How will the retrofit programme to achieve net zero carbon impact customers?

orbit building communities

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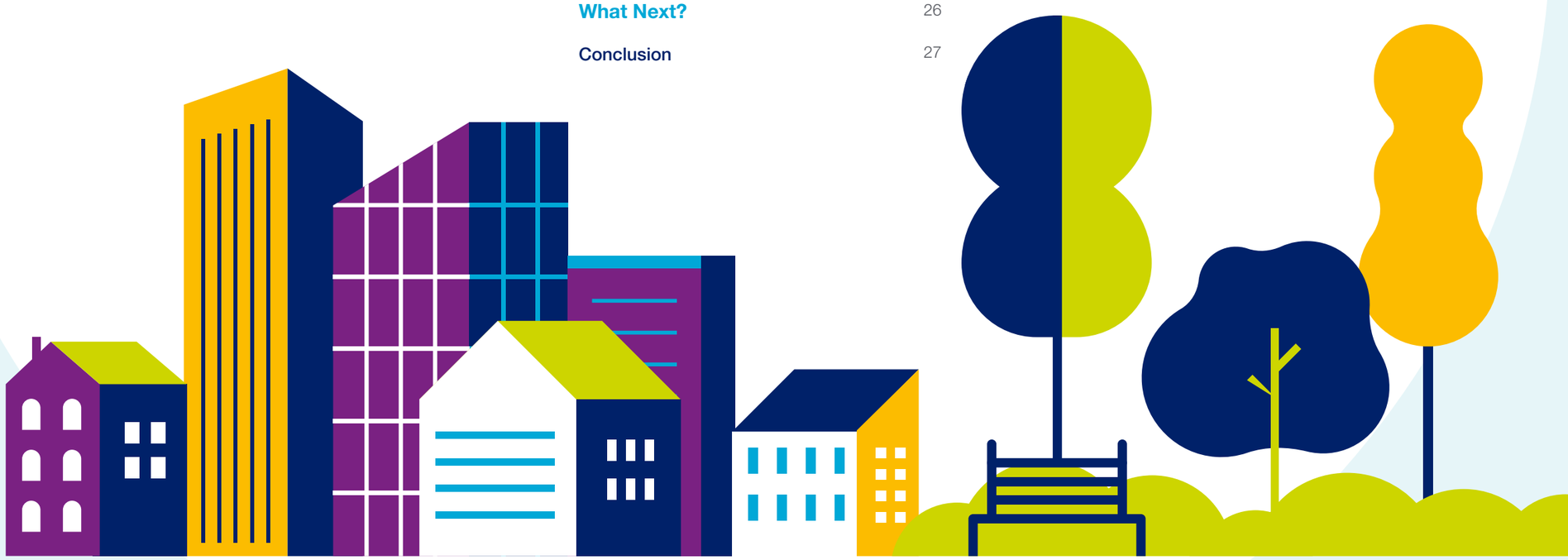
Contents



INTRODUCTION

Executive summary

Orbit recognises the immediacy of the climate emergency and has a responsibility as an organisation to act on direct and indirect emissions, including the portfolio of Orbit properties. Orbit's 2025 corporate strategy reflects the importance of action to adapt to a changing climate, drive decarbonisation, and develop a net zero carbon strategy.

The UK Government's 2050 net zero carbon target places significant challenges on housing with 80% of homes that will exist in 2050 having already been built today. National commitments for social housing also require Orbit homes to meet the EPC target of C and above by 2030. Therefore, Orbit faces a long term challenge to retrofit existing housing stock through cost effective and innovative means.

As part of Orbit's organisational culture, customers are at the core of how Orbit tackles environmental challenges. Through tackling climate change, **Orbit must balance customer's needs and ensure a positive outcome for both them and the environment**, indeed these two things are intertwined and trying to satisfy them independently will not realise true success or sustainability.

There are increasing developments and trials in retrofit technology but limited research into how these changes will impact people living within these homes. To address this gap, Orbit commissioned a research project with the University of Leeds to investigate how the decarbonisation retrofit programme will impact its customers in situ.

In early 2021, Orbit successfully secured £1.45 million as part of the Social Housing Decarbonisation Fund (SHDF) Demonstrator pilot in partnership with Stratford-On-Avon District Council, which supports the decarbonisation of social housing over 2021/22.

The UK-wide scheme supports Orbit and 16 other Demonstrator projects to demonstrate innovative approaches to a **whole-house retrofit approach** at scale. In addition to the £1.45 million funding, Orbit is investing a further £2.2 million into the project, assessing the efficacy of installing carbon reduction measures on current housing stock. The project will not only improve the energy efficiency of customers' homes but go one step further and contribute to meeting the UK's net-zero carbon emissions target.

Orbit has set out a high level strategy to net-zero carbon for existing stock in line with government targets, it follows a staged approach to retrofit works over 30 years, by enhancing the fabric of the building (e.g. loft insulation and double glazed windows) reducing the demand for energy, changing the heating type (e.g. air-source heat pumps) reducing the need for fossil fuel consumption, and installing technologies (e.g. solar panels) to offset the remaining emissions. Advances in technology and funding cycles underline Orbit's incremental approach. In contrast, the SHDF requires Orbit to adopt a whole-house approach, in which retrofit works are completed all at once. A whole-house retrofit approach sees the property as a system of interfaces and users that interact, not independent of each other and from users' practices and lifestyles.

This research focuses on how the retrofit works will impact Orbit's customers in situ both during the retrofit process and post-completion, with a particular focus on fuel poverty, thermal comfort, and mental and physical wellbeing. The research aims to identify the benefits and challenges of a whole-house approach, whilst considering the role of communication, awareness and technology to identify opportunities to minimise disruption to the customer and facilitate adaptation to retrofit changes for optimal environmental performance.

Recommendations

The following recommendations are outcomes of the project: '***How will the retrofit programme impact customers?***'. The research focuses on how the retrofit programme will impact Orbit's customers in situ both during the retrofit works and post-works, with a particular focus on fuel poverty, thermal comfort, and mental and physical wellbeing.

Recommendation 1:

Increase community participation in the decarbonisation agenda from now until 2050 and allow customers to make non-technical decisions during the pre-work stage of the retrofit programme.

Recommendation 2:

Develop customer segmentation of categorised household types.
Conduct customer profiling to enable most suitable engagement throughout the retrofit process. Households types should look for similarities in current levels of customer satisfaction with Orbit and current energy consumption behaviours and attitudes.

Recommendation 3:

Invest in employee training to increase awareness and understanding of Orbit Earth's commitments and, more specifically, Orbit's decarbonisation strategy. The training should be offered to all customer-facing positions, including all PAS2035 roles.

Recommendation 4:

Build transparency and trust throughout the retrofit programme by managing customer expectations and collaborating with customers on mitigation and offsetting strategies.

Recommendation 5:

Collaborate with other social housing providers undertaking demonstrator projects to develop a toolkit on retrofit best practice which focuses on customer experience.
The toolkit could contain a checklist of strategies which applies to all customers and all housing stock.

Recommendation 6:

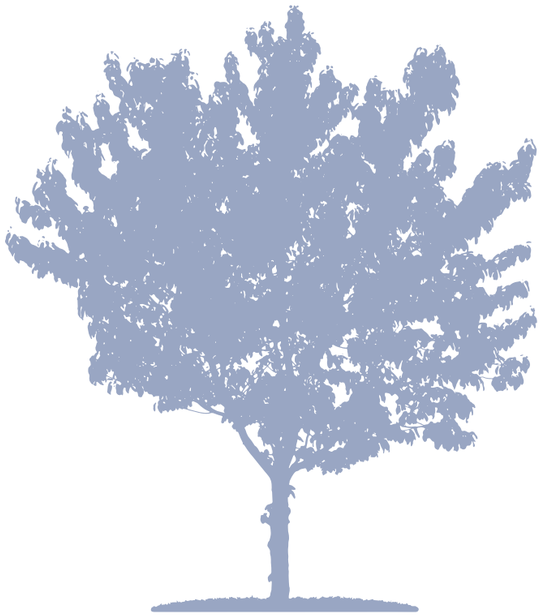
Focus on the importance of communication and awareness within the pre-works, handover and future repair stages in order to mitigate risks during the Works and Post-works stages.

Recommendation 7:

Integrate the learnings from 'whole-house in one go' retrofit approach into the net zero carbon strategy to reflect the customer voice.

Recommendation 8:

Address traditional negative associations surrounding electric heating systems.
Start to change the narrative to aid transition to new technologies.



THE PROJECT

Project Design

Key aims

1. Identify and evaluate the risks associated with the retrofit programme and its outcomes, to minimise disruption to the customer.
2. Identify areas of opportunity during the retrofit programme and the effects on customers to facilitate customer adaption to retrofit changes and drive decarbonisation targets.
3. Investigate whether there is a significant affordability risk to Orbit customers and Orbit as a business from a net zero carbon home.
4. Investigate demographical and situational influences which impact customer engagement preference.

Methodology

1. Conduct a literature review to identify:
    - **a.** effective customer engagement tools to reflect customer concerns and priorities.
    - **b.** benefits and challenges associated with the retrofit process and its outcomes.
2. Interview the retrofit coordinator to identify the potential added value to the installation process of the whole-house retrofit approach.
3. Survey a sample of Orbit customers to better understand:
    - **a.** current customer habits towards energy consumption and the capacity for behavioural changes.
    - **b.** customers' perceived ability and accountability to contribute to Orbit's decarbonisation strategy within their properties.
4. Cross reference responses with a recent broader climate change and environmental issues customer survey to identify emerging trends in customer responses.

Customer survey

In May 2021 Orbit conducted research with around 900 customers to gain insight on customer understanding, behaviour and priorities in relation to climate change and environmental issues. From this research 220 rented customers gave consent to be contacted again regarding Orbit Earth's environmental plans.

These customers were approached with a short survey of 15 questions, which was completed by 39 rented customers (18% response rate) to understand current energy behaviours within the home and the capacity for required behavioural change post retrofit. Survey questions also explored customers' perceived ability and accountability to contribute to Orbit's decarbonisation strategy. The survey provided valuable quantitative baseline data on this subject, but it should be noted that conclusions drawn from this second piece of research are limited as respondents had explicitly expressed an interest in environmental issues, therefore their responses may not represent the wider Orbit customer base.

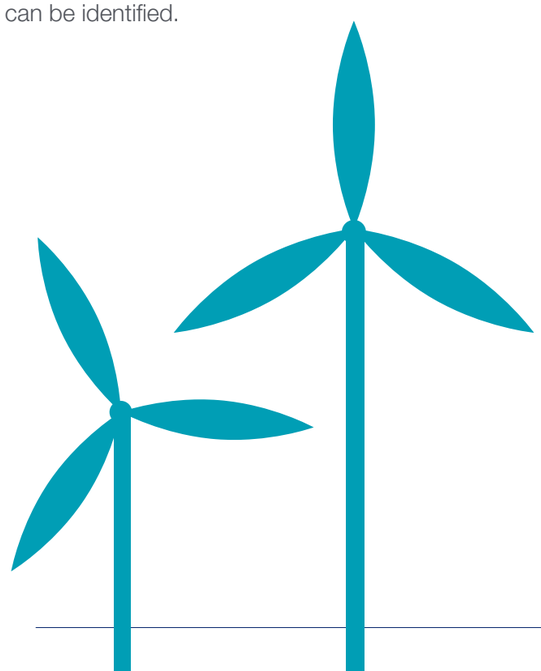
The survey undertaken collected demographic information, including age and gender, to identify different groups of customers and their preferences, and compare responses to previous research. Background research suggests that energy efficiency may benefit certain age categories such as children and older people, and age determines motivations behind energy-saving behaviour and attitudes on energy efficiency. Other research suggests significant gender variation exists in both subjective thermal comfort preferences and experience of thermal discomfort.

This research collates both sets of survey responses to link the respondents' views and awareness of climate change and net-zero carbon with more in depth insights on energy behaviour and readiness to adapt to retrofit works. The questions were based on research suggesting that improving knowledge and skills related to energy-saving behaviour enables residents to adjust their competence levels and alter consumption behaviours in line with energy efficiency improvements. Scholars consider the whole-house approach to advance disruption of habits. Therefore, establishing customer's current behaviour and attitudes on home energy efficiency allows us to understand better their willingness and ability to adapt these post retrofit.

Literature review

The literature review explored resident's experiences of previous retrofit projects involving a whole-house approach, with the primary focus on six retrofit projects, which all saw residents remain in situ during the works. The projects were all carried out over the past 15 years within the wider housing sector and include owner occupied, privately rented and socially rented and council owned properties.

The literature review identified the benefits and challenges experienced by these residents during works and post-works, and highlighted any significant risks to customers throughout the retrofit programme. It is important to note that the literature review covered different types of properties than those involved in the Orbit SHDF pilot, for example the Wilmcote House and Edward Woods Estate projects were the retrofitting of high rise buildings. Resident experiences may also be influenced by different demographic and situational influences and the introduction of the PAS2035 standard, which differs from older, commonly used retrofit models such as EnerPHit, which may also cause a difference in resident experiences. However, whole-house approach retrofits are likely to cause similar extents of disruption, therefore, general areas of disruption and risks, as well as benefits can be identified.



Conversations

Findings from the survey and literature review were built on by several conversations within Orbit and externally, to allow further, first-hand customer experiences to be recognised and valued. The conversations highlighted different perspectives of the retrofit programme from employment and skills, community investment, customer experience, asset management and environmental sustainability.

Savills are undertaking the PAS2035 role of the retrofit coordinator as part of the SHDF pilot. The retrofit coordinator project manages each stage of the process as well as protecting the homeowner and public interests. An interview conducted with Savills gathered information regarding customer engagement gaps throughout the programme, procedures for onsite workers, and potential added value to the installation process. Act On Energy, a locally-based independent energy advice charity, is undertaking pre-retrofit customer engagement and offering impartial advice to the households involved in Orbit's SHDF pilot. An interview conducted with Act On Energy, explored the current readiness of residents to change their behaviour to achieve carbon and financial savings, and identified emerging patterns from initial contact with residents.

The London School of Economics' (LSE) Housing and Communities research group and Energy Plus Academy is a knowledge exchange programme which aims to help social landlords and tenants find ways to reduce energy use in homes to tackle fuel poverty. As part of this research, interviews were conducted with representatives of the research group who have been involved in the Wilmcote House and Edward Woods Estate projects. Interviews identified the prominent successes and failures of these retrofits.

Risk ownership

The initial focus of the project was to determine the differences between the benefits seen by residents *during* and *after* the retrofit programme. However, research quickly identified that residents are impacted at more and much earlier stages, therefore the project scope was expanded to reflect this and to ensure a more well-rounded understanding of the effects at all stages.

The commonly used and traditional stages of the retrofit are: preparation, design, construction, handover, and in-use, and planning frameworks commonly fail to consider additional stages. Orbit also considers the following as additional key stages: appraisal, pre-construction and repair. Significantly, the research suggests that such stages are frequently overlooked from a resident engagement perspective and require more attention for project success, particularly the pre-project planning process. The literature review indicated that **averting risk in the pre-works stage most effectively mitigate risks during the works and post-works stages**.

Once risks were identified, the project explored at which stage the risk could affect Orbit customers. The risk ownership was then attributed to a role involved in the retrofit programme, such as PAS2035 supply chain roles, Orbit and Orbit customers themselves. Risk ownership depended on the role's ability and resources to mitigate and offset disruption to the customer. **Assigning mitigation and offsetting strategies to each retrofit stage and role presents opportunities to improve the customer experience** whilst allowing Orbit to identify opportunities during the retrofit programme to communicate more effectively with customers.

The project gathered information from the literature review, conversations, and survey responses to design two roadmaps for a successful retrofit process from a customer perspective during the five core retrofit stages:

- pre-works;
- during works;
- handover;
- post-works; and,
- future repairs and maintenance.

The whole house retrofit approach -

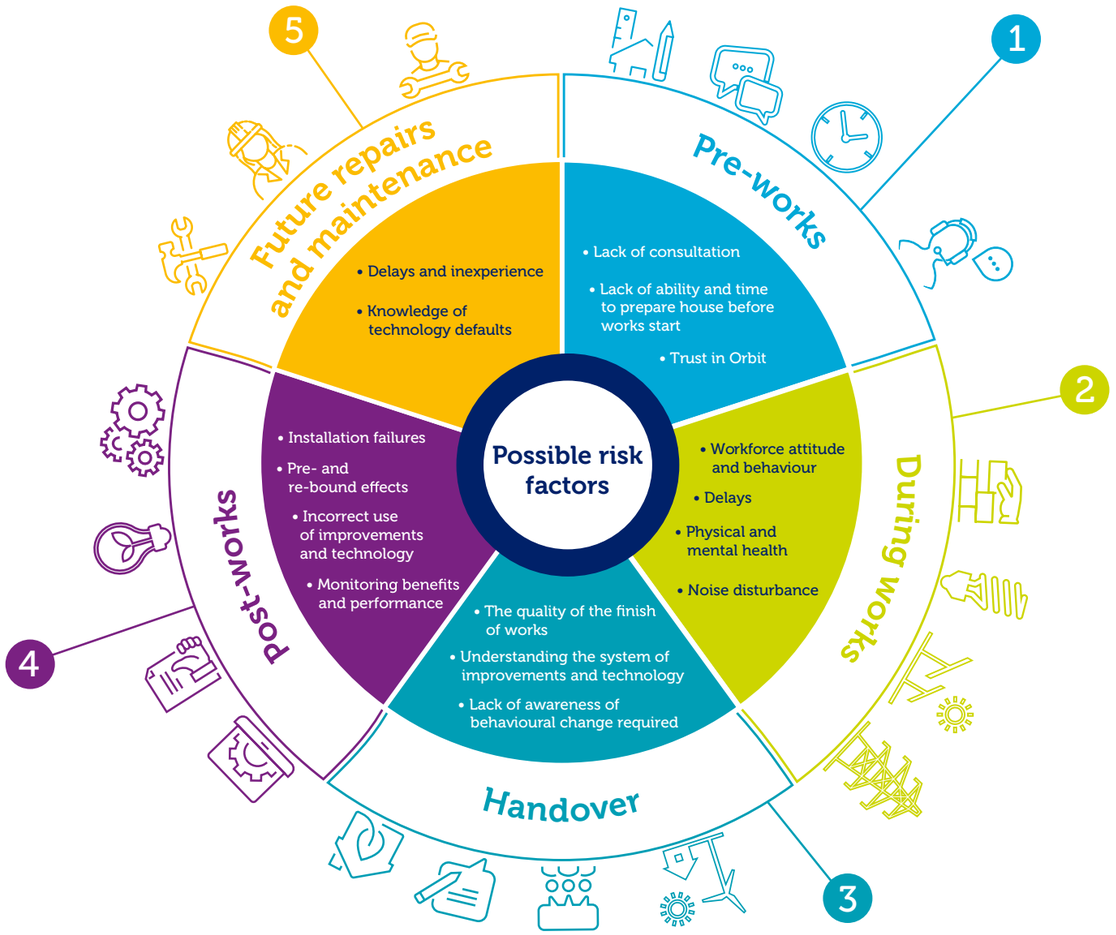
How should Orbit ensure a positive customer experience?

By 2050 all UK homes must become net zero carbon to meet government climate change targets. The national and organisational decarbonisation strategies mean that the majority of existing homes will need to be retrofitted to meet these targets. Different approaches to retrofit will impact Orbit customers' household use and behaviours, particularly those associated with heating and cooling.

Here we set out the risks that may occur during the five core retrofit stages: pre-works, during works, handover, post-works and future repairs and maintenance.

The post-works stage refers to day to day experiences living within a retrofitted property and how customers are likely to adapt to the energy efficiency improvement works. The future repairs and maintenance stage outlines any improvements or repairs to the works following the installation, carried out by maintenance teams or external contractors.

The length of the core retrofit stages will be project-specific and determined by Orbit. Mitigation and offsetting measures should be considered to ensure a positive experience for customers throughout the whole house retrofit approach, these are detailed by stage below.



Recommendations

1. Pre-works

- **Lack of consultation**. Consult customers in the design process on non-technical decisions that maximise the opportunities of the retrofit works and enables an element of choice. Discuss mitigation strategies with customers to alleviate social and individual-level risks occurring during stages 2-5.
- **Lack of ability and time to prepare the home before works start**. Provide and promote pre-works services to increase the readiness of customers to engage in the retrofit programme and minimise inconvenience.
- **Trust in Orbit**. Assess customers' current levels of satisfaction with Orbit, such as track record on repairs and other services, and engage through Orbit's trusted neighbourhood employees and community liaison officers. Ensure the complaints procedure is well communicated to customers.
- **Expectation management**. Prepare customers for the outcomes of the retrofit programme and Orbit's decarbonisation agenda in general, including possible areas of disruption and consideration of general household sustainability.
- **Customer profiling**. Conduct customer profiling to understand which benefits of the retrofit programme are most applicable to them. Profiling should also include physical and mental health requirements, capacity for behavioural change, and current perception of Orbit.

2. During works

- **Workforce attitude and behaviour**. Ensure workers are aware of the broader purpose of the programme and value a customer-focused approach. Ensure the workforce have adequate training and capacity to manage customer relations.
- **Delays**. Keep customers well-informed of progress, delays and changes and the reasons behind them. Increase the capacity of the customer liaison or customer care roles to respond to customer concerns in connection with the retrofit installation.
- **Physical and mental health**. Refer to the customer profiling of vulnerabilities and pre-existing health conditions to understand customer's physical and mental health needs, and offer customer's exclusive access to Better Days programme.
- **Noise disturbance**. Refer to the customer profiling of customer's needs of their home environment, i.e. if customers are working from home or children are at home during the project timeframe. Acknowledge disruption and consider the efficacy of 'daytime decanting' whereby customers can use community spaces to study, work or access calming environments.

3. Handover

- **Poor quality of finish**. Create a customer satisfaction checklist for organisational use to ensure that all interior jobs required to be completed as part of the retrofit works are completed within the handover stage. Provide handover services by refitting customer's blinds and curtains, refreshing paint work.
- **Inadequate understanding new system of improvements and technologies**. Ensure that demonstrations acknowledge how the new technologies and improvements combine to form a connected whole-house system as well as how to operate them individually.
- **Lack of awareness of behavioural change required**. Create personalised, easy-to-follow information for customers taking into account customer's communication preferences (from Stage 1 profiling). Ensure customer-facing employees are trained in carbon literacy.

4. Post-works

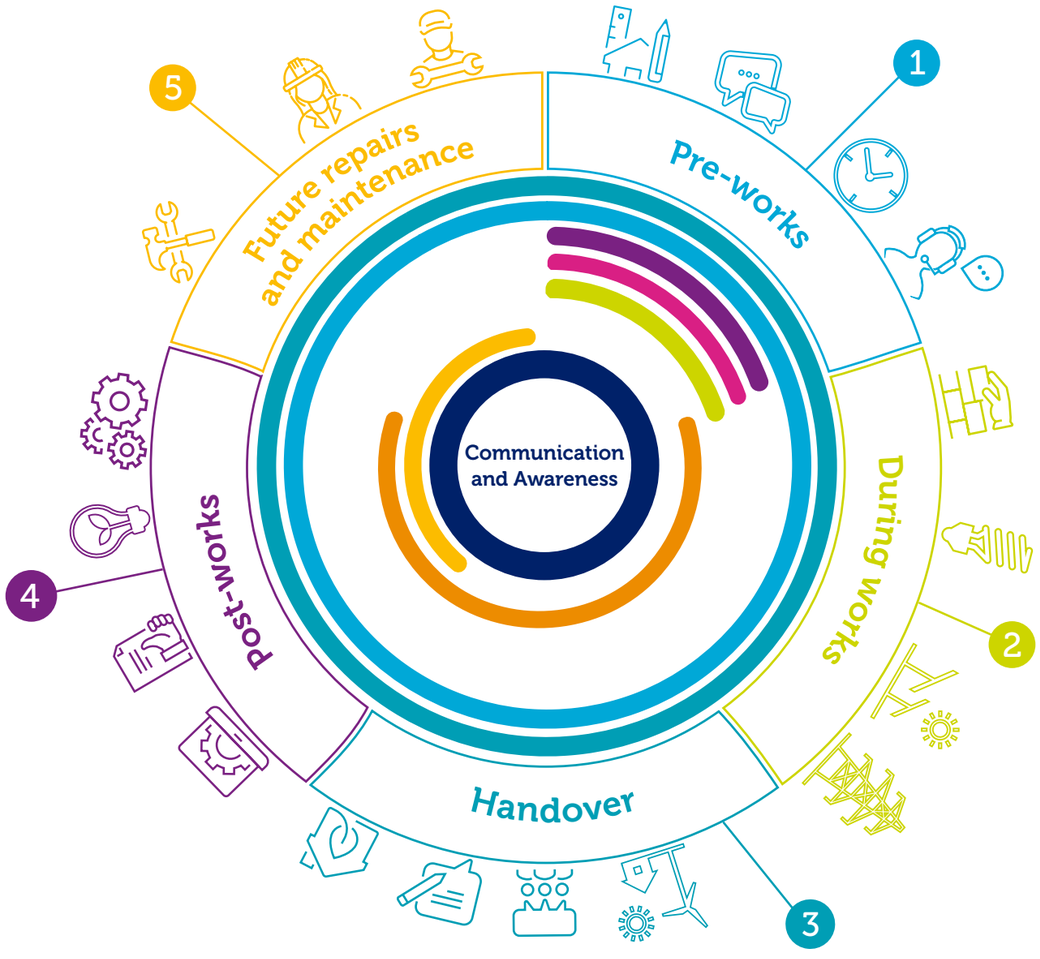
- **Installation-related failures**. Increase the capacity of customer liaison to respond to teething problems, ongoing queries and concerns about the works. Provide a list of key contacts for technical and operational aftercare support.
- **Pre and re-bound effects**. Evaluate customer's thermal comfort level and health outcomes compared to the achieved financial and carbon savings. Ensure financial outcomes reflect comfort outcomes. Offer advice platforms to customers unable to keep energy bills below 20% of take-home household income post-works.
- **Incorrect use of a retrofitted home**. Conduct a period of post-occupancy evaluation to support customers and evaluate novel technologies. Encourage customer feedback and monitoring of technologies to communicate back to design and installation teams and feed into the ongoing retrofit programme.

5. Future repairs and maintenance

- **Delays and inexperience**. Ensure that maintenance and monitoring is a continuous loop throughout the process and building's lifetime. Ensure maintenance teams and internal Orbit employees have adequate up-to-date training in the use and repair of energy efficiency improvement works.
- **Knowledge of technology defaults**. Develop a logging repair system which helps customers and Orbit monitor the quality and status of retrofit measures over time. Integrate retrofit trials and pilots into repairs and maintenance cycles.

How should Orbit ensure a positive customer experience?

Here we set out the various roles that have a responsibility to deliver the awareness required by customers during the five core retrofit stages: pre-works, during works, handover, post-works and future repairs and maintenance. The length of the core retrofit stages will be project-specific and determined by Orbit. The information that customers should be made aware of during these stages are summarised on the following page.



Roles

Orbit · Retrofit Coordinator · Retrofit Advisor · Retrofit Assessor · Retrofit Designer · Retrofit Installer · Retrofit Evaluator

Recommended information required by the customer

1. Pre-works

- Orbit's net zero carbon strategy
- Customer's behavioural adaptations required during Stage 4 of the retrofit programme. Wider behavioural change required in terms of energy efficiency during Stages 1-5
- Awareness of and how to access support services
- The outcomes of the pre-works survey and property assessment, i.e. which energy efficiency improvement works are necessary and what the customer's home will look like in Stages 3-5
- Complaints procedure
- Early benefits of the retrofit work
- The TrustMark company installing the retrofit works
- The retrofit roles customers are expecting to encounter throughout the programme

2. During works

- Guidance on the use and purpose of the retrofit measures
- Reminders of information from stage 1 as necessary

3. Handover

- Understanding the system of improvements and technology
- Recognising the seasonal differences in system requirements
- Opportunity to feedback on works stage
- Understanding the differences between pre/post retrofit energy consumption
- Understanding the differences in energy bills structure and layout

4. Post-works

- Monitoring of success indicators (including the frequency and method of monitoring):
  - Customer satisfaction
  - Performance of the energy efficiency improvement work
  - Behavioural change
- Quality assurance processes e.g. inspections

5. Future repairs and maintenance

- Quality assurance processes
- The role of developments to and emerging technologies in relation to potential updates to customer's homes (long-term)
- How to recognise and log repairs related to retrofit technology

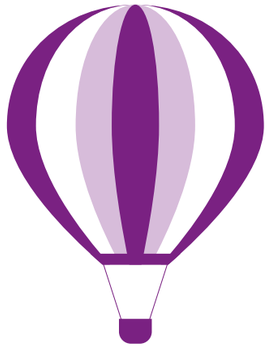
THE FINDINGS

Project findings

Customer survey

The survey responses indicate a slight disconnect between customers' interest in having an environmentally friendly property and their individual capacity to improve energy efficiency in their homes. Customers are motivated to become energy efficient both by saving money and becoming more environmentally friendly in similar measures. In this way, it appears customers may not be aware of the extent of the environmental (carbon) and financial (energy bills savings) benefits of the retrofit programme, therefore it is important that both are communicated to the customer and should be given equal weighting in this communication.

Customers expressed that they would prefer to adopt a whole-house in one go approach rather than having the works completed in stages, due to confining the disruption to a single period rather than multiple i.e. under six months compared to work consisting of one or two months every five years. Furthermore, with whole-house retrofit in one go, customers will likely experience the maximum benefit of the retrofit works in financial, health and energy performance terms in the short term as well as long term.



Throughout the retrofit programme, **customers identify trust, detailed information and customer service as the most critical factors in ensuring a positive experience**. Such responses indicate that building knowledge and awareness of a net zero carbon home with customers and communication throughout the retrofit process are vital to overall success.

Customers would prefer Orbit to work in partnership with the local authority, which echoes other research in which residents valued cohesive local sustainability strategies and reassurance of the local authority's backing for social and environmental projects. Therefore, thought should be given to joint engagement, communication, and awareness campaigns and support strategies with the local authority to build community engagement and to maximise retrofit success.

The survey found higher customer satisfaction with the overall performance, reliability and ease of use of current gas heating systems compared to electric heating systems. In contrast, customers view electric heating systems as more challenging to use and lower performing. A preference for gas central heating systems implies Orbit must address this association when introducing more electric-based heating systems during decarbonisation to avoid resistance against retrofit measures. It is important to note that there will be a significant difference between the current electric heating used in Orbit homes (i.e. electric boilers or storage heaters) and the energy efficiency improvement works (i.e. air source heat pumps and MHVR systems).

Responses show that customers are moderately satisfied with all aspects of their heating systems, from overall performance in adequately heating their home, to reliability and overall ease of use. These responses show that there is scope to encourage customers to adapt from their current heating systems to new retrofit measures, and customers may consider replacing their heating systems whilst it still works.

More specifically, the responses show that irrespective of heating type, customers collectively struggle with their ability to control temperature levels throughout the home. Responses indicate that the role of technology directly impacts customer satisfaction of their heating systems, mainly to control temperature levels which presents a challenge for managing thermal comfort through energy efficiency improvement works.

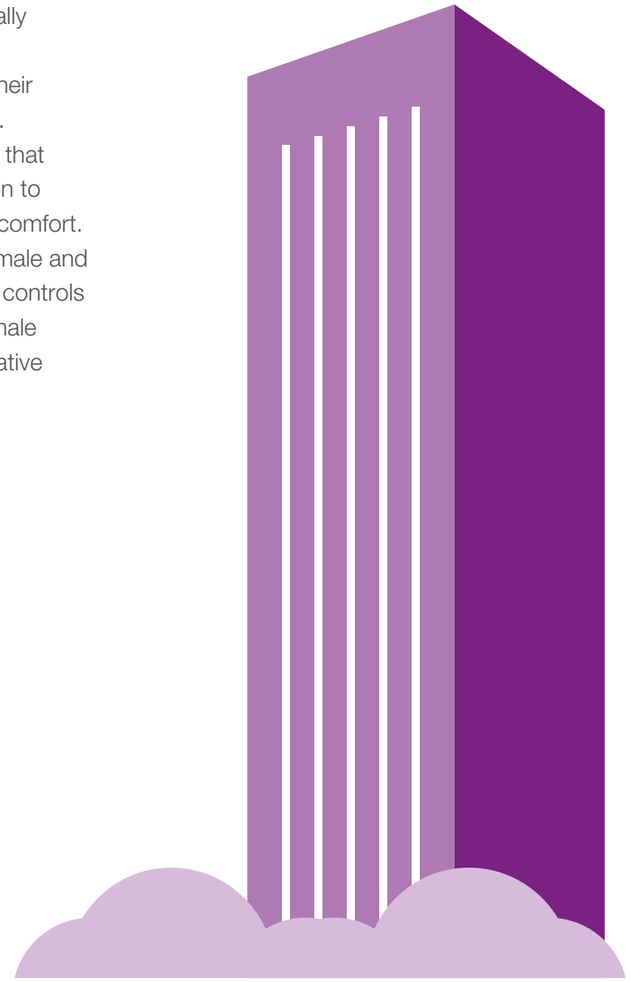
Customer responses show that there is space to improve customer's energy-saving behaviour at a simplistic level, such as considering ventilation and switching off appliances. The responses also show that customers are more likely to change their behaviour to improve and manage their thermal comfort by regularly adjusting heating controls and thermostats and moving through the home spaces to find a comfortable temperature, than improving their energy efficiency through other means, indicating that customers display energy-saving behaviour to benefit their warmth and comfort over home energy efficiency. Although several factors are likely to be influencing factors, this behaviour shows that customers will adapt to their surroundings to find comfort, and customers can connect energy efficiency through thermal comfort to their daily lives.

Demographic influences

Female households and those with young children are more prepared than other household makeups to change their individual behaviour within their homes to become more energy efficient. These findings agree with research which suggests that those with young children are more likely to wear warmer clothing and avoid using the heating when children are not in the property, in contrast to adjusting heating controls for the warmth of their children when they are at home.

Responses show that women have a greater need for warmth and experience thermal discomfort more often than men. These insights correlate with research suggesting traditionally thermal environments are better tailored to men, and women are more likely to adjust their behaviour to become thermally comfortable. This also supports research which identifies that some females carry out individual level action to improve their thermal comfort or endure discomfort. However, there is no gender bias between male and female customers adjusting heating system controls such as thermostats, which suggests that male respondents are less likely to look for alternative ways to manage their comfort.

In terms of customer engagement, preferences differ between age categories. Younger customers (25 - 54) opt for communication and support from Orbit through an app or post. Older customers (55+) opt for communications and support from Orbit through the Orbit customer website and community champions. Customers, irrespective of age, preferred to be shown how to use the new technologies or heating systems through information from onsite workers face-to-face or a leaflet. Customers, irrespective of age, preferred Orbit to support them throughout the retrofit programme by email or face-to-face contact.



Risk of decreased energy affordability

There is no sector standard definition for fuel poverty. The government has updated the fuel poverty metric for households in England to the Low Income Energy Efficiency (LILEE) in recent years. The LILEE accounts for individual circumstances by showing both the extent and severity of fuel poverty through the fuel poverty gap by measuring energy efficiency rating and residual income below the poverty line. However, for the purposes of this research, a fuel poor household is defined as a household that spends more than 10% of its income on maintaining an adequate level of warmth.

The research categorised respondents into three groups of take-home household income on energy bills: less than 10%, 10%-20% and over 20%. Customers within the 10-20% category are considered to be in 'low-level fuel poverty' in which they may grapple with competing priorities or uncertain circumstances leaving them vulnerable to fuel poverty. Customers spending 20% or more of their take-home household income on maintaining an adequate level of warmth clearly indicates financial difficulties.

Customers in 'low-level fuel poverty' are less likely than other categories, to seek advice to be more energy efficient to save money on energy bills, despite the benefits it would bring. Customers in this category may be unaware that they are spending too much on their energy bills compared to national averages. They may be uninformed of how to access energy advice, how it could help them or may have a complex situation preventing them from taking action. Alternatively, customers in this category may be content with this proportion of spend on energy bills. Research indicates that most social housing residents do not think of themselves as fuel poor and that the terminology is degrading and unhelpful. Residents from previous retrofit projects have suggested for housing associations to refrain from emphasising financial savings as the sole motivation of a whole-house approach. Therefore, financial benefits should be placed in the wider context of other benefits, particularly for those in 'low-level fuel poverty'.

Customers spending more than 20% of their take-home household income on their energy bills are the least interested in their homes being more environmentally friendly, and are less prepared to change behaviour to become more energy efficient. Customers spending more money on energy bills are also less likely to switch their energy provider to save money. Unsurprisingly more households in this category live in homes rated EPC C – E; they are also more likely to be single parents or families with young children, which concurs with other research. It appears that customers spending more money on energy bills may have a lack of capacity or additional responsibilities preventing them from seeking energy efficiency advice and/or the ability to change behaviours.

Many social housing residents have reported that they would struggle if energy prices increased post-retrofit completion, consequently it is vital to consider the risk of energy affordability for Orbit's customers. Given the knowledge that Orbit customers spending more money on their energy bills are more likely to go without heating to save money, any risk to energy bills increasing should be mitigated as a priority. If not, there is likely to be significant impacts on Orbit customers' lives, including a downturn in mental and physical health, higher rates of arrears and a growth of distrust towards Orbit.

Literature review

Previous resident experience

Residents' previous experience of a whole-house retrofit highlighted recurring negative incidents, including delays, quality, disruption/inconvenience and strain on mental and physical health. However, the most significant challenge reported by residents was adapting to the new retrofit technologies.

Retrofit myths leave residents concerned about the efficiency of new heating technology compared to more traditional heating systems. Therefore, focus must be built around acknowledging that there will be a shift from well-established technologies and educating residents in the benefits of these.

Residents are able to adapt to enhancing fabric measures and installing solar panels, but less able to adapt to the change in heating source. This presents a further challenge with net zero carbon homes with the transition from high-grade heating such as a gas boiler to a lower grade of heating such as a heat pump, requiring specific awareness and different behaviours. In the 6 projects reviewed, some, residents could not understand the meaning or urgency of warning lights and instructions.

The most common factors inconveniencing residents during the construction phase included noise, mess, space restraints, and electricity and heating supply disruption. Residents encountered fatigue due to incessant visits from installation and project teams, which reduced resident goodwill throughout the project and created feelings of hopelessness that the process would never end. Disruption was heightened by the unfamiliarity of some retrofit measures within combined, whole-house systems, which caused uncertainty of the potential benefits.

Residents were also aware of the lack of action by the private sector and an unclear government strategy. So new trials and technologies within the social housing sector causes resident concern about the availability of guarantees in projects and being used as 'guinea pigs'.

Risks

Research indicates that preventing risk in the pre-works stage most effectively reduces risks during the works and post-works stage. Customers require more information regarding the retrofit works and the related challenges in the pre-works stage so they can engage effectively with the retrofit programme. Residents need well-organised and accessible handover procedures which are non-technical and provide easy-to-follow demonstrations or explanations. Without full understanding of how their heating operates, customers will likely seek informal advice from friends or family or use the systems in the traditional manner, which could negatively impact the system performance.

Historically, retrofit pilots have been independent of repairs and maintenance programmes, so residents feel that works are 'fit and forget' interventions. Repair severity and delays are worsened by the fact they are only likely to be recognised and reported in harsher climates when systems fail.

The prebound effect versus the rebound effect

A significant risk related to the outcomes of the retrofit programme includes customers not taking advantage of their low carbon homes by continuing to heat them to a temperature lower than they find comfortable, known as 'the prebound effect'. The prebound effect prevents customers from achieving comfortable temperatures in their homes despite increased energy efficiency.

On the opposite spectrum, the 'rebound effect' defines the difference between the expected and the actual environmental savings from the retrofit works, with customers increasing their energy usage so the savings are 'take-back' or eroded.

Residents may lack understanding of how retrofit works combine within a system, with measures tending to be individually established but new when installed together. Residents may also assume that the improvements are 'passive', where the resident does not need to adapt to gain the benefit, which counteracts the systemic nature of a whole-house approach.

A question of trust

A recurrent theme in the literature identifies the lack of trust between housing associations, delivery partners and residents.

Research found that residents withdraw from the retrofit process if they are unaware of what the works are trying to achieve. Trust can therefore be increased if customers can identify why the works are taking place.

Residents involved in previous retrofit programmes believe that improving employee knowledge in decarbonisation, for example through carbon literacy training, earns trust and more effectively links the targets of the retrofit programme with organisational commitments.

Opportunities

Opportunities to maximise benefits attributed to lifestyle, health and comfort, should be given specific attention when driving the decarbonisation agenda. Identifying customer's health status and vulnerabilities at the pre-works stage can help PAS2035 roles and Orbit to adapt the design and installation to address health needs and requirements. It is important to therefore consider health and wellbeing as a consistent topic of communication throughout the retrofit programme, as well as an outcome of the retrofit works. Determining customers' mental and physical health requirements within their homes will facilitate profiling situational and demographic factors that determine how Orbit communicate with residents in the pre-works stage.

Aligning with the customer's lifestyle

Being able to align and tie in other minor home improvements and give customers an element of choice alongside the retrofit works helps build engagement, positive relationships and all-important trust. Such choices allow customers to take pride and ownership in their homes through decisions based on lighting, paint colours and textiles, or installing EV charging points or flood prevention measures in flood-prone areas. Resident engagement at pre-works stage can also build valuable anecdotal knowledge on issues like mould and damp, helping to minimise unforeseen issues like delays, additional costs, disruptions, and worsening current problems.

A whole-house approach

A whole-house approach is more likely to motivate receptivity to other small energy-saving actions. Therefore, to facilitate a shift in residents' energy-use behaviour, Orbit must understand and address current individual energy consumption behaviours and attitudes, and emphasise the Retrofit Advisor PAS2035 role in helping to gather this information. This will maximise the opportunity to increase resident awareness and communicate the benefits of a whole-house approach pre-works through a simple customer point of contact. Research indicates that residents require clarity on the roles and responsibilities involved in the retrofit programme, and the role of customer liaison officers was vital in fulfilling this requirement.

Many risks to customers are mitigated by using a whole-house approach. Fabric first measures are the most logical to implement as they improve thermal comfort and increase energy affordability. Conversely, benefits from renewable energy measures and alternative heating sources can be lacking in their immediate benefit or at least can be perceived as less effective as traditional improvements. Therefore, combining retrofit measures as part of a whole-house approach can generate goodwill, gain buy-in and even start to create demand from customers.

Many lessons learned from a successful whole-house approach can be translated to Orbit's incremental retrofit approach too. For example, both approaches must ensure that the evaluation of the building condition and customer profiling during the pre-works is integrated into the overall planning at each stage. The importance of sequencing within a whole-house approach should be applied to other retrofit approaches too. It is key to ensuring that sequencing applies to unplanned challenges and solving unforeseen problems which can compromise building performance. For example, holes drilled in wall insulation to allow re-wiring can reduce airtightness and decrease thermal performance. In a whole-house approach, communication failures between designers, customers and installers during the works and post-works can lead to wrong choices of technology, installation failures or on-site problem solving. Similarly, these communication risks are applicable between each stage of an incremental approach, both can leave residents dissatisfied and homes underperforming.

WHAT NEXT?

Conclusion

The most significant risk associated with the retrofit programme may be the disconnect between customers' interest in having an environmentally friendly home and their individual capacity to improve the energy efficiency in their homes. Without customer motivation and ability to change their behaviour within their homes, the success of the retrofit programme will be limited.

Many risks identified relate to lack of thorough customer engagement being built into the preworks stage of the retrofit process alongside the assessment of the property condition. This early engagement is just as, if not more important than engagement at latter stages (during and post-works). Pre-retrofit works attitudes may determine whether the prebound and rebound effects may occur and it will be key to address customer situations before works start to assess whether customers are making sacrifices in terms of thermal comfort. This is the case for most risks which can be mitigated within the pre-works stage.

Similarly, lessons from previous retrofit projects suggest that more effective handover processes determine how customers engage with the retrofit programme. Likewise, more organised repair processes determine how customers benefit from the retrofit works and trust their housing provider to upkeep and maintain their properties to meet their needs. Therefore, risks attributed to the 'pre-works', 'handover' and 'repair' stages require more attention for the holistic success of any retrofit programme and ensuring the capacity of resources and facilities within these transitional stages is essential to minimise disruption and enhance opportunities during the entire retrofit process.

Trust between Orbit and its customers is expected to impact on whether there will be a positive or negative retrofit experience. For customers to care about Orbit's environmental commitments, Orbit should build its capacity to focus on customers' view of Orbit as an organisation and its decarbonisation agenda, and customers' capacity to adapt to new behaviours and attitudes. Orbit (and consequently, customers) will also benefit from ensuring there is consistent messaging from all employees regarding its decarbonisation agenda. Increasing customer awareness of Orbit's decarbonisation goals through wider communication including dissemination through internal teams across all business departments will help build trust with customers.

The level of disruption during a whole-house approach is widely recognised by Orbit. The main disruption areas are characterised by delays, inconvenience and inadequacies in the skills and installation quality of measures. Customers are able to overcome the disruption involved in the retrofit if the purpose of the works is integrated into Orbit's wider values and workforce, i.e. they understand the end goal.

Customers are motivated to become energy efficient by saving money and being more environmentally friendly in similar measures, but it is important to recognise that the benefits of the whole-house retrofit approach must be tailored to individuals to help them to change behaviours. Certain customers, such as females, young families with children, older people, tend to have more of an interest in decarbonisation and the benefits attributed to home energy efficiency improvements. Subsequently it is clear that situational and demographical differences play a role in how Orbit should engage with its customers.

Customer behaviour is already changing in line with efficiency principles particularly in the context of thermal comfort, however there is scope for customers to continue to improve their energy-saving behaviour. Customers are prepared to act to better their thermal comfort but not always through heating system temperature control. Therefore, there is a need for further research to focus on how customers can be empowered to manage their thermal comfort in a retrofitted home. Continued communication efforts will be needed to debunk the myths surrounding retrofit and break away from the preferences of traditionally heated homes.

Customers are likely to become increasingly concerned about their comfort and wellbeing levels within their properties for reasons including: increasing energy prices, a desire to live more environmentally friendly and healthier lifestyles and increasing climatic variations (colder winters and warmer summers). Discussing thermal comfort with customers will be more beneficial and productive than using the term 'fuel poverty' as a defining element of the retrofit programme.

Decreasing energy affordability poses a significant risk to Orbit and its customers. Those spending more money on their energy bills are more likely to go without heating to save money. This may be worsened by these customers having less capacity to improve their financial security and participate in retrofit programmes. In managing fuel poor households and the retrofit programme, communication and engagement strategies must differ depending on the pre-retrofit household spend on energy bills.

Households spending more of their household income on energy bills have less capacity or interest in being energy efficient to save money or to be environmentally friendly. This presents a potential barrier to the success of the retrofit programme if Orbit fail to consider customers' interest and preparedness to adopt retrofit works. These customers are more likely to be single-parent households or young families, which may have more immediate priorities preventing them from accessing support or caring about environmental agendas. Therefore, Orbit must connect the climate crisis and, more specifically, net zero carbon homes to customers' personal needs and challenges. Other support services and advice programmes can be used to facilitate customers with more immediate priorities and increase customer's capacity to care about the environment. In this way, customers are more likely to value the works and overcome disruption if they have a personal interest and care for the tangible outcomes.

Given there is time between short term current retrofit pilots and the longer term decarbonisation target deadlines, Orbit should use this time to monitor current household levels of fuel poverty, household behaviour and asset performance. Building this picture prior to customer involvement in the retrofit programme will ensure the most positive customer experience.

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