Devon Retrofit MK II: A study and investigation into Devon's rural building archetypes for retrofit actions and measures

September 2022

This report was produced for	-	South West Net Zero Hub
Issue date	-	September 2022
Version	-	Version 6 FINAL
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1. Executive Summary

Overview

The majority of housing stock in the UK is classified as urban and this drives much of the analysis and thinking around housing 'retrofit pathways'. But counties like Devon have a much higher proportion of rural housing which has different features and needs to that mostly found in urban environments. Local authorities, community energy groups and other bodies with retrofitting homes on their agenda require accurate and specific data in order to develop strategies to increase the uptake of retrofit. Categorising a smaller collection of housing types can help local authorities and other public bodies to analyse:

- which retrofit pathways are needed.
- where to target their support.
- the homeowners who inhabit properties

Phase 1 – The Task

This project developed a specific approach to examine whether rural homes in Devon could be categorised in a small number of housing types rather than the more traditional 'archetype analysis' approach that can often generate thousands of different scenarios.

The analysis used EPC data and SAP ratings to assess the homes on a property-by-property basis, applying a range of constraints on maximum costs and level of disruption to potential retrofit pathways. Through the use of software developed by Parity Pathways, resultant SAP scores and EPC ratings could be modelled, helping paint a picture for the entire county. 12 flashcards were developed in order to provide an immediately accessible archetype for each identified type of home – something that homeowners, installers and retrofit professionals could all easily recognise.

Following on

The main questions arising from the study were:

What might be the main pathways for each of those home types to become 'net zero'?

- What do the people in a representative sample of these homes think about this approach and these pathways?
    - How can this help local authorities?

After researching historical attitudes to retrofit and in line with the spirit of this work, it was felt that simplifying the pathways for homeowners would align with outcomes desired by the agencies involved, namely: straightforward, accessible approaches to increasing uptake. Accordingly, two possible pathways were narrowed down which were:

Achieving net zero emissions through:

1. Disruptive retrofit measures

2. Non-disruptive retrofit measures

Phase 2 – Survey Design

A survey was developed for homeowners in rural areas of Devon and carried out by those working for community energy groups from across the county. The results from 321 responses were collated. In addition to the survey, focus groups were commissioned and interviewed.

The key findings from the survey form the basis for the conclusions and recommendations in this report:

1. 93.7% of homes – approximately 104,000 properties in rural Devon fit one of just twelve home types
2. 63% of those who responded to the survey wanted to take action on their heating systems to lower their impact on the environment
3. An average of 95% of respondents felt it would be helpful to have a trusted intermediary to provide advice and information to homeowners about the next steps in their retrofit journey.
4. 79% of respondents felt it is important *(essential*) that local tradespeople are able to deliver the home improvements
5. On average, 90% felt that communication around home energy improvements needs to be as non-technical as possible

Conclusions

After consideration of the qualitative and quantitative data and key findings, the following conclusions can be drawn:

- The use of a non-technical and simple way of describing how best to retrofit homes would be helpful when homeowners are considering taking action. Simple but recognizable terms and examples relevant to the householder are effective in promoting take-up of retrofit.
- Clearly setting out what the home pathways are and what to do next is important
- The use of trusted intermediaries such as local community groups or local authorities to highlight a clear customer journey carried much weight with householders.
- It is of high importance that local tradespeople are employed to carry out the work.

Recommendations

- The creation of a guide specifically aimed at taking homeowners on their retrofit journey using easy to understand language and concepts. The guide should be aimed at the county of Devon specifically and take into account building archetypes in the area and important findings from this study

- Involving community energy organisations in the roll out of local authority led retrofit initiatives using grant funding or aimed at the able to pay market

- Creating and encouraging the development of a local supply chain of installers and retrofit professionals, tied into relationships with the local authorities and community energy organisations

2.Introduction

The commission

Regen and Parity Projects were commissioned by West of England Combined Authority on behalf of the South West Net Zero Hub to undertake a short study assessing primarily rural home types in Devon as defined by the Department for Environment and Rural Affairs (DEFRA) and discern:

- how those home types might have their energy efficiency improved
- what a representative sample of home occupiers might think about those improvements.

Whilst similar studies have been undertaken before, this study focused on reaching mainly rural householders that are not already engaged with energy, energy efficiency or retrofit, using surveys and targeted household visits to gather their views. The results of the analysis and surveys have informed how current domestic retrofit schemes might be deployed, as well as producing a meaningful set of 'home type' descriptions that can be used to help communicate retrofit pathways to homeowners.

Main Tasks

Delivery of this work was organised into two phases:

1. **Analysis of existing Data**

- The Parity Projects 'Pathways' tool was used to analyse the homes in three representative districts in Devon and establish a manageable number of home 'types' commonly found in Devon.

- For each home type, Parity in partnership with Regen, the SW Net Zero Hub and Devon County Council agreed a simple pathway for each one that outlines the measures needed to reduce their energy consumption and environmental impact.

2. **Homeowner Survey**

- Once the home types were developed, the costs and benefits associated with each 'typical pathway' formed the basis of a survey aimed primarily at householders in Devon.

- The results of this survey, and related focus groups, provided insight into whether there are any patterns or trends in householder views on retrofit.

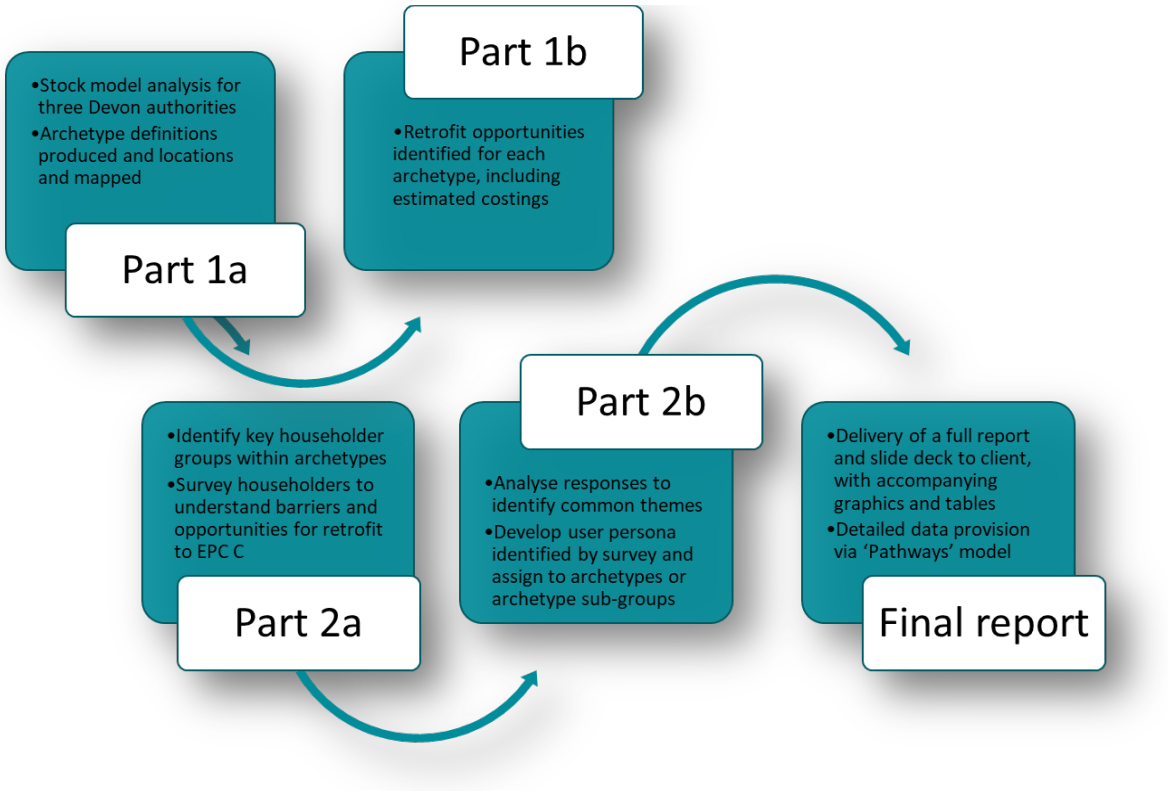


Figure 1 Phasing of the study

Report Structure

This report presents:

- an overview of how the housing stock in Devon was assessed, the home types developed and the pathways of 'typical retrofit' created. (For a detailed understanding of how the Parity Projects 'Pathways' tool was used, see appendix 2)

- A summary of the key findings from the survey and focus groups testing the home type pathways to net zero with householders.

- Conclusions drawn from the summary of key findings detailing:
    - Disparities and similarities in responses from those surveyed
    - Contrast and comparison between quantitative and qualitative data.

- Recommendations for future local authority, community energy or similar organisation initiatives and schema in this area.

3.Phase 1: Identifying home types in Devon

The challenge

The study concentrated focus on those private rental or owner-occupier households that might be rural, and/or in a more unusual building type. Due to the nature of the landscape, historic industry and patterns of settlement, Devon was expected to contain significant numbers of rural properties that can be classed as 'difficult to treat'. This means, of construction that makes common retrofit measures challenging or prohibitively expensive.

In addition, as has been found with other areas across the country, it is expected that these homes are tenanted or owned by people with limited or no engagement in energy or retrofitting measures.

Meeting expectations

An expected outcome of this study is to produce a manageable number of 'home types' (see section 3.1) that reflect the common makeup of form, construction type and heating fuel in Devon, that can have a simple 'typical retrofit' plan identified with outline budget costs. These plans can then be tested with homeowners to get a better understanding of their appetite to adopt them.

The home archetypes focused primarily on physical features of the properties and did not include any assessment of home tenure or household income, but in the public engagement, some questions about income and ownership were asked, to see what impact, if any, these factors had on the results.

Parity Projects performed detailed analysis of the range and spread of homes in Devon (see appendix 2), to establish a meaningful, representative yet manageable number of distinct home types.

3.1. Developing the home types

Building Archetypes

Whilst every home is different and will have a unique pathway to net zero grouping types of home together so that common approaches to lowering their carbon emissions and improving their energy efficiency can be developed significantly reduces the barriers to developing retrofit pathways. Most of the construction industry use the idea of 'archetypes': a description of the main features of a building that differentiate from others.

Categorisation

Approaches to grouping homes differ but can range from thousands of different archetypes that consider variation in build form, construction type, heating type and details about the occupants, to just a handful that focus on features that make the biggest

difference to retrofitting. How detailed those archetypes need to be is dependent on where retrofit is targeted.

Zero-ing in

In discussion with Parity Projects, the SW Net Zero Hub, and Devon County Council, it was decided that focussing on just twelve so called 'archetypes' of homes would provide a good balance between accommodating variation and being a manageable number. In recognition of the fact these archetypes are distinct from what building construction specialists would understand an archetype to be, in this study they are referred to as 'home types'.

Due to budget constraints, data from three district areas was selected to represent the county of Devon, reflecting a mix of urban, rural and coastal: North Devon, Mid Devon and Teignbridge.

Assessment parameters

Broadly, this assessment looked at the *primary* features that might impact the typical retrofit measures that might be adopted for a property, at the expense of granularity about their costs. This meant that houses and flats were differentiated, but within that split, the type of house, and position in terrace or row remained undifferentiated. This can mean that the projected costs of the pathways for each home might be misleading for any individual home, but the purpose of this work was to produce 'typical pathways' that give an indication of associated cost, not a specific home retrofit plan.

The home types developed for ongoing analysis in phase 1 and underpinning the survey in phase 2 of this work are shown in table 1. The primary distinguishing features between home types are detailed below;

Table 1 Distinction between home types

Storey Detail	Bungalow House Flat Maisonette
Wall Cavity	Present Absent
Wall Construction	Timber Brick Granite Stone Cob
Primary Heating	Gas

	Electricity Oil

From this basic suite of archetypes, further sub-divisions were then possible which formed the 12 archetypes selected to take forward to retrofit pathway mapping.

Table 2 Home types used in this study

Home type	Criteria	Typical description	No. and % of rural stock in Devon*	
1	Houses & Bungalows Cavity walls Mains gas heating	Mid-century detached, cavity houses on mains gas	40,785	36.8%
2	Houses & Bungalows Cavity walls Electric heating	Mid-century detached, cavity houses on electric	10,808	9.7%
3	Houses & Bungalows Cavity walls Other heating	Mid-century detached, cavity houses on oil	14,642	13.1%
4	Houses & Bungalows Granite walls Not mains gas heating	Victorian granite detached houses off gas	12,465	11.2%
5	Flats & Maisonettes Cavity walls Any heating fuel	Late mid-century cavity flats	7,208	6.5%
6	Houses & Bungalows Granite walls Mains gas heating	Victorian granite detached houses on mains gas	5,176	4.6%
7	Houses & Bungalows Timber frame walls Any heating fuel	Mid-century semi or detached, timber frame houses	2,868	2.6%
8	Houses & Bungalows Cob walls Any heating fuel	Cob, detached houses	4,590	4.1%
9	Houses & Bungalows Uninsulated solid walls Mains gas heating	Late Victorian/Edwardian terraces on mains gas	1,656	1.5%
10	Flats & Maisonettes Granite walls Any heating fuel	Victorian granite converted houses	2,002	1.8%
11	Flats & Maisonettes Uninsulated solid walls Any heating fuel	Late Victorian/Edwardian converted terraces	818	0.7%
12	Houses & Bungalows Uninsulated solid walls Not mains gas heating	Late Victorian/Edwardian houses off gas	1,368	1.2%

*Of the homes that have EPCs

Coverage and going forward with analysis

93.7% of the homes in the rural areas of Devon that have EPCs are covered by the twelve Home Types, totalling about 104,000 properties.

The analysis used EPC data and SAP ratings to assess the homes on a property-by-property basis, applying a range of constraints on maximum costs and level of disruption to potential retrofit pathways. Through the use of Pathways software, resultant SAP scores and EPC ratings could be modelled, helping paint a picture for the entire county. The detail of this analysis can be found in Appendix 2.

3.2. Developing home type retrofit pathways

Simplification

In the same way that home types were simplified to a manageable number, the same was true of producing retrofit 'plans' for each of those types. For each type, there is an almost infinite number of measures and approaches that could be taken to lower the carbon impact and improve energy efficiency. The complexity of measures and how they interact with each other is a key part of any retrofit assessment. The question can be asked: Is it better to install several less disruptive measures that may have only marginal impact on energy bills, or to undertake just one very disruptive measure like internal wall insulation which can have a significant impact?

Limiting pathways

Installing more disruptive and efficient energy efficiency measures (such as internal wall insulation or underfloor insulation), remains a relatively niche market. In order to boost energy efficiency activity, the vast menu of options needs to be simplified so that homeowners can make informed decisions without researching every permutation from scratch.

For this reason, we decided to limit the potential options or pathways of energy efficiency improvements to rural properties to just two. From previous work, it was clear that most homeowners see the level of disruption associated with energy efficiency retrofit as a major differentiator. From that reasoning flowed the two types of pathway finally considered:

1. net zero emissions, *excluding* disruptive measures
2. net zero emissions, *including* disruptive measures

These two 'typical' pathways have been set out in a simple way for each of the twelve home types including typical costs, energy bill savings and carbon reductions.

Costing the pathways

For each home type, there were a range of costs for upgrading energy efficiency and becoming 'net-zero ready' - able to affordably use electric heating that is likely to be a net zero fuel in the 2030s. There are numerous approaches to retrofitting existing homes to improve energy efficiency and enable them to be net zero ready, and these various scenarios can be reproduced by the Parity Projects 'Pathways' tool.

For simplicity of communication, the median cost per home of all the potential pathways to net zero emissions was selected to be the best representation of that retrofit pathway and taken forward into the survey in phase 2. Full details of the methodology for developing the pathways can be found in appendix 5.

Table 1 Median investment for pathways, per home type

Home type	Criteria	Typical description	NZ Pathway median typical approx. cost	Approx. No. of homes in the three districts
1	Houses & Bungalows Cavity walls Mains gas heating	Mid-century detached homes on mains gas with a wall cavity	£16,425	29,000
2	Houses & Bungalows Cavity walls Electric heating	Mid-century detached homes with electric heating and a wall cavity	£27,375	5700
3	Houses & Bungalows Cavity walls Other heating	Mid-century detached homes with oil heating and a wall cavity	£25,610	9200
4	Houses & Bungalows Granite walls Not mains gas heating	Victorian granite detached homes without gas heating	£37,780	8800
5	Flats & Maisonettes Cavity walls Any heating fuel	Late mid-century flats with cavity walls	£12,890	3300
6	Houses & Bungalows Granite walls Mains gas heating	Victorian granite detached homers with mains gas heating	£28,020	3700
7	Houses & Bungalows Timber frame walls Any heating fuel	Mid-century semi or detached timber frame homes	£19,880	1900

8	Houses & Bungalows Cob walls Any heating fuel	Victorian cob detached homes	£29,860	4700
9	Houses & Bungalows Uninsulated solid walls Mains gas heating	Late Victorian/Edwardian terraces with mains gas heating	£26,160	1300
10	Flats & Maisonet's Granite walls Any heating fuel	Victorian granite converted flats	£21,530	1200
11	Flats & Maisonet's Uninsulated solid walls Any heating fuel	Late Victorian/Edwardian terraces converted into flats	£22,560	600
12	Houses & Bungalows Uninsulated solid walls Not mains gas heating	Late Victorian/Edwardian houses off gas grid	£34,790	1000

3.3. Home Type outputs

The aim of phase 1 was to review the range of home construction and heating types in rural Devon and develop a meaningful, but simple set of home types that represent them. The purpose of developing these home types is to help communicate retrofit pathways, the benefits and budget costs to homeowners.

Making home types accessible – Flash Cards

From these home types, a series of flash cards were developed in order to give a quick, easily recognisable impression of a building archetype to anyone who has use of this report, including:

- Local Authorities
- Installers
- Retrofit professionals
- Community energy organisations.

It was felt that using annotated graphics improved the attractiveness and immediacy of understanding amongst those who conceived of retrofit as overly technical and difficult to engage with. (See Appendix 5).

Engaging with homeowners – the challenge

We know from previous work that engaging with homeowners about energy efficiency and heating technologies can be challenging. Uncertainty about the most effective approach, potential disruption, technical jargon and financial implications combine to make discussions about improvements difficult.

By creating a small list of home types, each with just two pathways to net zero, it is hoped that those conversations can be made simpler and easier for community groups and local authorities.

Going forward

Phase 2 tested the 'home types' approach and the associated pathways/messaging with a representative sample of rural homeowners in Devon, through surveys and focus groups. The results from this testing provided the quantitative and qualitative data which forms the conclusions and recommendations for this study.

4. Phase 2: qualitative survey

Groundwork

The purpose of phase 2 was to approach householders in Devon with the basic, indicative information about how their home might achieve net zero emissions through the pathways developed in phase 1. This was followed by analysing the sample responses to questions asked about the required measures and costs involved in the pathways. In addition, intelligence was gathered about messaging and communication around retrofitting homes.

The three outputs from phase 1 can be categorised thus:

- A list of twelve simplified home types, that were representative of rural Devon homes
- Two types of pathway for each home type that achieves net zero emissions
- A list of 200 specific addresses within the three representative districts that provided a good sample of those home types and social demographics.

Homeowner Survey

These outputs provide the basis for the quantitative and qualitative survey undertaken in phase 2 in which Devon householders were invited to participate in an online survey in two ways:

1. Each of the 200 addresses identified in phase 1 was visited in person by a member of the local community energy group and invited to complete the online survey. A leaflet was left if occupants were not in.
2. The online survey was promoted via social media and newsletters, open to all but aimed primarily at householders in Devon and in home types commonly found in more rural areas.

All survey respondents had the option of being included in a prize draw, and the majority of respondents (78%) chose this option. Of these, 87 wanted to claim funded Home Retrofit Assessment, and 164 opted for a retail voucher.

Gathering the target sector

Parity Projects generated a list of specific households in three Devon districts that covered a range of demographics and home types, with whom the survey was shared online. To ensure that every attempt was made to engage households that were difficult to reach, a community energy group active in each district physically visited 200 of these specific households to encourage and help householders engage.

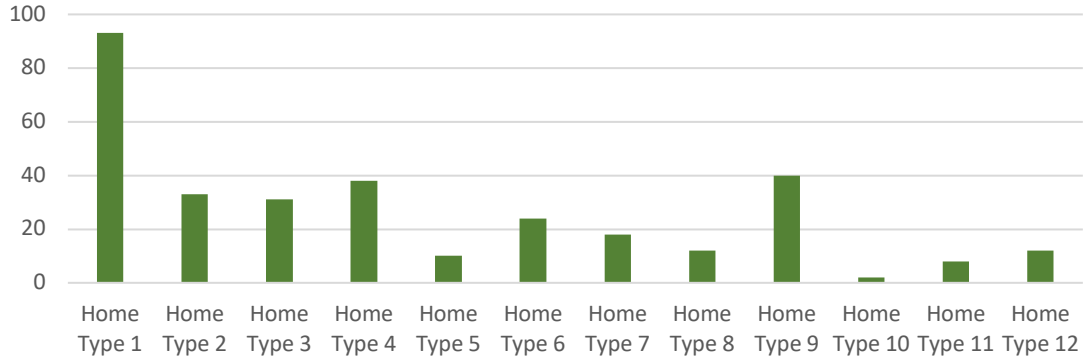


Figure 2. Level of participation from each home type

Survey Design

The survey questions were designed to pinpoint respondents' attitudes towards their home becoming net zero, the key barriers involved, and their views on the proposed pathway for their home type. The survey was designed to take just over 12 minutes to complete.

Questions covered six broad themes:

1. What is the householders appetite for a Home Improvement Plan?
2. Does the householder think the home needs to be improved?
3. What would a Home Improvement Plan need to achieve to be of interest?
4. Has the householder had experience of making home improvements?
5. Does the householder have any concerns about the Home Improvement Plan?
6. What would make undertaking a Home Improvement Plan easier?

Thematic and COM-B analysis

These six themes were analysed both with regard to Home Type and with a Capability, Opportunity, Motivation, Behaviour (COM-B) approach.

The COM-B model assesses different household groups, who are more or less likely to carry out retrofit and what their barriers and enablers are for retrofit, based on the COM-B framework of behavioral change. This works on the idea that to carry out a behavior (B), an individual must have the capability (C), opportunity (O) and motivation (M) to do so. The analysis can be found in Appendix 2.

Each respondent is ranked as high, medium or low for capability, opportunity and motivation, based on relevant questions.

4.1 Outcomes

There were 321 completed responses to the survey (18 as a direct result of a visit from the community energy group and 303 from other channels), with all Home types being represented.

Although there were survey responses representing all 12 Home Types, there was significant range in the numbers for each type. The Home Type with the highest number of responses was Home Type 1 (Brick homes with a cavity and gas heating - 93 responses completed) with Home Type 10 (Granite flats or maisonettes) receiving the least (2 completed responses).

Key findings for the whole cohort (321 responses) *Table 3*

- More than half of respondents believed their homes needed to achieve higher levels of heat retention (59% responding agree or strongly agree), and that their heating systems could be less environmentally damaging (63% responding agree or strongly agree)

- 77% of respondents agreed or strongly agreed to the concept of having a Home Improvement Plan for their property however, less than half of respondents were comfortable with spending the money on the home improvement plan typical for their home (40% either agreed or strongly agreed that they would be comfortable paying for a plan).

- The cost of retrofitting properties varied according to the home type and pathway but ranged from £6,000 to over £39,000. (See Appendix 5 for details)

- There did not appear to be a strong link between respondent's home types and their answers on motivation, perceived capability, or opportunity (COM-B framework) to undertake energy efficiency improvements to their homes.

- The biggest concern displayed by respondents regarding home improvement plans was knowing that local trades were available to undertake the work.

- Another very pressing concern was regarding uncertainty in respondents of the impact on their house value, if retrofit work were to take place.

4.2 Behavioural change analysis

Key findings

The spread of these results can be seen in figure *Figure 2 Correlation between capability, opportunity and motivation* scores. The figure shows broadly that opportunity and capability

are related, but don't seem have a firm relationship with motivation. This indicates that motivation to undertake a retrofit pathway across people's different abilities or opportunity is fairly equal.

Someone scoring high in all three categories is the most likely to carry out retrofit. So, by comparing answers of different groups across the range, the study aimed to find out key elements of importance to those who are likely to execute the behaviour and key barriers holding people back who are less likely to execute the behaviour. To do this, questions regarding preferred outcomes, concerns and required support, were assessed for three distinct groups:

1. **Those with high motivation.** Also scoring at least a medium capability and opportunity. (25% of responses) *This group could be interpreted as an initial easiest target group, whose preferred outcomes we are especially interested in.*

2. **Those with medium motivation** –predominantly due to having known of another homeowner experiencing a negative interaction with retrofit and only agreeing rather than strongly agreeing to liking the idea of retrofit. Also scoring at least a medium capability and opportunity. (32% of responses) *By comparing their concerns to the first group, we can draw out perhaps the most important concerns to address in order to entice more people, who are otherwise capable.*

3. **Those with low capability and/or low opportunity with at least medium motivation.** (33% of responses) *By comparing the differences in support required to the previous two groups, we can draw out the supports to focus on, to entice those who are interested, but need more support.*

Note that a group with low motivation has not been assessed in this exercise. While it may be interesting to understand those who are not at all interested in retrofit, very few respondents fell into this category who had any capability or opportunity to carry out retrofit.

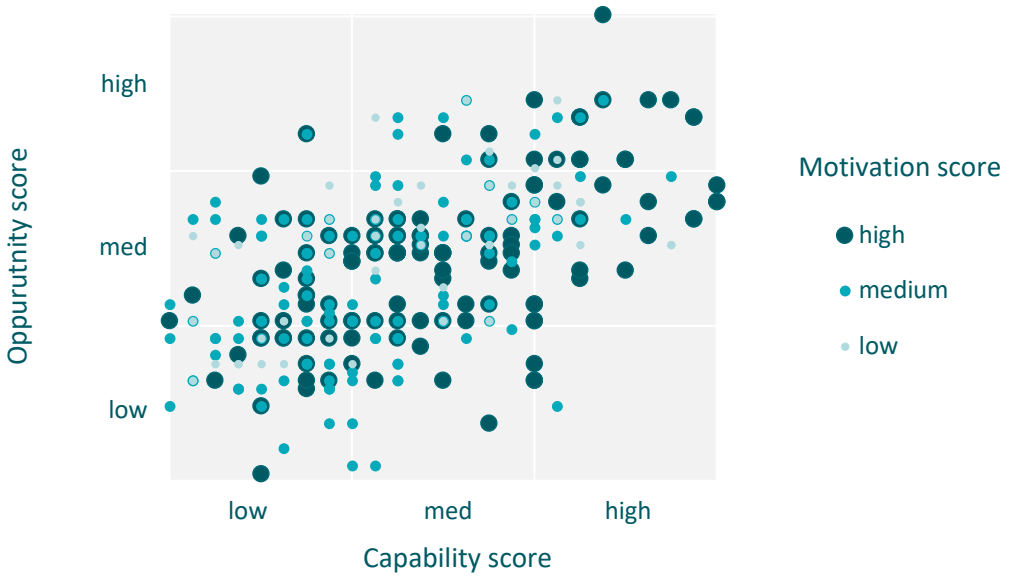


Figure 2 Correlation between capability, opportunity and motivation scores

Conclusions – COM-B findings

- The survey responses show a positive correlation between capability and motivation, and capability and opportunity. This can be seen in how the results bunch in columns in Figure 2.

- The variation in COM scores is spread equally across the home types, so no home type can be assumed to be more or less likely to engage with retrofit.

- There is strong consensus across those who are highly motivated that a reduction in carbon emissions is an essential outcome. For the slightly less motivated groups, there is less consensus, but carbon emissions are still the highest priority on average.

- A reduction in motivation from the medium motivation group appears to come from personal bad experience. The medium motivation group were also found to be significantly more concerned about disruptions during work with those concerned rising from 48 to 77% compared to the highly motivated group.

- Findings from the final group with less capability and opportunity suggest that the key blocker to uptake is education and trusted advice.
    - This group had a significant increase in "clearer information about technology and process" as a support requirement, rising from 32 to 65% when compared to the average.
    - Despite being on average as motivated as the first two groups, this group were significantly less enthusiastic about all the possible work outcomes and correspondingly, more enthusiastic about all the support requirements suggested.

4.3 Thematic analysis

Key Findings

The analysis of findings from the thematic analysis across Home Types can be found in Appendix 3.

What is the householder's appetite to have a Home Improvement Plan?

- The majority of householders like the idea of a home improvement plan (77% across home types)
- Just 41% of the respondents would be comfortable paying for the retrofit pathway indicated for their home type and ranging from £6,000 to over £39,000
- There is some indication that householders in granite construction homes and homes without cavities were slightly more inclined to invest in a home. improvement plan, but in general less than 50% of respondents would be comfortable paying the typical pathway cost for their home type. This seems to be related to concerns about uncertainty about the resultant impact on house

prices, and that impact on energy bills seems to be of lower importance than comfort levels and carbon impact.

Does the householder think the home needs to be improved?

- The desire to improve homes for either comfort or environmental reasons is broadly similar across all home types, with about 60% of householders wanting to make improvements for either (or both) reasons.
- Respondents in home types with no wall cavity were more likely to think their homes needed a higher level of heat retention. The home types that had the highest number of respondents agree or strongly agree to this were Type 9 and Type 11 (Houses and flats with no cavity). Type 7 (Granite houses on gas) were not far behind with 75% agreement in total.
- The homes with the least numbers of respondents agreeing their homes needed to keep the heat in better were Type 7, 8 and 5: Timber, Cob and flats with a cavity. (39%, 42% and 40% respectively).

What would a Home Improvement Plan need to achieve to be of interest?

- When considering what benefits the home improvement should deliver, lower carbon emissions was the most popular 'essential' reason.
- On average across home types, lowering carbon footprint and improving health outcomes for the residents were seen as more 'essential' than protecting against energy price rises.

Has the householder had experience of making home improvements?

- Around half of all respondents across all home types have either made improvements to their homes or have thought about it. (55% and 53% respectively)
- Very few householders (12% across home types) were aware of how to access the installers required to carry out improvement works.
- Very few householders (15% across home types) have a plan to improve their homes.

Does the householder have any concerns about the Home Improvement Plan?

- There is a moderate amount of concern from across home types about how improvements might impact house prices (an average of 48% of respondents across home types listed 'Very Concerned').
- There was low concern that applying for grants or funding would be difficult or confusing (16%), but a moderate amount of concern that planning the works would be difficult or confusing (27%).
- There is low concern that any works might be poor quality, just 6% across all home types.

What would make undertaking a Home Improvement Plan easier?

- A change in the law about home heating is not seen as important with an average of 30% of respondents believing this to be 'essential', far below some of the other options.
- Low mortgage rates for homes with Home Improvement Plans are not seen as important, with just an average of 21% of respondents believing this to be 'essential'.
- An average of 79% of respondents across home types believe that having local trades delivering the work is 'essential'.

4.4 Survey design and implementation - impacts

Substantial efforts were put into giving the survey the best chance of success by reaching demographics that are difficult to reach and who do not normally engage with the subject of energy efficiency. In this instance:

- The survey was easily accessible (online)
- The survey completion time was expected to be low, at less than 15 minutes
- On successful completion, respondents were entered into a prize draw, winning either a funded home improvement survey or a £250 retail voucher
- 200 homes were specifically targeted in clusters within each of the Devon districts and time funded for a community energy group to visit each home and explain/help householders with the survey
- The survey was promoted online through social media and newsletters.

Regarding the demographic split shown across responses to the survey:

- The majority of respondents were owner-occupiers (nearly 90%)
- The majority of respondents were either retired or employed (28% and 65% respectively)
- The majority of respondents were living in a household with no children (70%)

Issues of engagement

303 additional online surveys were completed, after homeowners taking part in the initial study had been targeted. Just 18 of the 200 initial householders successfully completed a survey, which at just under 10% is about what would be expected, but also should be interrogated.

Feedback from the community energy groups undertaking the doorstep visits to the 200 homes reported that many of the householders were simply not home, too busy to engage or were unsure why they had been singled out for the survey, which may have impacted their responses.

Discussions about making alterations to homes is highly emotive and on at least one occasion started out with the householder being understandably defensive when asked about their energy bills and investing in retrofit measures. However, the community energy groups also reported that they had several good conversations with householders who had not previously engaged with them and were interested in knowing more.

The weather was extremely cold the week the surveys were carried out which may have impacted on how willing householders were to carry out a doorstop survey.

Communication and language play critical roles in engaging householders with energy efficiency. The purpose of the survey and analysis was to focus on rural, mainly disengaged households, and therefore it was important to avoid technical jargon whenever possible. This can be challenging, given the technical nature of the home type pathways.

Trusted and Local

Feedback from the community energy groups undertaking the surveys highlighted that householders appreciated more accessible descriptions of what improvements would likely be suitable for their homes and the likely costs. This would appear to reflect that engagement with trusted intermediaries like community energy groups and retrofit coordinators encourages discussion which may have a positive effect in in increasing uptake.

The survey responses clearly identify local tradespeople as important to ensuring that householders are comfortable investing in a retrofit plan, but also that householders were unsure of who can undertake energy improvement to their homes. This is a clear signal that there needs to be some intervention in any localised market, likely to be from a local or regional authority, to not only upskill businesses in home improvement works, but also to help householders find them.

5.Conclusions

The purpose of this work has been twofold.

1. To develop simple, meaningful descriptions of how homes typical in rural Devon could be retrofitted to achieve net zero, and how much that might cost.

2. To test pathways with a representative sample of householders in three districts of rural Devon, with a survey asking what people thought of the retrofit pathways.

There were two questions this study covered that are important to the customer journey for energy efficiency:

1. Home types: What would a set of easy to understand, but meaningful set of pathways look like for rural Devon?

2. Communication: Are there any lessons to be learnt in how we communicate with householders about energy efficiency pathways and retrofitting?

The findings of this analysis inform how local authorities and other stakeholders such as community energy groups could help householders understand energy efficiency options and pathways to net zero. The work also provides valuable lessons on how further surveys and public communication could be shaped to improve engagement.

Home Types

Parity Projects analysed over 100,000 different rural homes in Devon, using data such as EPCs. From this analysis, just 12 different types of home described over 93% of rural homes. Each home type had two energy efficiency pathways (one with only measures that were not disruptive and a second that included more disruptive and intrusive measures) with budget costs produced.

When shown to a sample of householders, the majority supported this way of describing homes and the potential pathway plans. Most householders surveyed were in favour of taking action to lower bills and the carbon emissions of their homes by retrofitting and found the pathways a useful prompt.

, Most householders felt they would need financial support to make the improvements and stressed the importance of local tradespeople being available to deliver the work. However, it was clear from the survey results that most householders were unsure of how to find suitable advice on what improvements to make, and who could make them.

Most householders welcomed the idea of local authorities and community stakeholders helping provide information and advice on making energy efficiency improvements.

Communication

Domestic energy retrofit covers a wide variety of technical measures that are often implemented by a range of installers and trades. Through the qualitative survey, householders confirmed that:

- A non-technical and simple way of describing how best to retrofit homes would be helpful in considering taking action
- Clearly setting out what the home pathways are and what to do next is important
- Using trusted intermediary's such as community / parish/ church groups to highlight a clear customer journey would be valuable

Regarding the survey itself, there were a number of lessons learned.

- The importance of an open and easy to use online survey, backed up by physical visits with those less likely to engage proactively with an online process
- Avoid attempting to engage people on their doorsteps in winter or dark evenings
- Be clear about how and why the homeowner was being included in the survey
- If undertaking 'doorstepping', allow sufficient time to explain and engage with the householder
- Use non-technical language
- Provide clear 'next steps' and an indication of the likely customer journey
- Provide follow up resources or contact if the homeowner authorizes them

Appendix 1: Homes Type data

Home Type 1 - Houses, wall cavities, mains gas heating

Typical sub-archetype: Mid-century detached cavity houses on mains gas

Net Zero without considering disruptive measure (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		62	£835	3,638
LED lights	£36	62	£825	3,630
Draughtproofing windows and doors	£260	63	£809	3,547
Loft insulation top up to >300mm	£650	64	£786	3,420
A++ double glazing	£6,000	68	£682	2,867
Air source heat pump with existing radiator system	£12,000	68	£790	1,135
Resulting Property	£18,900	68	£790	1,135

Net Zero considering disruptive measures (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		62	£835	3,630
LED lights	£36	62	£825	3,630
Draughtproofing windows and doors	£260	63	£809	3,540
Loft insulation top up to >300mm	£650	64	£786	3,420
A++ double glazing	£6,000	68	£682	2,860
Insulated solid floors	£1,690	70	£644	2,660
Air source heat pump with existing radiator system	£12,000	68	£779	1,110
Resulting Property	£20,600	68	£779	1,110

Common other interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
PV panels	£4000	+15-20	£250	450

Cavity wall insulation if not already filled	£1500	+6	£180	850

Superhome interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
External wall insulation	£10,000	+3-4	£75	400
Air source heat pump with a new radiator system	£15,000	+11		

Measures that may be restricted in Conservation Areas, Areas of Outstanding Natural Beauty or with a listing:

- External wall insulation if not already rendered
- PV panels or solar thermal
- Double glazing – usually permitted in conservation areas or AONB but not listed buildings where secondary glazing may be an option
- Air source heat pumps in extreme circumstances due to external kit

Home type 2 - Houses, wall cavities, electric heating

Typical sub-archetype: Mid-century detached cavity houses on electric

Net Zero without considering disruptive measure (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		58	£1,100	2,734
LED lights	£36	59	£1,094	2,729
Air source heat pump with a new radiator system	£15,400	69	£782	1,124
PV panels	£4,200	80	£532	589
Resulting Property	£20,160	80	£532	589

Net Zero considering disruptive measures (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		58	£1,100	2,734
LED lights	£30.00	58	£1,094	2,729
Insulated solid floors	£1,840	60	£1,029	2,557
A++ double glazing	£6,350	65	£913	2,251
External insulation to the cavity walls	£11,230	71	£744	1,802
Air source heat pump with a new radiator system	£15,900	71	£727	1,045
PV panels	£4,230	82	£477	510
Resulting Property	£39,580	82	£477	510

Common other interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
Loft top up	£650	+1-3	£50	200
Cavity wall insulation (where uninsulated)	£1500	+6	£180	850

Measures that may be restricted in Conservation Areas, Areas of Outstanding Natural Beauty or with a Listing:

- External wall insulation if not already rendered

- PV panels or solar thermal
- Double glazing – usually acceptable in Conservation areas or Areas of Outstanding Natural Beauty but not listed buildings where secondary glazing may be an option
- Air source heat pumps in extreme circumstances due to the appearance of external fittings.

Home type 3 - Houses, wall cavities, other heating fuel (not electricity or gas)

Typical sub-archetype:Mid-century detached cavity houses on oil

Net Zero without considering disruptive measure (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		46	£964	6,002
LED lights	£60	47	£926	5,979
Loft insulation top up to >300mm	£862	60	£713	4,491
Air source heat pump with new radiator system	£15,900	69	£902	1,296
PV Panels	£2,140	72	£822	1,122
Resulting Property	£18,960	72	£790	1,135

Net Zero considering disruptive measures (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		46	£964	6,002
LED lights	£60	47	£926	5,979
Loft insulation top up to >300mm	£860	60	£714	4,491
Insulated solid floors	£2,180	62	£670	4,185
Air source heat pump with new radiator system	£15,900	71	£857	1,231
PV Panels	£2,140	74	£776	1,058
Resulting Property	£21,140	74	£776	1,058

Common other interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
A++ double glazing	£6000	+4	£100	300
Cavity wall Insulation (where uninsulated)	£1500	+6	£180	850

Superhome interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
External wall insulation on top of the cavity wall insulation	£10,000	+3-4	£75	400

Measures that may be restricted in Conservation Areas, Areas of Outstanding Natural Beauty or with a listing:

- External wall insulation if not already rendered
- PV panels or solar thermal
- Double glazing – usually acceptable in Conservation areas or Areas of Outstanding Natural Beauty but not listed buildings where secondary glazing may be an option
- Air source heat pumps in extreme circumstances due to external appearance of fittings.

Home type 4 - Houses, granite walls, not connected to mains gas

Typical sub-archetype: Victorian granite detached houses off gas

Net Zero without considering disruptive measure (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		34	£1,400	8,550
LED lights	£100	35	£1,360	8,530
Loft insulation top up to >300mm	£640	37	£1,320	8,240
Air source heat pump with new radiator system	£15,900	58	£1,410	2,015
PV panels	£5,510	71	£1,080	1,300
Resulting Property	£22,150	71	£1080	1,300

Net Zero considering disruptive measures (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		34	£1,400	8,550
LED lights	£100	35	£1,360	8,530
Loft insulation top up to >300mm	£640	37	£1,320	8,240
External wall insulation	£15,240	63	£780	4,390
Solid floor insulation	£2,340	66	£730	4,050
Air source heat pump with new radiator system	£15,900	75	£820	1,180
PV panels	£5,510	88	£490	470
Resulting Property	£39,730	88	£490	470

Common other interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
A++ Double glazing	£6000	+4	£100	300
Internal wall insulation at an alternative to external wall insulation	£15,000	20	£500	3,000

Superhome interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving

Air source heat pump with underfloor heating	£15,000	+10	-	3,000

Measures that may be restricted in Conservation Areas, Areas of Outstanding Natural Beauty or with a listing:

- External wall insulation if not already rendered
- PV panels or solar thermal
- Double glazing – usually ok in Conservation or AONB but not listed buildings where secondary glazing may be an option
- Air source heat pumps in extreme circumstances due to external kit

Home type 5 - Flats, wall cavities, Any heating fuel

Typical sub-archetype: Late mid-century cavity flats

Net Zero without considering disruptive measure (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		46	£1,035	2,830
LED lights	£66	48	£1,000	2,810
Cavity wall insulation	£985	53	£897	2,330
Air source heat pump with enhanced existing radiator system	£12,000	76	£490	690
Resulting Property	£13,050	76	£490	690

Net Zero considering disruptive measures (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		46	£1,035	2,830
LED lights	£65	48	£1,000	2,810
Cavity wall insulation	£985	53	£900	2,330
Solid floor insulation	£2,370	57	£825	2,000
A++ double glazing	£4,500	60	£770	1,740
Air source heat pump enhanced existing radiator system	£12,000	80	£405	580
Resulting Property	£19,920	80	£405	580

Common other interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
PV panels on the block	£4000	+15-20	£250	450
Cavity wall insulation	£1500	+6	£180	850
High heat retention storage heaters as an alternative to heat pump if currently on electric heating	£4000	+10	£170	165
Communal heat pump as an alternative to individual heat pump	£13,000	+20	£300	1,390
Loft or flat roof insulation if top floor flat	£1,000	+5	£100	120

Superhome interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
External wall insulation on top of the cavity wall insulation	£10,000	+3-4	£75	400
Air source heat pump with a new radiator system	£15,000	+20	£300	1,200

Measures that may be restricted in Conservation Areas, Areas of Outstanding Natural Beauty or with a Listing:

- External wall insulation if not already rendered
- PV panels or solar thermal
- Double glazing – usually ok in Conservation or AONB but not listed buildings where secondary glazing may be an option
- Air source heat pumps in extreme circumstances due to external kit

Home type 6 - Houses, granite construction, mains gas heating

Typical sub-archetype: Victorian granite detached houses on mains gas

Net Zero without considering disruptive measure (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		39	£2,530	12,990
>300mm loft insulation	£920	48	£2,160	11,000
Draughtproof doors and windows	£360	49	£2,100	10,670
Block open chimneys	£300	49	£2,080	10,570
Air source heat pump with enhanced existing radiator system	£12,000	58	£1,890	6,010
Resulting Property	£13,590	58	£1,890	6,010

Net Zero considering disruptive measures (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		39	£2,530	11,700
>300mm loft insulation	£920	48	£2,160	9,910
Draughtproof doors and windows	£360	49	£2,100	9,620
Block open chimneys	£300	49	£2,080	9,520
External wall insulation	£19,880	66	£1,415	6,250
Air source heat pump with enhanced existing radiator system	£12,000	74	£1,200	1,720
Resulting Property	£33,470	74	£1,200	1,720

Common other interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
Solid floor insulation	£3,000	+2	£150	500
Internal wall insulation as an alternative to external wall insulation	£40,000	+17	£600	32,00
PV panels	£4000	+15-20	£250	450

Superhome interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
Air source heat pump with underfloor heating system	£16,000	+11	£300	5,000
Ground source heat pump with underfloor heating system	£22,000	+13	£350	£5,500

Measures that may be restricted in Conservation Areas, Areas of Outstanding Natural Beauty or with a Listing:

- External wall insulation if not already rendered
- PV panels or solar thermal
- Double glazing – usually ok in Conservation or AONB but not listed buildings where secondary glazing may be an option
- Air source heat pumps in extreme circumstances due to external kit

Home type 7 - Houses, T=timber frame construction, Any heating fuel

Typical sub-archetype: Mid-century semi or detached timber frame houses

Net Zero without considering disruptive measure (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		51	£1,060	4,690
LED lights	£60	53	£1,020	4,660
Loft insulation top up to >300mm	£860	67	£700	2,960
Air source heat pump with enhanced existing radiator system	£12,000	67	£820	1,180
PV panels	£7,570	89	£350	160
Resulting Property	£20,500	89	£350	160

Net Zero considering disruptive measures (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		51	£1,064	4,690
LED lights	£60	53	£1,030	4,660
Loft insulation top up to >300mm	£860	67	£700	2,960
Suspended floor insulation	£3,190	69	£650	2,690
Air source heat pump with enhanced existing radiator system	£12,000	69	£770	1,110
PV panels	£7,570	91	£290	90
Resulting Property	£23,690	91	£290	90

Common other interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
A++ double glazing	£8,000	+4	£100	300

Superhome interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
Air source heat pump with underfloor heating system	£16,000	-	-	1,300

Upgraded wall insulation	£12,000	+17	£600	32,00

Measures that may be restricted in Conservation Areas, Areas of Outstanding Natural Beauty or with a Listing:

- External wall insulation if not already rendered
- PV panels or solar thermal
- Double glazing – usually ok in Conservation or AONB but not listed buildings where secondary glazing may be an option
- Air source heat pumps in extreme circumstances due to external kit

Home type 8 - Houses, cob construction, Any heating fuel

Typical sub-archetype: Pre twentieth century cob detached houses

Net Zero without considering disruptive measure (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		51	£1,530	9,610
Block open chimneys	£300	52	£1,520	9,560
Loft insulation top up to >300mm	£800	53	£1,480	9,270
Air source heat pump with new radiator system	£19,800	73	£1,350	1,940
PV panels	£7,710	85	£880	910
Resulting Property	£28,620	85	£880	1,130

Net Zero considering disruptive measures (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		51	£1,530	9,610
Block open chimneys	£300	52	£1,520	9,560
Loft insulation top up to >300mm	£800	53	£1,480	9,270
Solid floor insulation	£3,860	56	£1,400	8,750
Air source heat pump with new radiator system	£19,800	75	£1,290	1,840
PV panels	£7,710	86	£810	820
Resulting Property	£32,490	86	£810	820

Common other interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
A++ double glazing	£8,000	+4	£100	300
LED Lights	£60	+2	£40	50

Superhome interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
External or internal wall insulation	£13,000	+17	£600	32,00

Air source heat pump with underfloor heating	£15,000	+20	£150	6,200
Ground source heat pump with underfloor heating	£24,000	+22	£200	7,000

Measures that may be restricted in Conservation Areas, Areas of Outstanding Natural Beauty or with a Listing:

- External wall insulation if not already rendered
- PV panels or solar thermal
- Double glazing – usually ok in Conservation or AONB but not listed buildings where secondary glazing may be an option
- Air source heat pumps in extreme circumstances due to external kit

Home type 9 - Houses, uninsulated brick construction, mains gas heating

Typical sub-archetype: Late Victorian/Edwardian terraces on mains gas

Net Zero without considering disruptive measure (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		45	£1,050	4,360
LED lights	£60	46	£1,020	4,330
Loft insulation top up to >300mm	£790	53	£880	3,640
Air source heat pump with enhanced existing radiator system	£12,000	54	£980	1,400
Resulting Property	£12,860	54	£980	1,130

Net Zero considering disruptive measures (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		45	£1,050	4,360
LED lights	£60	46	£1,020	4,330
Loft insulation top up to >300mm	£790	53	£880	3,640
Internal wall insulation	£15,720	66	£620	2,360
Solid floor insulation	£1,450	67	£600	2,260
Air source heat pump with enhanced existing radiator system	£12,000	64	£780	1,120
Resulting Property	£30,040	64	£780	1,120

Common other interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
PV panels	£4000	+15-20	£250	450
External wall insulation as an alternative to internal wall insulation	£16,000	+13	£160	1,300

Superhome interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
Air source heat pump with underfloor heating	£15,000	-	-	1,100

Measures that may be restricted in Conservation Areas, Areas of Outstanding Natural Beauty or with a Listing:

- External wall insulation if not already rendered
- PV panels or solar thermal
- Double glazing – usually ok in Conservation or AONB but not listed buildings where secondary glazing may be an option
- Air source heat pumps in extreme circumstances due to external kit

Home type 10 - Flats, granite construction, Any heating fuel

Typical sub-archetype: Pre twentieth century granite converted houses

Net Zero without considering disruptive measure (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		60	£660	1,600
A++ double glazing	£3,810	63	£610	1,480
High heat retention storage heaters	£1,600	69	£510	1,290
PV panels	£3,750	80	£360	980
Resulting Property	£9,160	80	£360	1,130

Net Zero considering disruptive measures (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		60	£660	1,600
Internal wall insulation	£3,670	77	£370	890
A++ double glazing	£3,810	80	£320	760
High heat retention storage heaters	£1,600	82	£300	720
PV panels	£3,750	93	£150	410
Resulting Property	£12,970	93	£150	410

Common other interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
PV panels	£4000	+15-20	£250	450
External wall insulation as an alternative to internal wall insulation	£6,000	+15	£300	700

Superhome interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
Air source heat pump with a new radiator system	£15,000	+5	-	500

Measures that may be restricted in Conservation Areas, Areas of Outstanding Natural Beauty or with a Listing:

- External wall insulation if not already rendered
- PV panels or solar thermal
- Double glazing – usually ok in Conservation or AONB but not listed buildings where secondary glazing may be an option
- Air source heat pumps in extreme circumstances due to external kit

Home type 11 - Flats, Uninsulated brick construction, Any heating fuel

Typical sub-archetype: Late Victorian/Edwardian converted terraces

Net Zero without considering disruptive measure (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		53	£1,010	2,400
LED lights	£60	54	£980	2,370
Draughtproof doors and windows	£180	54	£970	2,360
A++ double glazing	£3,020	59	£870	2,110
Loft insulation top up to >300mm	£570	59	£860	2,090
High heat retention storage heaters	£2,400	63	£790	1,960
Resulting Property	£6,243	63	£790	1,960

Net Zero considering disruptive measures (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		53	£1,010	2,400
LED lights	£60	54	£980	2,370
Draughtproof doors and windows	£180	57	£910	2,210
Internal wall insulation	£5,290	67	£700	1,680
A++ double glazing	£3,020	72	£600	1,430
Loft insulation top up to >300mm	£570	72	£590	1,410
High heat retention storage heaters	£2,400	73	£580	1,390
Resulting Property	£11,680	73	£580	1,390

Common other interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
PV panels	£4000	+15-20	£250	450
External wall insulation to the entire block/house as an alternative to internal wall insulation	£6,000	+10	£220	700

Superhome interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
Air source heat pump with a new radiator system	£15,000	+15	£460	1,600

Measures that may be restricted in Conservation Areas, Areas of Outstanding Natural Beauty or with a Listing:

- External wall insulation if not already rendered
- PV panels or solar thermal
- Double glazing – usually ok in Conservation or AONB but not listed buildings where secondary glazing may be an option
- Air source heat pumps in extreme circumstances due to external kit

Home type 12 - Houses, uninsulated brick construction, not on mains gas

Typical sub-archetype: Late Victorian/Edwardian houses off gas

Net Zero without considering disruptive measure (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		51	£1,310	3,490
LED lights	£66	52	£1,270	3,460
Loft insulation top up to >300mm	£640	55	£1,180	3,210
Air source heat pump new radiator system	£15,900	65	£870	1,260
PV panels	£4,020	77	£640	760
Resulting Property	£20,630	77	£640	760

Net Zero considering disruptive measures (cumulative impact)

	Costs	SAP Score	Fuel Bill	$KgCO_2$
Current Property		51	£1,310	3,490
LED lights	£66	52	£1,270	3,460
Loft insulation top up to >300mm	£640	55	£1,180	3,210
External wall insulation	£8,730	68	£840	2,200
Solid floor insulation	£1,750	70	£790	2,050
Air source heat pump new radiator system	£15,900	70	£760	1,100
PV panels	£4,010	81	£530	600
Resulting Property	£31,110	81	£530	600

Common other interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving
Internal wall as an alternative to external wall insulation	£10,000	+3-4	£75	400
A++ double glazing	£7000	+3	£60	170

Superhome interventions:

	Cost	Example SAP Saving	Example fuel bill £ saving	Example $kgCO_2$ saving

None	-	-	-	-

Measures that may be restricted in Conservation Areas, Areas of Outstanding Natural Beauty or with a Listing:

- External wall insulation if not already rendered
- PV panels or solar thermal
- Double glazing – usually ok in Conservation or AONB but not listed buildings where secondary glazing may be an option
- Air source heat pumps in extreme circumstances due to external kit

Appendix 2: Behavioural change analysis

5.1. Methodology

This model assesses different household groups, who are more or less likely to carry out retrofit, and what their barriers and enablers are. The COM-B framework of behavioral change has been used to do this. The framework works on the basis that to carry out a behavior (B), an individual must have the capability (C), opportunity (O) and motivation (M) to do so. Applying the theory to retrofit, the factors are defined as follows:

- I am *motivated* because… (the inspiration)
    - I like the idea of carrying out retrofit
    - I know people who have done it
- I am *capable* because… (the personal)
    - I understand what I need to do or where to go for advice
    - I have the finances to carry out the task
- I have the *opportunity* because… (the external)
    - I know of tradespeople who would carry out the work
    - I'm planning on staying for a long time and/or have not just renovated or changed my heating

Scores for each factor are calculated using the survey questions analogous to the definitions above. Participants are then denoted high, medium, and low scores for capability, opportunity and motivation. This provides each participant with a COM score, e.g. high-med-low for high capability, medium opportunity and low motivation.

5.2. Results

The three components of the model are known to be intrinsically linked, so it is not surprising to see a positive correlation between them (see Figure 3). However, somewhat surprisingly there was no clear relationship was found between the overall COM score and home types in this sample size. When motivation, capability and opportunity ae examined together, the range of scores is similar across homes types. Three groups of interest are defined in order to assess the changes in their specific motivations, barriers and enablers, which can be seen in Figure 4 (note that all of these questions are independent from the questions which define the COM score).

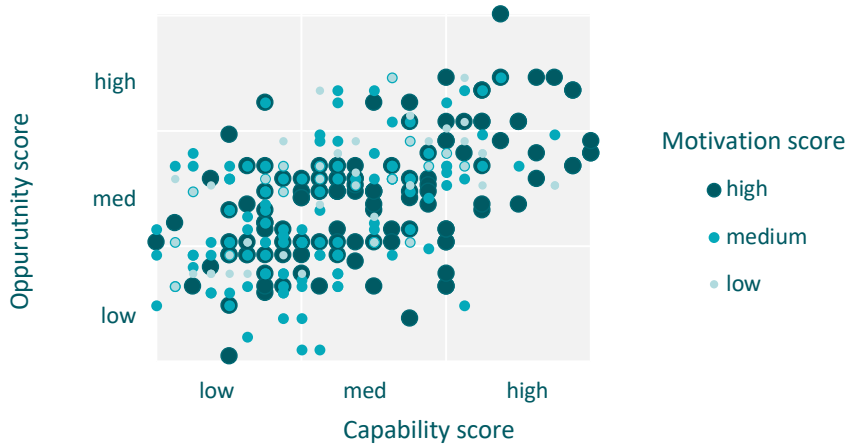
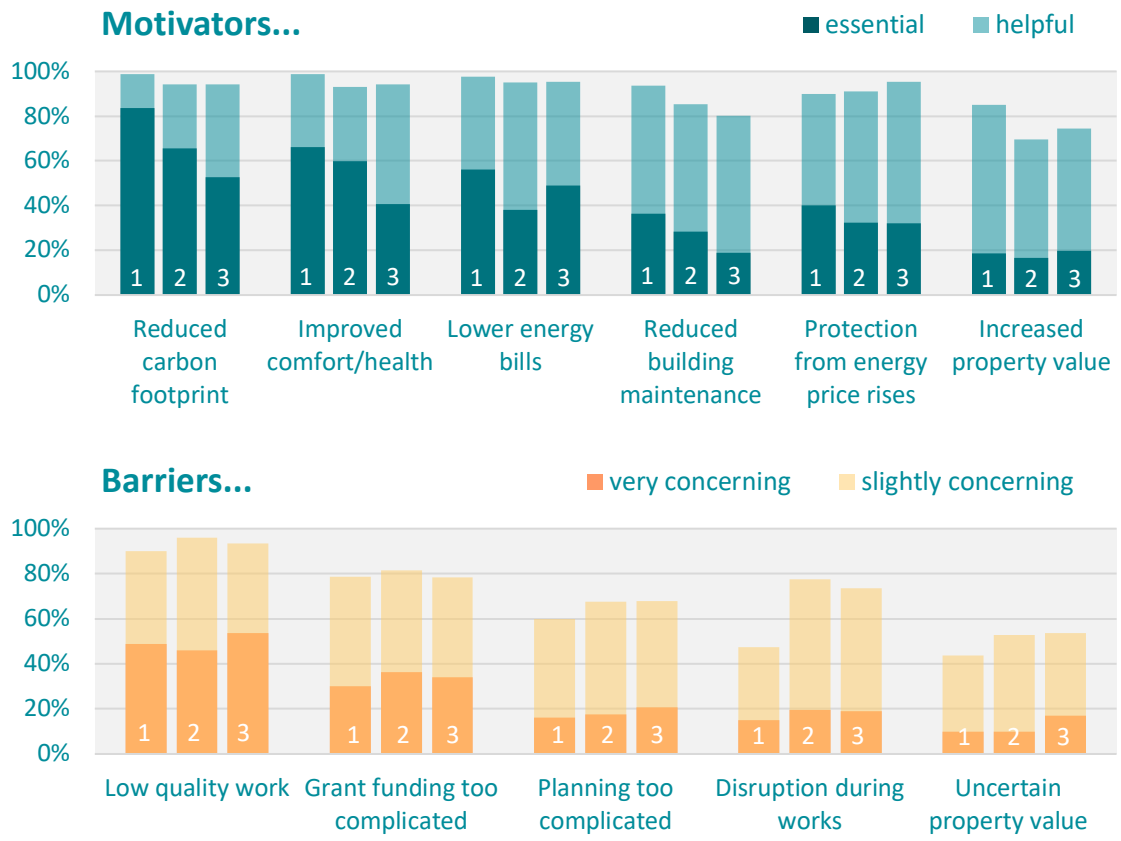


Figure 3 Correlation between capability, opportunity and motivation scores

1. **Group 1: High motivation. Also scoring at least a medium for capability and opportunity** (25% of responses)
   The high motivation score is reached by *agreeing* or *strongly agreeing* that the respondent likes the idea of retrofit and if they know anyone who has undergone similar works, their experience was positive. This group could be considered the easiest-to-reach target group, which is confirmed by the result that 73% have carried out some form of retrofit before, and 44% have a retrofit plan for their home. There is strong consensus from this group that a reduced carbon footprint is an essential outcome of works. They also generally think that improved health/comfort and lower energy bills are essential.
2. **Group 2: Medium motivation. Also scoring at least a medium for capability and opportunity** (32% of responses)
   The medium motivation group means that they *agree* to liking the idea of retrofit in their home, however have known people who have carried out similar works and had a negative experience. The results imply this could be from personal experience – 87% have carried out retrofit and 66% have a retrofit plan. Their answers are broadly similar to group 1 (high motivation). A notable difference is the concern of disruption during works which rises from 48% for group 1 to 77% for group 2 for those who find it *slightly concerning* or *very concerning*. This suggests that this concern could be the most damaging deterrent, preventing otherwise capable households from carrying out retrofit.
3. **Group 3: Low capability and/or low opportunity with at least medium for motivation** (33% of responses)
   Group 3 is characterized by having considerable material blockers to retrofit (e.g. not having the finances, not understanding the need, or not knowing tradespeople in the area), but still indicating that they like the idea of retrofit. Group 3's answers also follow similar patterns to groups 1 and 2 (like group 2, they are also concerned about disruption during works). Despite on average scoring as highly as groups 1 and 2 in motivation, they are on average significantly less enthusiastic about every work

outcome. As capability refers in part to understanding of need, this may be because this group has thought about retrofit less, if at all, and so does not have strongly formed feelings yet around what benefits they would like to see (50% of this group have carried out some form of retrofit and just 9% have a retrofit plan). Correspondingly, this group is more enthusiastic about every support requirement suggested. Most notably, while the survey average across all groups is 32%, 65% of this group rates "clearer information about technology and process" as *required*.



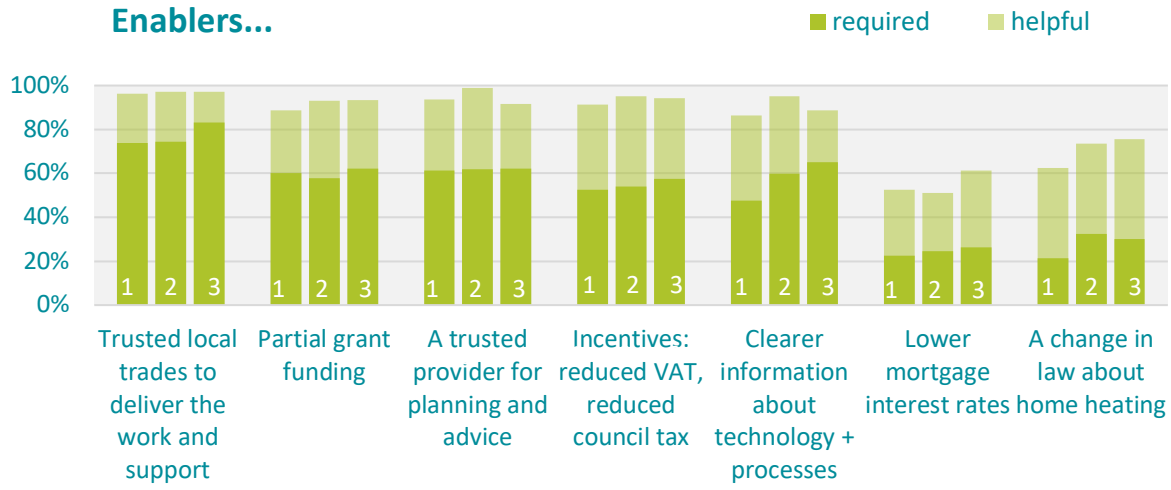


Figure 4 Proportional scores for survey statements, across the different behavioural change groups

Appendix 3: Thematic Analysis

The 321 survey responses were assessed thematically by home type, identifying any trends for any of the twelve different home types.

Survey questions were based around six particular themes or aspects of home improvement. Broadly, these can be described as:

1. What do you think about the idea and cost of a Home Improvement Plan?
2. Do you think you need a Home Improvement Plan?
3. Have you done any home improvements or know of people that have?
4. What features would home improvements of the type outlined in the pathway have to deliver for you?
5. What concerns do you have about delivering a Home Improvement Plan?
6. What would make undertaking a Home Improvement Plan more attractive to you?

Theme 1: What do you think about the idea and cost of a Home Improvement Plan?

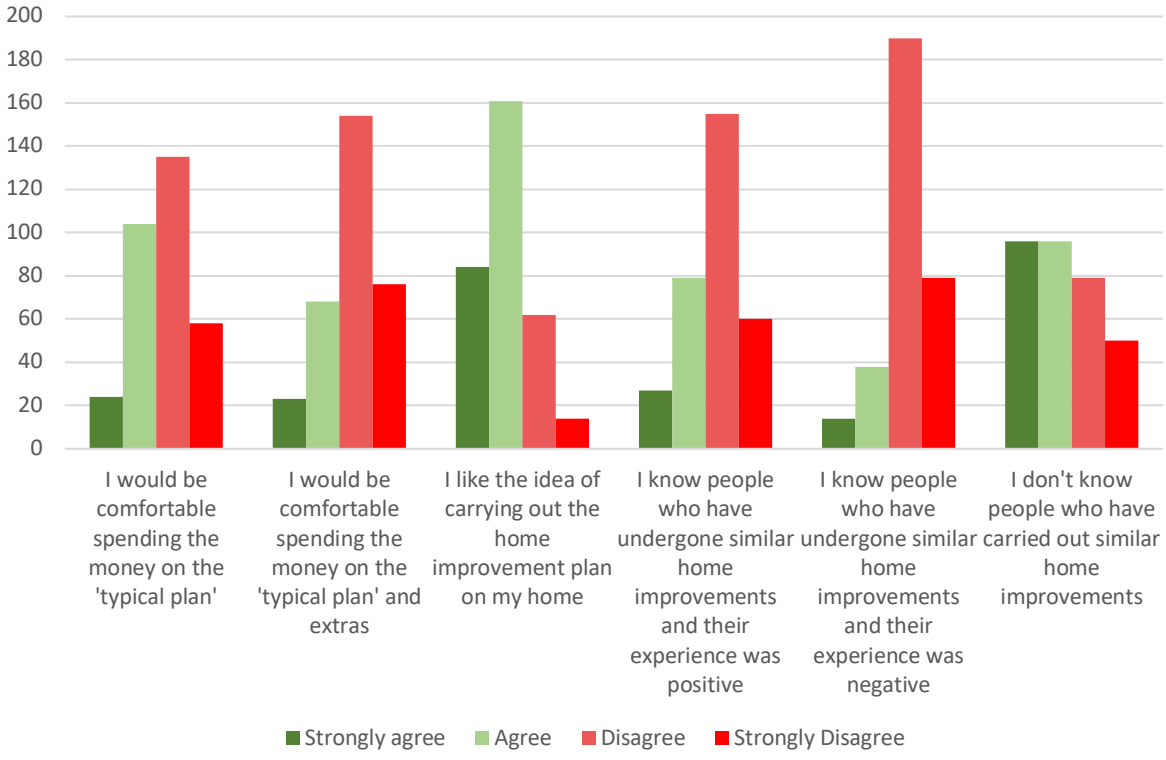


Figure 5 Householder views on the idea and cost of Home Improvement Plans

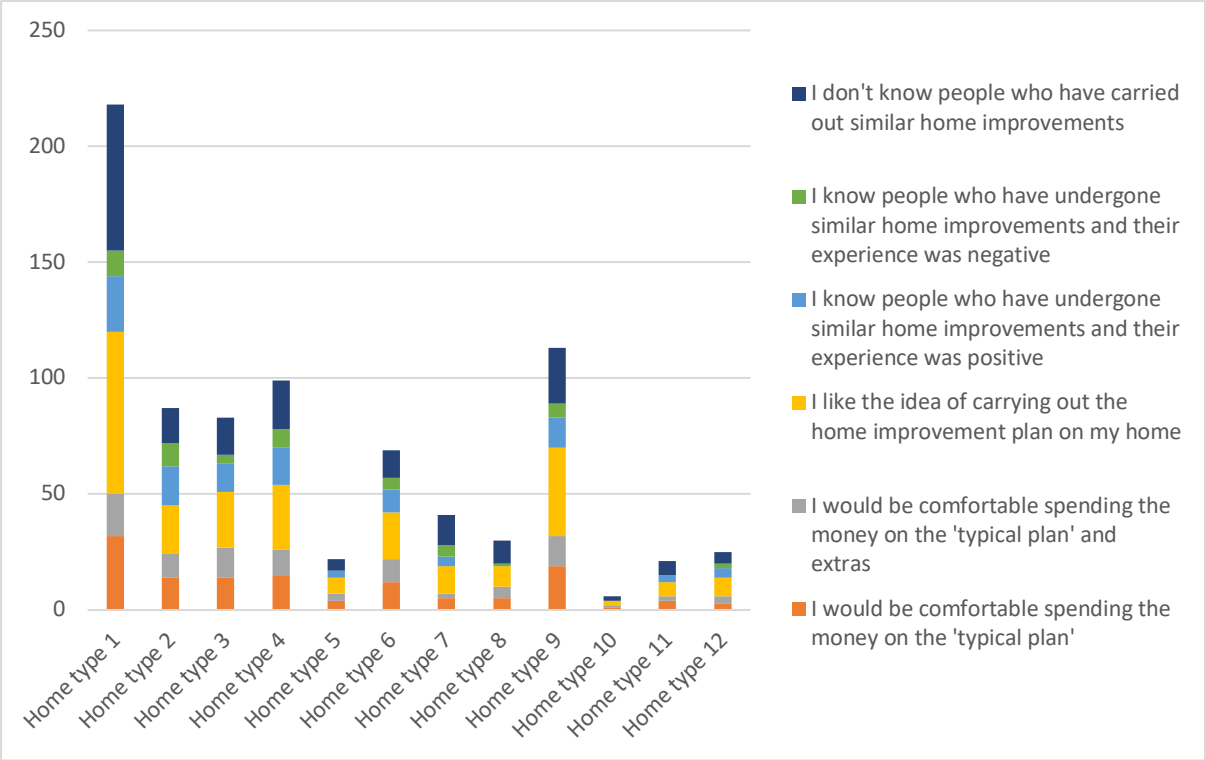


Figure 6 Respondents that strongly agreed or agreed with statements about Home Improvement Plans, by home type

Theme 2: Did the householder think their home needed improvement?

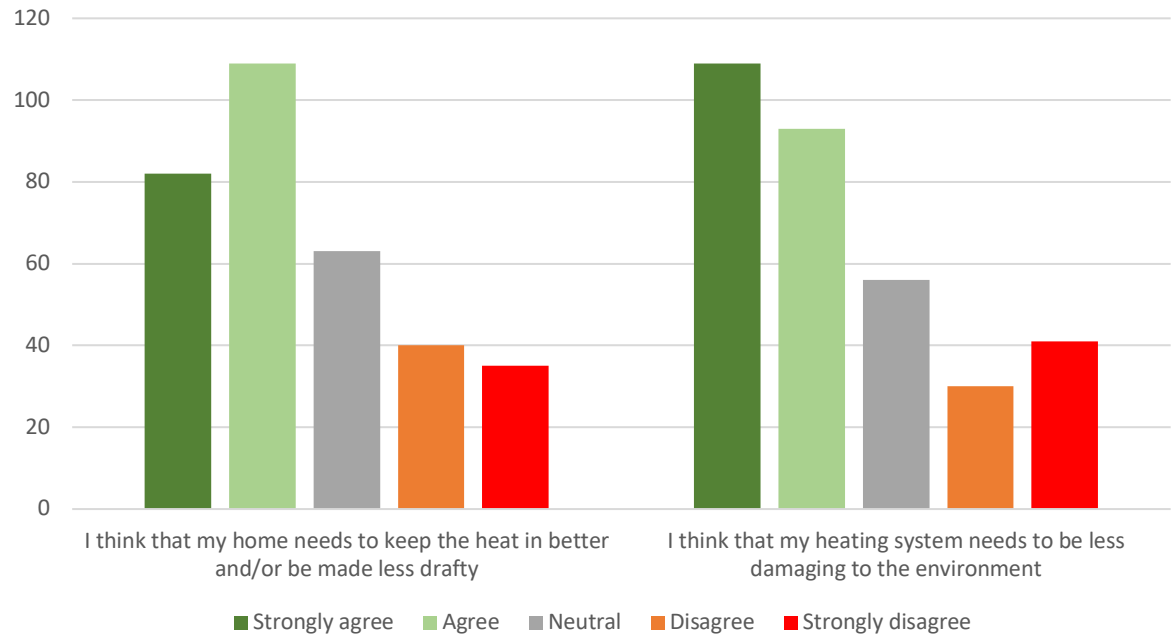


Figure 7 Do you think your home needs improvement? – Overall results

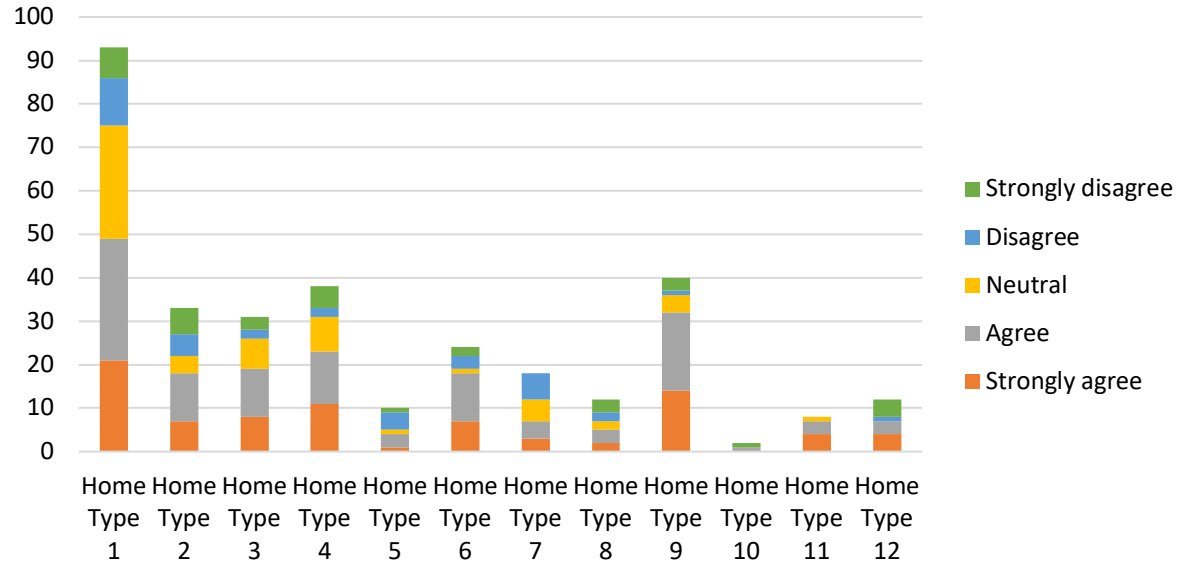


Figure 8 "I think that my home needs to keep the heat in better and/or be made less draughty", by home type

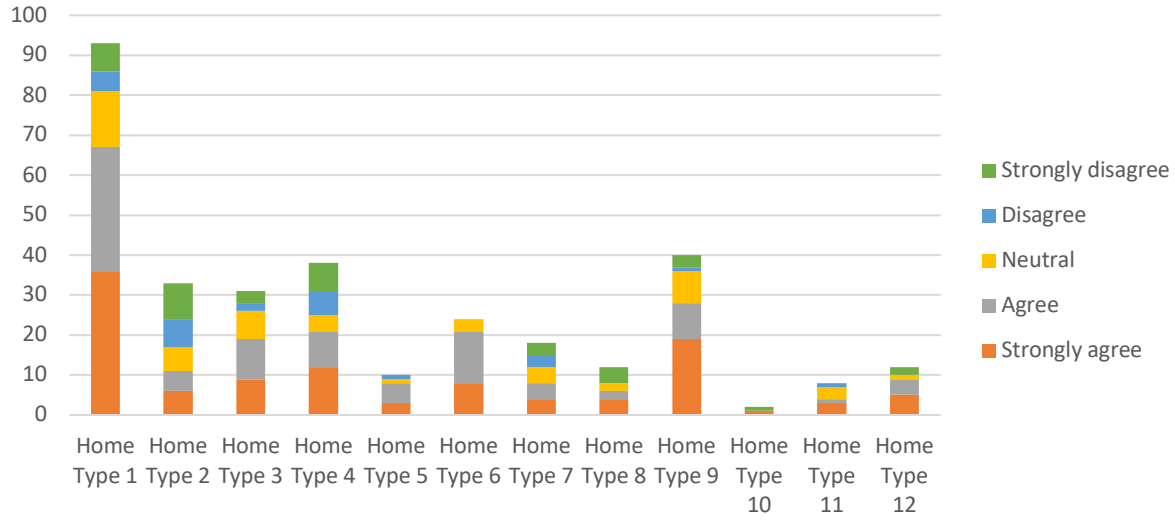


Figure 9 "I think that my heating system needs to be less damaging to the environment", by home type

Theme 3: Have you done any home improvements or know of people that have?

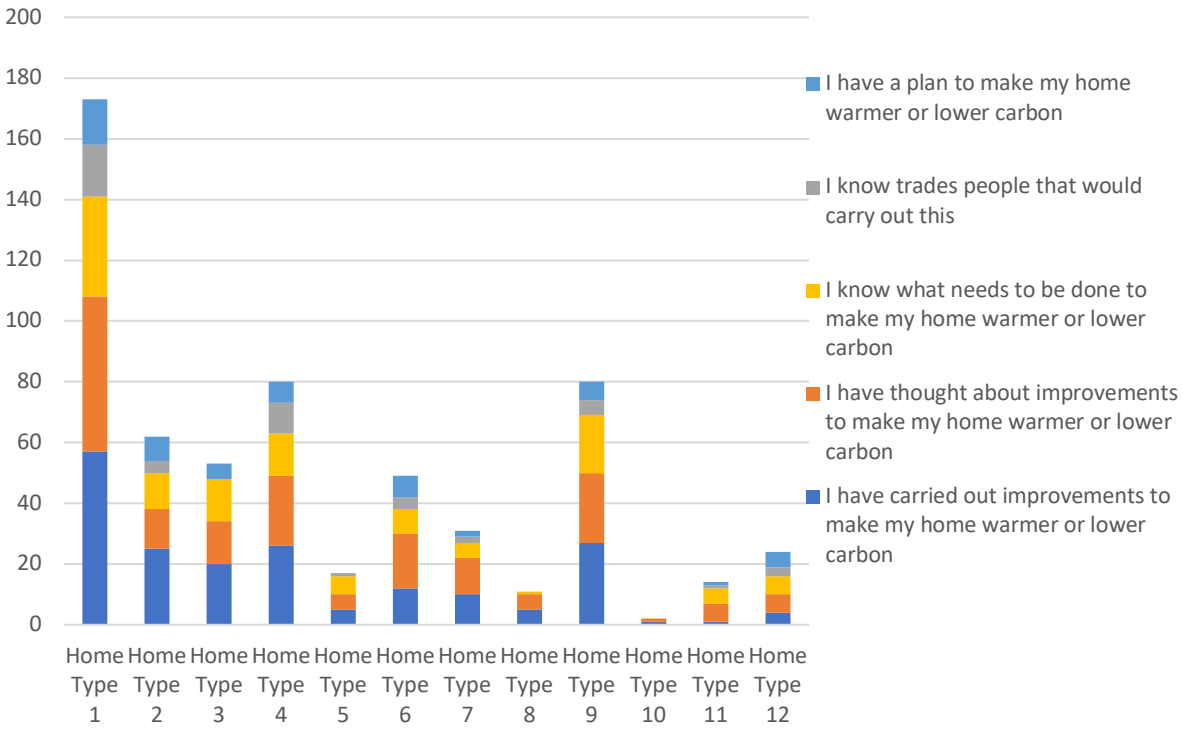


Figure 10 Positive responses to questions around home energy and decarbonisation (agree or strongly agree), by home type

Theme 4: What features would home improvements of the type outlined in the pathway have to deliver for you?

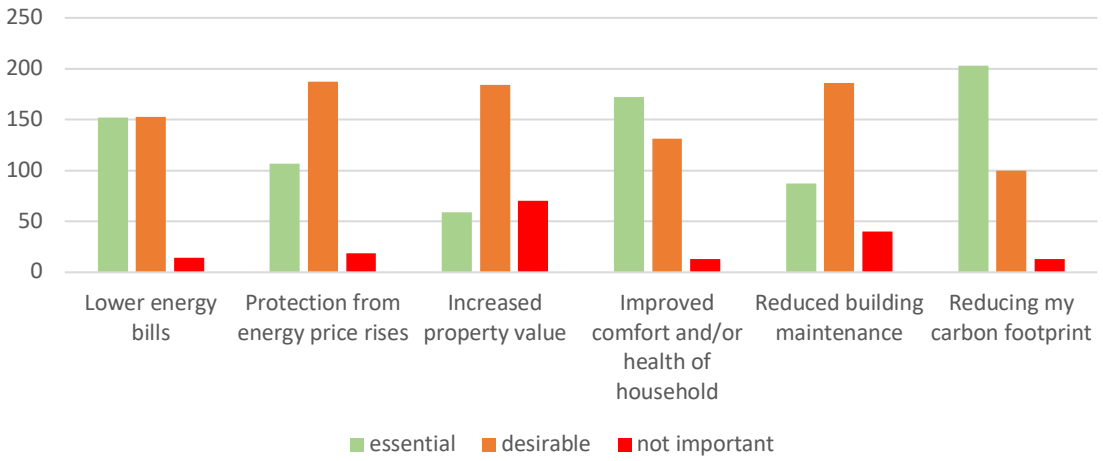


Figure 11 What features would a Home Improvement Plan would be of value to respondents?

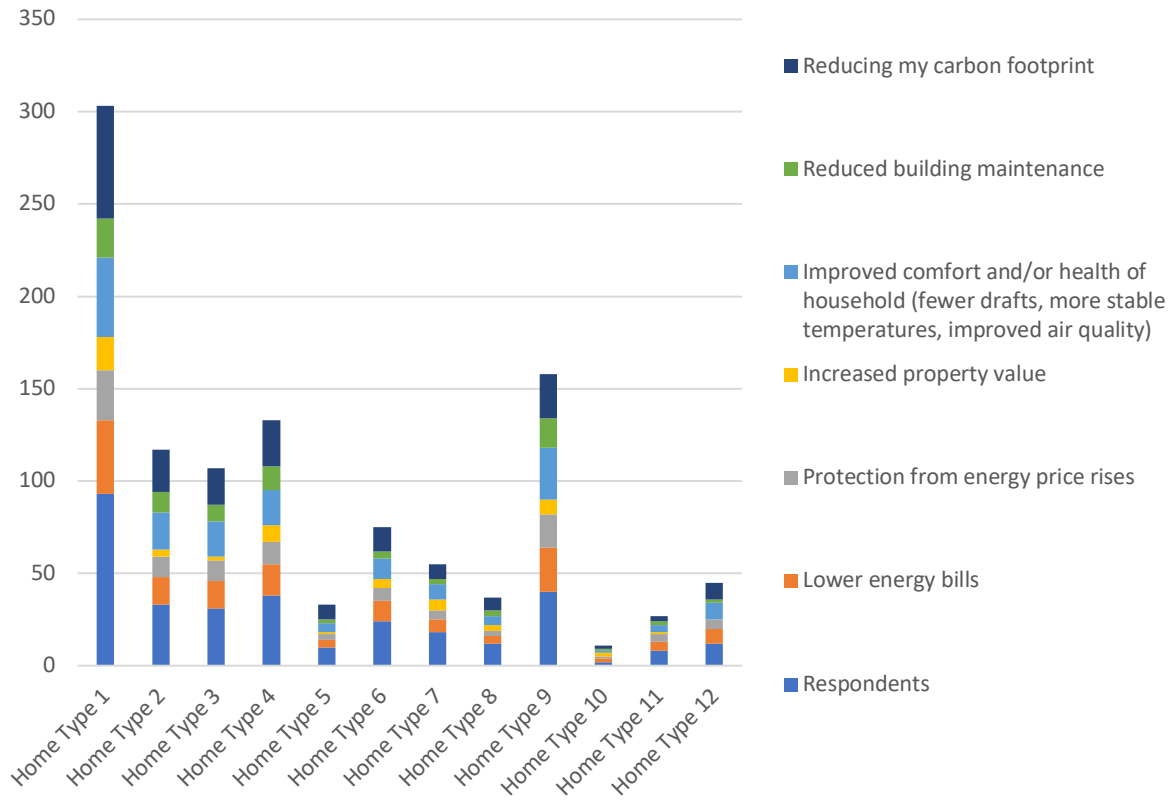


Figure 12 Features of a Home Improvement Plan deemed 'essential', by home type

Theme 5: What concerns do you have about delivering a Home Improvement Plan?

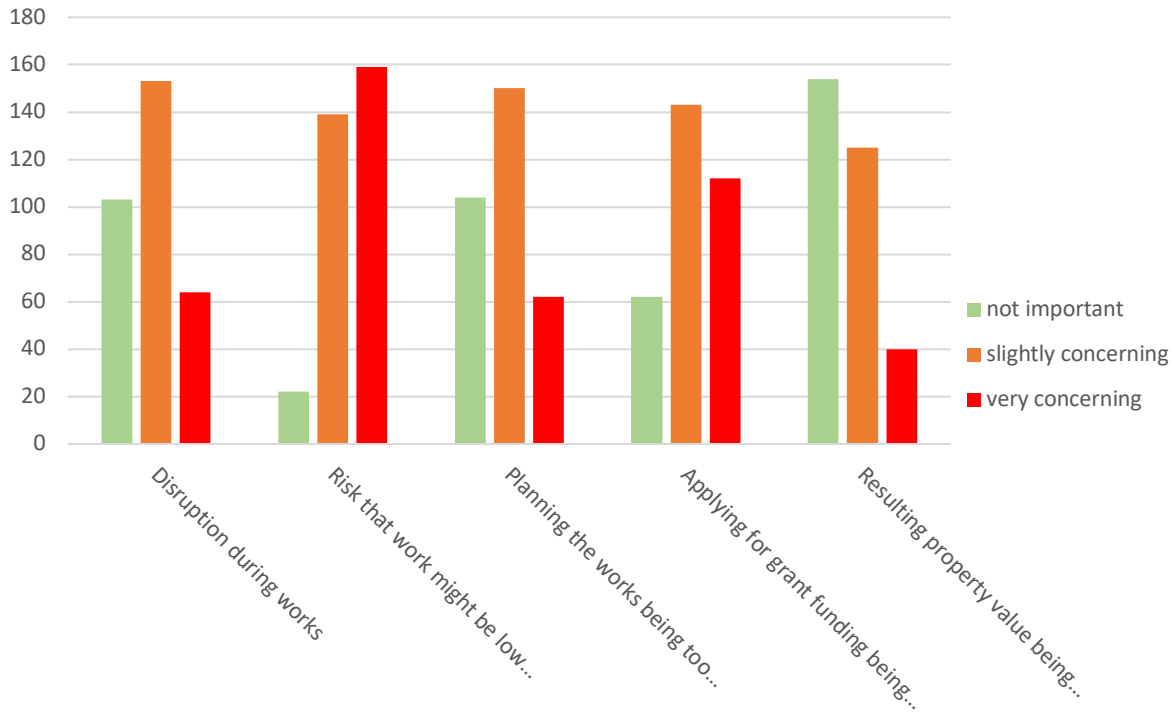


Figure 13 Concerns about undertaking a Home Improvement Plan, all respondents

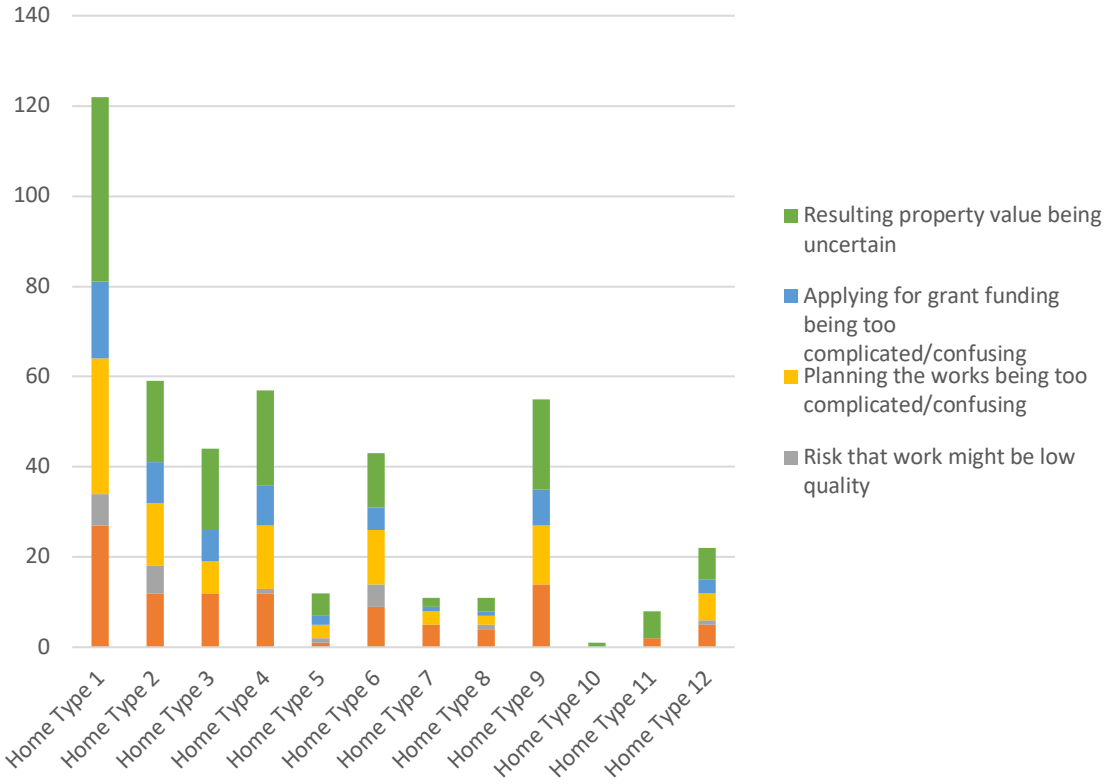


Figure 14 Respondents selecting 'very concerned' to potential home improvement risks, by home type

Theme 6: What would make undertaking a Home Improvement Plan more attractive to you?

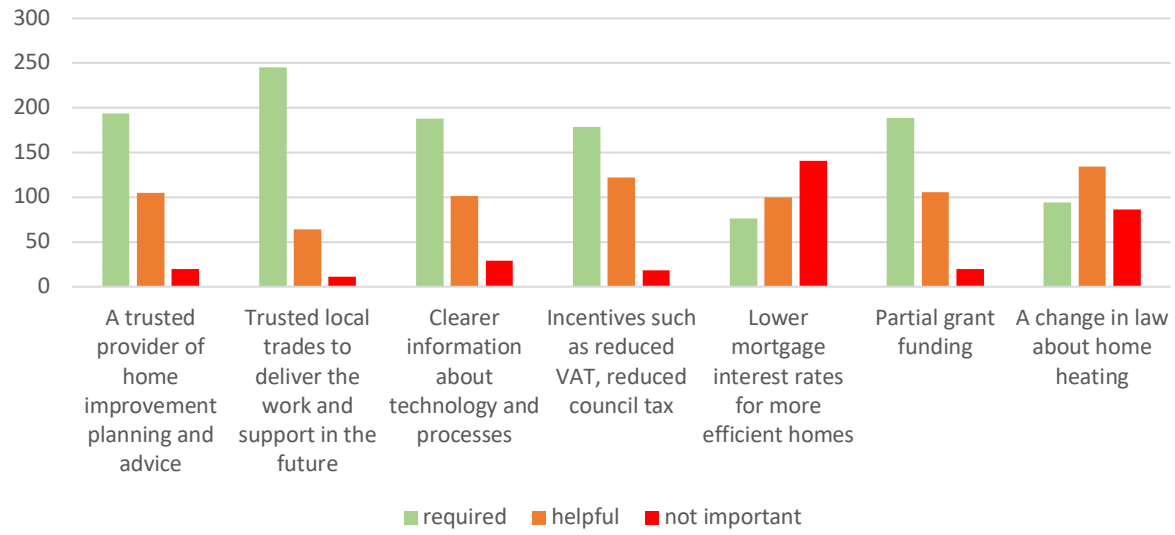


Figure 15 What would make undertaking a Home Improvement Plan more attractive to householders? All respondents.

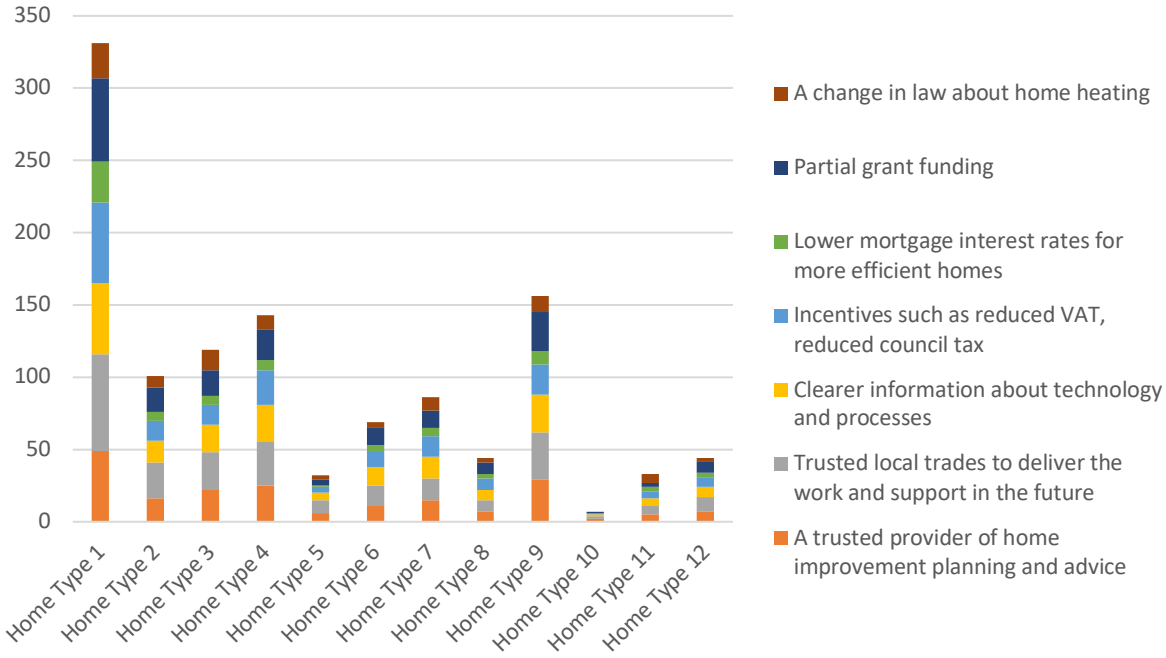


Figure 16 Features respondents classed as 'required' for undertaking a Home Improvement Plan

Reviewing all the survey responses across the twelve home types can help identify trends that can be compared to the findings from COM-B and thematic analyses.

Table 2 Proportion of respondents strongly agreeing or agreeing with survey statements, by home type

		Home Type 1	Home Type 2	Home Type 3	Home Type 4	Home Type 5	Home Type 6	Home Type 7	Home Type 8	Home Type 9	Home Type 10	Home Type 11	Home Type 12
	Construction type	House	House	House	House	Flat	House	House	House	House	Flat	Flat	House
	Wall Cavity?	Cavity	Cavity	Cavity	Granite	Cavity	Granite	Timber	Cob	No Cavity	Granite	No Cavity	No Cavity
	Heating fuel?	Gas	Electric	Other	Electric		Gas			Gas			Electric
	Number of respondents	93	33	31	38	10	24	18	12	40	2	8	12
Theme 1	I think that my home needs to keep the heat in better and/or be made less draughty.	53%	55%	61%	61%	40%	75%	39%	42%	80%	50%	88%	58%
	I think that my heating system needs to be less damaging to the environment	72%	33%	61%	55%	80%	88%	44%	50%	70%	50%	50%	75%
Theme 2	I have carried out improvements to make my home warmer or lower carbon	61%	76%	65%	68%	50%	50%	56%	42%	68%	50%	13%	33%
	I have thought about improvements to make my home warmer or lower carbon	55%	39%	45%	61%	50%	75%	67%	42%	58%	50%	75%	50%
	I know trades people that would carry out this	18%	12%	0%	26%	10%	17%	11%	0%	13%	0%	13%	25%
	I know what needs to be done to make my home warmer or lower carbon	35%	36%	45%	37%	60%	33%	28%	8%	48%	0%	63%	50%
	I have a plan to make my home warmer or lower carbon	16%	24%	16%	18%	0%	29%	11%	0%	15%	0%	13%	42%
Theme 3	I would be comfortable spending the money on the 'typical plan'	34%	42%	45%	39%	40%	50%	28%	42%	48%	50%	50%	25%
	I would be comfortable spending the money on the 'typical plan' and extras	19%	30%	42%	29%	30%	42%	11%	42%	33%	50%	25%	25%
	I like the idea of carrying out the home improvement plan on my home	75%	64%	77%	74%	70%	83%	67%	75%	95%	100%	75%	67%
	I know people who have had similar home improvements and their experience was positive	26%	52%	39%	42%	30%	42%	22%	0%	33%	0%	38%	33%
	I know people who have had similar home improvements and their experience was negative	12%	30%	13%	21%	0%	21%	28%	8%	15%	0%	0%	17%
	I don't know people who have carried out similar home improvements	68%	45%	52%	55%	50%	50%	72%	83%	60%	100%	75%	42%

Theme 4	Concerned that planning the works being too complicated/confusing	32%	42%	23%	37%	30%	50%	17%	17%	33%	0%	0%	50%
	Concerned that applying for grant funding being too complicated/confusing	18%	27%	23%	24%	20%	21%	6%	8%	20%	0%	0%	25%
	Concerned about resulting property value being uncertain	44%	55%	58%	55%	50%	50%	11%	25%	50%	50%	75%	58%
	Concerned about disruption during works	29%	36%	39%	32%	10%	38%	28%	33%	35%	0%	25%	42%
	Concerned there's a risk that work might be low quality	8%	18%	0%	3%	10%	21%	0%	8%	0%	0%	0%	8%
Theme 5	Lower energy bills are essential	43%	45%	48%	45%	40%	46%	39%	33%	60%	100%	63%	67%
	Protection from energy price rises is essential	29%	33%	35%	32%	30%	29%	28%	25%	45%	50%	50%	42%
	Increased property value is essential	19%	12%	6%	24%	10%	21%	33%	25%	20%	100%	13%	0%
	Improved comfort and/or health of household is essential	46%	61%	61%	50%	50%	46%	44%	42%	70%	50%	50%	75%
	Reduced building maintenance is essential	23%	33%	29%	34%	20%	17%	17%	25%	40%	50%	25%	17%
	Reducing my carbon footprint is essential	66%	70%	65%	66%	80%	54%	44%	58%	60%	100%	38%	75%
Theme 6	A trusted provider of home improvement planning and advice is essential	53%	48%	71%	66%	60%	46%	83%	58%	73%	100%	63%	58%
	Trusted local trades to deliver the work and support in the future is essential	72%	76%	84%	79%	90%	58%	83%	67%	83%	100%	75%	83%
	Clearer information about technology and processes is essential	53%	45%	61%	68%	50%	54%	83%	58%	65%	50%	63%	58%
	Incentives such as reduced VAT, reduced council tax are essential	60%	42%	45%	63%	40%	46%	78%	67%	53%	50%	63%	58%
	Lower mortgage interest rates for more efficient homes are essential	30%	18%	19%	18%	10%	17%	33%	25%	23%	0%	38%	25%
	Partial grant funding is essential	62%	52%	58%	55%	40%	50%	67%	67%	68%	50%	38%	67%
	A change in law about home heating is essential	26%	24%	45%	26%	30%	17%	50%	25%	28%	0%	75%	17%

It is clear from this matrix analysis approach that there are statements that score strongly for most home types, either high or low. Specifically;

Theme 1: Does the home need to be improved?

- Generally, most respondents indicated that their homes did need some energy improvement, due either to comfort or environmental concerns. Overall, the response to this question was perhaps less emphatic than had been expected

Theme 2: Have you carried out improvements or know how to carry out improvements?

- Most respondents, across home types, reported having made some energy efficiency improvements to their home in the last five years, including the home types typically considered 'difficult to treat', such as cob houses and granite flats.
- The two most clear findings in this theme were that almost all respondents, across home types, did not have a plan to improve the energy efficiency of their home and would not know any tradespeople to carry out any energy efficiency improvements

Theme 3: Engaging with Home Improvement Plans

- There was strong support for the idea of a Home Improvement Plan across all home types, with between 64% and 100% of all home type respondents saying they agreed or strongly agreed that they liked the idea .
- However, when asked about other households they knew who had undertaken similar improvements, there was a much more mixed picture, indicating that seeing improvements in other peoples' homes has only a limited impact on a householder's interest in doing so for themselves.

Theme 4: Concerns

There were two strong signals from the survey about concerns.

- There was little concern across home types that the work could be of poor quality
- There was relatively high concern that home improvement works could impact house prices.
- These statements are somewhat contradictory but indicate that there not so much is about the quality of individual measures, but how those measures might be perceived by potential buyers. For example, concern that solar PV on roofs might impair a future house buyer's ability to get a mortgage on the property.

Theme 5: Important features of a home improvement plan

- The most popular reason for undertaking a home improvement plan, across almost all home types, as to lower environmental impact, scoring higher than lowering energy bills or protecting against future energy bill price rises.
- Improving house prices and reducing home maintenance scored low and were seen as much lower importance by respondents

Theme 6: What would improve the 'offer' of a Home Improvement Plan?

- Use of trusted, local tradespeople to deliver the work was the top scoring feature for improving engagement with Home Improvement Plans, closely followed by having a trusted local provider of planning and advice
- Lower mortgage rates and changes to the law were not seen as being important drivers of encouraging uptake of Home Improvement Plans.

Appendix 4: Parity Project Pathways report

Separate Report

Appendix 5: Home Type Flashcards

Separate File

This report was produced for	- South West Net Zero Hub
Issue date	- June 2022
Version	- 5
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