy suppliers. An Energy Aggregator enables small scale energy generators/storage to sell energy or flexibility services in tradable quantities to the National Grid, local network/service operators (DNO or DSO) or other energy supply companies on the energy market.

These opportunities are not available to individual domestic customers but are becoming available to federated groups of customers. Regulatory changes will open this up to new business opportunities (P375¹⁰¹ and P379¹⁰²). These are expected to be in place within 18 months to 2 years; some will be provided in the Local Energy Bill¹⁰³. We propose that an aggregator service provider should work with the finance vehicle, to enable all households to access this income. The key elements of the aggregator's services are battery control software, relationship with householders and an energy trading desk.

A number of social housing providers have large numbers of PV installations, so may be able to enter the more lucrative parts of the energy market and National Grid Balancing Services if battery storage is added to these portfolios. This would create early income with which to supplement retrofit cost recovery.

Income Opportunities

Demand Side Response - Energy storage is able to reduce loads on local distribution, national transmission and generation infrastructure. The market for this service is currently in a state of considerable flux, but as it is a service it is not currently reliable¹⁰⁴.

DNUoS and TNUoS Distribution and Transmission charges are similarly under review and no longer certain as means of deriving income¹⁰⁵. More research will be needed to identify upper and lower boundaries for both scale and likelihood of the various income options.

The Balancing Mechanism of the National Grid Energy System Operator (ESO) provides two additional sources of income¹⁰⁶.

Frequency Response & Firm Frequency Response - These are both mature products and the minimum entry requirement means this market is likely to be saturated relatively soon.

Fast Reserve, Short term operating reserve (STOR), Demand Turn Up - These are not currently areas in which the storage market has made many entries. However it is likely to be a growth area as the move to 100% non-fossil fuel power moves on. Minimum entry requirements are high so large scale aggregation is needed.

Energy Market - This is an easier area for distributed generation and storage to enter. Smoothing demand profiles for electricity suppliers, reduces supplier risk for which there are derivable incomes.

Day Ahead and Within Day trading are most likely form of trading and will be between an aggregator who acts on behalf of battery owners controlling their batteries and the energy suppliers.

The different trading options need comparative analysis.

¹⁰⁰ eg <https://www.centrica.com/media-centre/news/2019/a-virtual-power-plant-for-every-home/>

¹⁰¹ <https://www.elexon.co.uk/mod-proposal/p375/>

¹⁰² <https://www.elexon.co.uk/mod-proposal/p379/>

¹⁰³ <https://services.parliament.uk/bills/2019-21/localelectricity.html>

¹⁰⁴ <https://gridbeyond.com/>

¹⁰⁵ <https://powercompare.co.uk/duos-tnuos-charges/>

¹⁰⁶ <https://www.nationalgrideso.com/industry-information/balancing-services>

All of these options add up to income forecasts of between £60 and £90 /kWh of storage per annum.

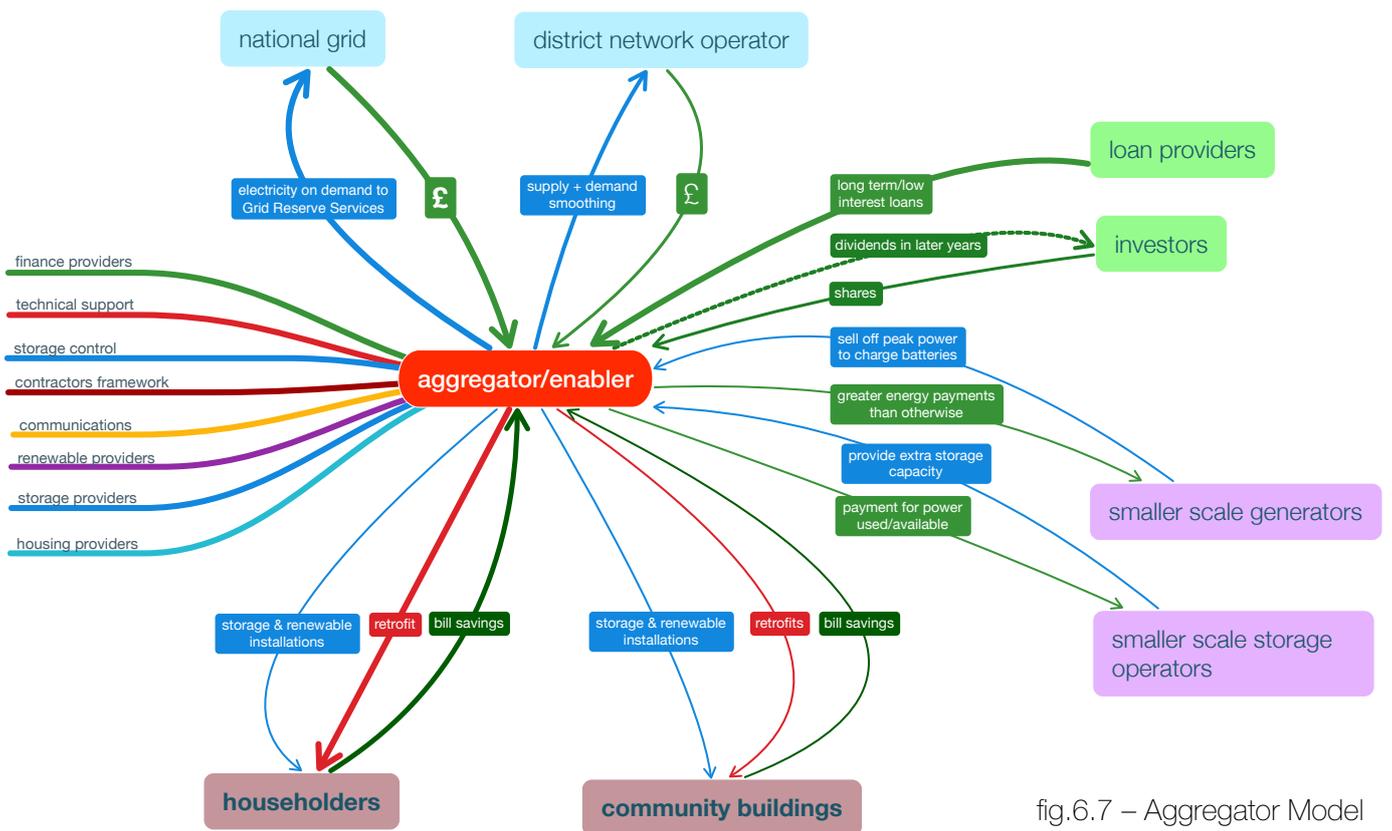


fig.6.7 – Aggregator Model

Aggregator Model

An aggregator can act on behalf of many battery owners, controlling their batteries to sell power to energy suppliers. A model of just how much integration might be possible, the potential income streams and relationships is outlined in fig.6.7. The revenues above are constantly changing so need an organisation to manage and optimise them. A number of businesses are developing these services, including Evergreen Smart Power, Upside, Ovo Energy, Octopus Energy and Local Energy Market (Greater Manchester).

An aggregator can also allow promotion of more small scale generators and stimulation of community based installations.

Combining PV and batteries (as Homes as Energy Systems project¹⁰⁷ is rehearsing) when scaled up will offer both the route to fastest emissions reduction while the supply chain develops but also an income stream that can help with the early retrofits while the industry gets better at it. Greater Manchester’s new Local Energy Market will provide a means by which that PV & storage once aggregated can get to customers to realise that income stream¹⁰⁸. This could also take place in West Yorkshire. Recognising that not every house is suitable for PV (although the parameters are expanding) there are already storage options at neighbourhood scale which could be an exciting if not challenging area for community based usage models.

7.d Carbon Trading

The carbon market (EU ETS) still exists and the CCC is arguing for a UK ETS with carbon prices of about £30-£50/tonne CO₂. A route for consumers has not yet been created, it is however available for commercial operators. It may be useful to investigate whether an aggregator might also be able to sell the carbon saved in the scheme to derive additional income as the mechanism does not yet exist.

¹⁰⁷ <https://retrofitworks.co.uk/haes/>

¹⁰⁸ <https://gtr.ukri.org/projects?ref=133799>

7.e Rented Housing Cost Recovery Methods

The issue of split incentive is complex and the recovery of capital investment where the end user is different from the investor. The following approaches have been identified as a possible resolution.

Service Charges - It may be possible to redeem costs of works through a service charge that is less than the tenant's energy costs to ensure they are not made worse off. They could have to not qualify for benefit so the state is not simply funding retrofit through the Housing Benefit bill. Most Registered Provider's are very resistant to taking on additional liabilities when their businesses are already under so much pressure¹⁰⁹. There may be regulatory restrictions which need examining to form an ask to government.

ESCo model - The landlord takes on paying the costs of heating for which it charges the tenant. This energy bill can then be changed to a loan repayment by the social housing provider. Again while seen as attractive the additional liability has not yet been taken on.¹¹⁰

Voids programme with post works rent increase reflecting improvements – especially if teamed with advertising properties total cost of occupation rather than rent only, this may be acceptable to tenants. However, it would require the state to be part of the negotiation as it will mean homes are unlikely to fit within housing benefit ceilings. It may need an acceptance by the Treasury that it was partially subsidising the journey to zero through this route.

Re-direction of planned and major repairs budgets - This approach is unlikely to pay for a whole house retrofit, but this can add to the additional revenues that can be deployed. It has been explored at length by Energiesprong UK¹¹¹.

Green Deal Plan attached to the meter - the facility still exists. This would be a minimal cost option to the landlord, the finance vehicle could provide the actual loans. Landlords could retrofit a property while it is empty, attach the green deal payments to the meter to be paid by future tenants. Tenants would need to be convinced that the total cost of occupation would not be higher. this would require engagement with private landlords as they will need to give permission for works.

Participating in the generation + storage programme - minimum performance conditions for properties to participate in a PV + battery programme, or a contractual commitment that the monies generated will be used for this purpose could encourage some private landlords to take part. Escrow could be deployed to make sure that happened

All in rental model - rents includes all the bills. This is currently largely confined to older people's housing and there are issues with benefits, but it may be attractive in some cases.

component 8 financial vehicle

A regional finance vehicle for retrofit could provide the following advantages :

- to take in large scale low cost finance from multiple sources, to lend to householders to fund works
- make policy led decisions such as offering equity loans to less well-off households
- hold, redeploy or share out surpluses from different elements of the programme
- to provide certainty of funding pipeline to encourage investment in skills

forms of vehicle and ownership

Public sector ownership of the finance vehicle would give it access to lower cost finance (through strength of covenant), the ability to deliver multiple economic, environmental and social goals, as well as a level of control over the retrofit process as finance could be linked to approved assessment methods, contractors and other issues discussed in this report.

¹⁰⁹ "What are the Barriers to Retrofit in Social Housing?" Cambridge Architectural Research 2018

¹¹⁰ "Increasing capacities in Cities for innovating financing in energy efficiency" CityInvest 2015

¹¹¹ https://www.projectscene.uk/wp-content/uploads/2018/10/10_Jon-Warren.pdf

There are options for the delivery of these loans, again depending on the level of intervention regarded as desired or acceptable. The options range from a loan fund administered by others (Lendology, local council or building society), a Green Bank (local or national) which could have a public shareholding element, or creation of a wholly owned finance vehicle (either buying in services or directly employing staff).

additional revenue opportunities

What needs further testing is how to make the model robust enough to deal with the lack of certainty of some revenues while being flexible enough to take best advantage of them when they come forward.

The Able-to-pay market will be critical as many will elect to have retrofits done for all the other reasons laid out above. While this reduces the impact on other policy drivers it enables the programme to keep developing, while other means of delivering to those in fuel poverty are brought forward .

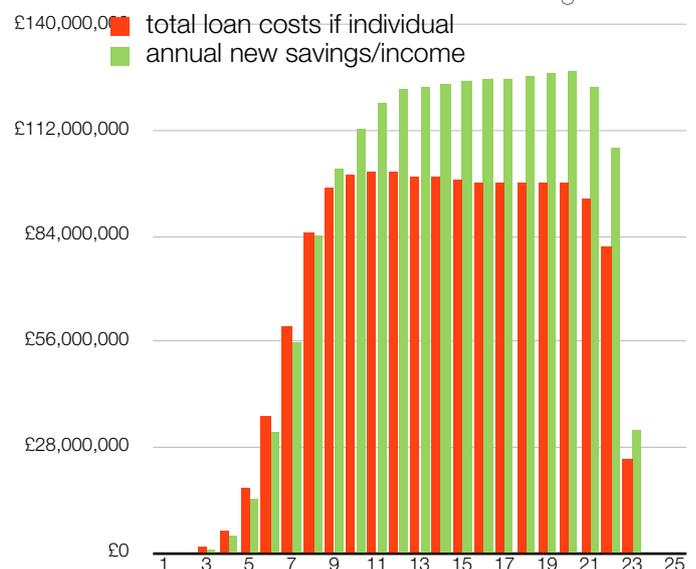
Work needs to be done to chart the gradual market perception of improvements in value over time to allow some level of extrapolation/forecasting and factor this into the model - some property owners will elect to make their home better as long as the money spent is captured in a rise in value. The increase in capital value could close the gap between costs and savings/revenues.

delivering investment returns

Deploying PV & storage ahead of demand reduction works can help close the gap in the opening years. However the model will be more robust if this is not the only measure. Figure 6.8 shows that in future years a considerable surplus is possible. A model that defers payments to later years may be worth examining as there are considerable future surpluses which may to be attractive to the founding patient investors. How the rest of the market develops around this new vehicle is critical to that idea. Given this is not a closed model, there is a risk that once this public sector intervention has reduced the cost by stimulating the market new players will enter that market and undercut. While there is an argument that this is precisely what public sector intervention is set up to do, this needs modelling so that the basis of the founding investment is clear. The barriers to participation in the energy storage incomes should keep this model ahead of future competition along with the, by this point, tried and tested trusted offer.

Further research needs to be done to see if central government innovation and business development funding might be deployed to underwrite this risk so that local public and third sector investors feel more confident locking money up here instead of somewhere else.

fig 6.8 total annual loan costs against total savings/income



forms of investment in homes

The ways in which homes owners will be able to pay for their works will vary the extent of deployable savings, surplus value over their existing mortgages, and income to support a loan. This again is an area of research that needs further analysis to see whether a progressive lending structure can fit the demographic of the regions households, mapped against the household types :

1. Able to pay #1

It is likely that there are people able to pay for the retrofits themselves out of savings. These will be unlikely to be a crucial part of this model although there is a possibility of developing a retrofit bond which would a more 'Able-To-Pay' householder might invest in that covers the cost of their retrofit on maturity.

2. Able to pay #2

Others may still need borrowing but have sufficient asset cover on their home and a high enough disposable income to be able to borrow at 'High Street' rates. While there may be an instinct to let the high street provide this service, there is an argument that in fact providing these more commercial loans to these householders would then create a margin over cost that would enable further reaching support to be delivered to the less well off

3. Able to pay #3

A sector of the regions householders will have the incomes that support a loan but will have bought houses more recently so have so asset cover over and above their existing mortgages to secure further borrowing. These people will need an unsecured loan - quite a familiar product in the public sector for home improvement loans. However this able to pay sector would be able to afford interest.

4. Less able to pay

If the cost of finance is cheap enough, the loan periods are shorter and there are enough able to pay customers, then this creates space for unsecured loans to this sector at the interest rate paid by the loan fund to attract capital.

5. Struggling to pay - equity lending with interest payments

The proportions of different loans will need to be managed so that those in need can be granted loans that do not have to be paid back until the house is sold. A policy decision will be required on the fair share of house value increase to replace interest payments. This category would be those unable to pay their energy bills without hardship but may be able to cover the interest costs if the principle was repaid on sale of the property.

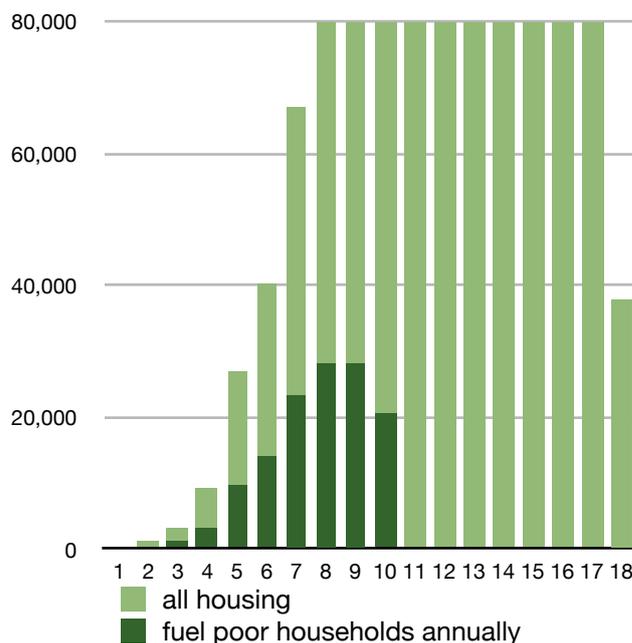
6. Unable to pay - equity lending with no payments until sale

Those least able to pay their energy bills will not be able to loan payments either. This final lending category would be heavily subsidised by the loans in the earlier categories so would need a smaller proportion. These loans would not be repaid until the property was sold, and there would be no other payments during the loan. It may be possible for some finance costs to be redeemed by rising values at point of sale but it is possible the housing market will suffer over the coming years so it may be best to model this loan form without. There are also adoption issues when shares of future rise in value are taken.

This part of the vehicle's development will need both modelling and stress testing, experiences of the successes and failures of these various lending forms already deployed will need analysis.

If enough volume of lending goes through the vehicle, this will enable more lending to those in fuel poverty, creating the opportunity to extinguish fuel poverty in the region by 2030. See fig. 6.9

fig 6.9 graph showing retrofits for fuel poor households as part of wider programme



risk analysis & stress testing

This proposal will need a risk analysis including issues such as: availability of low enough cost finance, volatility of energy market, works cost variability, supply chain failures, appropriateness/quality of work, underperformance of measures, consumer trust and uptake, non payment of loans, property value fluctuations and changes in legislation or regulation.

Mitigation of these will be crucial. Scenarios will need to be tested to see if the inputs to the model are sufficiently varied to be enable proportions and extent of activity to mitigate those risks.

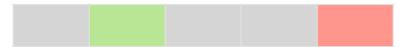
The schemes that have failed (such as the Energy Saving Co-op and Birmingham Energy Savers) as well as those that have worked has been looked at as part of this research, however a future study for this vehicle would benefit from looking at those in more detail.

Any loan mechanism will require Financial Conduct Authority (FCA) certification.

Risk and profit are almost always linked - except in many joint ventures between public and private sector when the risk tends to sit with the public sector while profits accrue to the private interests. This is a model used a lot in the Western world, seen as a function of the public sector to act on behalf of the private one, but in this case the surpluses from this venture are crucial to the carbon and bill savings, jobs, healthy homes realised as well as the numbers of people permanently lifted out of fuel poverty. The more margin on its activities distributed the less carbon can be saved, the fewer people helped into healthier homes, out of fuel poverty or into viable dignified employment. We would recommend pursuing a relationship with the private sector based on well procured service agreements rather than profit shares, even though this does require create care in setting up agreements.

component 9 scalability

9.a delivery vehicle



Councils and Registered Providers have used various organisational models as a means of delivering packages of works to property owners, such as adaptations, home improvement or retrofit. There is no reason why the deployment of these models should be limited to public spending. While it is unlikely that all of the region's retrofit work would be done this way, a scalable delivery model that can carry out retrofit work offers control over quality and delivery. The scale of the challenge and need for co-ordinated, rapid, scalable response creates a strong argument for greater power in a single agency or agencies. There are a range of different and compliant procurement routes:

I. Approved Contractor list

A list of service deliverers that have passed a certain threshold for entry; such as vetting, minimum performance requirements, recommendation. There are still some Local Authorities running these¹¹² as well as several private providers that charge contractors a fee to enter. Trustmark and PAS2035 will be creating one of these for accreditation in key retrofit sectors.

II. Multi-stakeholder consortium/co-operative Delivery Agency

Assembling clients and contractors as members of one organisation, with a performance threshold for contractors to enter and with systems to facilitate tendering and quality control. Retrofit Works are the leading version¹¹³.

III. Dynamic Purchasing System (DPS)

A form of procurement model that complies with public procurement rules and allows entry at any time following pre-qualification; contracts are then awarded through a competitive process within its members. Suitable where the product is not simple or fixed, requires administration¹¹⁴. This also has the benefit of allowing removal of poorly performing contractors.

IV. Fixed Framework for clearly defined outputs

These are opened for application on the basis of a selection process, usually for relatively restricted and easily comparable services such as boilers or PV. They run for a set period during which those prices are fixed. Products can be directly selected from the list or subject to mini-competition.

V. Delivery Contract with a single commercial provider

A public sector body lets a contract to a single entity with quality and value for money arrangements set out at tender stage with KPI's to ensure future compliance. The length of the contract can stimulate investment. This can allow for a fee to cover the cost of finding projects.

¹¹² <https://www.calderdale.gov.uk/v2/residents/housing/adapting-or-improving-homes/home-repairs>

¹¹³ <https://retrofitworks.co.uk>

¹¹⁴ https://www.local.gov.uk/sites/default/files/documents/4%2030%20DPS%20Guidance_04_Web.pdf

VI. Special Purpose Vehicle / Joint venture

Local Authority sets up an external company, often with commercial partners, with specific operational objectives. Not yet used for retrofit but used in regeneration¹¹⁵ and some new build housing¹¹⁶.

Much has been delivered through types 1, 3 and 4. Retrofit Works is the leading example of type 2, an enhancement of an approved contractor list creating a kind of smaller scale DPS with an IT backbone to reduce on-costs and administration. The experience of fixed frameworks nationally suggest that, for a market place evolving as rapidly as retrofit, a DPS might be a better route where public procurement rules need to be complied with. 5 is the current incarnation of Better Homes Yorkshire.

The legal and political hurdles of a Special Purpose Vehicle (SPV) may make this too controversial to go for but it seems worthy of exploration as the German DENA¹¹⁷ energy agency could be argued to be something like this. DENA provides a centre of expertise, co-ordination and innovation. Could a regional version work?

Some of the software and organisational innovations of Retrofit Works suggest that creating a West Yorkshire organisation of this type could be seen as minimal regrets option while the viability of 6 is explored further. A DPS for social landlords could be set up alongside this to continue to deliver existing pipelines and funding streams while also allowing flexibility and development of measures deployed.

9.b demonstrators to increase scale



Retrofit at the level required is a very new industry with far fewer participants in the market than is needed. So the capacity needs to be grown. This comes from both trying it out and developing a pipeline that is large enough and long-lasting enough (>10 years) for companies to see sufficient merit in investing in taking part.

Demonstrators are a critical component in getting this moving. Methods can be rehearsed, early adopter and pioneer householders (keen on retrofit for wider reasons of health, carbon, cost and comfort) can be recruited to provide geographic and demographic coverage to ensure best visibility to all participants at occupant, political and financial level.

The process of recruiting the contractors for these demonstrators can then also prepare the initial DPS or framework that RP's and public funders can utilise without further procurement requirements. The depth of testing of competencies, customer service and product delivery quality in a live project will be far greater than that possible in a framework or DPS creation process.

Homes as Energy Systems (HaES) is an ERDF project in Greater Manchester looking to build capacity at the level of demand reduction appropriate to the scale of carbon emissions reduction needed.

Many more like this are needed, the latest BEIS Whole House Retrofit competition was the sort of thing needed but in this case focussed very closely on the Energiesprong model of off-site fabrication of retrofit components.

9.c competitions



Forming demonstration projects as well publicised competitions has been shown to be effective in creating 'hooks' for story placement, allowing targeted awareness raising across multiple areas of interest if allied with a communications strategy and the resources to deliver it. This can feed the creation of a retrofit hub, allowing a more organic growth responding to the changing circumstance.

High visibility also helps create incentives to deliver best value from contractors, although other mechanisms deployed alongside will improve this in a deeper more concerted way, such as better contract models (6a), warranties (6b), energy performance guarantees (6c) and better quality control (6d) through things like remote works monitoring (4d) already deployed by Retrofit Works.

¹¹⁵ <https://commonweal.scot/the-key-ideas/8-create-special-purpose-vehicles-such-as-national-mutual-companies-for-major-public-investment-in-projects/index.html>

¹¹⁶ <https://moderngov.lambeth.gov.uk/documents/s77353/Homes%20for%20Lambeth%20an%20SPV%20for%20Lambeth%20Appendix%20C.pdf>

¹¹⁷ <https://www.dena.de/en/home/>

Competitions or rolling competitive funds would develop designer/contractor teams delivering deep retrofits that they would be prepared to then both warranty and roll out at scale after further research and development.

9.d pipeline development



Taking lessons from the original Energiesprong in the Netherlands, early contractor engagement to explain the likely programme of work is highly beneficial. By aligning the proposed demonstrators with both homes already in the pipeline and the results of the market intelligence identifying the future target ones, this can enable the demonstrators to be part of the procurement process of that pipeline alongside other components. There was a higher degree of contractor willingness to cooperate in NL than was the experience in the UK, but the scale of work that will be needed will provide work for multiple contractors.

9.e supply chain development: product development



Key to developing a trusted offer at an affordable price is the identification and development of better solutions to key problems encountered in retrofitting homes.

This can happen in 3 ways:

- Product use diversification
- Amendments to existing products
- Developing new products

Retrofit at the level required is currently a niche industry, the CERT, CESP and ECO programmes established an 'industry custom and practice' which has been shown in too many cases to be inadequate¹¹⁸. Silicone mastic and PVC trims are being used at critical points to prevent rainwater ingress which regularly fail and in more cases is not the aesthetic which property owners who will be paying for this work will enjoy.

In some cases this product development has happened - this process needs to be accelerated. An example is the junction between roofs and walls receiving external wall insulation (EWI). On some housing, especially terraced, there is no eaves under which to finish the insulation, it is often not possible to extend the roof over it. To deal with this Prewett Bizley created an aluminium solution¹¹⁹ now called EWI Pro¹²⁰, red.coop created a stainless steel version¹²¹ to improve longevity and safety of maintenance access. Both solve a critical junction issue but are currently expensive, once pipeline becomes more established these are the kinds of things to upscale so reducing price.

product availability

Engagement with multiple players needs to happen to accelerate product innovation. This can happen at different levels: existing meet the buyer type events have been shown to encourage this kind of activity for the adoption of new products such as Climate KIC, Low Carbon Homes and the former Ecobuild. Events could provide an opportunity for specifiers and contractors to see new products and discuss the innovations they need with manufacturers.

Communication between those planning retrofit and those supplying the materials needs to be established and sustained, making sure there is enough of the right product in the right places. This starts at the manufacturer level and extends through its distribution arrangements. A regional approach to this should enable supply bottlenecks to be eliminated and prices to be kept down through streamlining of supply by better planning and notification of upcoming demand. The acceleration to 80,000 properties a year will need planning. As has come out in the interviews, there is confidence this can happen if there is certainty of pipeline.

¹¹⁸ <https://research.historicengland.org.uk/Report.aspx?i=15747>

¹¹⁹ <http://www.prewettbizley.com/-built-projectretrofit-for-the-future-house-index>

¹²⁰ <https://www.ewipro.co.uk/ewi-pro/what-is-ewi-pro/>

¹²¹ <http://red.coop/ewi>

9.f develop connections between new & existing delivery infrastructure

Develop connections between DPS and existing frameworks

Re:allies already has a Materials Framework¹²², This is currently for higher value items but as volume increase so do the opportunities to develop standardisation of materials specification. Merchants are partners in these frameworks so this presents an opportunity to use the throughput of the DPS to develop sufficient volume for the same products to be available through the shops and so be available to smaller businesses in the repairs, maintenance and improvements (RMI) sector.

component 10 workforce development

Without progress in this area there is much less chance of retrofit at scale happening. A public sector intervention may be the only way of dealing with inertia in the training system and an apprentice system ill-suited to the current structures of sub-contract construction.

The UK construction workforce is already inadequate in terms of numbers of people and depth of skills for existing construction work¹²³. To support a programme of 80,000 retrofits a year there will need to be a much larger workforce.

People will be unlikely to make a decision to train in a particular industry unless they can see a future in it. The failure of the Green Deal has made this more difficult. It is important to develop credible pipeline for work alongside the means to create the workforce to fulfil it. It is likely that much of this new workforce will need to be made up of people coming into the workforce for the first time. Developing interest in retrofit at schools and colleges will assist, then provide relevant training courses. We have modelled the delivery profile to match both the creation of the workforce and the development of the cost-effective retrofit proposition.

The workforce is going to come via multiple routes.

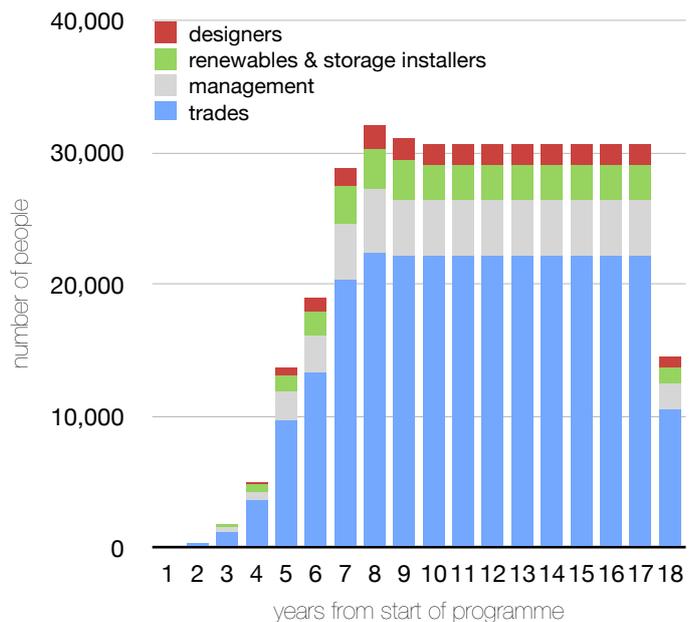
- Those already in the building industry who need upskilling
- Those changing career path who may already have some appropriate skills
- Those who want or need to make a complete career change
- People still in education choosing a career

This should inform the recovery path out of the COVID-19 pandemic.

The skills needed are mostly already present in the construction workforce and in most case would fit within the skillsets of many familiar standard trades (see appendix IV). The ones that are not could form new trades such as an air-tightness operative or gradually becomes allocated to usual trades, becoming more expert in the field as the market develops.

It follows that existing skills infrastructure, with some adjustments, is the place to start creating the workforce needed. Our modelling of the levels of retrofit required across the region’s housing stock show a need for a 30,000 strong workforce that needs developing and sustaining over the next 18 years (fig 6.10). This is derived from analysis of labour time on a range of retrofit projects.

fig 6.10 approximate workforce size over the life of the programme



¹²² <https://www.re-allies.com/frameworks/merchants-framework/>

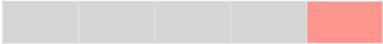
¹²³ <https://policy.ciob.org/wp-content/uploads/2019/01/Shortage-Occupations-in-Construction-A-cross-industry-research-report-January-2019.pdf>

The opening years of retrofit will be characterised by individual retrofits before it is feasible to roll out area based deep retrofits, as the demand and acceptability will not have developed sufficiently to get a large enough proportion of a street to decide to have it done. This means that trades will have to be largely self directed and able to adapt to changing demands on site. This will require changes to the traditional methods of organising construction sites.

Multi-skills tradespeople will become highly sought after for much of the retrofit as that will speed things up and reduce costs. However, compliance with PAS2035 across multiple measures will need to be resolved.

skills matrix

	schools	colleges	adult edcation	training colleges	apprenticeship	on the job
introduction/taster						
toolbox training						
skill development (uncertified)						
accredited skills training						
GCSE/A-level						
BTEC						
NVQ						
HNC/HND						
Degree						

10.a audit of skills, providers & methods 

The starting point is to know what is already available, ranging from providers of toolbox talks, on-site training, skills enhancement as well as the more familiar institutions starting from scratch. To be clear this is not just a shortage of the trades people but the people that supply the details and materials needed for the work, that manage them and their workflow. Surveyors, retrofit designers and assessors, architectural designers and technicians.

This study should also examine the cost efficiency and quality of the outcomes and for which sectors of society.

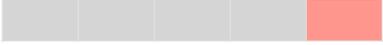
10.b training provision study 

Once there is a more knowledge of what is available, the next task is identify the best ways to fill the gaps. In many cases with sufficient pipeline certainty, existing institutions can expand, but there could also be retraining, particularly for those in declining industries. With so many people train across so many different levels of skill, experience and academic level there is a need to ensure variety of provision.

10.c awareness raising 

While this may fall into communications strategy development it will have a different set of audiences and timeline as it will need to attract some into this workforce before the mass programme starts if supply and demand problems are not to undermine the programme.

10.d schools introductions



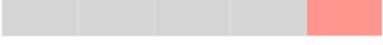
People will be unlikely to make a decision to train in a particular industry unless they can see a future in it. The retrofit industry will be able to be attractive to many who would not normally see themselves in site roles, efforts should be made in the early stages of developing this soon to be massive industry to attract young people to the idea of careers in this field given the age of many of the skilled tradespeople we currently have¹²⁴

10.e apprenticeship development



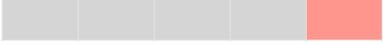
A problem in the retrofit industry is that there are too few with the necessary retrofit experience to apprentice to. Furthermore in order to be able to invest in an apprentice there needs to be pipeline, but there also needs to be more assistance from skills providers to support retrofit apprentices - a service which does not exist as the training isn't there to match them to.

10.f college & university engagement



The graph on the earlier pages also shows the proportion of possible degrees and diploma level skills needed. PAS 2035 mandates certain skilled people required by there are very few providers of this training and very little attention being paid to complimentary skills that could also be delivered part of delivering this element of a retrofit workforce. A key reason for this will be lack of demand, so there is a need to engage with FE colleges and universities to assess how best to deliver the skills in a sustainable fashion.

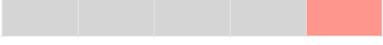
10.g DLO & TU engagement



Direct Labour organisations could be critical in delivering the changes needed, given the lead taken by social housing providers they have the interest position for more operatives as the industry grows where they will be driven in this training by results on site.

The Trade Union movement already has a 1 million Climate Jobs campaign¹²⁵ engaging with this will not only help spread the word about the possibility of retrofit it will also enable greater some trade unions who are supporting their members in jobs less compatible with achieving a zero carbon society to see other ways to deliver that support that will help with the task

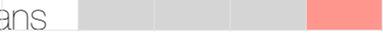
10.h industry participation



As well as supply chain, industry can also engage in building a workforce - their engagement in identifying the most appropriate skills in which they would like people trained, They can also help build awareness of the opportunities through sponsoring activities like travelling classrooms

Without much more progress in this area there is much less chance of retrofit at scale happening. Inertia in the training system, a dysfunctional apprentice system ill-suited to the current structures of sub-contract construction mean a public sector intervention may be the only way of rising above the one of training currently available if at all.

10.i work with local authorities on their COVID recovery plans



This will enable a co-ordinated approach to re-skilling of people made unemployed by the crisis as well as a maximising their chance of longer term jobs by co-ordinating activity

¹²⁴ <https://www.constructionmanagemagazine.com/revealed-how-uks-construction-workforce-ageing/>

¹²⁵ <https://www.campaigncc.org/climatejobs>

VII. further ideas for exploration - enablers

a. identify opportunities for community involvement

On an immediate level community networks are going to be able to promote participation in a retrofit programme far more effectively than people from outside.

Looking slightly wider, the money spent on utility bills is the largest single spend in a community so it's redirection offers the potential for regeneration.

In the longer terms this also enables support for activities and the development of more informed clients for the work, reducing the 'take back' effect, making regeneration something more to be done by communities not to them. This will enable community networks to be used to increase deployment and sustain it in the longer term.¹²⁶

b. Personal Retrofit Investment Fund

Working with finance institutions to develop a retrofit specific savings account. Early work on pathways and establishing a viable large scale business model suggested an accelerated rollout of solar panels & storage. Income generated from installations could be held in an account to fund future retrofit works as the market develops. This may make early solar panel installations more successful without reducing future fabric works while avoiding households coming to rely on PV income for other expenditures.

rented housing:

Landlords are not the bill payer so it is difficult for them to justify the levels of investment into the homes required by a zero carbon target. Many of the following ideas have been tried out on Registered Providers. Some of these could form part of future asks to government:

There is little activity that shows a clear way forward in tackling energy standards the private rented sector, which has doubled in size over the last 20 years. There have been plenty of ideas, but few proven. Some seem worth further exploration:

c. working with lettings agents

Get property agents to advertise total cost of occupation (TCO) on rental properties.

This will enable prospective tenants to make a more informed judgement. This is easy as the mandatory EPC has the data needed for this on it. Work will need to be done to allow for variations in occupant behaviour, underperformance and sanction for variation. While this requires there to be a choice available for that prospective tenant, it could establish clear market advantage for more efficient properties. In some cases (subject to housing benefit ceilings) it may allow rents on more efficient properties to be higher.

This may be able to happen regionally but would benefit from a federal approach to better encourage participation. With state intervention it could be mandatory. The Combined Authority could work with landlords and letting agents to establish common codes of practice on this.

Create a good practice letting agent

By creating a letting agent with a good track record that tenants can trust, more tenants will use it, this will encourage more landlords to lodge properties with it. This will enable conditions to entry to be placed on it's register to be enacted such as energy efficiency or even just total cost of occupation. A letting agent could be a private homes version of Manchester Student Homes, setting a bar that others will have to follow to stay in the market so raising standards.

sustainable housing label

¹²⁶ Regeneration and Retrofit UKGBC 2017

A labelling system that gets you access to cheaper finance, attractive to the upper end of tenants, similar to Minergie in Switzerland. This could go along side the previous measure. Work done in Manchester with commercial landlords has suggested that labelling for the good performers can be an attractive option for those engaged landlords as it helps with market differentiation. Engaging with the private rented domestic equivalent may be worth exploring.

letting agent ++

Much has been written about providing heat as a service and about “all in rental” models. Is there an extension to this where an operation takes over a property, retrofits it and lets it out for a total cost that would be similar or less than what the total cost of occupation would have been, taking on utility payments as the Energiesprong model? This is sometimes called a Green Lease.

d. Repairs, Maintenance & Improvements (RMI)



An off-shoot of this could be property maintenance via a service co-operative such as RetrofitWorks so support local RMI SME's transparently and accountably. There is the possibility that some struggling small scale and 'accidental' landlords may welcome the opportunity to have their homes properly looked after and let in a way they know is good practice and retains the value of their asset. This could also extend into those working away on long term contracts. Loan conditions might even allow for 1st refusal if the landlord decides to sell on so enable a gradual regrowth of better quality lower cost rented housing. Over time this could lead to people living in healthier affordable homes with a new hybrid form of municipal intervention into housing sitting between social renting and private ownership.

e. Minimum Energy Efficiency Standards



This is argued by many to be the only way to bring the PRS along, it is a regulatory stick and requires state intervention and is therefore outside the Combined Authority's control. That's said this could be on a list of asks of government and delivery to accompany it could be worked out.

f. Landlord Licensing



This would enable minimum property standards to be part of the landlord licensing, creating a regulatory necessity for better performing homes. This is currently limited in scope and range by the government so would need to be enabled by the state. However if this happens it gives local control over regulation. The West Yorkshire Combined Authority and others may decided to lobby for this if the current stigma over licensing as only being for very poor quality could be overcome.

g. green mortgage for buy to let



Cheaper finance if the landlord upgrades the property - a PRS version of the Ecology and Nationwide green mortgages (that have lower rates the higher the energy performance. Work needs to be done as to whether this model can be reduced in cost if done at larger scale.

h. equity lending to private landlords



This is a clear incentive that would need to be costed. It would not have to only be repayable at sale, the loans could be partly or wholly repayment loans too to best suit the owners and the ability to redeploy the funds to those in need as soon as possible.

Access to this lending could be conditional on energy demand reduction. In addition, to help ensure that at the point of sale the homes have not dropped in value if not actually improved it is logical that there is a condition on the loans that the homes are properly looked after and rented in such a way that they promote good practice.

VIII.delivery & recommendations

Actions are needed across the multiple components identified in the previous section to enable the rollout of a larger scale retrofit programme. Some of these can be done at regional level, others require action at a national level while many can be delivered by joint action with other regions. The components table (appendix VI) suggests which ones these might be done at which level. Based on the research, key areas for action in the next year have been identified.

These are relatively small packages of work that lay down critical foundations upon which to build the next set of building blocks as can be seen in figure 8.1 below.

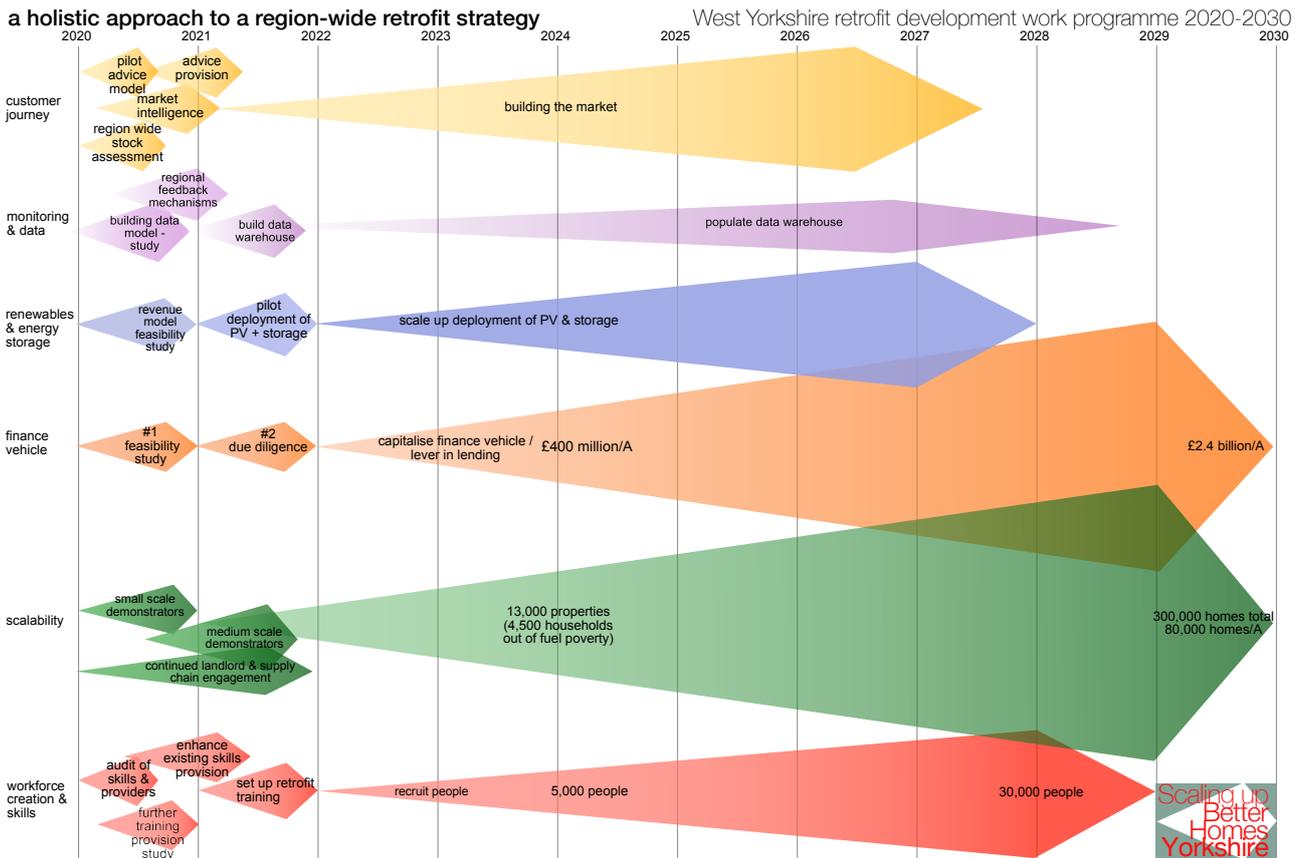


fig.8.1 approximate timeline

The scale of these initial packages of work would make it possible for the first years activities to be delivered by the existing capacity of the combined authority and its constituent local authorities. As the results of further research and concurrent activities recommended here become apparent it will then be possible to work out the detail of the delivery options.

Delivery divides into two distinct areas of endeavour; firstly that of coordinating this assembly of further research and early constituent components and the delivery of the actual works on site.

retrofit hub

Several aspects of a region wide retrofit programme require co-ordination and some centralised activities. This sits above the components listed. The first step is to develop a community of interest to develop the elements of the hub's activities.

To organised a retrofit programme effectively requires data on:

1. detailed information on the property types, their condition and the retrofit measures best suited to them
2. current energy consumption of those homes

3. what has been done to homes, not just within public sector led programmes
4. how those measures have performed and are performing:
 - 4.1. for the property
 - 4.2. for the occupant
 - 4.3. for the contractor
5. market segmentation and triggers

The need for building data and ability to see how retrofit measures perform appears to be a minimum requirement in creating a region wide mass deep whole house retrofit programme. However this can go further depending on the level of public sector ownership control and subsequent intervention desired.

It also needs to assist in giving clear line of sight through pipeline creation, skills, accreditation, manufacturing, warranties, maintenance etc.

Key components it might deliver can overlap, again in order of level of direct participation:

- Data gathering
- Promotion (to both building owners and contractors)
- Signposting
- Independent advice
- Co-ordination
- Assessments
- Demand aggregator
- Distributor of retrofit funds

These are programme on-costs which will need paying for and ties in with the challenging issue of how assessments are delivered. The understanding and willingness to accept upfront fees is difficult in many activities not just retrofit, what they service is unfamiliar as this is such a new arena. Various options have been tried and each has issues:

1. The contractor is charged a finders or referral fee that they pass onto the customer as part of the costs of the retrofit.¹²⁷
2. The hub is the delivery body for the retrofits so the assessment fee is wrapped up in the total running costs funded by margins from the works delivered¹²⁸.
3. The assessments are revenue funded from public subsidy on the basis of their role in policy delivery¹²⁹

All of these can be incremental approaches to data accuracy and potentially hybridise the methods of cost recovery. So for example Parity's CROHM+ software package can give a rough idea for minimal individual cost per property: this would be enough to get customer buy-in, at which point charging for more detailed assessment becomes an easier ask.

Setting up apex organisations can be costly and too often does not lead to the intended outcomes. The recommendation therefore is that the functions of this body can be tested and grown in separate parts over the short to medium term, leading to a suite of tested functions. After this testing period, more informed decisions can be made as to the most effective measures in carbon, cost and customer terms.

Given the proposed initially small but rapidly accelerating profile of works, this can start with identifiable tendered packages of work fulfilling the intelligence gathering component needs. These can be built on to generate the services needed in a more continuous form.

¹²⁷ Greater Manchester Combined Authority Green Deal Communities 2015

¹²⁸ Cosy Homes Oxfordshire

¹²⁹ Warmworks Scotland

In the meantime however we see merit in establishing some of the organisational prerequisites, not least a community of interest that can be resourced to meet and start to build the relationships needed to comment on, if not supervise, some of this work. This could start as a network and grow from there.

Facilitated by West Midlands Combined Authority (WMCA), a fuel poverty community of interest has become a key informer/influencer of WMCA policy and strategy - the Warm Homes Save Lives 2020 report¹³⁰ developed with the input of over 40 organisations has informed an ask of Government of £100m in the recent economic stimulus proposal.

recommendations:

- 1. identify staff resources to create building blocks for the hub**
- 2. community of interest: create a retrofit network made up of a variety of stakeholders (contractors, clients, supply chain and intermediaries) facilitated by a cross Combined Authority working group**

components needed

component 1 customer journey

The starting point for the customer journey is establishing what retrofit work is required for each building and how to encourage them to embrace a low energy renovation, so that the offer to the customer is of a high standard of reliability and accurately costed. Consistent independent should be nurtured through the initial pilot scheme.

1b detailed stock analysis with proposals as to how fo fill the gaps

1c market intelligence

3c,d,e) feedback and data repository

To track, identify and disseminate best practice, develop of a framework for a data repository where not only the 'Building Passports' can be lodged but also the transactions and the feedback on measures, methods and who did the work. This would enable market intelligence to be honed, alongside improvement to measures and deployment. Databases and software can be made interoperable by having an accessible Application Programming Interface (API) so that they can talk to each other. This will need to be worked on in collaboration with a wider community of interest to enable interoperability and integration with assessment methods, best practice and estimating packages (4a) as well as Trustmark's Data Warehouse. It is likely that this piece of work would be tapped into what is happening around mass customisation (4b)

- 3. commission work to create building passports to generate high quality data to help with planning programmes and retrofits**
- 4. commission an updatable model of market intelligence**

component 3 monitoring & data

- 5. develop relationships to build common program interfaces for a data repository - as part of that partnership, develop the regional data repository**

component 7 additional revenues

Further research needs to be commissioned on how to generate additional revenues from solar pv and battery installations and how to enable landlords to recover costs from tenants.

¹³⁰ https://shapuk.files.wordpress.com/2020/09/warm-homes-save-lives-west-midlands-fuel-poverty-programme-proposal-february-2020_corrected-graphic-layout.pdf

c energy production & storage aggregation

Additional revenues can assist with cost recovery across all tenures, enabling much greater levels of demand reduction to be viable immediately rather than after massive subsidy to develop the market. The current front runner in generating these additional revenues is energy storage. It is a very new area however so is under continuous development with investors chasing different opportunities. The risks are proportional to the opportunities so given the failure of so many public sector promoted energy retailers it is crucial to create far greater certainty, before investing.

To this end a review needs undertaking of all of the domestic energy aggregators and their providers of financing. This needs to include their methods of operating, on-costs, scalability and charging structure to those whose batteries and PV is managed by their platform, control methods, software used and its security.

The study will need to assess and quantify:

- Benefits of self consumption
- Benefits of selling to the grid
- Benefits of onsite storage combined with distributed generation
- Benefits of distributed generation to distribution network

recommendation

- 6. commission research on the accessibility and reliability of energy sales revenues and the steps necessary to realise them**
- 7. analyse the best deployment, adoption and efficiency characteristics of the storage form required**

e rented housing cost recovery models

A major revenue need for rented housing providers is to be able to identify ways of sharing the benefits of the energy bill reductions retrofit affords their tenants or identify other revenue streams that can help. This has been the subject of much debate over the last ten years and the perception of risks that made many models unacceptable a decade ago may have changed in the context of a climate emergency. Assessing the most effective models will enable Registered Providers taking a strong lead on delivering a zero carbon future.

recommendation

- 8. create a task group of rented housing experts and representatives to create a delivery plan for viable cost recovery models**

component 8 finance vehicle

To set up a finance vehicle, able to offer a blended finance package of low cost loans and any available grants, to suit the needs of a range of building owners. Working with a suitable aggregator, it should provide access to other income opportunities resulting from retrofit work, including energy sales. The finance vehicle should later provide opportunities for local investment in retrofit, through a bond or share issue and be able to take deposits into Personal Retrofit Investment Funds.

The stages for this might be:

- I. Feasibility Study to confirm financial assumptions. Much of the evidence is either in this report or in the reports studied, it needs a third party view from a greater position of financial expertise that can also bring in appropriate legislation, governance and the cost benefits of the different models described earlier, with risk and sensitivity analyses.
- II. Political adoption - support of key decision makers will be essential.
- III. Due diligence work - issues arising out of the feasibility study - governance, finance sources, improving quality of stress testing, further sensitivity and risk analyses, FCA registration and State Aid compliance.

IV. Then set up: the scale of the early stages of the programme should keep early outlay within what is politically acceptable, while further borrowing can be negotiated but not drawn down until the case on the ground is proven by the early retrofits.

The revenue study for the PV/energy storage needs doing quickly, to model the income that can be obtained from energy sales to the grid. This will have a considerable effect on the business model adopted to roll out deep retrofits.

As we have identified, detaching the PV/storage from the rest of the retrofit to allow that part of the programme to be accelerated and could generate considerable upfront income and carbon savings. To avoid households getting used to spending this income on other things, we have proposed a Personal Retrofit Investment Fund. It is similar to the old building society model, where the PV & storage can be deployed early with the revenues set aside to cover a householder's future retrofit when they feel more more satisfied with the development of the market, service delivery or products range available.

If grid sales revenues turn out not be feasibly realisable as modelled, then the speed of roll out may need to be amended or other revenues identified.

recommendation

9. commission a feasibility study on the next steps to creating a finance vehicle

component 9 scalability & pipeline

The target for year one of the programme is a large scale pilot of 300 deep retrofits, used to build the organisational structures and processes which will enable scaling up in future years.

An early demonstrator would need professional design advice with the cost of this factored into the project costing. Good practice versions of this design advice are interactive rather than linear and prescriptive - with a little more development this service can then become a technical advice service which will become a component of the Retrofit Hub. A resourced project advisory board can then act as peer review for that to best ensure both the validity of the advice and the way it is imparted.

Other recommendations arise from this major component to do with improving the range of delivery choices and delivering the first year's deep retrofit programme:

recommendations:

10.set up a regional sub-group of Retrofit Works to encourage collaborative working in the supply chain

11.set up a Dynamic Purchasing System (DPS)

12.commission further research on Special Purpose Vehicle (SPV) options and whether they offer a credible scalable pathway

13.identify a loan stream to fund the first year's demonstrator programme

14.develop briefs for competitions for the first year programme

15.create a management structure for those projects

16.develop and resource a communications strategy

component 10 workforce development & skills

Workforce development is a much slower growth endeavour: the work pipeline needs to be definite enough for contractors to start to recruit; the certainty of the jobs is needed to encourage people to go and get the skills; all of that is needed for skills providers to invest in the courses.

Training and accreditation providers have been let down by cancelled retrofit workstreams (namely Green Deal) so they will need to see a building retrofit market to have certainty of future needs.

Some tasks such as toolbox talks or on the job training can be delivered immediately by suppliers to existing trades. However some key roles need training programmes, such as retrofit coordinator and other PAS2035 roles.

recommendations

17. use stimulus funding to support training for PAS 2035 and PAS 2030:2019 roles and accreditation to be ready for Green Homes Grants response

18. carry out an audit of existing skills and training providers

remaining components

There are other components that do not have a solely regional provenance. While these do not need to be the responsibility of regional bodies to set up, many of these components have economic benefits and there may be much to be gained from aiming for first mover advantage - be that clusters of expertise in the region or co-location of symbiotic parts of the supply chain. A key parameter behind that decision will be what capacity is already in the region that can be built on - this can be academic, commercial or even social/voluntary.

Some of these components will not require much for them to be ready for the job in hand. This list needs further consultation or suggestions.

recommendations

19. start dialogue with other Combined Authorities and Local Authorities about how to create more federal responses to delivery of the retrofit components list

20. identify capacity regionally to be able to seize first mover advantage on delivery of the components

West Yorkshire Combined Authority strategic plans	Headlines/ Targets/ Objectives	Response in this report
<p><i>The Leeds City Region Enterprise Partnership Strategic Economic Plan 2106 - 2036- 4 economic priorities</i> Boosting productivity Supporting clean growth Enabling inclusive growth Delivering 21st century transport</p>	<p>By 2036 the City Region will: create upwards of 35,000 additional jobs and an additional £3.7 billion of annual economic output seek to exceed the national average on high level skills</p>	<p>30,000 jobs to be created by 2030. A £2.4bn programme p.a. at its peak. Training and upskilling required to fill a wide range of roles.</p>
<p>Inclusive Growth Connecting people to economically viable opportunities, supporting career and work progression and using investment and procurement to drive change, grow local markets and supply chains, and increase productivity.</p>	<p>Digital businesses in West Yorkshire twice as inclusive as UK average offering more flexible working options. NEET free City Region.</p>	<p>Potential to create flexible jobs in a number of roles.</p>
<p>Tackling the Climate Emergency – the Combined Authority is working with partners to ensure Leeds City Region is a net zero economy by 2038</p>	<p>Investment in clean growth could add £11 billion to the economy and create over 100,000 jobs.</p>	<p>As above.</p>
<p><i>The Leeds City Region Energy Delivery Plan December 2018 – 5 strategic priorities</i> 1. Resource efficient business and industry 2. New energy generation 3. Energy efficiency and empowering consumers 4. Smart grid systems integration 5. Efficient and integrated transport</p>	<p>Green City Region web portal and one-stop shop. • Expand the advice and services provided under the Leeds Business Growth Hub to include advice on how to best 57 approach the transition towards low carbon energy opportunities, including environmental, energy and water topics • Create an online web portal that clearly signposts existing technical, financial and social support and that covers energy and environmental topics of interest to businesses, the public sector and individuals. Green curricula in apprenticeships Carbon Capture, Utilisation and Storage Heat networks H21 trials Public Estates renewables programme Community energy schemes Green bonds for financing renewables energy projects Scaling up Better Homes Yorkshire Funding from the original BHY was brought together from multiple sources, including national government (Green Deal Communities, Central Heating Fund), Growth Deal, local authority capital plans, ECO, customer contributions and National Grid. Whole system domestic energy efficiency retrofit demonstrator Public sector retrofitting Whole energy system approach pilot Energy storage for council-housing mounted solar PV Smart Leeds City Region</p>	<p>Scaling up retrofit will require progress on many of the initiatives proposed in the delivery plan.</p>
<p><i>The West Yorkshire Carbon Emissions Reduction Pathways report 2020</i> a net zero carbon economy by 2038, and to have made significant progress by 2030. By 2038, under the pathways, emissions from buildings would reduce by: • Max Ambition – 89 percent • High Hydrogen – 89 percent • Balanced – 84 percent</p>	<p>· Retrofitting nearly 700,000 homes with energy efficiency measures such as loft and cavity wall insulation · Installing heat pump heating systems in over 300,000 homes. · Generating enough electricity from onshore wind and solar to power more than 162,000 homes. · Investigating the implementation of carbon capture and storage technology to energy from waste facilities.</p>	<p>Scaling up retrofit aligns with the reduction pathways, adopting a ‘no regrets’ approach to investment decisions with awareness of future energy system transformation options.</p>
<p><i>The Leeds City Region Enterprise Partnership Local Industrial Strategy</i> Leeds City Region Enterprise Partnership (the LEP) aims to put healthy lives at the heart. Leeds City Region is a £70 billion regional economy but there is also an £11bn productivity gap. UK’s largest regional finance centre. UK’s highest number of manufacturing jobs.</p>	<p>Help workers adapt to technological change with better digital and creative skills delivered through inclusive, accessible training. Future-proof existing and future housing stock to reduce fuel poverty and create healthy, sustainable communities.</p>	<p>Scaling up retrofit proposals deliver against the Local Industrial Strategy.</p>
<p><i>The West Yorkshire Economic Recovery Plan</i></p>	<p>£10m for STEM skills £500,000 for Hub 30,000 new jobs Stage 1 - £50 million to accelerate over 25 schemes (£30m energy efficiency schemes improving 3500 homes, £20m for over 150 public buildings by 2022).</p>	<p>Developing the building blocks for a scaling up retrofit programme will be kickstarted by this funding.</p>
<p><i>West Yorkshire Combined Authority employment and skills programme – to be reviewed</i> <i>the Combined Authority digital skills partnership - established</i></p>	<p>The region has a highly skilled, diverse and flexible workforce that has access to good jobs and contributes to a productive, resilient and innovative economy. Employers are able to influence training provision that supports the progression of a diverse workforce. There is a stable learning provider base offering good quality education aligned to labour market needs.</p>	<p>Scaling up retrofit will require new training and upskilling provision for a range of roles required to deliver retrofit successfully across all levels.</p>
<p><i>West Yorkshire Combined Authority Devolution deal</i></p>	<p>Includes control of the £63m annual Adult Education Budget for West Yorkshire to closer align spending on skills to the opportunities and needs in the local economy. Government commitment to engage with the Combined Authority on priorities emerging from the Future Ready Skills Commission</p>	<p>As above</p>