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# **The Impact of Domestic Energy Efficiency Retrofit Schemes on Householder Attitudes and Behaviours**

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## **Abstract**

Retrofitting existing housing stock to improve energy efficiency is often required to meet climate mitigation, public health and fuel poverty targets. Increasing uptake and effectiveness of retrofit schemes requires understanding of their impacts on householder attitudes and behaviours. This paper reports results of a survey of 500 Kirklees householders in the UK, where the Kirklees Warm Zone scheme took place. This was a local government led city-scale domestic retrofit programme that installed energy efficiency measures at no charge in over 50,000 houses. The results highlight key design features of the scheme, socio-economic and attitudinal factors that affected take-up of energy efficiency measures and impacts on behaviour and energy use after adoption. The results emphasise the role that positive feedback plays in reinforcing pro-environmental attitudes and behaviours of participants and in addressing concerns of non-participants. Our findings have implications for the design and operation of future domestic energy efficiency retrofit schemes.

## **Acknowledgements**

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## **Key Words**

Retrofit; domestic; energy; efficiency; household; attitudes; behaviours.

## **1. Introduction**

Domestic energy use accounts for more than 25% of UK carbon emissions, with 65% of UK domestic energy use coming from space heating (Palmer and Cooper 2012). Any attempt to substantially reduce domestic sector energy use, and hence CO<sub>2</sub> emissions, therefore needs to target the energy that households use for space heating. As 17.6 million of the 22.7 million residential buildings/dwellings in England were constructed pre-1980, with less than 2% being added a year, the retrofitting of much of the existing housing stock is required if domestic energy use is to be addressed (Sweatman and Managan 2010, ONS 2014).

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However, recent rates of installation of loft and cavity wall insulations are unlikely to meet current targets, and a substantial increase in the level and rate of their adoption is required (CCC 2011, 2012, Kellett 2007).

The retrofit challenge has to be seen within the context of broader background trends in domestic energy use and carbon emissions. In the UK, although we should note that domestic energy use can vary significantly from year to year depending on the weather, in the period from 1971 to 2011 total domestic energy use increased by 5.5% (DECC, 2013a), but because of a substantial increase in the number of households in this period (DCLG, 2013) per household energy use fell by 21.7%. However, in the more recent period from 1991 to 2011, total energy use from the UK domestic sector fell by 13% (DECC, 2013a), and per household energy use fell by 25%. Changes in the carbon intensity of energy supply to households (DECC, 2012) meant that from 1991 to 2011 carbon emissions attributed to energy consumption in homes fell by 27%, and per household carbon emissions fell by 37%. Recent reductions have been attributed to a range of factors, including increases in energy prices and the impacts of government energy efficiency policies (Palmer and Cooper 2012). What this shows is that domestic energy use and carbon emissions are likely to be the outcome of interactions between factors including the number of households, the level of consumption, levels of energy efficiency, and the carbon intensity of energy supply.

UK policies aimed at improving energy efficiency and reducing CO<sub>2</sub> emissions from the domestic sector have undergone very significant changes in recent years. A completely new funding approach - the Green Deal - was launched in January 2013, and offers loans to homeowners that install energy saving measures which are paid back through savings on their energy bills. Various forms of domestic insulation can be installed through the scheme. As of February 2014, 129,842 assessments had been conducted, with 626 of the targeted 10,000 installations having been completed (DECC 2013, Carrington 2013, Hough and White 2014). This highlights the need for better understanding of the factors that encourage or discourage householder participation in retrofit schemes. The Energy Companies Obligation (ECO) - which runs alongside the Green Deal - requires energy companies to install energy savings measures to 'low-income' and vulnerable households. In Autumn 2013, further changes to the level and duration of ECO funding were announced that will take effect during 2014. In addition, in May 2014, the UK Government announced that grants of between £500 - £1000 will be made available to individuals installing energy efficiency measures (Vaughan 2014).

Other retrofit schemes also exist in the UK, including those that have been run by different local authorities or at the community level (Kellett 2007). The local authority led Kirklees Warm Zone (KWZ) scheme – which is the largest example of such a scheme so far completed in the UK - was the first to offer free loft and cavity wall insulation to all suitable properties. Between 2007 and 2010, the KWZ scheme successfully installed insulation in 51,155 homes. This was estimated to save 105,913 MWh per year, under the assumption that 50% of the potential energy savings from the insulation installed would be taken in comfort improvements rather than reduced energy use (Edrich et al. 2011).

## 2. Retrofitting Schemes and their Assessment

Numerous studies have attempted to evaluate the benefits of domestic energy conservation, although most tend to evaluate energy savings alone rather than wider socio-economic benefits such as health benefits. A study of an Irish scheme that sought to bring the thermal standards of 1.2 million houses up to those required by building regulations demonstrated that of the overall benefits, energy reduction accounted for 57%, with health improvements, increases in comfort levels or other improvements accounting for the rest. In monetary terms, the study calculated an overall benefit-cost ratio of 3.0, with a net societal benefit of €3.12 billion, under a 5% discount rate and with a 7 year payback period (Clinch and Healy 2000). Analysis of a comparable scheme in New Zealand suggested a benefit-cost ratio of between 2.6 and 4.6 (Grimes et al. 2012). These analyses suggest that retrofit schemes can have clear social and economic as well as environmental benefits (Clinch and Healy 2000, Goodacre, Sharples, and Smith 2002).

Whilst broader health and social benefits can be identified, their scale and significance can be hard to evaluate (Liddell and Morris 2010). It is widely accepted that living in cold, damp or mouldy indoor environments can have negative health implications (Mudarri and Fisk 2007). Studies have made links between cold homes and winter respiratory disease among older people (Rudge and Gilchrist 2005), and it has been estimated that every £1 spent on keeping homes warmer saves 42p in health care costs (FoE and Marmot Review Team 2011). Around 4 million (18%) of UK households are in fuel poverty, when defined as households spending more than 10% of their income on heating (we use this definition in our study) (DECC, 2011b). Numerous studies have shown that living in fuel poverty and/or cold, damp homes can have a wide-range of impacts on health and well-being (Harrington et al. 2005, Harris et al. 2010, Milne and Boardman 2000, Clinch and Healy 2000, Ormandy and Ezratty 2012).

Enhancing energy efficiency – particularly through insulation – can help to tackle fuel poverty. However, there is often a difference between the predicted and actual energy savings realised from energy efficiency measures (Milne and Boardman 2000). Some of this can be explained through the ‘rebound’ effect, where money saved from efficiency is used to improve comfort levels through higher temperatures in homes or to increase other forms of energy-consuming activity. Clinch and Healy (2000) suggest that this is most noticeable in low-income houses in fuel poverty. Milne and Boardman (2000) estimated that, across a broader sample of households, 30% of energy savings from domestic heat retrofit measures are taken in increased heat and comfort levels but that for households in fuel poverty this figure increases to 50% (Milne and Boardman 2000). An indirect rebound effect, where savings from more efficient household heating are spent on other goods and services that have energy and CO<sub>2</sub> implications have been estimated at around 34% (Chitnis et al. 2013).

Given the potential benefits of energy efficiency schemes, and the potential significance of rebound effects, it is important to understand the ways in which energy efficiency retrofit schemes both influence and are influenced by energy related attitudes, behaviours and decisions. These issues can be evaluated from multiple perspectives, and it is clear that a multitude of factors that shape attitudes, values, norms and habits also need consideration

(Abrahamse et al. 2005, Steg 2008, Darnton et al. 2011, Young and Middlemiss 2012). The age of individuals (Day and Hitchens 2011), the quality of information and levels of uncertainty (Tovar 2012), and the influence of significant life events, such as unemployment or moving home, can all impact on decision-making and behaviour in this area for example (Schäfer, Jaeger-Erben, and Bamberg 2012). A study of retrofit energy saving schemes in the Netherlands revealed numerous socio-demographic factors impacting behaviour (Poortinga et al. 2003). Research into the UK 'Pay As You Save' (PAYS) scheme identified financial savings as the primary driver of insulation retrofitting (DECC and EST 2011). Other notable factors include consciousness of climate change and levels of social interaction (Hori et al. 2013). Large media campaigns are also highlighted as having been effective at changing behaviour (Lindén, Carlsson-Kanyama, and Eriksson 2006, Paço and Varejão 2010). The factors influencing decision-making and behaviour have been categorised according to their internal (e.g. personal attitudes), group (e.g. social norms) or external (e.g. energy prices) dimensions (Milne and Boardman 2000).

The ease of adopting measures has also been found to increase their uptake, whilst factors such as length of residence and type and location of dwelling also impacted on both levels of participation in and the impact of retrofit schemes (Tovar 2012, Pitt 2012). Barriers to participation identified include the lack of proportional increases in property values from energy saving measures, poor information and the low priority attached to energy efficiency (Tuominen et al. 2012).

Both wider and domestic infrastructures and contextual factors provide a situational and structural environment that can facilitate or constrain pro-environmental behaviours (Lorenzoni, Nicholson-Cole, and Whitmarsh 2007, Geels 2005, Jackson 2005). Similarly, pro-environmental behaviours can 'spill over' and be replicated in other areas. For instance, it has been found that energy efficiency actions such as installing insulation can lead to the uptake of other efficiency measures or behaviours (Thøgersen and Ölander 2003, Thøgersen 1999).

Information alone is highlighted as insufficient to change behaviours (Crompton 2010). Motivation is also required, such as a desire to save money or reduce environmental impacts, but motivation can be impacted by factors including the extra level of comfort available or the effort required to participate (Steg 2008). Where motivation exists, what Croucher (2011) calls the 'energy efficiency gap' may mean that cost effective actions may still not be taken. Information inadequacies and large up-front costs can prevent take-up of cost-effective options, as can people waiting until their appliances need to be replaced or for the next more advanced generation of products (Croucher 2011).

Several theoretical approaches have been used to investigate this area, based on sociological and psychological underpinnings (Chatterton 2011, Dolan et al. 2012). Approaches associated with psychology and behavioural economics, such as 'Perceived Theory of Behaviour' (PTB), assume that decisions are taken under conditions of bounded rationality, with factors such as poor access to information or time constraints reducing pro-environmental outcomes. Even where personal values are well aligned with pro-environmental behaviours, actions can still be impacted by barriers, resulting in the 'value

action gap'. Within the PTB model, these barriers can be perceptual (Ajzen 1991). It is also recognised that individuals or groups can display aspects of 'cognitive dissonance' where they possess different values that conflict with each other (European Commission 2012).

More socially orientated models, which focus on actions rather than actors, note that systems can lock-in unsustainable behaviours (Chatterton 2011). The sociological slant is that the evolution of consumption patterns over time can dominate behaviour (Shove 2003). For example a global understanding of a comfortable building temperature of 22°C has gradually emerged, overriding local norms of comfort, such that office buildings in New York and Dubai now aspire to keep their premises at the same temperature despite radically different climates (Michaelis 2003). This is an important empirical observation, as it suggests that consumption is somehow gradually shifting over time, and it is clear that such shifting norms of consumption can have substantial impacts on resource use. However, whilst recognising that context and situational or systemic factors are important, the need for personal action is still recognised (Steg and Vlek 2009). This study takes a multi-disciplinary approach (Young and Middlemiss 2012) bringing together research evidence from different disciplines, including environmental studies, policy studies, geography, social psychology, and consumer science. The research and analysis methods applied consumer science and environmental studies quantitative approaches while the conclusions used a policy studies approach to develop policy relevant contributions.

### **3. Case Study: The Kirklees Warm Zone Scheme**

As noted above, retrofitting of existing housing stock in the UK is required to meet climate change mitigation objectives as well as other goals relating to public health and fuel poverty. If targets are to be met, large numbers and more rapid rates of retrofit will be required (CCC 2010, 2011). Fuller understanding of the design, delivery, take-up and impact of domestic energy efficiency retrofit schemes is therefore needed. The Kirklees Warm Zone (KWZ) scheme offers an opportunity to investigate these factors and influences, including the role that socioeconomic and attitudinal effects play in shaping levels of participation in and the impacts of a city-scale energy saving retrofit scheme.

Kirklees is a metropolitan borough of West Yorkshire in the UK, with a population of 425,500 (ONS 2013). The KWZ scheme – which operated between 2007-2010 - received international recognition for the reductions in energy use, fuel bills, fuel poverty and carbon emissions that it generated, as well as the wider economic benefits, including the creation of 126 jobs, that it stimulated (Edrich et al. 2011). One of the scheme's central aims was to provide free loft and cavity wall insulation to all suitable properties in the area with a minimum of disruption to householders. The scheme received full capital funding, meaning that all insulations were offered free to households. The scheme was funded mainly by Kirklees Council which provided a £12 million grant fund through the sale of its stake in Leeds Bradford International Airport in 2007 (Edrich et al. 2011, Bridgepoint 2007). Additional funding came from the power utility Scottish Power that provided £9.1 million, the UK government Warm Front scheme (£7 million), the Regional Housing Board (£1 Million), Energy Trusts (£0.34 million) and the energy infrastructure firm National Grid Transco (£0.15 million) (Kirklees Council 2011) According to Kirklees Council's report on the scheme, the:

“cost to the council was approximately £12.50/t CO<sub>2</sub> saved, this has assumed that 50% of the potential energy savings have been taken as increased thermal comfort rather than actual energy savings” (Edrich et al. 2011, p.21).

In addition to loft and cavity wall insulation, other measures including free energy efficient light bulbs and carbon monoxide meters were offered, alongside advice on other available council services (Edrich et al. 2011). Of the 176,000 households in the area, 165,686 were visited as part of the scheme, 134,000 households had a preliminary (doorstep) assessment, 111,000 of which went on to have a fuller survey and 51,000 households had measures installed. A total of 64,000 measures were installed, including insulation in 43,000 lofts and 21,000 cavity walls (see Webber, Gouldson and Kerr, forthcoming). Although council housing was assessed through the KWZ scheme, any measures undertaken in these properties were done so through the separate ‘Decent Homes’ scheme (Edrich et al. 2011).

Great focus was placed on the marketing of the KWZ scheme, which included a ‘warm-up’ phase of posters and engagement with local community groups. The scheme relied on home visits through ‘door-knocking’ and the undertaking of assessments to establish the feasibility of the various energy efficiency measures. All homes were ‘door knocked’ at least three times. Of those properties visited, 81% had assessments, whilst no contact could be made in 14% of cases and 5% of those contacted refused any further engagement (Edrich et al. 2011). There was also a ‘mop-up’ phase in the scheme, with the aim of encouraging take-up among residents who were initially sceptical or suspicious of the offer of free measures but who had been reassured by the progress and wider take up of the scheme. 17% of assessments and 28% of insulations were achieved through this phase.

Both because of its scale and its timing, the KWZ scheme can be seen as something of a front runner that offers a good case study through which to evaluate the impacts of retrofit schemes on householder attitudes and behaviours. Although it differs in some important respects from contemporary retrofit schemes such as the UK Green Deal, particularly with regard to its provision of free energy efficiency measures to households, such an evaluation clearly has broader relevance and can inform the design, delivery, take-up and impacts of other domestic energy efficiency retrofit schemes. As such, this research seeks to examine the statistical relationships between attitudes and socioeconomic variables and participation or non-participation in the KWZ scheme.

Hence, the primary research question for this study is: what roles do different socioeconomic and attitudinal factors play in shaping levels of participation in and the impacts of a city-scale energy retrofit scheme? Secondary research questions relate to the reasons for participation and non-participation, the characteristics of participants and non-participants and the impacts of participation on behaviour.

#### **4. Research Approach and Methods**

Due to the above research questions, primary data for the evaluation of the KWZ scheme was collected through a questionnaire survey. This was chosen as the most time and cost-effective method for collecting data on householder attitudes and reported behaviours on a

large scale (Marsden and Wright 2010). The questionnaire was constructed using information gathered through a review of the literature and 6 in-depth telephone interviews conducted with individuals who had had energy saving measures installed within their homes, and it was also informed by a 'door step' survey that was conducted during the assessment stage of KWZ scheme. As such, this research has taken both qualitative (telephone interviews) and quantitative (questionnaire) approaches. The relative pros and cons and suitability of these approaches is based on the research questions asks. The initial telephone interviews we conducted to confirm the validity and appropriateness of the categories and questions used in the questionnaire, through 'how' and 'why' questioning. Conversely, the questionnaire sought to quantify the answers to these questions ('how much'). For a more detailed discussion on research methodologies consult Creswell (2003).

In total, the questionnaire included 52 questions covering topics identified as relevant to the answering of the research questions and in line with the results of the literature review and telephone interviews. These topics included questions under the headings of:

- 'You and your home'.
- 'Your attitudes'.
- 'Your home and your energy use'.
- 'Your motivations and influences' (for people who had energy saving measures installed as part of the KWZ scheme).
- 'The impact of the measures in your home' (for people who had energy saving measures installed as part of the KWZ scheme).
- 'Your interest in future energy savings'.

The questionnaire – which was conducted in the summer of 2013 - was completed through face-to-face interviews in public places within Kirklees and took approximately 15 minutes to complete. Different locations were used to collect the data in order to obtain a representative sample of the Kirklees population. Members of the public were approached at random to complete the survey. In order to participate in the survey, respondents had to be aged over 24, have lived in the same house within the Kirklees area since 2008 and be the main bill payer or one of the main bill payers within a household.

505 responses were obtained through this process; 141 of these had had measures installed through the KWZ scheme, with 138 having had loft insulation and 87 cavity wall insulation. The 141 respondents to the survey who undertook energy saving retrofit actions through the KWZ scheme will be identified throughout the remainder of the paper as the KWZ group; the 364 respondents to the survey who did not take part in the KWZ scheme will be identified as the non-KWZ group.

Upon analysis, minor alterations were required in terms of the age and socio-economic classification (SeC) of the respondents; the data was weighted accordingly using post-stratification weights, in line with the characteristics of the Kirklees population, as informed by data from the Office for National Statistics. A manual step-wise programming approach was used, involving calculating the appropriate weights for age and SeC separately, but



sequentially, until both characteristics matched those for the Kirklees population (see Johnson and Christensen (2010) for a guide).

Whilst the authors acknowledge that a wider set of variables could have been used to weight the data, such as gender, the data for these variables was incomplete, prohibiting their use. In addition, checks were made to assess the representativeness of the data in terms of the characteristics of the dwellings, for example the date of construction, ownership type and type of dwelling. As noted above, the KWZ scheme did not undertake measures within council houses and hence is not representative of residence types across Kirklees or England. Our data for date of construction was also incomplete and not directly comparable to other available data sets due to differing categories, however from rough calculation it appears we may have oversampled respondents living in dwellings constructed pre-1945. Due to incomplete and incompatible data we were unable to correct this. Whilst this is regrettable, due to incomplete age of construction data, weighing this variable was unsuccessful. Whilst this could impact upon the results, this research is concerned with SeC group and attitudinal factors and how these interact with pro-environmental behaviours. These factors were weighed and are representative of wider populations.

Once the data collection and weighting processes had been completed, the data were analysed using SPSS and MS Excel. Ordinal data, such as that collected through 5 point Likert scales, was coded from 1 to 5, with 'Strongly agree' coded as 1 through to 'Strongly disagree' as 5. Associations between group differences were investigated. Due to the prevalence of 5 point Likert type data and nominal group data, between group differences were analysed through Mann-Whitney U test or Kruskal-Wallis H tests. These are rank-based non-parametric tests that can be used to determine differences between independent groups.

The Mann-Whitney U test requires a dependent variable that is ordinal or continuous and independent categorical variables. Mean rank or median results, depending on the distributions of the two independent variable groups, are then used to provide further comparisons between the groups. The Kruskal-Wallis H test similarly requires a dependent variable that is ordinal or continuous and but an independent variable consisting of three or more categorical, independent groups; post-hoc Mann-Whitney U tests are usually performed on positive results of the Kruskal-Wallis H test. This is done to identify the specific pairs for which the identified differences apply.

Chi-squared tests, which can be used to identify relationships between two categorical variables, were also utilised. A Chi-squared test is applicable where two variables are measured at the ordinal or nominal scale, and consist of two or more categorical independent groups. The null hypothesis states that the variables are independent of each other, expressed through an 'expected' cell count; the alternative hypothesis states that the variables have a statistical relationship. This test relies on all expected cell counts being greater than 5. The results can be explored by comparing the expected and actual cell counts, as well as through symmetric measures to ascertain the strength of the association, where 0 equals no association and +1 complete association. Where appropriate, the specific

test used is noted within the results. For a more detailed description of these tests see Sheskin (2003).

## 5. Results

### - Levels of Participation and Non-Participation

95% of the 500 respondents surveyed had heard of the KWZ scheme before taking part in the survey. 18% had heard about the scheme but did not participate in any way, 30% had the doorstep survey but did not have measures installed, 20% had a more formal assessment but no measures installed and 32% participated in all stages and had measures installed (see Figure 1).

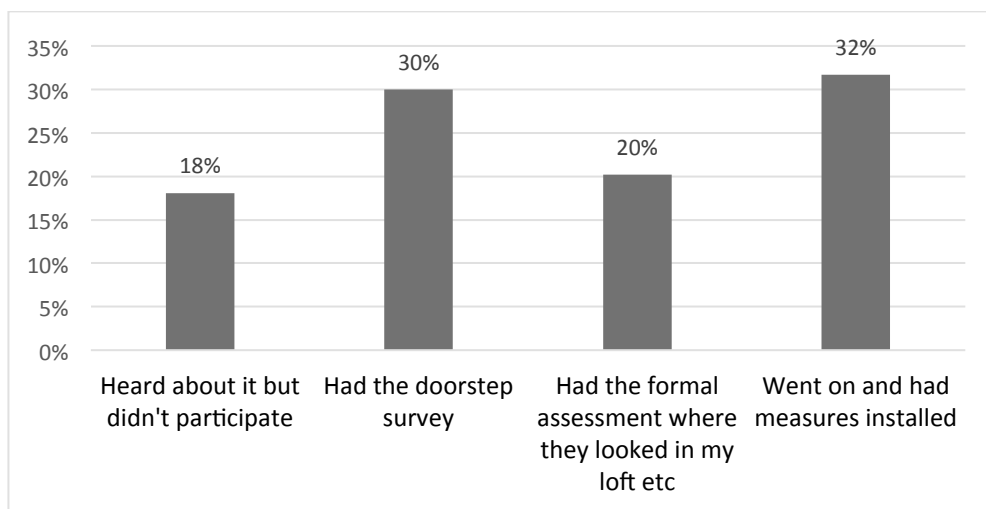


Figure 1: If you have heard of the KWZ scheme, which of these applies to you?

### - Characteristics of Participants and Non-Participants

The survey also gathered data on the attitudes and reported habits of participants and non-participants in the KWZ scheme. The results of the Mann-Whitney U tests found statistically significant differences in the responses of participants and non-participants in 3 areas. For these tests participation or non-participation in the KWZ scheme was used as the independent variable, whilst their opinion was used as the dependant variable. The results indicate that 67% of participants in the scheme agreed that they enjoyed saving energy, compared to 58% of non-participants (Figure 2). Similarly, they reveal that 75% of participants feel obliged to do their bit for the environment, compared to 65% of non-participants (Figure 3). And they show that 62% of participants felt that they should save energy where possible compared to 41% of non-participants (Figure 3).

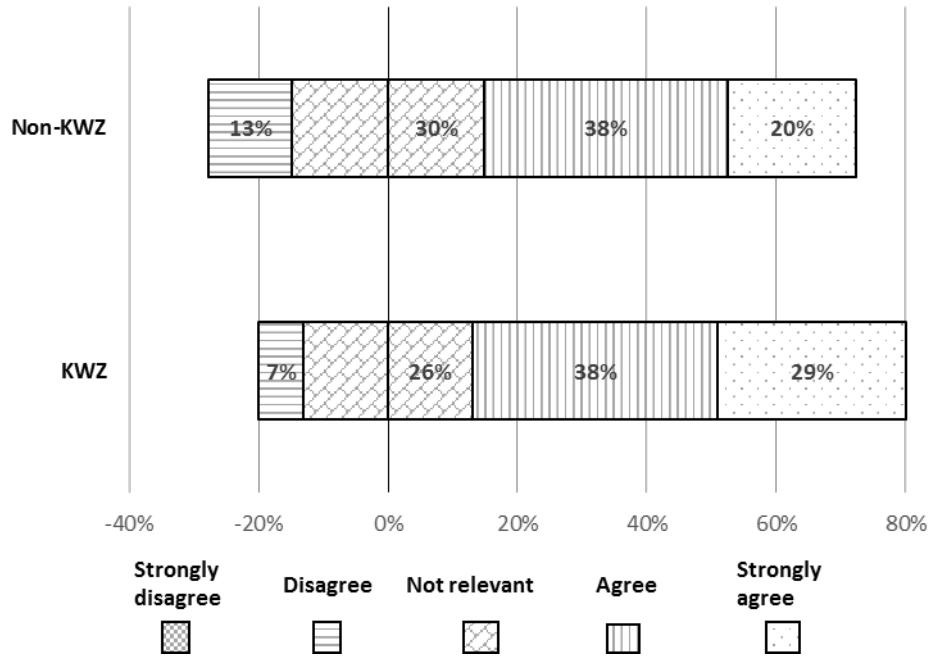


Figure 2: 'I enjoy saving energy'

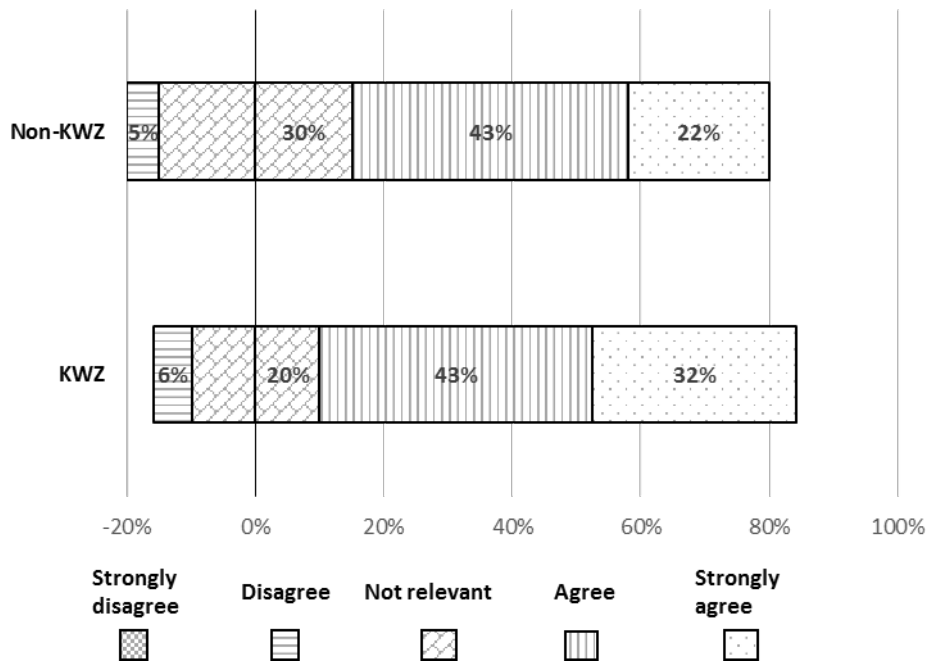


Figure 3: 'I feel obliged to do my bit for the environment'

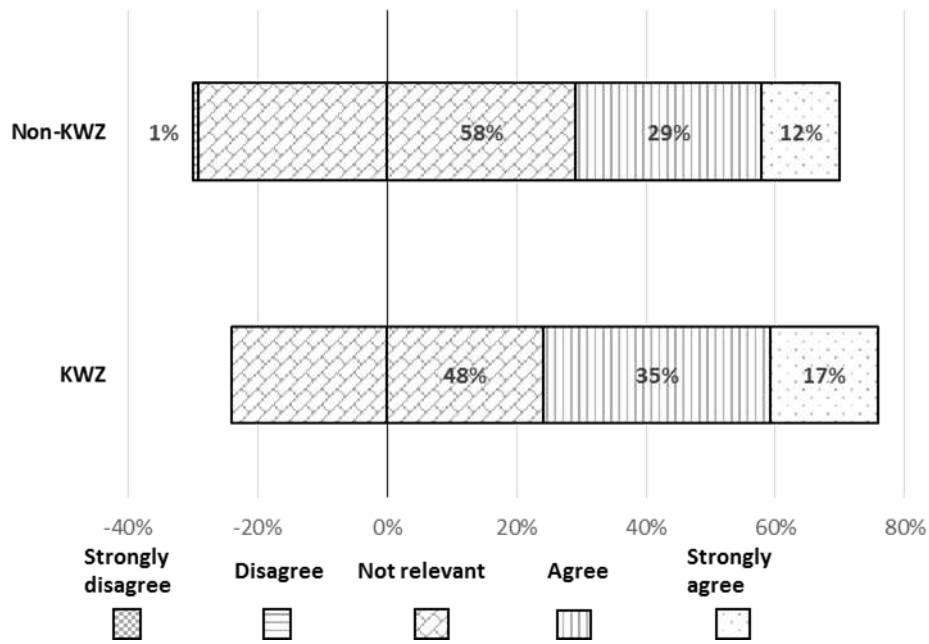


Figure 4: 'If energy can be saved in the household, it should be'

**- Reasons for Participation and Non-Participation**

Participants in the scheme (the KWZ group) were asked to identify the primary reasons for deciding to participate. 98% of respondents in this group agreed or strongly agreed that they did so as the measures were 'free of charge'. This indicates that out of the options presented, cost considerations were a central motivator. However, 82% agreed or strongly agreed that reducing their environmental impact was also a factor (see Figure 5).

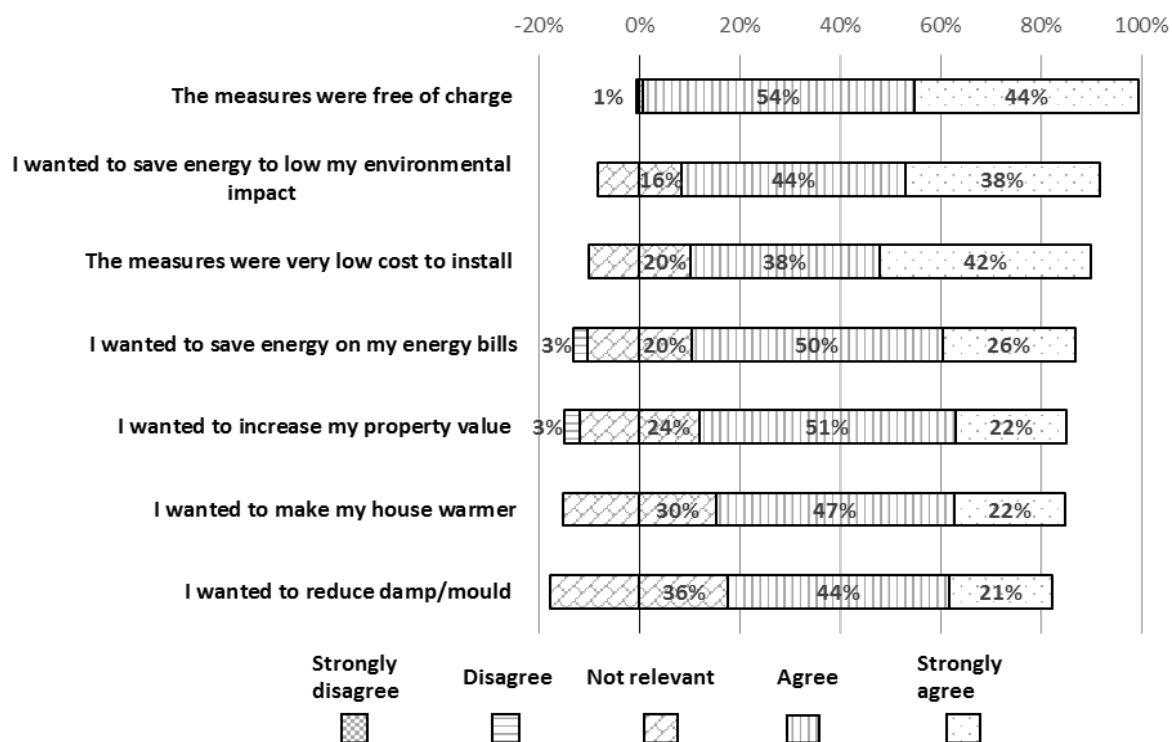


Figure 5: I installed energy saving measures in my home because.... (Tick all that apply).

The responses to this question were then further analysed to investigate whether there were statistically significant differences across different socio-economic groups (SeC) in the reasons cited for participating in the scheme. Survey data was used to categorise respondents as ‘never worked or long-term unemployed’, in ‘semi-routine and routine occupations’, in ‘intermediate occupations’, or in ‘managerial and professional occupations’, as per standard SeC groups. Kruskal-Wallis H tests were performed to test for significant differences in the reasons cited for participation (5-point Likert data), between the multiple socio-economic groups; SeC groups were tested as the independent variable, whilst their cited reasons for participation were the dependant variable. These were followed with post-hoc Mann-Whitney U tests, which were used to identify the statistically significant differences between specific pairs of socio-economic groups.

Statistically significant differences were revealed in a number of areas. The desire to reduce energy bills was given a higher priority by those in the ‘never worked and long-term unemployed’ and ‘semi-routine and routine occupations’ groups than those in ‘managerial and professional occupations’ (see Figure 6). Participation of those in the ‘never worked and long-term unemployed’ group was motivated more by the desire to increase property values than it was for those in the ‘managerial and professional occupations’ and ‘intermediate occupations’ groups (see Figure 7). The same was true for both the desire to make the house warmer (see Figure 8) and the desire to reduce damp/mould (see Figure 9).

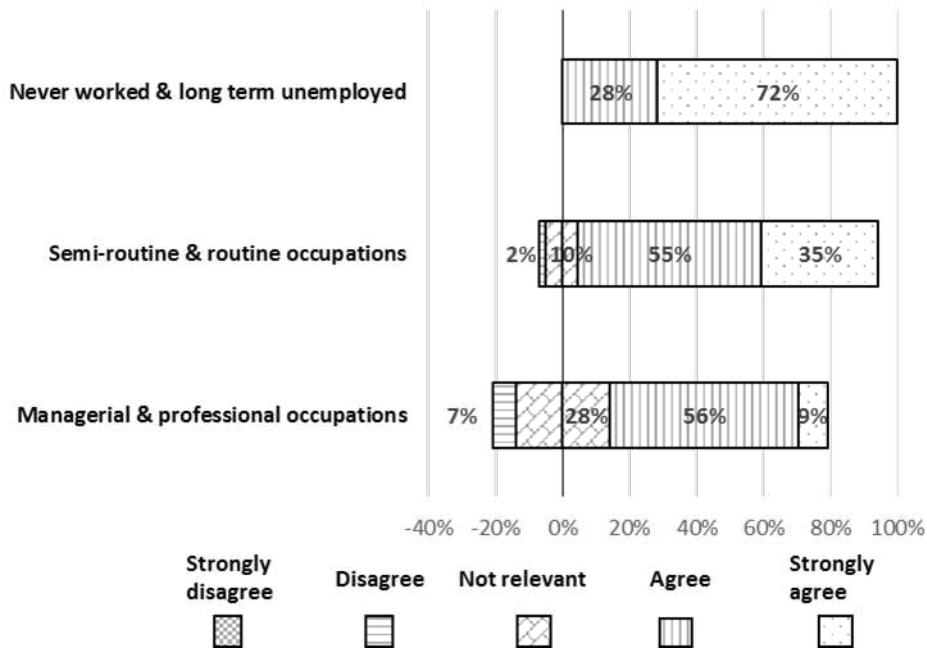


Figure 6: 'I wanted to save money on my energy bills'

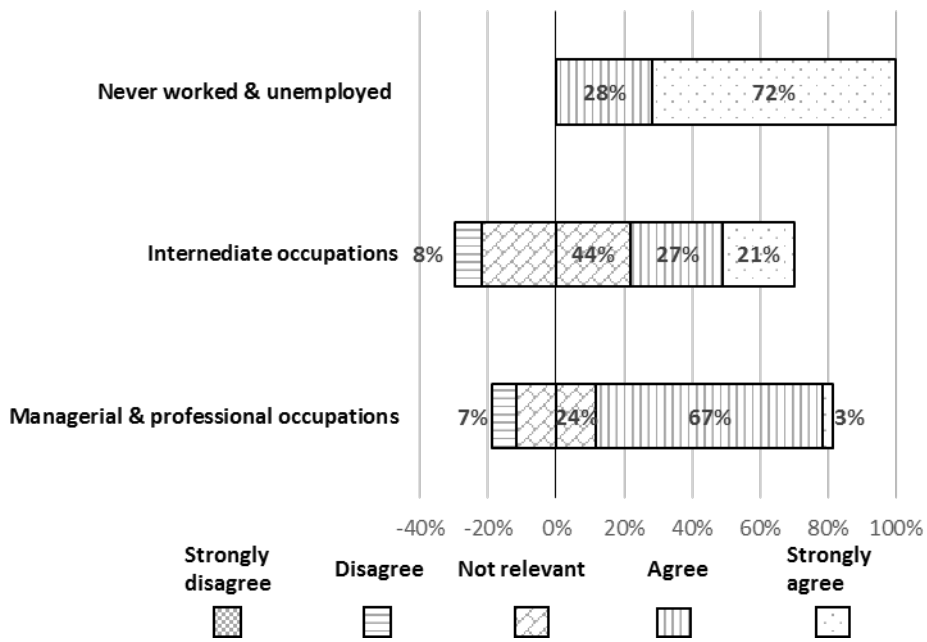


Figure 7: 'I wanted to increase my property value'



Figure 8: 'I wanted to make my house warmer'

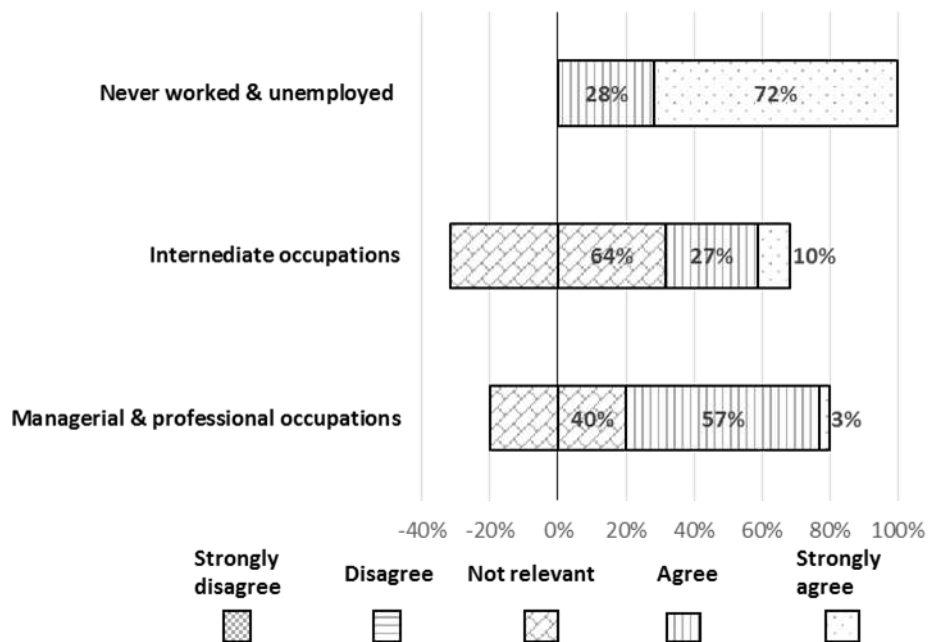


Figure 9: 'I wanted to reduce damp/mould'

Participants in the scheme were also asked to identify, from a range of possible responses, factors that were relevant to their decision to participate (see Figure 10). 'Energy saving was in the news' received the highest number of responses, cited by 13%, followed by 'I had retired' with 10% and thirdly, 'I was doing other renovation work' with 9%. The 10% of individuals who cited retirement as a factor represented 70% of the number of retired respondents in the sample, a substantially higher figure than the 10% they represent when considered alongside other respondents.

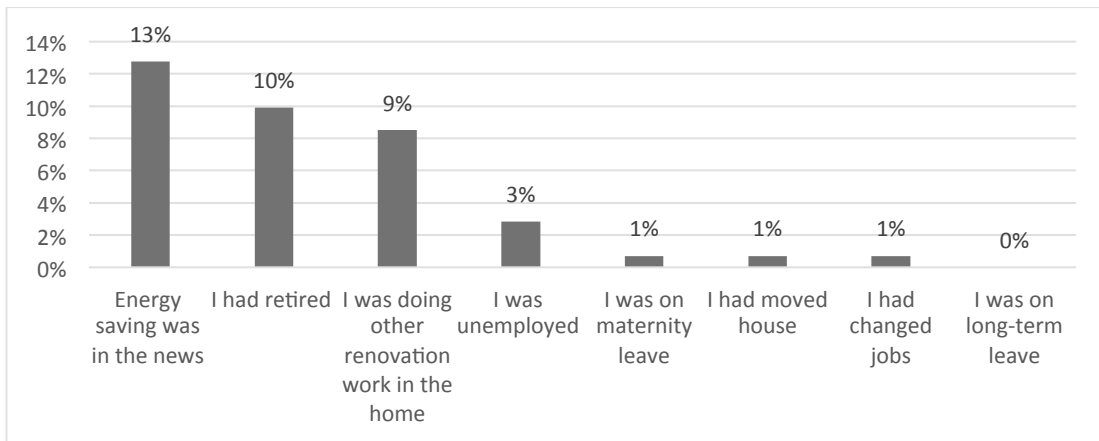


Figure 10: Factors relevant at the time of your KWZ energy efficiency measures installation. Respondents asked to tick 'all that apply'.

Non-participants were also asked about the main factors shaping their decision. 40% cited a desire to avoid disruption, whilst 25% cited 'I did not have time' or 'My loft was inaccessible', as shown in Figure 11.

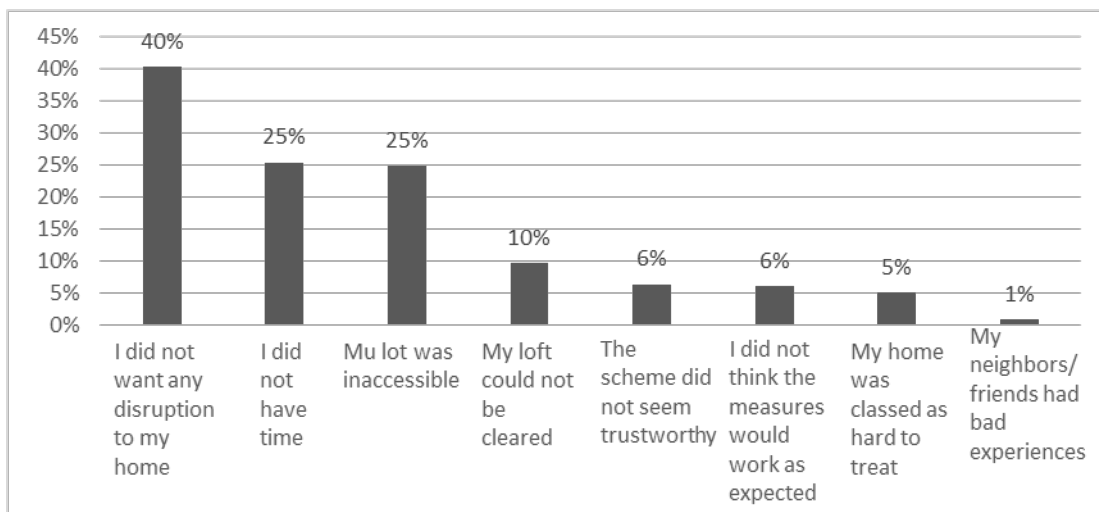


Figure 11: If you were offered KWZ measures, why did you not take them up? Respondents were asked to tick 'all that applied'.

Chi-square tests of association were conducted on SeC classifications, as the independent variable, and each reason cited for not participating in the KWZ scheme, as the dependant variable. This test was used as the variables contained categorical (rather than ordinal) data.

The test was valid as all expected cell frequencies were greater than five, and there was a statistically significant association between SeC groups and citing 'I did not want disruption to my home' as factors,  $\chi^2(6) = 36.281, p < .000$ . There was a moderately strong association,  $\phi = .341, p < .000$  between the SeC groups and the cited factors for not participating in the KWZ scheme. The 'Managerial and professional occupations' and the 'Never worked or unemployed' SeC groups both had greater than expected cell counts, compared with the chi squared distribution, whilst all other classifications cited this factor less than expected (compared to the chi-squared distribution). This indicates that both



these SeC groups were more likely than expected to cite disruption as a factor for not agreeing to the installation of the KWZ measures.

**- Experiences with Participation**

Respondents who had KWZ measures installed within their properties were broadly positive about their experience (Figure 12). A majority of respondents felt that the process was flexible, convenient, efficient, and that they had retained sufficient control over the process. Only a minority identified the process as creating a lot of mess or meaning that they had to take time off work.

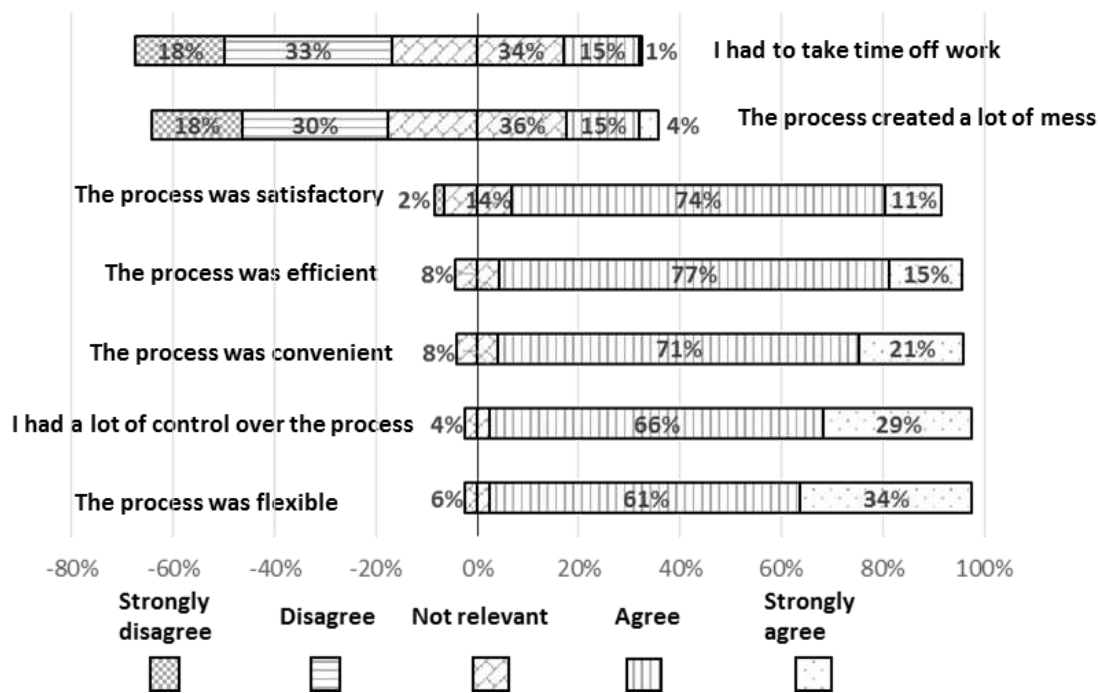


Figure 12: Opinions of KWZ Installation Process

**- Impacts of Participation**

For those that did participate, the survey provided data on the reported impact of the KWZ measures on energy monitoring habits, and thermostat and heating settings. 29% of participants reported that they had started to measure their energy use after measures were installed, compared to 2% who did so before measures were installed and 15% who did so both before and after. However, 55% of all participants did not monitor energy use either before or after participating in the scheme.

With regard to the use of energy before and after participation, 2% of respondents reported that they had turned the thermostat up after having measures installed, 69% left the thermostat at the same level and 28% turned it down. Similarly, 4% said that they had the heating on more after having measures installed, whilst 68% said the heating was used for the same period and 29% said they used the heating less.

In terms of reported benefits, Figure 13 shows that reduced drafts, lower energy bills and reduced levels of damp were cited as the main benefits. Increased levels of comfort or improved health were rarely cited as benefits.

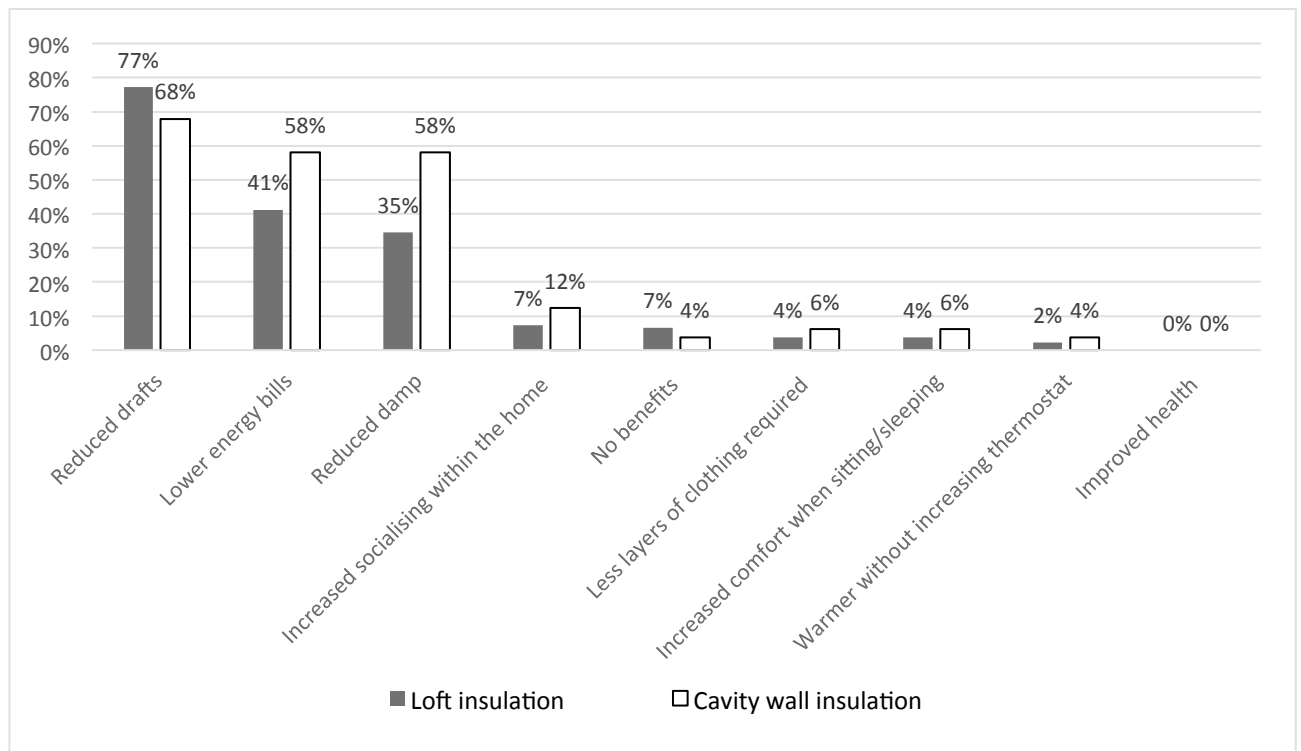


Figure 13: Please tell us if you've noticed any benefit from the measures you've installed.

### Impacts of Participation on Future Intentions.

All respondents were asked what conditions they considered necessary for them to install further energy saving measures in the future (see Figure 4). Having access to free measures and the prospect of a guaranteed reduction in energy use were reported as the two most important conditions in deciding whether or not to install energy reduction measures in the future, irrelevant of participation in the KWZ scheme.

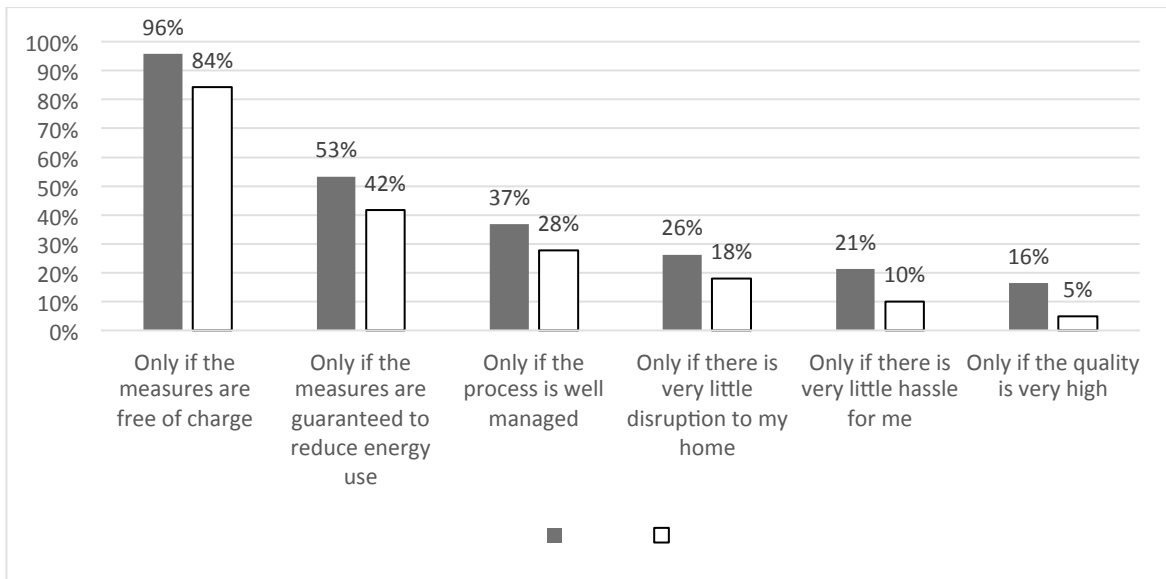


Figure 14: 'Under what conditions would you consider installing further energy saving measures in the future? Responses split according to KWZ versus Non-KWZ groups'. Respondents asked to tick 'all that apply'.

Chi-square tests of association were conducted between participants and non-participants in the KWZ scheme to identify if any differences existed between the two groups in terms of future intentions; here participation or non-participation was tested as the independent variable, with their opinion or response as the dependant variable. These found that participation in the KWZ scheme increased the extent to which respondents would adopt energy savings in the future but only if they were free of charge, could be installed with a minimum of hassle and were of very high quality. These increases were small but they were nonetheless statistically significant. It should be noted that it would be expected for individuals to place a high rating on a 'free service'. However, the results here are still important in terms of the comparison between KWZ and non-KWZ participants, with the chi-square test identifying a statistically significant difference between these two groups.

All respondents were also asked to comment on their ability to save energy in the future, whether they would be able to find the correct information and whether they would trust organisations, such as their Energy Company, bank or local authority to help them to do so. Mann-Whitney U tests were conducted to compare the responses of participants and non-participants; again here, participation or non-participation was tested as the independent variable, with their responses treated as the dependant variable. The results found that there were a number of statistically significant differences, with participants being more positive about their ability to save energy in the future (Figure 15), and to find the correct information to enable them to do so (Figure 16), and more trusting that their local authority could help them to do so (Figure 17).

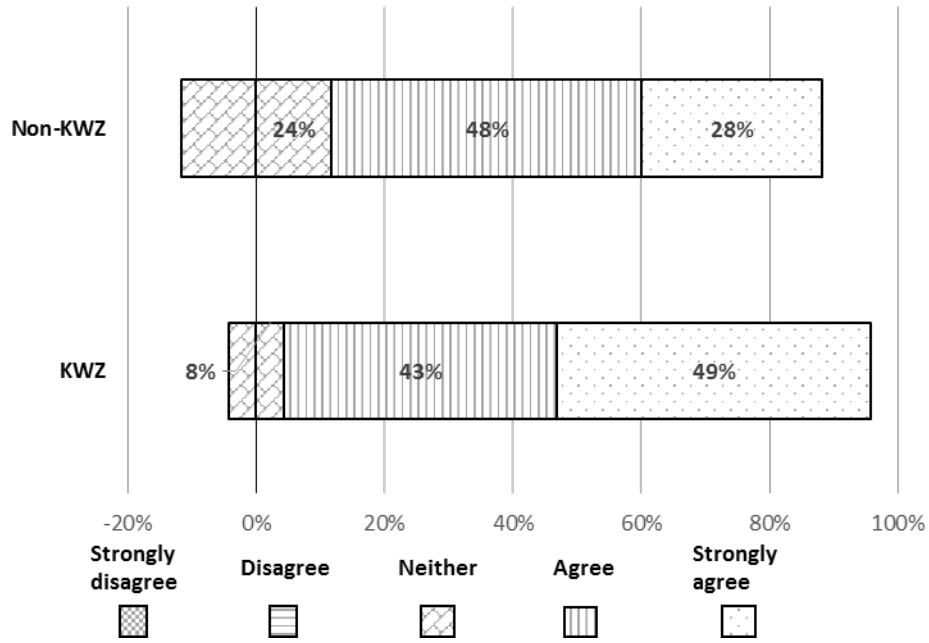


Figure 15: 'I think that I can save energy within my home in the future'

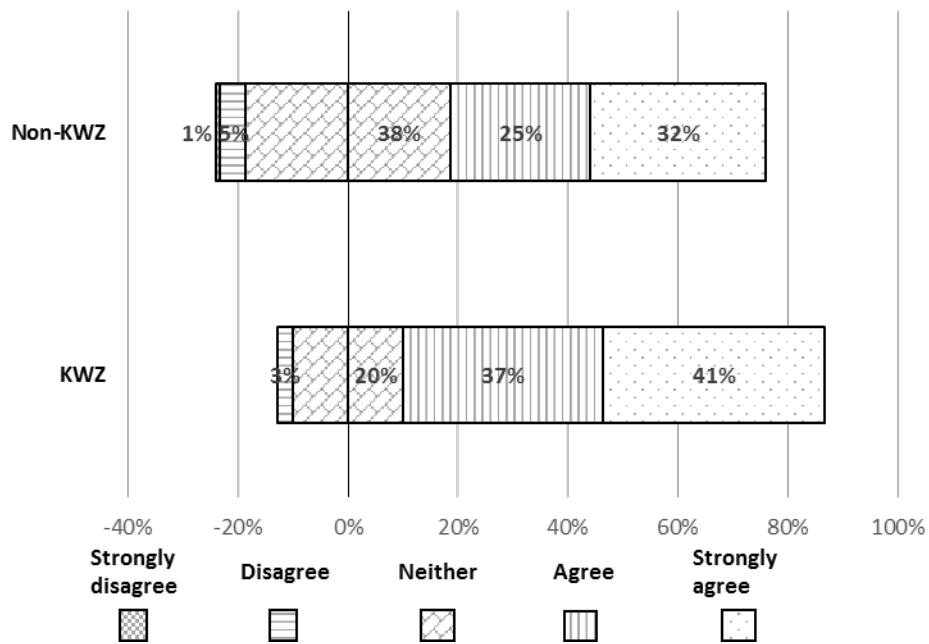


Figure 16: 'I think I will find the right information to help me save energy in my home in the future'

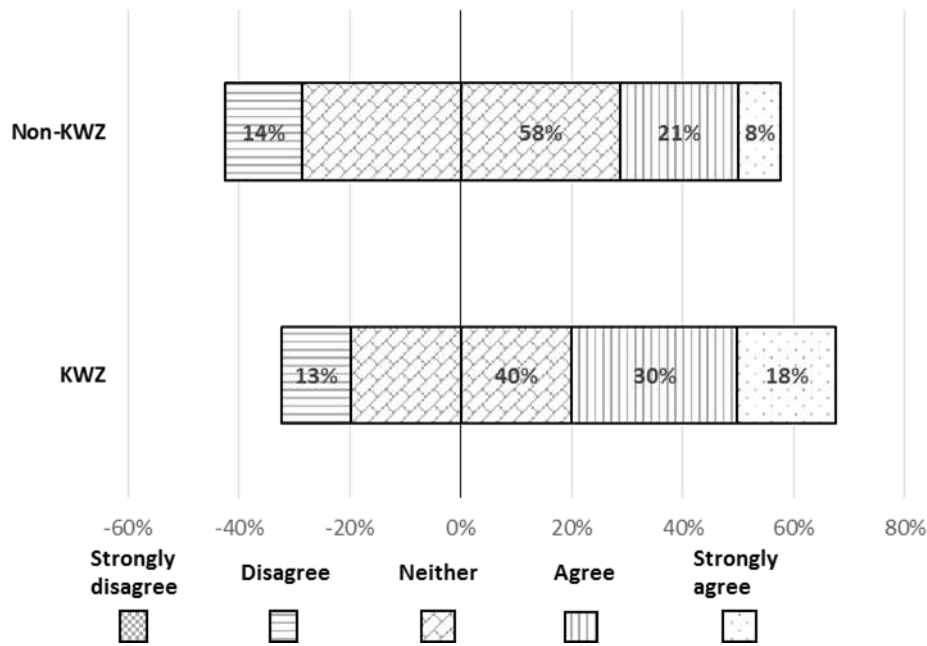


Figure 17: 'I would trust my local authority to help me with energy saving in the future'

Finally, respondents were asked whether they had heard of the Green Deal, the UK's main national level policy to promote domestic sector retrofit. There was no statistically significant difference between the KWZ and Non-KWZ groups; 27% of KWZ participants and 24% of non-participants had heard of the Green Deal. After being informed of the policy's operation and structure, respondents were then asked whether they would take part in the Green Deal. Although no statistically significant difference was found between the KWZ and non-KWZ groups, 39% of KWZ participants suggested that they would be likely to participate, as compared to 26% of non-KWZ group.

## 6. Discussion

The survey results reveal a lot about the motives for and against participating in the KWZ scheme and about the characteristics of participants and non-participants. Although the findings obviously relate to the specific context (including the schemes lack of focus upon council housing), some insights can be drawn that are likely to be of wider relevance.

### ***- Reasons for and against participation***

A key factor that is specific to the KWZ case is the fact that the measures to be adopted were provided to participating households without any charge. This proved to be the major factor motivating participation in the KWZ scheme, followed by the desire to reduce energy use and concern about the environment. Evaluations of previous schemes have also highlighted these pro-environmental attitudes as significant factors motivating participation in retrofit schemes (DECC and EST 2011). The potential to combine retrofit activities with other renovation work being carried out also encouraged participation, and householders that had recently retired were also more likely to participate. The role that transitional periods can play in retrofitting actions is also noted within the literature (Schäfer, Jaeger-

Erben, and Bamberg 2012). For lower income groups, saving money on energy bills was the strongest motive for participation, followed by the desire for a warmer house and to reduce mould. This supports the perhaps unsurprising finding of previous research that lower socio-economic groups may prioritise the social and economic rather than the environmental aspects of participation (Owen and Videras 2006).

In examining the motives of the households that did participate in the KWZ scheme, it is hard to disentangle the impacts of all of these factors from the fact that the measures were offered to households for free. This limits the extent to which we can draw insights from this case that help us to understand the reasons why households participate in schemes that do charge for the installation of measures. However, it is important to point out that for non-participants the converse is also true. In evaluations of schemes that charge for the installation of measures, it is hard to disentangle the impacts of charges from those of all of the other factors that discourage participation. In this case, no such disentangling is necessary and all of those other factors that preclude participation in retrofit schemes therefore come into sharper focus.

A number of barriers precluded or discouraged participation in the KWZ scheme. Some of these related to feasibility, for example where the physical characteristics of the property made it hard to treat. Others related more to choice, particularly to the desire to avoid disruption or a lack of time. The desire to avoid disruption was significant amongst different socio-economic groups. Previous research has highlighted that the offering of free loft clearance services alongside retrofitting scheme increased take up by 3% (Haynes 2012). Highlighting positive feedback from participants who found that the installation of insulation was not messy, disruptive or time consuming, or that it helped to reduce the mould and damp that are linked to the respiratory problems associated with fuel poverty and poorly insulated homes (Mudarri and Fisk 2007, Rudge and Gilchrist 2005) might also help to promote participation.

#### ***- Impacts of and on householder attitudes and behaviours***

Analysis of the characteristics and attitudes of participants and non-participants offers some valuable insights. Participants in the scheme had more positive attitudes to the environment and energy saving and towards contributing to environmental protection than non-participants. They were also more confident in their ability to find the information that other research has found to play an important role in enabling pro-environmental behaviours (Croucher 2011, Tuominen et al. 2012). Participants were also more confident in their ability to achieve energy savings than non-participants, and they also reported higher levels of trust in their local authorities to deliver retrofit measures than non-participants, even though levels of trust in for example energy companies, local building companies or banks did not differ between the two groups.

Collectively, these findings suggest that participants were more concerned, more confident, more empowered and more trusting in their local authority than non-participants. These attitudinal effects may have also led to behavioural spill-overs – for example where participation increased the likelihood of household energy monitoring, which other research

has found can enable further energy efficiency and curtailment activities (Geels 2005, Jackson 2005, Lorenzoni, Nicholson-Cole, and Whitmarsh 2007, Thøgersen 1999, Thøgersen and Ölander 2003).

The research therefore shows a clear correlation between positive environmental attitudes and participation in retrofit schemes. However, the fact that the survey was conducted after the scheme had been completed makes it impossible to be certain if householders' positive environmental attitudes led them to participate in the scheme, or if they were to some extent the result of their participation in the scheme. Participation in the KWZ scheme may have both stemmed from and contributed to the further development of pro-environmental attitudes.

This introduces an important evolutionary element into the debate, as it suggests that with positive feedback from participation in retrofit schemes, pro-environmental attitudes and behaviours could become self-reinforcing amongst participants. Effective and trustworthy communication could also play a role in ensuring that the positive experiences of the participants are used to address some of the concerns of non-participants. However, this also implies that negative feedback could have the opposite effect – bad experiences could suppress pro-environmental attitudes and stifle further pro-environmental behaviours amongst participants and whilst also reinforcing the concerns of non-participants. Although the significance of these evolutionary dimensions has not been widely examined, the importance of these attitudinal factors has been emphasised in the wider literature (European Commission 2012, Abrahamse et al. 2005, Abrahamse and Steg 2009, Milne and Boardman 2000).

## **6. Conclusions and Implications for Policy Makers**

The analysis of the impacts of the KWZ Scheme on householder attitudes and behaviours has significant but perhaps not particularly surprising implications for policy and for the design and delivery of other retrofit schemes.

The findings show that retrofit schemes can secure significant levels of participation, and generate positive experiences and outcomes, if they are offered by a trusted provider and if they are effectively marketed and promoted. They indicate that retrofit schemes can perform well if they target early movers with pro-environmental attitudes, especially at moments in time when they are most likely to participate (i.e. during renovations, shortly after retirement). They also suggest that retrofit schemes – and their marketing – should emphasise the positive aspects of participation (i.e. the energy savings and health improvements that they generate and the environmental impacts they help to avoid) whilst also addressing the concerns that can discourage participation (i.e. the lack of trust or confidence in the provider and the measures, demands on time, possible levels of hassle and disruption). They highlight that the positive aspects that motivate participation, and the concerns that preclude participation, can vary across SeC group and they therefore suggest that targeted interventions and communications may be necessary to build widespread engagement.

The results indicate that retrofit schemes should actively seek to build on any early successes that they generate and that they should evaluate and effectively communicate the positive experiences of the early movers, and use these both to stimulate further action amongst participants and to address the concerns of non-participants. Whilst these results stress the significance of positive feedback for the on-going success of retrofit schemes, by implication they also highlight the potential impacts of negative feedback. As stated above, negative experiences with badly designed or delivered retrofit schemes could help to suppress pro-environmental attitudes, stifle further pro-environmental behaviours and reinforce the concerns of non-participants. Once this has happened, extra effort is likely to be needed to create and build confidence, secure participation and start to generate the positive feedback loops that seem to be so important. There are clear implications here in contexts where retrofit schemes have been introduced that have not proven to be particularly popular or effective.

Lastly, and of course not surprisingly, the findings of the evaluation of the KWZ scheme suggest that free schemes can be widely (but interestingly not universally) popular. Obviously, this raises important issues about the ways in which retrofit schemes can be financed. Given the apparent potential for retrofit schemes to generate positive feedback that then enables further action and wider participation, and for this to generate socially and environmental beneficial outcomes, it may be that there is a case for subsidies to be used to promote participation in retrofit schemes. These may be particularly important for schemes in their early stages or in contexts where the negative impacts of past schemes mean that extra impetus and support is needed to get new retrofit initiatives moving.

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