CarbonCo–op

PWP3 D2_Householder Pay for Performance (P4P) demand assessment report

Ofgem SIF RetroMeter project (Discovery phase)

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Author: Helen Grimshaw and Jonathan Atkinson, Carbon Co-op
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Brief: to produce a Householder P4P demand assessment report, naming previous schemes delivered by Carbon Co-op and making a clear assessment of potential demand for a P4P financing solution, including highlighting barriers experienced in previous retrofit programmes both nationally and locally.

1. Executive summary

This deliverable sets out some of the key work done to date by Carbon Co-op on retrofit delivery. These previous projects show potential for ambitious retrofit schemes to be delivered. This ambition has several aspects - ranging from the scale of measures (in particular the notion of whole house retrofit, and not piecemeal or single measures), the centering of residents in design and delivery, area and neighbourhood based approaches, and a focus on high quality works. We believe our approaches can offer a high degree of control around design, specification and installation - which brings benefits when it comes to evaluating whether intended outcomes are met.

Within our own work, and the retrofit sector more broadly, we are understanding performance in more detail. We are observing general trends of digitisation and an appreciation for the role of quality data. This interest in performance and data exists within the owner occupier and social housing sectors in particular - and there is a growing sense that we are moving away from bespoke and 'one off' evaluation exercises, with demand for approaches that are scalable and can be integrated with wider retrofit systems and processes.

There is also increasing consensus around some key metrics - such as Energy Use Intensity (EUI) that support evaluation approaches based on 'actual' and metered consumption. Such metrics not only support Measurement and Verification (M&V) at a 'point in time', but also assist comparisons within the housing stock, and support target setting that is aligned with 2050/decarbonisation trajectories.

All of the projects discussed have a financing solution to them - from grants to loans and co-funding, demonstrating that there are a variety of financial solutions available, and the requirement in most cases to stack these.

The evidence on 'payment for performance' is less clear, particularly at the level of the householder. Research demonstrates a variety of motivations for householders commissioning works, with financial motivations only one among many. Related to this, the potential to evaluate the impact of retrofit works is complex - if motivations vary then the data required to evidence the delivery of 'a successful retrofit' is equally complex. Quantifying metered energy savings is one aspect of this - and presents methodological challenges in a domestic setting.

We believe it's important to acknowledge that there is a spectrum of 'pay for performance' - at the most basic level this involves payment for outcomes generated, and at the opposite end it involves contractual arrangements that are more complex. From a householder perspective, 'pay for performance' might simply equate to a 'cashback' bonus for those already doing retrofit. However, we know from experience that processes need to be simple and easy to navigate - because retrofit has many 'moving parts' as it is. To make this work requires an appreciation and experience of service design and systems thinking. For a delivery

provider, ‘pay for performance’ may form one aspect of finance stacking, but the risk of this needs to be manageable.

For this project, and any subsequent phases, it will be important to build in learning from programmes that have specifically operated in a domestic setting. For example, Energiesprong, whilst piloted in the UK has not seen the growth expected - what are the reasons for this, and is there relevance to the local delivery models that we try to pilot through alpha and/or beta phase of SIF.

2. Introduction

Carbon Co-op is a Community Benefit Society - it is an energy services and advocacy co-operative that helps people and communities to make the radical reductions in home carbon emissions necessary to avoid runaway climate change. It does this through the work of teams spanning:

- Energy systems
- Retrofit
- Energy commons

The potential of evaluation approaches, tools and services cuts across all three teams. Potential outputs from these projects (such as a data warehouse/insight) have relevance to our energy commons team delivering energy planning and engagement work in specific local areas.

This report summarises our work to date across domestic retrofit delivery, highlighting some of the key barriers to retrofit more broadly, plus learning from initial research with householders and retrofit service provider People Powered Retrofit (PPR) around evaluation and the potential for metered energy savings tools.

3. Retrofit delivery by Carbon Co-op

Prior to Community Green Deal (2012 onwards) Carbon Co-op's activities focused on advice, community champions, training and broadly exploring models for community involvement in domestic energy efficiency and retrofit. Three projects in particular have informed Carbon Co-op's delivery role to date:

A Green Open Homes event at a Carbon Co-op member's retrofitted home

3.1 Community Green Deal

Starting in 2012, this was Carbon Co-op's first foray into delivery. Community Green Deal was a pivotal scheme, not only for exploring the technical possibilities and challenges of retrofit, but also informing how Carbon Co-op would approach delivery on future projects. This was a challenging project (exposure to risk, procurement of contractors) but one that generated a huge amount of learning.

Relevance and/or learning for P4P

This project involved stacking of different finance streams, with owner occupiers contributing their own savings, zero interest loans (offered as part of the Department of Energy and Climate Change pilot programme) and small elements of ECO (Energy Company Obligation) grants. Whilst the programme had an overall

ambition to reduce carbon emissions to 80% of 1990 levels, performance outcomes (in energy savings or otherwise) were not contractual or linked to the loans available. However, the project generated key learning for Carbon Co-op around:

- the administrative costs of stacking finance, the risks associated with it, and the organisational capacity and skills needed.
- the interest in post-occupancy evaluation from this 'pioneering' set of householders, with one leading on the data collection and analysis post-works (informing the CIBSE technical symposium paper referenced below). It is worth noting that demand for evaluation may vary between these early adopter householders and the 'mass market' and 'laggards.'
- The inadequacy of modelling techniques such as RdSAP (Reduced version of the government's Standard Assessment Procedure) - e.g. a household receiving substantial fabric and heating works, and who has subsequently installed a heat pump and heat battery, has seen a lowering of the EPC (Energy Performance Certificate) rating each time.
- Recouping of investment - several years later one householder sold their property, and how the value of the retrofit work could be demonstrated to potential buyers was of interest to them.

3.2 Energy Empowerment Greater Manchester

(2018, funder Friends Provident Foundation)

This project aimed to develop a new whole house retrofit business model. By incorporating finance, technical expertise, supply chain development, householder engagement, and dissemination of lessons learnt, the project sought to establish a closed-loop economic system that built local social capital through investing in domestic retrofit. Delivery was envisaged through the Levy Area Based Scheme, and although elements of this were delayed by the pandemic - the project supported valuable development work. This scheme is now in the design and planning stage, and also linked to the Ebento project (both of which are further outlined below) which will generate learning related to data collection and pay for performance schemes.

3.3 People Powered Retrofit: research and development phase

Energy efficiency is a key part of decarbonisation efforts in the UK, but there is a lack of effective retrofit policies, business models or delivery mechanisms, especially for the 'able-to-pay' owner-occupier sector. The BEIS (Department of Business, Energy and Industrial Strategy) 'Call for Evidence on Building a Market for Energy Efficiency' (2017) signalled a change in approach from government, highlighting small scale contractor networks, trusted community intermediaries and a localised approach to creating new markets. BEIS funded a series of pilot approaches to build learning on the effectiveness of such approaches - People Powered Retrofit was one of these and started as a partnership project between Carbon Co-op and URBED. It involved a six-month research and development phase which ended in March 2019, followed by a two-year delivery phase from 2019 to 2021.

The research phase for PPR included analysis of financial offers, as this is commonly cited as a barrier to retrofit. In this research we examined several different types of finance, including:

- Commercial retrofit mortgages and loans
- Interest free loan offers
- Green loans via credit unions
- Lifetime mortgage and equity release
- Pay as you save models, including Energy Performance Contracts.

This research highlighted that whilst Energy Performance Contract type arrangements have been rolled out in a number of EU countries including the UK (most notably in the Greater London Authority RE:FIT programme), these schemes have focused on public buildings and to a lesser extent public housing. Private business contracts are less common and very little has been done in terms of private domestic properties (due to the high contract arrangement fees). There are examples of community energy ESCO (Energy Services Companies) initiatives around 'pay as you save,' such as Brighton and Hove Energy Services Co - but in this case costs are not guaranteed and therefore the risks of under-performance lie with the householder rather than the installer.

What do our members need?

In interviews and focus groups – of the eight households interviewed only one considered finance to be their most significant barrier, though for three households it was significant. In the focus group the offer of assistance with identifying possible grants and subsidies scored 18/20 and the possibility of a low interest retrofit loan was 17/20 in terms of usefulness for their retrofit project. All our focus group felt that an interest free loan would encourage them to take more significant carbon reduction measures than they were considering at present. Membership survey - In terms of householders who responded to our Carbon Co-op member survey a small majority said that finance was a barrier, in terms of borrowing 64% had the money to carry out the majority of works and would be looking to borrow less than 25% of the total cost of their retrofit, vs. only 3% who are looking to borrow the full costs.

People Powered Retrofit was spun off into its own Community Benefit Society in 2021 and is delivering services to support homeowner clients on their whole house retrofit journey. It also works on supply chain development and training, as well as supporting other community based intermediaries to replicate aspects of the approach.

Carbon Co-op members pictured outside of their retrofitted home.

Relevance and/or learning for P4P

In summary, for the majority of current Carbon Co-op members finance is not the primary barrier to retrofit works, that said low cost or interest free finance options can be used as a spur to action in particular in encouraging deeper retrofit. Finance is likely to become a more significant challenge if we expand from our current membership base into a more mass market programme.

4. Retrofit Improvement measures

The following tables summarise projects that involve physical works to homes:

Community Green Deal	
Primary objectives	To deliver a whole house retrofit project for owner occupiers testing elements of the government's Green Deal.
Dates	2012 - 2015
Location	Greater Manchester
Number of homes	12
Tenure	Owner occupier
Types of homes	Mid and end-terraces, semi-detached
Measures	Varying combinations of: External wall insulation Internal wall insulation (as appropriate, often on front elevation) Triple-glazed timber replacement windows New insulated doors Humidity controlled passive stack ventilation systems Loft insulation top up Floor insulation Air tightness works High-efficiency solar photovoltaic panels Low flow hot water fittings New efficient boilers to some homes Note: no electrification of heat. At this time, the understanding of domestic heat pumps and suitability was in infancy.
Finance	Blend of: Household savings Zero interest loans (DECC funded pilot) ECO Grant funded design work
Contractual relationships	9 households were consolidated into a single contract, with Carbon Co-op sitting between the householder and contractor.
Savings delivered	Average of 47% reduction in gas use. PV panels generate approximately as much electricity as the household uses. The project came very close to achieving the ambitious target of cutting emissions to 17kgCO2/m2.a (representing ~80% emissions cut from 1990 levels needed to reach the nation's (then) 2050 emissions target). Bill savings between £200 and £650/year. Comfort improvements.

Evaluation methods	Manual data collection and analysis using bills, comparison with pre-retrofit and modelled data. Mostly compiled and analysed by the retrofit designer and one active householder participant. Findings shared at CIBSE Technical Symposium 2017 (Heaslip and McCann, 2017).

Levenshulme Area Based Scheme (ABS)	
Primary objectives	To bring together innovative forms of finance, bulk procurement, contractor training, and householder and community engagement to pilot a closed-loop economic system for local domestic retrofit through a community client intermediary.
Dates	Early engagement/targeting in 2020 (then paused due to COVID) - as of April 2023, at design and planning stage.
Location	Levenshulme, Manchester (3 clusters of homes - some on same streets or neighbouring properties).
Number of homes	8
Tenure	Owner occupier
Types of homes	Mid and end-terraces
Measures	Set package of retrofit works, similar to the other houses in the scheme, but with small adjustments to fit the home and household's priorities, including: Loft and roof insulation Replacement doors High performance double glazing Draught proofing Decentralised MEV External wall insulation Heating control upgrades Cap and fill chimney, chimney balloon
Finance	Blend of: Grant funding Zero interest loans (local authority financed Group Works Assistance Loans)
Contractual relationships	As Community Green Deal - households will be consolidated into a single contract, with Carbon Co-op sitting between the householder and contractor, and commissioning designers and other professionals.
Savings delivered	N/A project is at design and planning stage.
Evaluation methods	Mixed methods - in-depth qualitative data collection with householders and stakeholders (e.g. surveys, interviews around

	perceptions of comfort, health impacts, affordability etc to satisfaction with process). Quantitative data collection - linked to Ebento project aims.

5. Other relevant Carbon Co-op projects

5.1 EBENTO

A 3 year innovation partnership project, funded under the European Union's Horizon research and innovation programme. The EBENTO project aims to:

- develop an integrated platform for all actors involved in the building renovation sector
- be a one-stop-shop platform to enhance the coordination and management of energy performance contracting (EPC)
- gather data on energy performance, comfort, financial schemes, technologies and competencies.

The Levy Area Based Scheme (ABS) forms one of 4 demonstrator projects. The other residential projects in Spain, Greece and Estonia differ in ownership and control structures - the Levy ABS offers an alternative perspective in the challenges of data access, collection, monitoring and evaluation with multiple owner occupier households.

The project will generate learning on different performance based business models (for example, through stakeholder interviews being conducted spring-early summer 2023) and data collection frameworks/repositories to support the implementation of these. Monitoring equipment is also being installed in Levy ABS homes with a view to collecting a robust set of baseline and post-works data.

5.2 Social Housing Decarbonisation Fund (SHDF)

Staff at Carbon Co-op have experience of SHDF projects, particularly those in the Demonstrator cohort. In particular, this involvement was around the monitoring and evaluation approach and setting up systems for data collection. This included working with monitoring and heating control platform Switchee on one project. The SHDF funding waves are of interest, as there has been a general trend away from substantial monitoring and evidencing of outcomes towards a looser approach on later phases. We suspect there are several factors driving this, including the tight timescales for delivery and a lack of skills, capacity and administrative resourcing for this work amongst those delivering projects. It is also worth noting that a significant focus on publicly procured schemes of this kind, is the emphasis on comfort and internal environmental quality. However, delivering bill savings for tenants is also a driver, and this may be an area of interest in relation to pay for performance models and verification methods.

The move towards 'digitalisation of retrofit' (from a government perspective, and for housing providers) could be a considerable opportunity for verification methods and potential pay for performance models.

The table on the next page outlines the approach to monitoring and evaluation across the SHDF funding waves.

	SHDF Demonstrator	SHDF Wave 1 (2021)	SHDF Wave 2.1 (2022)
Aims	Broadly concerned with performance aspects (including meeting 50 kWh/m2/year space heating demand, whether fabric and systems perform as intended), plus the impact on residents. - Energy, bills and carbon savings delivered in each home. - Comfort - which should be achieved or improved in all internal spaces.	- To at least minimum EPC Band C; except Band F/G homes that cannot reach this (Band D instead). - Space heating demand target of 90 kwh/m2/year or better (as per SAP 2012) (or justification if not achievable). - Tenant energy bills should not increase for equivalent home warmth, and it is expected that bills will reduce.	As per wave 1 in terms of EPC band and space heating demand target, plus: - to maximise comfort and bill savings for tenants and to maximise the home's suitability for low carbon heating either now or in the future. - optional innovation support of up to 2% of capital spend per bid, or a maximum of £600k per bid, to assist in the digitalisation of retrofit.
Delivery	- PAS2035 compliant - Evaluation & reporting on metrics - External evaluation commissioned by BEIS (address level modelling, phone surveys with residents)	- PAS2035 compliant - Reporting on metrics to BEIS - External evaluation commissioned by BEIS (address level modelling, research with tenants, installers and delivery partners).	- PAS2035 compliant - Reporting on metrics to BEIS - External evaluation commissioned by BEIS (address level modelling, on-site and in-person interviews and fieldwork with selected project leads, their delivery partners and project beneficiaries).
Specified monitoring parameters	- Internal temperature - Relative humidity - Space heating energy demand	None	None

	- Indoor air quality (VOCs, CO2, Particulates) - Thermal imaging (optional)		
Other notes		“BEIS will support this endeavour by streamlining and automating as much of the data collection process as possible, making use of algorithms to calculate potential carbon savings and aggregate data rather than requiring awarded parties to double key information.”	‘Digitalisation of retrofit’ support*.

* The definition of the digitalisation of retrofit considered for SHDF Wave 2.1 funding encompasses the following:

- The usage of smart technology, sensors and monitoring platforms to collect relevant real world data (from the properties being retrofitted) for the assessment of properties to enable retrofit, or after retrofit for monitoring and evaluation purposes.
- The usage of building information modelling technology to design retrofit solutions using real world data from the properties being retrofitted.
- The usage of energy efficiency measurement and electricity demand management tools to optimise energy usage, including reducing peak demand.
- Other innovative digital technologies may be considered where they are clearly distinct from typical retrofit practice (where typical practice includes conventional stock modelling) and drive benefits in cost or time efficiency, scalability, or quality of information. Applicants using this definition should define why the technology is innovative, what the benefits are, and how they will adopt them.

6. Barriers to domestic retrofit, nationally and locally

Much has been written about barriers to retrofit across the industry which we don't intend to replicate in detail here. However, our experience at Carbon Co-op amplifies the following themes:

Policy

- Immature market for the owner occupier sector in particular - previous policy interventions (like 'pay as you save') failed to take account of the complexity of retrofit and householder decision making – particularly when considering multiple measures.
- Planning policy - there is often a lack of specific domestic retrofit policies and practical information at a local level. What does exist is often not joined up with other policies (such as heritage and conservation) and guidance is scattered and at times incoherent.
- Uncertainty and/or fluctuating policy and funding landscape for social landlords. Funding scheme requirements frequently change (including monitoring and evaluation aspects).

Process/approach

- Pre-conceived standardised approaches to marketing segmentation, promotion, sales, delivery and supply chains are not relevant or appropriate to the able to pay sector.
- EPC data is often unreliable and inaccurate - and this is the backbone of targeting and decision making in the social housing sector in particular.
- Unproved business case for retrofit - in Palmer et al., study, interviewees said advocacy around the commercial and operational benefits could be improved, including reducing running costs for tenants, complaints, and maintenance costs.

Physical/infrastructure

- Concerns over the quality of work (common across tenures).
- Insufficient contractors to satisfy householder demand for quality retrofit, with a historical lack of engagement with those operating in the RMI (refurbishment, maintenance and improvement) sector and who are well placed to deliver household level works. The same goes for other professionals essential to quality works - such as architects - that adequately understand building physics risks and the integration of measures.

- Access to poor quality data for baselining and evaluating works - smart meter installations in particular are still patchy and so the availability of metered data is not consistent across clients within a service.

The PPR Research and Development phase report (Atkinson *et al.,* 2019) outlines in more detail key barriers experienced by owner occupiers (particular those considered 'early adopters'), as well as suggesting ways that an approach like PPR might start to overcome them. Of particular relevance:

- We found **financial imperatives and 'pay back' were not key barriers or driving factors for decision making** - contradicting accepted thinking in this area. Instead, householders were influenced by a range of intangible motivations and drivers including quality of works, climate change concerns, quality of life, health, comfort and home environment and the attitudes of friends, neighbours and co-workers. These motivations and priorities are important to evaluation, because they are the factors against which invested parties want to measure change.

- Reasons for being 'stuck' on a retrofit journey varied, but the most significant were:
    - Being **overwhelmed by the complexity and technical detail** involved in retrofit.
    - **Difficulty in making key decisions** with worries about risks and what could go wrong.
    - Being **confused by conflicting advice** from different professionals within the sector.
    - **Problems finding contractors and problems with ensuring high quality works.**

- We looked at options for householders seeking finance for home retrofit projects with our research concluding that **financial barriers are not as significant as had been previously assumed.** Despite this, we did find that small amounts of funds, i.e. 0-25% of project works budgets, could enable householders to go further in the scope and scale of works i.e. from single measures to multiple ones, or from advanced measures and phased approached to a full whole house retrofit undertaken in one step. It is worth noting that finance may be a more significant barrier now, with inflationary/cost of living pressures, rising costs of borrowing etc.

- Energy and data are increasingly interlinked and **a range of ICT and back-end systems are required to deliver end to end retrofit services.** Data management requirements include qualitative information about householder motivations, expectations and briefs, assessment data relating to home construction and building materials and ongoing energy bill and home environmental data to baseline performance and track impact.

7. Routes to retrofit and evaluation

As part of the business development work for OpenEnEffs (Open Energy Efficiency – a project funded by InnovateUK under the Prospering from the Energy Revolution programme) we looked at the broader context for retrofit and evaluation for different use cases. This is important to understand when looking at barriers to P4P (pay for performance) models and evaluation more broadly.

Routes to retrofit and evaluation in the **owner occupier/able to pay** sector:

Route	Description	Likely evaluation approach	Relevance to metered energy savings approaches
Retrofit procured in response to specific funding opportunities (e.g. Social Housing Decarbonisation Fund - SHDF, Green Homes Grant Local Authority Delivery, Home Upgrade Grant)	Measures to bring properties up to a particular standard - for example, EPC band C, a particular space heating demand target (e.g. 90kWh/m2/year). Procurement routes will vary, but professionals are likely to be involved in design, planning and delivery.	The evaluation approach is likely to be driven by the funding criteria. For example, on SHDF demonstrator projects extensive evaluation was required, and housing providers were likely willing to commission an expert consultant as part of the team. This kind of evaluation may be more focused on detailed BPE techniques (e.g. measures of thermal performance, in-depth internal monitoring). On later phases of SHDF, evaluation requirements were relaxed and could be delivered as part of standard PAS2035 activities.	Possible role for a tool in a basic to intermediate[1] evaluation service offer, with the number of homes in a programme meaning there are efficiency gains over (relatively easy) interrogation of meter/bill data and degree day analysis. However, PAS2035 requires lodgement at property level, with the primary evidence requirement at basic level a simple occupancy survey. Evaluation in PAS2035 is linked to 'intended outcomes' - so the metrics a provider wants to evaluate may include energy savings, but also several other metrics (such as fuel bill, carbon savings, comfort, air quality).
Retrofit procured as part of planned stock improvement programmes.	Opportunity taken to install measures alongside other improvement works (for example, roof replacement with insulation, gable wall repairs with	There may be minimal evaluation (e.g. tenant satisfaction). This is likely to be done in-house, or required of the contractor through procurement processes.	A tool may provide useful data to reinforce the approach of combining retrofit with stock improvement. This could be particularly useful on single meter point applications (e.g. a block, substation). However, where EPC ratings remain a key driver (including regulatory), there may be little incentive. Ease of use and low cost will

[1] PAS2035 operates an 'escalation' approach to evaluation, with more in-depth 'intermediate' evaluation only required where outcomes from basic evaluation show significant divergence from intended outcomes. Intermediate and advanced stages require more detailed building performance evaluation techniques and probing that would not be addressed by PowerShaper Tracker.

	EWI, ventilation with kitchen/bathroom replacements).		be important given the above and financial pressures elsewhere. The quality of housing data varies and landlords have a limited understanding of where smart meters have been installed.
Retrofit procured as part of an energy performance contracting programme (such as energiesprong[2], although approaches vary).	The contractor/solution provider signs a performance guarantee.	This model of delivery may require closely monitoring the energy consumption (and other metrics) post-completion - in the case of energiesprong this includes segregating end uses sufficiently. Relevant metrics: - Net energy consumption - Space heating energy demand - Resident electricity use allowance In other sectors (such as public sector buildings) energy performance contracts are already in use - an example being the Re:fit framework (Local Partnerships, online). In this case energy savings, usually in kWh and £s, are agreed and contractually guaranteed, and once the measure has been installed or delivered, they must be measured and verified.	Potential applicability is high, but in housing the market is extremely immature, with a very different context to the commercial sector. Energiesprong targets apply per property, across a scheme. For this reason whilst you might want portfolio level analysis, you'd also want individual property level calculations run. Interest in range (e.g. maximum and minimum consumption) for portfolio level analysis. May be dealing with a high number and granularity of metrics in assessing performance overall - which may limit the relevance of a metered energy savings metric.

Routes to retrofit and evaluation in **publicly procured** domestic retrofit:

[2] An example of this being Energiesprong. See Gill, Z (2022) for details of the metrics used in the performance guarantee.

Route	Description	Likely evaluation approach	Relevance to metered energy savings approaches
Retrofit procured in response to specific funding opportunities (e.g. Social Housing Decarbonisation Fund - SHDF, Green Homes Grant Local Authority Delivery, Home Upgrade Grant)	Measures to bring properties up to a particular standard - for example, EPC band C, a particular space heating demand target (e.g. 90kWh/m2/year). Procurement routes will vary, but professionals are likely to be involved in design, planning and delivery.	The evaluation approach is likely to be driven by the funding criteria. For example, on SHDF demonstrator projects extensive evaluation was required, and housing providers were likely willing to commission an expert consultant as part of the team. This kind of evaluation may be more focused on detailed BPE techniques (e.g. measures of thermal performance, in-depth internal monitoring). On later phases of SHDF, evaluation requirements were relaxed and could be delivered as part of standard PAS2035 activities.	Possible role for a tool in a basic to intermediate[3] evaluation service offer, with the number of homes in a programme meaning there are efficiency gains over (relatively easy) interrogation of meter/bill data and degree day analysis. However, PAS2035 requires lodgement at property level, with the primary evidence requirement at basic level a simple occupancy survey. Evaluation in PAS2035 is linked to 'intended outcomes' - so the metrics a provider wants to evaluate may include energy savings, but also several other metrics (such as fuel bill, carbon savings, comfort, air quality).
Retrofit procured as part of planned stock improvement programmes.	Opportunity taken to install measures alongside other improvement works (for example, roof replacement with insulation, gable wall repairs with EWI, ventilation with	There may be minimal evaluation (e.g. tenant satisfaction). This is likely to be done in-house, or required of the contractor through procurement processes.	A tool may provide useful data to reinforce the approach of combining retrofit with stock improvement. This could be particularly useful on single meter point applications (e.g. a block, substation). However, where EPC ratings remain a key driver (including regulatory), there may be little incentive. Ease of use and low cost will be important given the above and financial pressures elsewhere.

[3] PAS2035 operates an 'escalation' approach to evaluation, with more in-depth 'intermediate' evaluation only required where outcomes from basic evaluation show significant divergence from intended outcomes. Intermediate and advanced stages require more detailed building performance evaluation techniques and probing that would not be addressed by PowerShaper Tracker.

	kitchen/bathroom replacements).		The quality of housing data varies and landlords have a limited understanding of where smart meters have been installed.
Retrofit procured as part of an energy performance contracting programme (such as energiesprong[4], although approaches vary).	The contractor/solution provider signs a performance guarantee.	This model of delivery may require closely monitoring the energy consumption (and other metrics) post-completion - in the case of energiesprong this includes segregating end uses sufficiently. Relevant metrics: - Net energy consumption - Space heating energy demand - Resident electricity use allowance In other sectors (such as public sector buildings) energy performance contracts are already in use - an example being the Re:fit framework (Local Partnerships, online). In this case energy savings, usually in kWh and £s, are agreed and contractually guaranteed, and once the measure has been installed or delivered, they must be measured and verified.	Potential applicability is high, but in housing the market is extremely immature, with a very different context to the commercial sector. Energiesprong targets apply per property, across a scheme. For this reason whilst you might want portfolio level analysis, you'd also want individual property level calculations run. Interest in range (e.g. maximum and minimum consumption) for portfolio level analysis. May be dealing with a high number and granularity of metrics in assessing performance overall - which may limit the relevance of a metered energy savings metric.

[4] An example of this being Energiesprong. See Gill, Z (2022) for details of the metrics used in the performance guarantee.

8. Assessment of potential demand for a Pay For Performance (P4P) financing solution

The **lack of financing options** (see for example, the BEIS Green Homes Finance Accelerator, online) for owner occupiers means there are few drivers ('sticks and carrots') currently. However, Carbon Co-op and partners PPR are exploring projects in this area (including further research) as early as this summer.

Very few or no precedents for metered energy savings, particularly in the owner occupier sector. There are no precedents (in the UK at least, for homes in the private sector) for grant or loan schemes mandating metered energy savings (or indeed measures of 'actual' performance). At present, most vetting relates to proof of installation by a competent scheme or person (e.g. a Microgeneration Certification Scheme - MCS - certificate), adhoc visual checks to ensure a measure actually exists and possibly an updated EPC (i.e based on modelled data). For example, Ecology Building Society's C-change retrofit discount (online) on their mortgage offer works through a pre and post-works EPC comparison.

8.1 Learning from past schemes

The Green Deal was designed on the premise of 'pay as you save' and there was research done to gauge householder appetite as part of this (Energy Saving Trust and DECC, 2011), but it was a significantly different approach - i.e. not based on performance or 'actual' data. Furthermore, the National Audit Office (2016) found that:

"The Department did not test the Green Deal finance design with consumers. Many stakeholders warned the Department that it would be difficult to persuade people to pay for measures themselves. Its own consumer survey did not provide a strong case for schemes like the Green Deal creating demand. The Department understood these concerns, but implemented the scheme anyway, as it believed its market-led model held little financial risk for the government. Even where there was consumer interest, people were initially put off by the complexity of the process of arranging a loan."

The nearest most householders have come to 'pay for performance' is payments for renewable electricity or heat generation (via Feed In Tariffs and Renewable Heat Incentives) - where they have been rewarded for the kWh generated by their domestic systems. However, deeming was a common element of those programmes (i.e. payments based on an estimated heat demand from an Energy Performance Certificate, up to a cap). Later changes to these schemes - such as the Renewable Heat Incentive requirement for 'metering for performance' for heat pumps (and the Metering and Monitoring Service Package route - Ofgem online) are

primarily about helping participants measure their heat pump's electricity usage and efficiency.

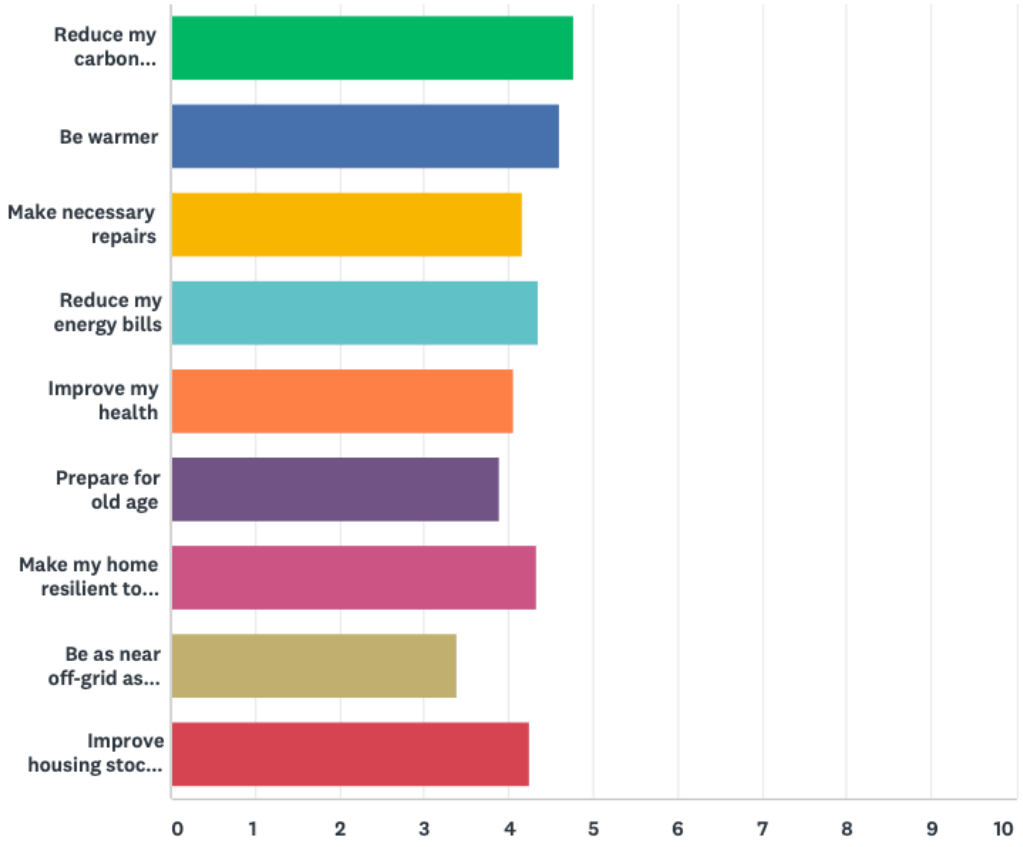
We believe the value proposition for fabric works (such as insulation) is more nuanced, and the range of factors that influence performance is complex. This is one of the reasons why models like Energisprong have such granularity (and complexity) within their energy performance guarantee. Some of the findings of their UK pilots are shared online (Energiesprong UK, online).

There are some important lessons here around:

- Engaging householders on potential pay for performance models, which are very unfamiliar, particularly in the owner occupier sector
- Engaging householders on the monitoring, evaluation and data access requirements of any such approaches
- Understanding the broader context and barriers of domestic retrofit, and the objectives of householders and intermediaries - to avoid adding further complexity and ensuring that any such approach or tool compliments 'the whole.'

8.2 Past Carbon Co-op research on motivations for retrofit

Our research and projects over the past decade tells a narrative of householders being influenced by a range of intangible motivations and drivers including quality of works, climate change concerns, quality of life, health, comfort and home environment and the attitudes of friends, neighbours and co-workers.



Carbon Co-op membership survey: 2018 (50 respondents to this question)

(Note: the top motivation is 'reduce my carbon emissions,' and the bottom three are 'make my home resilient to future environmental impacts,' 'be as near off-grid as possible,' and 'improve housing stock for future generations.')

Other themes (from other comments):

- Acting as an exemplar for others
- Generate learning for their next home
- Improve the home environment more generally (e.g. improve natural light)
- Reduce the heat load/energy demand for a future tenant
- Improve grid resilience

Of these respondents:

- 82% (41) strongly agreed or agreed that when making decisions they would weigh up financial costs with potential carbon savings. 6% (3) neither agreed nor disagreed, and 12% (6) disagreed or strongly disagreed.
- 58% (29) strongly agreed or agreed that they like to monitor home energy usage.

Retrofit personas

The Rogers Innovation curve (Rogers, 1962) divides householders into Innovators, Early Adopters, Early and Late Majority and Laggards. The focus for services like People Powered Retrofit is Innovators and Early Adopters as they constitute a targeted but sizable fraction of the population (around 15%) and are more motivated to commission work and tolerate disruption. Informed by the work of Val Mitchel and Victoria Haines at Loughborough University (Haines and Mitchell, 2014), during the research phase of People Powered Retrofit we developed a series of 'retrofit personas' to further breakdown target 'Early Adopter' householders. The most common and relevant personas from the Carbon Co-op member survey results were:

Persona	Description	Priorities and motivations
Civic Minded Retirees	Looking for comfort and long-term security of costs in their home. Often also wishing to make a contribution to the wider community by 'doing the right thing'. Limited in own technical know-how, and don't want to get involved in the very technical detail, but want to make sure it's a good job, so guarantees and accreditations matter. Likely to want to get 'big jobs' out of the way in one go so they can enjoy their home in comfort. May also be looking to include age-friendly adaptations such as downstairs bathrooms.	Creating a secure and comfortable home. Cost certainty (both capital and future expenditure). Keen to make sure it's a good job. Leaving a good legacy - in their home and to the wider world.
Climate Pragmatists	Looking to make a comfortable family home, whilst tackling energy efficiency improvements. Don't want to waste money, but sees improvements as an investment, and willing to go beyond just those measures that offer quick simple payback - so long as the value can be defined. Due to limited budgets and ability to put up with disruption may be aiming for a whole house retrofit in stages. Likely to have existing contacts with local builders - but these builders may not have the skills needed for retrofit work. Want some control, but happy to pay trades and professionals to deal with the detail.	Comfort and value (in cash and carbon terms) are key priorities. Retrofit needs to fit around family life and work commitments.
Climate Idealists	Driven to make deep retrofit improvements due to concerns about climate change mitigation and adaptation. Willing to put in a	Climate concerns are key motivator, most decisions

	lot of time, effort and money to meet the climate challenge. See themselves as pioneers creating exemplar projects. Very concerned with quality and energy performance, but may be less motivated by aesthetic concerns. Likely to be unsentimental about the existing features of a house and willing to make dramatic changes. See themselves as part of a society-wide project.	will be filtered through this Lens. Committed and keen to share knowledge and understanding.

These (and other) personas may be worth revisiting in view of the pilot programme design/targeting and any 'pay for performance element' - particularly when considering the definition of 'performance' and how any value from that is distributed, as well as appetite for sharing data and being part of an innovative programme.

8.3 Learning from OpenEnEffs: engagement with People Powered Retrofit on metered energy savings

Whilst in our research for OpenEnEffs PPR acknowledged energy performance contracting, any further exploration of this is likely to be significantly down the line for them. The service is focused initially on finessing support for householders, and significant effort is being invested in supply chain engagement and training; i.e. there are other, more critical, barriers to be overcome first. Performance contracting is felt to be a step too far currently. We believe this may limit the role of a metered energy savings tool in this context in the short and medium term.

Primary research with householder clients confirmed motivations for retrofit, which is useful for informing what they would look for in an evaluation offer. Of greatest relevance is an interest in 'reducing home energy demand,' but all themes ranked highly (including reduction in carbon emissions, improved comfort, reduced fuel bills, improved air quality, and delivery to a high standard). This suggests that whilst a metered energy savings metric is likely to be of interest, this will sit within a broader evaluation exercise that seeks to capture the other metrics. It is also important to note that the sample size for this survey was small, albeit an engaged cohort (<10).

At an individual property level, the service has concerns it may duplicate work that would be done anyway (should a basic analysis of pre/post works energy data be done), and if the savings are not as expected, i.e. small or there is greater energy use, you would want to explore this in more detail (by probing occupancy, behavioural, building factors) anyway. They also questioned the extent to which the methodology and tool adds value over simple analysis of bill/meter data with a simple degree day calculation.

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