Warm Homes Fund Programme Evaluation

Final Report

Newcastle University

NEA
Action for Warm Homes

Foreword from National Grid

Affordable Warmth Solutions CIC has been helping to eradicate fuel poverty since 2009 and National Grid has been proud to support them from the start, firstly in establishing the business to provide heating solutions to under-served areas and then, in 2017, committing £150m to set up the Warm Homes Fund.

The impacts of fuel poverty and living in cold, damp homes are numerous from physical and mental health and wellbeing to disrupted development of children and social isolation. We believe businesses have a duty to contribute to society and the communities they serve and our commitment through the Warm Homes Fund has been to provide financial support to help struggling households improve the heating and insulation of their properties to make them easier and cheaper to heat.

Newcastle University and their evaluation team partners, National Energy Action and Energy Audit Company, were appointed to deliver this evaluation of the Warm Homes Fund programme in Summer 2019 following a competitive tender process. As administrators of the programme, Affordable Warmth Solutions CIC received a number of bids but were particularly impressed by the consortium's track record, their proposed methodology, their data analysis capabilities and, of course, the expected value for money. Above all, it was important for National Grid that there was a rigorous, independent evaluation of the programme.

The Warm Homes Fund has been a challenging programme to deliver and, indeed, it remains ongoing at the time of publication of this report. Covid presented challenges in respect of carrying out work in people's homes, particularly the homes of the vulnerable and subsequently, the impact of both the pandemic and Brexit created challenges in the supply chain which has led to issues with product availability and upward pressure on costs. Changes to other industry schemes (e.g. ECO and FPNES) during the course of the programme have also impacted delivery timescales. The analysis set out in the report is therefore not based on the full spend of £150m but includes the expected benefits from the funds which have yet to be spent. We are grateful to Affordable Warmth Solutions for delivering the programme through this challenging period.

This final report is the culmination of significant effort and builds on the three interim reports which have been issued previously. We are particularly pleased that, through the analysis and lessons learned both from the challenges noted above and the specific experiences of the many projects which have benefited from the Warm Homes Fund, a blueprint has been developed which offers a structure and insights into how large-scale programmes of this nature might be delivered. We hope this can generate healthy debate with both Government and industry colleagues to build on the successes of the Warm Homes Fund and other similar programmes and contribute to the delivery of targets for reducing and, ultimately, eliminating fuel poverty.

We would like to thank both the evaluation team for producing this extremely valuable piece of work and you, the reader, for taking the time to see the social and economic value that the Warm Homes Fund has been able to deliver but also to understand the challenges and opportunities which lie ahead.

Chris Bennett
UK Policy & Regulation Director
nationalgrid

Foreword from Newcastle University

The consortium has been working together on evaluating the impacts of the Warm Homes Fund for over three years, from 2019 to 2022. It has seen first-hand some of the significant and positive effects that the funding has had on the lives of many families and households, and how it has helped partner organisations to deliver on their own commitments to affordable and sustainable energy. This includes considerable improvements to **quality of life** in the home, marked improvements in **mental and physical health** and on average, **a £922 reduction in annual household energy costs**. It has also had the effect of **lifting over 4,000 households out of fuel poverty**. These affordability improvements mean that most beneficiary households can now heat their homes without making painful trade-offs between energy and other essentials, such as food and essential travel. We have also been in touch with project delivery teams and heard that the vast majority feel that the scheme **effectively targeted vulnerable households**.

The period in which the Warm Homes Fund has operated, and in which this evaluation has taken place, have been some of the most challenging imaginable. The Covid-19 crisis and its long-term impacts did not halt the programme, and the impacts created are all the more significant given the severe challenges of delivering in-home energy installations and advice in the context of national lockdowns and a global health emergency. A different crisis developed as energy prices began to rise in 2021 and reached unprecedented levels in 2022, which impacted heavily on the qualitative sense of energy affordability as experienced by households who benefitted from the programme. The evaluation includes both quantitative and qualitative evaluation of this energy price crisis and its impacts on households, and the ways in which the measures installed through the Warm Homes Fund provided protection from the worst effects of energy price rises.

Alongside the detailed and multi-disciplinary analysis of impacts laid out in the full and abridged evaluation reports, we have also listened to households and project delivery teams about what energy efficiency schemes of the future should include, what should be prioritised and how to design such future programmes. This is the focus of the **Blueprint for the Design of Future Energy Efficiency Programmes**, also referred to as the **DEEP Blueprint**, which sits alongside the Evaluation Report as a companion document. The DEEP Blueprint focuses on guidance for **key actors**, involved in **governance, management and delivery** of future schemes by providing f**ive core elements** for future energy efficiency programme design, and **ten guiding principles**, two for each core element.

The evaluation has been a truly collaborative endeavour. The consortium includes academic, charity and private sector expertise working in close dialogue with one another and with colleagues from a wide range of organisations in energy efficiency policy and delivery. As a result, we are confident that the evaluation and blueprint are resources that can work for and reflect the experiences of those working in the energy efficiency arena but also the households and communities they serve.

The evaluation consortium, made up of colleagues from Newcastle University, National Energy Action, Energy Audit Company Ltd, and Bristol University look forward to working with old and new colleagues alike to make the report and blueprint resources as impactful as possible.

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List of abbreviations

ASHP – Air source heat pump

AWS – Affordable Warmth Solutions CIC

BEIS – Department for Business, Energy and Industrial Strategy

BRE – Building Research Establishment

BUS – Boiler Upgrade Scheme

CCG – Clinical Commissioning Group

COPD – Chronic obstructive pulmonary disease

DECC – Department of Energy and Climate Change

DFG – Disabled Facilities Grant

DLUHC – Department for Levelling Up, Housing and Communities

DNO – Distribution network operator

DRHI – Domestic Renewable Heat Incentive

EAC – Energy Audit Company Ltd

ECO – Energy Company Obligation

EPC – Energy Performance Certificate

EESHH - Energy Efficiency Standard for Social Housing

FPNES – Fuel Poor Network Extension Scheme

FHS – Future Homes Standard

GDN – Gas distribution network

GHG LAD – Green Homes Grant Local Authority Delivery

HEEPS ABS - Home Energy Efficiency Programmes for Scotland: Area Based Schemes

HHCC – Housing Health Cost Calculator

HHSRS - Housing Health and Safety Rating System

HUGS – Home Upgrade Grant Scheme

IMD – Index of Multiple Deprivation

LAD – Local Authority District

LPG – Liquid petroleum gas

LIHC – Low Income High Costs fuel poverty definition

LILEE – Low Income Low Energy Efficiency fuel poverty definition

LSOA – Lower Super Output Area

MEES – Minimum Energy Efficiency Standards

MHCLG - Ministry for Housing, Communities and Local Government

MPC – Marginal propensity to consume

NCFO - National Concessionary Fuel Office

NCFS - National Concessionary Fuel Scheme

NEA – National Energy Action

NHS – National Health Service

NICE – National Institute for Health and Care Excellence

ONS – Office for National Statistics

PCDF - Product Characteristics Definitions File

RdSAP – Reduced data Standard Assessment Procedure

RoSPA – Royal Society for the Prevention of Accidents

RSL - Registered social landlord

SAM - Social accounting matrix

SAP – Standard Assessment Procedure

SHDF – Social Housing Decarbonisation Fund

SHQS – Scottish Housing Quality Standard

SOI – Statement of Intent (ECO Flex)

Solar PV – Solar photovoltaics

TLO – Tenant liaison officer

WEMWBS – Warwick–Edinburgh Mental Wellbeing Scales

WHD – Warm Home Discount

WHD II – Warm Home Discount Industry Initiatives

WHF – Warm Homes Fund

Executive summary

Funded by National Grid and administered by Affordable Warmth Solutions (AWS), the Warm Homes Fund (WHF) was one of the largest fuel poverty programmes to be delivered in Great Britain, representing private sector investment of £150mn. The programme has been evaluated by a consortium made up of Newcastle University, National Energy Action (NEA), and Energy Audit Company (EAC), with support from academics at University of Bristol. This summary presents the key findings of the evaluation. The full findings of the evaluation, as well as a shorter summary report, are published separately.

Also published separately is a detailed blueprint for the future design and delivery of fuel poverty and energy efficiency programmes. This blueprint summarises the main findings of the evaluation and makes recommendations as to how fuel poverty and energy efficiency schemes should be designed in the future, including the core guiding principles that they should aim to follow.

Energy and environmental modelling

The evaluation used pre- and post-improvement Energy Performance Certificate (EPC) data and project returns data from the WHF, to produce modelling of households' fuel poverty status, required running costs, and fuel poverty gap before and after the installation of new heating systems. Where applicable, it also identified any other improvement measures provided to beneficiary homes. The total number of modelled homes was 15,690 from a total of 27,239 homes improved via the Programme, and the key findings are as follows:

- The average SAP rating of the dwellings before any improvements were made was approximately 51, corresponding to SAP band E. This is considerably lower than the national average, which is around 60. **After making improvements the average rose to 68, one point below band C**. The main effect is movement from the E, F and G bands into the C and D bands.

- **Before making improvements, 6,428 homes (41%) had annual running costs above £2,000. Post-intervention, the number of homes with over £2,000 running costs fell by over 90% to 460**. In terms of averages, the mean annual running costs dropped from £2,011 to £1,089 – in other words, **on average the installation of a new heating system saved households £922 per year**. This was based on a fuel prices figure calculated prior to the beginning of the energy crisis in October 2021.

- **Wales has the largest range of cost savings, and the highest median net cost saving per year**. Savings are also comparatively high for Orkney and North East Scotland. This potentially reflects the greater impact that can be achieved when rural communities, typically characterised by older and less efficient housing stock occupied by those on lower incomes, are targeted.

- Although there were approximately 5,500 homes (35%) that remained in fuel poverty (as defined by the Low Income Low Energy Efficiency (LILEE)[1] metric) after improvements were made, **the average fuel poverty gap (the energy bill reduction that a fuel-poor household would need in order not to be fuel poor) dropped sharply from £699 to £121. This means that on average, where a households remained fuel poor, their annual required running costs dropped by almost £600, greatly reducing the severity of fuel poverty**.

- **Average CO2 emissions per property across all modelled homes did not appreciably change. Findings show that they increased by a negligible sum of 3 kg/yr, from 2,746 kg/yr to 2,749 kg/yr.** This can be explained by the balance of measures installed through the WHF. The majority of heating systems that were replaced were electrically powered, predominantly storage and room heaters, and the majority of new systems were gas boilers. The electricity grid has decarbonised rapidly over recent years, and electical systems therefore emit less carbon than gas ones. However, the match-funded installation of insulation measures and air source heat pumps (ASHPs) through the Category 2 arm of the WHF has decreased emissions, thereby counterbalancing the WHF's overall impact on average domestic CO2 emissions. **It should be noted that this is still significantly below that of the average UK home, which emits approximately 3,644 kg/yr of CO2.**

- **To improve all 5,500 remaining fuel-poor households in the modelling dataset to EPC Band C, the total required amount of investment is £33,308,058.** As this is based on a sample of 15,690 homes, and to date the WHF programme has improved 27,239 homes, the extra required spend to eliminate fuel poverty across the entire project is estimated to be £57,825,251. However, in some cases this is not cost-effective, and a more workable solution that eliminates fuel poverty for some households is to permanently increase their income or reduce their energy bills through one means or another (e.g., through increases to social security payments, or the introduction of a social tariff in the energy market).

- **Affordable Warmth Benefits and Fuel Poverty pathways were the most successful at targeting fuel-poor households**, whereas ECO Flex, which is defined by local authorities and consequently varies across different geographical administrations, and Index of Multiple Deprivation (IMD) pathways, were much less successful, as shown below.[2]

Eligibility criteria	Fuel poor (LILEE)	Not fuel poor (LILEE)
Affordable Warmth Benefits	96%	4%
ECO Flex	32%	68%
Fuel Poverty	87%	13%
IMD	31%	69%

Social, economic, and health impacts of the programme

The outputs of the energy modelling analysis were used to inform an analysis of the WHF's broader economic impact. Using a Social Accounting Matrix developed by researchers at Strathclyde University, the evaluation team were able to conduct modelling of the economic impact of a) the transfer of capital from National Grid into the housing, construction and installer sector, as well as the support services sector; and b) the spending of any additional income obtained by households through reductions in their required running costs and subsequent energy bills. The movement of homes into higher SAP bands post-intervention was also used to calculate the savings to the National Health Service (NHS) due to WHF-led improvements, using the Building Research Establishment's Housing Health Cost Calculator.

The main findings of this analysis are:

- Economic modelling shows that from the initial £150mn investment in the construction, retrofit and installer sector, and the support services sector, **an additional £200mn of demand was stimulated in the economy**. This produced a total economic demand stimulus of £350mn. **This means that for every £1 invested in the WHF, a further £1.34 was stimulated in the wider economy.**

- **The total energy bill savings generated by the WHF**, which can be regarded as an increase in household disposable income, **was £10.8mn**. As this money was re-spent by households, a **further £14.4mn of spending took place**, demonstrating the positive economic impact of energy bill reductions on the wider economy.

1. Fuel poverty in England is measured using the Low Income Low Energy Efficiency (LILEE) indicator, which considers a household to be fuel poor if: a) it is living in a property with an energy efficiency rating of band D, E, F or G as determined by the most up-to-date Fuel Poverty Energy Efficiency Rating (FPEER) Methodology; and b) its disposable income (income after housing costs (AHC) and energy needs) would be below the poverty line.

2. The eligibility criteria used by the WHF are as follows: 1) affordable warmth benefits, whereby one or more of the household occupants is in receipt of a means-tested benefit; 2) ECO flex, whereby the household qualifies for assistance through meeting the local authority's flexible eligibility criteria; 3) fuel poverty, whereby the household has had a fuel poverty assessment carried out; 4) Index of Multiple Deprivation, whereby the household is located in a Lower Super Output Area which is in the top 25% of most deprived areas in the country. Note that the 'fuel poverty' pathway does not map exactly to the LILEE definition of fuel poverty utilised in the energy modelling analysis. This is because of the different methods used by WHF projects to calculate the eligibility for the 'fuel poverty' pathway, as well as the way in which the energy modelling analysis assumes and calculates income and energy efficiency.

- **Targeting low-income households** produces a larger economic impact. By targeting low-income households, the WHF grants produced a greater boost in demand across the economy than if the funding had been targeted at middle-income households. Analysis shows that **approximately £2mn more demand has been created by targeting low-income households; this arguably justifies spending on fuel poverty alleviation as a means of boosting economic growth**.

- The **total NHS cost savings generated by the WHF are estimated to be £2,491,381 per annum, while the wider societal benefits are estimated at £41,854,679 per annum**.

Impact on beneficiaries

Based on quantitative and qualitative research with WHF beneficiaries, which included 61 interviews with beneficiary households and 999 questionnaire responses, the programme's main impacts on households have been:

- Households reported substantial improvements to thermal comfort. **Pre-intervention, just 18% of households were able to keep their whole homes warm when it was cold outside. Post-intervention, this increased fourfold to three-quarters (76%).**

- Category 1 interventions resulted in the most substantial improvements to self-reported thermal comfort, with an increase of 73 percentage points, from 11% before intervention to 84% after intervention.

- **Changes in running costs have translated into self-reported improvements in energy affordability, especially for beneficiaries of Category 1 interventions.** Just over half (53%) of Category 1 households reported that they find their energy bills a lot easier or a little easier to afford now, compared to before the intervention. 44% of Category 2 households replied the same, as did 40% of Park Homes households and 31% of Category 3 households.

- **Four in five households were living in a home where at least one occupant had a cold-related health condition**, and over half were living in a home where at least one occupant had multiple such conditions. Over half (58%) of households agreed that not being able to keep warm at home affected their physical health, and 44% agreed that it affected their mental health.

- Post-intervention, **48% of households reported that their physical health was better than before, and 39% of respondents reported that their mental health was better**. In interviews, households reported improvements to musculoskeletal and respiratory health, mental wellbeing, and reductions in the prevalence of mould and damp in their homes. Interviews also suggested that the interventions likely prevented the development or exacerbation of health conditions for young children, enabled improvements in diet and nutrition for children and adults, and facilitated safer home environments for beneficiaries with dementia.

- **WHF interventions had a substantially positive impact on the prevalence and severity of rationing practices, such as cutting back on heating and not buying essential everyday items, such as food**; they also made beneficiaries feel that home environments were homely and safe, rather than alienating or hostile.

- **There were substantial improvements in WHF beneficiaries' ability to use and control their heating systems following their intervention, with 77% agreeing that they felt more able and confident about using and controlling their heating system.** In particular, interviewees with storage heaters in their properties frequently described them as difficult (if not impossible) to control effectively, and solid fuel fires and LPG heating systems were also discussed as near-impossible for beneficiaries to control. Accordingly, the recipients of first-time central heating installations discussed how replacing their storage heaters and solid fuel heating had dramatically improved the control they felt they had over their heating, their energy use and their homes.

- **Energy advice and capital measures interventions, delivered together as part of a single journey for households, resulted in better outcomes for recipients.**

Impacts on WHF projects

Finally, research with WHF projects' delivery partners highlighted four qualitative impacts on the organisations the WHF had funded. These were:

- WHF enabled delivery organisations to establish and expand internal resources, processes, delivery mechanisms, and partnerships.

- WHF contributed to, and in many cases helped, delivery organisations to achieve broader organisational priorities and strategies.

- Learnings obtained through the delivery of their projects enhanced delivery organisations' ability to undertake large-scale energy efficiency and fuel poverty projects in the future.

WHF unlocked additional resources and supported organisations in applying for and/or securing further funding for fuel poverty and energy efficiency schemes, thus further demonstrating the added value created by the WHF itself.

1. Introduction

1.1. The Warm Homes Fund

The Warm Homes Fund (WHF) was one of the largest fuel poverty schemes to be delivered in Great Britain; it was administered by Affordable Warmth Solutions (AWS) CIC, and represented £150mn of private sector investment from National Grid. Between 2019 and 2022 it delivered interventions to fuel-poor and vulnerable households across Great Britain, through three primary Categories of funding:

- Category 1, which was focused on urban homes and communities. Interventions delivered through Category 1 were primarily first-time gas central heating system installations, although a small number of alternative solutions were also delivered in urban homes.
- Category 2, which was focused on rural homes and off-gas communities. Interventions delivered through Category 2 were primarily air source heat pumps (ASHPs), and a smaller number of alternative solutions, especially oil and LPG, were delivered in the earlier phases of the programme.
- Category 3, which was focused on advice, health, and energy efficiency-related solutions to fuel poverty, such as the establishment of referral networks or single-point-of-contact health and housing services.

Later in the WHF, a fourth category was introduced, focusing on the extension of mains gas to Park Homes sites. The addition of Category 4 was stimulated by the (now replaced) Fuel Poverty Strategy for England[3], which noted that Park Homes residents were at particular risk from the harms associated with not being able to adequately heat their homes, and required further support to transition to mains gas supply.

The WHF was delivered during six rounds of funding, with bids invited from consortiums led by local authorities, housing associations, and other registered social landlords (RSLs). Bidders were expected to match-fund at least 50% of their total project value with alternative sources of funding, especially the Energy Company Obligation (ECO) and (for Category 1) the Fuel Poor Network Extension Scheme (FPNES). The WHF concluded in 2022, having delivered 27,239 first-time central heating systems to beneficiaries, alongside energy advice and match-funded measures such as insulation, solar photovoltaics (PV), and smaller interventions.

1.2. The evaluation

This evaluation was delivered by three organisations, all leaders in their respective fields, who united to form the WHF programme evaluation consortium:

- Newcastle University
- National Energy Action (NEA)
- Energy Audit Company (EAC)

Figure 1.1 below summarises the organisations' complementary roles and highlights the quality and comprehensive skill set within the collaboration. In addition, the evaluation included academic researchers from the University of Bristol, in a supporting capacity.

Figure 1.1: Schematic overview of evaluation consortium.

3. UK Government (2015) Cutting the cost of keeping warm.

Evaluation is a valuable and powerful tool for evidence-based decision making. It aids understanding about how change is brought about and provides insight into the effectiveness of programmes. Furthermore, robust evaluation provides greater transparency and accountability. Where programmes have been delivered over an extended period, as was the case with the WHF, evaluation can be focused to demonstrate the continuing value of investment, to inform whether and how programmes can be refocused or made more effective, and how an initiative may be transferrable – for example, by informing future energy efficiency and fuel poverty programme design.

The principal objectives of the evaluation were to:

- Develop appropriate input, output and impact measures, which will provide a basis on which delivery performance can be assessed.
- Determine the social and economic benefits from the WHF investment (return on investment).
- Determine the extent to which the support has reached the households most in need, and any regional differences, specifically between England, Scotland, and Wales.
- Produce a blueprint model that can be used to inform policymakers on options for delivering future large-scale energy efficiency programmes.

To meet these objectives, the evaluation adopted an Action Research strategy that integrated formative evaluation (to improve and shape) and summative evaluation (to assess outcomes). The formative strand focused on process evaluation and assessed progress against stated goals, effectiveness of delivery, and lessons learned. The summative element focused on the outcomes of the programme for multiple actors, including AWS, WHF project delivery organisations, and beneficiary households. This included a multi-factor assessment of the programme's return on investment, to quantify its social, economic and environmental impacts. Fieldwork was delivered in three waves over a period of three years. A full and detailed methodology, including an explanation of each component of the methods, is provided in Annex A.

1.3. A context of crises: the delivery of the Warm Homes Fund programme

This section places the design and delivery of the WHF, as well as the evaluation, within the context of two major external challenges that occurred at different points in its lifespan. The first was the Covid-19 pandemic, which significantly disrupted projects' delivery of the programme from March 2020. The second was the energy crisis, which led to rapid and unprecedented increases in fuel prices, especially from October 2021. As the evaluation concluded in December 2022, the average UK household was paying £2,500 per annum for energy, compared to £1,042 from October 2020 to April 2021. The impacts of both crises on the experiences of and outcomes for beneficiary households are analysed where appropriate in Section 3. However, both crises also had an impact on the delivery of the WHF, and help to set the context for the evaluation findings and methods.

At the onset of the Covid-19 pandemic in March 2020, most of the delivery by WHF projects was suspended. Between the initial and gradual reopening of society and the economy in the summer of 2020 and the close of the evaluation in December 2022, delivery of the programme diversified and transformed. During the initial lockdown period from March 2020, the WHF continued to engage with individual projects, supporting them to market, to create leads, and to prepare for the resumption of delivery when government guidance allowed it. Category 1 and Category 2 projects devised new, Covid-compliant ways of working in people's homes, and installations resumed. Similarly, Category 3 projects transitioned from delivering face-to-face energy advice in homes and communities, to providing an increasing amount of online and telephone support.

However, individual WHF projects delivered less on aggregate than was initially anticipated, with the period covering March to August 2020 being especially quiet. Challenges relating to Covid-19 were complicated by wider factors, some of which are explored from the perspective of WHF projects in Section 2. These included gas connection infrastructure delays as gas distribution networks (GDNs) prioritised emergency work; the movement or secondment of local authority staff from WHF projects to newly created Covid-19 response roles; and disruptions in the supply chain, as installers furloughed staff or faced operational and financial challenges. Inevitably, the vulnerable circumstances

of many WHF beneficiaries also created challenges regarding safe working practices and household engagement processes.

Ultimately, the Covid-19 pandemic also contributed to a considerable number of projects not being able to deliver on their contracts. The £150mn investment in the WHF from National Grid was, as a consequence, not all spent in the way that was initially planned. This is not to say that it was not allocated. Across five rounds of funding calls, all of this money was assigned to projects. However, a significant number of projects were not able to deliver on their initial proposals and eventually delivered a smaller number of interventions than planned; this was primarily because of Covid-19 and its interaction with other secondary factors and challenges, many of which are discussed in Section 2. As a result, the WHF developed subsequent 'phases', and the programme was able to provide more money to some WHF projects that were in a position to overdeliver on their initial estimates. It was also able to reinvest parts of the initial £150mn commitment from National Grid into other avenues to support fuel-poor households, such as the Fuel Bank Foundation. As of December 2022, the £150mn investment has been fully reallocated, with approximately £132mn invested in physical measures (principally central heating), but also some energy efficiency work; and £18mn has been invested in revenue services, principally advice. These figures are relevant to the evaluation not only because they represent the evolving delivery of the programme as a whole, but also because they impact on the economic modelling analysis conducted in Section 4.

Finally, the Covid-19 crisis and the energy crisis have both blunted the WHF's potential impact on projects and beneficiaries. As noted, where relevant, Section 3 discusses how experiences of the Covid-19 pandemic and increasing energy costs shaped the broader impact and outcomes achieved for beneficiaries. But at a broader level, both crises have intertwined to produce an ongoing financial crisis for millions of low-income and vulnerable households in the UK. The findings analysed in this evaluation need to be seen in this context, and specifically in the context of the counterfactual scenario of what might have been experienced by beneficiary households if they had not received support through the WHF. Put differently, although this counterfactual is difficult to concretely demonstrate through the findings of the evaluation, it is very likely that receiving support from the WHF has (at least partially) protected thousands of households from the worst impacts of the Covid-19 and energy crises.

1.4. Report aims and structure

This report has two primary purposes. The first is to comprehensively set out the methodology and full findings of the evaluation in long form. To aid readability and interpretation, two additional versions of this report have been produced: a shorter summary report, which explains and evidences the key findings from this report, and a four-page executive summary.

The second purpose of the report is to set out the evidence that informs an accompanying blueprint for the future design and delivery of fuel poverty and energy efficiency schemes. This blueprint summarises the main findings of the evaluation and makes evidence-based suggestions for how fuel poverty and energy efficiency schemes could be designed in the future, including the core guiding principles that they should aim to follow. This is a key output of the evaluation, which can be used to inform policymakers, and other scheme-designer and/or delivery organisations from public or private sectors, regarding options for delivering future large-scale programmes. The blueprint is intended to complement the final evaluation report as a practical resource. Subsequently, the blueprint is published separately; it references the evidence in this report where necessary to support the content, and it is here that readers will find the main recommendations of the evaluation.

To these ends, the report is structured as follows.

Section 2 explains how the WHF was delivered from the perspective of the organisations that delivered it: local authorities, housing associations, RSLs, and their partners. It explores the formation of project consortia and the driving factors of partnership-working, including their approach to match and gap funding, and how they sought to leverage additional value from their work in various ways. It also discusses projects' experiences and perceptions of eligibility criteria and targeting methods, noting the strengths and weaknesses of different approaches and spotlighting best practice where it was observed. Finally, it explores the challenges projects experienced and the outcomes for the different organisations involved in delivery consortia, thereby showing how the WHF has contributed to the growth of the organisations it funded in multiple, sometimes not obvious, ways.

Section 3 focuses on the impacts and outcomes achieved for household beneficiaries of WHF funding. Following a subsection explaining who the programme reached, it explores the impacts of the WHF on fuel poverty, energy affordability, and the severity of energy rationing practices, using data from household research and energy modelling analysis. It also evaluates the impacts of the programme on health and wellbeing, energy capabilities, and environmental awareness, showing that the impacts of receiving an intervention ripple far beyond the immediate benefits of helping households to access affordable warmth. Finally, where appropriate, this section highlights some of the negative aspects of householder experiences, with a view to suggesting how these experiences can be avoided or mitigated in future programmes.

Section 4 presents the outputs and results of a series of innovative modelling and mapping exercises. Energy modelling analysis, conducted by EAC, shows how the WHF has contributed to national and devolved fuel poverty targets, as well as reducing households' energy running costs, improvements to properties' energy efficiency, and the impact on carbon emissions from domestic buildings. This analysis is disaggregated spatially and geographically, showing the extent to which the WHF has reached different areas of Great Britain that might be in more or less need of support. Finally, using the outputs of the energy modelling, analysis presents the broader benefits of the WHF programme for the National Health Service (NHS) and the wider economy.

Finally, **Annex A** gives a detailed explanation of the methodology and methods used in the evaluation. However, sufficient information on methods is also provided where appropriate in the main body of the report, to enable the reader to understand the findings without continual reference to the annex.

2. How was the programme delivered? Experiences of project delivery

This section examines how the WHF was delivered by recipients of funding (delivery partners). It is split into nine themes: the germinations of WHF projects; the importance of partnership working; funding and finance; targeting processes; eligibility criteria; challenges and problem-solving; project experiences of householder withdrawal; the outcomes and impacts of delivering the scheme for delivery partners; and finally, key findings relating to Park Homes. Throughout, findings from surveys undertaken with delivery partners are used to demonstrate key themes and patterns in the data, and illustrative quotations are extracted from interviews with delivery partners and their collaborators.

2.1. Back to the beginning: project germination and drivers

This subsection examines the roots and beginnings of WHF projects. It describes and analyses three main themes identified by projects (fund recipients) regarding what had stimulated their applications for WHF funding. These themes can be summarised as: 1) to continue, extend, or diversify existing fuel poverty and energy efficiency schemes; 2) to implement pre-existing fuel poverty strategies and policies; and 3) to address local issues specific to geographical location. Some projects were driven by a combination of these three factors, and to a degree all three are interrelated. For the purpose of this analysis the three themes are treated separately, but intersections are noted where appropriate. The section also discusses two additional and important themes: namely, the role of external consultants in project development, and the WHF's importance in supporting organisations without previous experience of delivering fuel-poverty focused schemes.

For the majority of projects, their WHF application was to continue, expand, or branch pre-existing fuel poverty and energy efficiency schemes.

These projects had been running multifaceted programmes over consecutive years, and described WHF funding as an opportunity to consolidate and continue this delivery. The way in which projects approached WHF funding was typically dependent on the focus, scale and scope of their pre-existing programmes. For example, some projects had long-standing schemes focusing on insulation and other energy efficiency measures, but had less capital available for first-time central heating systems; whereas others were running ongoing heating upgrade schemes that WHF funding supplemented appropriately:

"I think it was looking to add value to what we were able to offer people in the county. We're always looking for funding for capital measures to put into people's homes. The energy advice line really is the foundation upon which we can build these other offers of support to people, especially with capital measures. We've obviously been referring for ECO measures for a long time. I think this project just added to that." Category 1, 2 and 3 project manager

"We're a home improvement agency and we already complete our own discretionary housing grants, including energy efficiency for heating. We were already doing these types of grants. One of our delivery partners […] notified us of this scheme that was coming about, that we could supplement some of the work that we do and concentrate on some first-time central heating." Category 1 project manager

"Yeah, I mean, I can't initially remember where I really found out about the funding. But I guess we found out about it and we obviously were already installing air source heat pumps, and we know we've got a lot of rural homes, so it kind of fitted well with that category of it being first-time central heating measures." Category 2 project manager

As these quotations demonstrate, projects often viewed the WHF as a way of adding value and reach to programmes that were already well established. There was a large variation in the exact ways that this occurred. For some projects, WHF funding enabled the expansion of a pre-existing project to a wider geographical area, while for others it facilitated the creation of new partnerships that enabled pre-existing projects to support new vulnerable groups that were previously considered 'hard to reach'. One Category 3 project described how securing WHF funding enabled them to take a pre-existing "behavioural change programme" delivered to their social housing tenants and refine it to be more focused on supporting fuel-poor households. Lastly, some projects described WHF funding as filling a gap in their existing provision, such as one project that had identified "this void for sort of coal-to-gas type work […] so this was another funding stream to complement the other ones that we had." While this was not always the case, as will be explored below, the majority of projects developed and designed their applications to consolidate and expand pre-existing services in diverse ways.

Projects discussed two primary drivers for their WHF applications and their broader work on fuel poverty and energy efficiency. Understandably, the primary driver for bidding for WHF support was organisational policies and strategies relating to fuel poverty.

In interviews, projects discussed a wide range of priorities that their WHF applications were designed to help address, such as improving household access to affordable warmth and energy; improving the energy efficiency of housing stock to comply with internal and external targets (e.g. progress against Net Zero and fuel poverty targets); reducing the proportion of social housing properties with storage heaters (a distinct objective for some RSLs); and improving the safety standards of social housing stock to comply with building safety regulations. In many cases, WHF funding was seen as contributing to several organisational priorities simultaneously, or at different times in delivery:

"When we embarked on this, we were looking at it as a true affordable warmth project, but subsequent to that we now have a sustainability strategy […] and we're looking at carbon issues as well." Category 2 project manager

"Obviously, its origins sit in providing affordable warmth for our customers, so reviewing the energy efficiency of our homes and seeing how we can upgrade them and also support the government's road map to Net Zero eventually. That's where it came from, and a desire to get into our own road map of energy efficiency for our homes and set our own journey out." Category 2 project manager

Notably, given the focus of Category 1 and Category 2 on installing first-time central heating systems, there is strong evidence that the design of the WHF in this way dovetailed aptly with organisational priorities regarding the removal of inefficient storage heating. This was driven by multiple factors, especially for RSLs, who noted that tenant feedback on affordability, housing stock data analysis, and difficulties in letting storage-heated properties, all stimulated organisational policies to replace storage heaters wherever practicable:

"It's always been a bit of a bugbear for us, the electric heating, because it tends to be unpopular with tenants, for obvious reasons, really. It's inefficient. It's expensive to run. It's difficult to control. Sometimes we have challenges around letting properties with those old, inefficient storage heating systems. So we kind of took a strategic decision that we wanted to replace those systems." Category 1 project manager

"Then as energy prices have gone up, the kind of level of satisfaction with existing heating systems, there's a direct correlation with – as the cost of a unit of electricity has risen, the number of our tenants who are just finding it crippling, really, to run their Economy 7 systems. Yeah, nice storage heaters, the big elephant in the room." Category 2 project manager

These priorities also merged with geographical factors to shape the funding category that projects applied for. Local authorities serving predominantly urban areas viewed Category 1 as a natural solution for their housing stock and their broader organisational priorities, whereas local authorities and RSLs with a higher number of rural households viewed Category 2 as a better fit. Category 3, on the other hand, was perceived as contributing to a broader range of organisational priorities that involved fuel poverty, affordable warmth, and reducing unnecessary pressure on local healthcare services by addressing cold-related ill health:

"So we have an organisation that delivers the bulk of health services for the city. So we got in touch with them and did some data-crunching, and realised that 20% of all the referrals into adult social care were because of an issue with a home, and a large percentage of that was to do with, you know, poor condition slash no heating slash – you know, fuel poverty, et cetera. And so the idea was that we will work in partnership with them and our community energy group to put two posts within adult social care, to try and – within a team, to try and bring – raise the capacity of that team and upskill the service in general, and raise the issue of health and housing, and how much poor housing can impact on health." Category 3 project manager

"All three local authorities – sorry, all four local authorities – have identified fuel poverty and excess winter deaths as part of their [Joint Strategic Needs Assessments]. So, it was on everybody's radar, but [we previously had] no real answer to it." Category 3 project manager

In contrast, some projects described being more driven by specific local issues.

Some projects talked specifically about vulnerabilities that were currently underserved in their pre-existing service provision, or that they had identified as particularly prevalent in their housing stock or geographical remit, and households whom they wanted to help. Notably, projects tended to discuss this in terms of intersecting or overlapping vulnerabilities that they had pinpointed as important to address; they found that geography, especially differing levels of urbanity and rurality, tied different vulnerabilities together to increase fuel poverty risk and prevalence. For example, projects discussed some of the local challenges facing their rural communities, as follows:

"[We're] quite heavily rural, too, so you've got a lot of older properties. You've got a lot of older residents. You've got a low-income economy and high fuel costs because large areas [...] are outside of the gas mains, and always will be." Category 1 and Category 3 project manager

"The majority of our other properties are in rural locations [...] we're dealing with probably a couple of different factors. We're dealing with factors with relatively low pay in some of these areas [...] also we have quite an ageing population, and we have people who have not very efficient heating systems. We've got properties that aren't particularly well insulated, and that manifests itself." Category 2 project manager

In contrast to these two quotations, other projects focused on the unique challenges of urban deprivation:

"Our terraced stock are our worst: coldest, dampest, excess cold; this, that and the other. People who live in there generally have all got health conditions, deprivation, all sorts." Category 1 project manager

"The biggest causes of fuel poverty in our area are an old housing stock, so we do have a lot of pre-1919 terraced properties, so we've got a lot of solid wall properties. It's low income, low income is quite prevalent." Category 1 project manager

"We've got, obviously, a high level of fuel poverty, well quite a high level of fuel poverty, and it's a [...] big metropolitan district with all different ... but it's overall very deprived. But all the deprivation is concentrated in the urban areas." Category 1 project manager

In addition, projects frequently referenced economic decline, deprivation, high unemployment rates, and the closure of local industries as challenges facing local areas. Interestingly, while no projects said their WHF bids were directly linked to broader organisational strategies to improve the economy of their local areas, several did at least recognise indirect impacts of reducing fuel poverty on local economic activity. One project, for example, linked their work to regeneration and revitalising local communities, whilst a second explicitly linked health improvement through fuel poverty interventions to labour market supply.

A final point concerning local drivers relates to projects that delivered area-based schemes. Two interviewees had delivered WHF projects that were aimed at addressing fuel poverty in specific social housing estates. As they explained,

"The estate, where the project was run, is our largest single estate within our portfolio, [...] about 180 homes in total, 138 of which are flats or studio. The rest are family homes, which were on the existing gas network, but the flats and studios were not. So, there was mains gas into the site, but not to the flats [...] the organisation was in a very difficult position with this estate because we'd installed a new-fangled electric heating system a few years previously, which really wasn't delivering. So, it was a big investment, but it was becoming a big problem because customers weren't getting the affordable warmth that they needed." Category 1 project manager

"The council had a lot of all-electric estates that were built in the '50s and '60s, and it long had a policy of putting in gas mains. Mainly because obviously, electric heating is expensive and difficult to use at the moment. Therefore, it's a way of improving the council properties and reducing fuel poverty for households. And just generally increasing the thermal comfort of properties. [This estate was] one of the last big areas that was untouched." Category 1 project manager

As these quotations show, a considerable number of projects designed schemes around specific housing estates that they wanted to focus on, both for reasons of reducing fuel poverty and simultaneously improving the energy efficiency of social housing stock. Overall, local issues were important drivers of projects' applications to the WHF, even though they were narrated and understood in different ways by different organisations.

The WHF helped organisations to build capacityin the delivery of fuel poverty schemes, specifically supporting organisations that previously had little or no experience of delivering fuel poverty schemes, and providing inexperienced organisations with a foundation that they could build on to deliver further work in the future.

In contrast to the findings earlier in this section, several WHF projects did not have significant track records in delivering fuel poverty schemes, or pre-existing programmes set up to support households with energy efficiency. In a competitive funding landscape, this can arguably lead to what could be called a 'two tier' structure in grant application successes, whereby organisations with the requisite experience and track record in delivery are successful precisely for these reasons, while inexperienced organisations are unsuccessful because they cannot demonstrate a history of effective delivery, and are therefore perceived as risky. The overall outcome of this system is the perpetuation of 'postcode lotteries' of funding and widening gaps in service provision. Put simply, if organisations cannot secure initial funding to begin fuel poverty programmes, they are unlikely to be able to resource those programmes – along with the necessary procurement frameworks, staffing, and associated essentials of delivery – on their own. In contrast, **the evidence shows it is likely that the WHF contributed to capacity-building for the delivery of fuel poverty and energy efficiency schemes across Great Britain, and will reduce regional inequalities in the accessing and delivery of funding streams in the future**.

One housing association, for example, narrated how their WHF application was originally stimulated by a change in direction at board level towards energy efficiency – which they previously had not been much involved in:

"So [my colleague] had the, sort of, brief I think from our board of directors that we should be trying to sort of get in the game, really, more in terms of any initiatives towards affordable housing – improving the affordability of our housing stock in terms of heating, and also the Net Zero agenda. There's one of our board members in particular who is, you know, is quite forward-thinking about this." Category 2 project manager

A second housing association discussed challenges associated with accessing funding, noting that they were cognisant of the need to improve the energy efficiency of their housing stock but struggling to access internal or external funds to do so. As they explained,

"... we've not got very deep pockets as a small organisation, so we needed grant funding to make it work. That was without a doubt because we couldn't have done it on our own [...] but then again, as a small organisation, we didn't have a great ... I don't have a track record in this sort of grant funding, nobody else did in the business." Category 1 project manager

Similarly, other projects described how they had previously undertaken small programmes of energy efficiency improvements, particularly on their social housing stock, but were unable to secure the investment required to scale-up their programmes to the level that their strategies required. One housing association also commented that the main impetus for looking in more detail at delivering energy efficiency was feedback from tenants, "saying *'I'm really struggling with my heating system' [...] that's where this all came from."*

In these situations, applying for and securing WHF funding was perceived as constructing a foundation

upon which a future of energy efficiency and fuel poverty delivery would be built. In some cases, WHF funding had enabled projects to develop partnerships with other organisations to deliver energy efficiency projects, now and in the future. For others, delivering WHF had enabled the setting-up of the internal resources, structures and procedures that were necessary for delivering fuel poverty and energy efficiency programmes. As one project narrated,

"There was quite a lot of work involved, for a team that was very fresh. We didn't know what we were doing when we set off. We're a lot more experienced now, in terms of getting everything lined up, asbestos surveys and customer surveys, and doing the low-income, high-cost surveys for funding. There was a lot of work to do and try and patchwork it all together. But somehow, we got there." Category 2 project manager

As this quotation hints at, some projects discussed delivering the WHF as a litmus test for their ability and capacity as an organisation; *"our first dipping of our toe,"* as one put it. For these projects, with little to no experience or track record in energy efficiency or fuel poverty provision, applying for and delivering the WHF was a learning experience that, above all, persuaded them they were capable of doing it. Looking forwards to the future, one project summarised that they were *"starting to cast our eyes around for the next opportunity and maybe to look at something at a bigger scale."* This shows that the WHF's willingness to support inexperienced projects was pivotal in enabling them to begin their own energy efficiency and fuel poverty delivery journeys.

External consultants were vital in identifying and supporting several lead WHF project partners.

As the next section will discuss, external consultants were important in the delivery of WHF projects overall, but several projects discussed how external consultants had driven WHF applications, playing leading roles in the identification of the fund, and in preparing and submitting applications. Usually, the external consultants noted by projects were energy suppliers, energy consultancies, or appliance manufacturers with different interests in supporting the delivery of energy efficiency schemes. In addition, projects that discussed the importance of external consultants in supporting the development of bids were often those that were inexperienced or had little-to-no track records in previous delivery, as discussed above. These projects described approaching, or being approached by external organisations, with proposals to work together on developing WHF bids:

"So, I can't remember how we found [them], but we approached [the external consultant] to support us with the application process, who do have a track record with Warm Homes Fund and other funding streams. So, they were our partner in, you know, applying for the funding." Category 1 project manager

"Yes, what we did was, initially, we've installed in the past about 46 air source heat pumps with [two manufacturers], as well, and then [one manufacturer was also] an actual installer who actually came to me and mentioned about the Warm Homes funding. And then we had a meeting with [the installer], the manufacturer, and [an energy supplier], as well, who have been involved with other projects with [the installer]. And after having the meeting [...] we had another meeting to guide us on how to do the application, how to submit the application. And what we did was we filled out the form, we sent it to [the energy supplier] to crosscheck because they've done it before in the past for other housing associations, and they crosschecked the application, and then after that, we submitted it to Warm Homes funding." Category 2 project manager

"I wasn't totally involved with this, but what happened was we had an energy officer [...] I believe it was [the energy officer] along with [the external consultant]; my understanding is there was a real partnership approach [and the consultant was] quite experienced in that field. And I think, probably from our organisation's perspective, we had not really embarked on something of that scale before." Category 1 project manager

As these quotations show, external consultants were perceived as vital to preparing and submitting applications because they had previous experience, knowledge and track records, which lead organisations often lacked. External consultants, especially energy suppliers, were also described as instrumental in building partnerships between different local authorities, to submit joint applications for WHF funding: *"It was them that came to us to suggest that they could be using this round of bids to try and build a group of local authorities,"* as one project interviewee said. This was corroborated by an interviewee from an energy supplier, who noted that *"we have supported the council to build the consortium, do the bid, and the kind of important things to put in that bid."*

These findings point to the importance of external consultants in identifying and facilitating opportunities for local authorities and RSLs. While this evaluation did not explore in detail the range of motivations of external consultants, there was typically a financial interest in assisting lead organisations to apply for WHF funding; especially when they were also involved as project partners managing or supporting delivery. But the evidence here suggests that they played a critical and broader role in the delivery of energy efficiency schemes – a topic that the next section will also explore.

2.2. Partnerships and the added value of project delivery consortia

This section examines the range, extent, and value of partnership working in the delivery of WHF projects. It describes how WHF projects explained the importance of partnerships, and what they considered to be effective partnership-working.

A wide range of partners were involved in WHF projects. Table 2.1 summarises the different actors that were partners, either formally or informally, with WHF lead organisations, as well as their typical roles.

Partner type	Typical role in WHF projects
Charities, not-for-profit organisations, and volunteer groups	• Supporting and/or leading WHF project and bid development • Generating referrals for Category 1 and Category 2 projects • Providing small quantities of gap funding for beneficiaries (e.g. for prepayment vouchers, draughtproofing measures) • Delivering energy advice under Category 3 funding • Supporting vulnerable households through the customer journey, including the provision of pre- and post-installation advice and instruction
Community energy groups	• Delivering energy advice under Category 3 funding
Consultancies	• Supporting and/or leading WHF project and bid development • Project-managing WHF projects • Accessing match and gap funding for WHF projects (e.g. ECO) • Managing and processing procurement frameworks
Contractors and installers	• Delivering measures for Category 1 and Category 2 projects • Generating referrals for Category 1 and Category 2 projects • Supporting vulnerable households through the installation process, including the provision of pre- and post-installation advice and instruction • Accessing match and gap funding for WHF projects, especially ECO
Distribution Network Operators (DNOs)	• Supporting Category 2 projects to deliver upgraded electricity network connections for ASHP installations
Emergency services	• Generating referrals for Category 1, Category 2, and Category 3 projects
Energy suppliers	• Supporting and/or leading WHF project and bid development • Project-managing WHF projects • Accessing match and gap funding for WHF projects (e.g. ECO) • Managing and processing procurement frameworks
Gas Distribution Networks (GDNs)	• Facilitating FPNES connections • Supporting WHF project and bid development
Health and social care actors (e.g. Clinical Commissioning Groups [CCGs], NHS Trusts)	• Generating referrals for Category 1, Category 2, and Category 3 projects • Providing match and gap funding (e.g. through public health funding budgets)
Local authorities departments (e.g. private sector licensing teams, adult social care)	• Supporting and/or leading WHF project and bid development • Accessing match and gap funding for WHF projects (e.g. through linked budgets in different local authority teams) • Generating referrals for Category 1, Category 2, and Category 3 projects
Social housing providers	• Supporting and/or leading WHF project and bid development • Accessing match and gap funding for WHF projects (e.g. through internal capital budgets) • Generating referrals for Category 1, Category 2, and Category 3 projects

Table 2.1: Partners and collaborators in WHF projects.

The majority of WHF partnerships were firmly based on historical foundations.

Project partners had often worked together for years, and sometimes decades, prior to delivering their WHF project; this was narrated as essential to the development and solidification of good working relationships that enabled successful delivery. Figure 2.1 shows that the majority of project survey respondents worked with existing partners (n=28) to deliver their WHF projects, with a smaller number working only with new partners or with no partners at all (n=23).

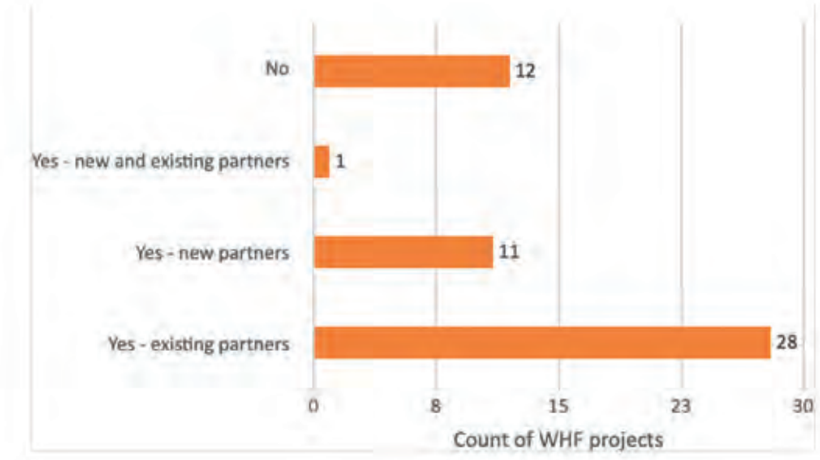

Figure 2.1: Responses to the project survey question 'Does your project work with other partners to identify suitable clients/households for WHF measures and/or advice?' (n=54).

A characteristic illustration of how this was narrated by projects was given by one interviewee, who stated that *"these aren't partnerships and things that we've specifically developed for this project [...] we've been doing this sort of work since 2001, and we've developed a lot of good local networks and a lot of good local partners have been our partners in this work for quite a number of years."* Several projects also emphasised the role of interpersonal relationships between individuals as fundamental to the formation and perpetuation of broader partnerships between different actors. As one project interviewee put it:

"I've kind of worked in this area for about 20 years, since 1996 – that's longer than that – so I kind of know – it's a terrible thing to say, isn't it – I know most of the people, all of the people in the district councils, like for example, all the housing officers, all the environmental health officers, because I've just known them all for years." Category 1 and 2 project manager

As the interviewee continued, these long-standing relationships ensured that any household issues tangentially related to fuel poverty, cold-related ill-health, or energy efficiency across the county tended to end up on his desk, and that different frontline council services encountering these issues would be told by their managers to *"give [his] lot a call, they might be able to help us with this."*

This interviewee is a distinct but representative example of the importance of personal relationships to the establishment and sustainability of referral networks, and projects also said these relationships were important to WHF bid applications and consortia formation.

For example, one WHF project, the lead on a multi local authority consortium, explained that the local authorities had *"always worked very closely together. And we've maintained that for many years. So, the process of coming together as a partnership was actually very easy, it was natural, just because of the history."* The importance of long-standing relationships with contractors was also discussed by projects, especially housing associations and RSLs that awarded multi-year contracts to installers, to deliver asset improvement and replacement programmes. Consistently, and irrespective of partner type, the role of historical and interpersonal relationships was emphasised by projects as crucial to the formation and perpetuation of good partnership-working.

Social relations of trust, friendship, and dedication to shared objectives, as well as the related qualities of individual staff, were identified as critical to effective partnership working. Correspondingly, it was widely agreed that all of these had to be meticulously established over time and solidified through shared experiences of project delivery.

As one project reflected, in a discussion about the merits of partnership working, *"it's the fact that we have very good working relationships set up with these organisations which is really helpful, so there's a trust there, there's a trust between us."* Beyond this, having established relationships meant partners knew how each other worked, the speed at which they would typically complete certain tasks, and the lengths they would go to support vulnerable residents or address snags in project delivery. This was particularly apparent in interviews with Category 1 and Category 2 projects, who often had time-honoured consortia that had worked together on previous schemes (e.g. on government schemes such as the Department for Energy and Climate Change's [DECC] Central Heating Fund), and it was discussed by local authorities, housing associations, and RSLs alike; many of whom had long-standing partnerships and ways of working with installers, charities and internal departments.

WHF funding has enabled the development of new partnerships and ways of working.

While well- and long-established partnerships were critical to project development and delivery, it was especially evident in interviews with Category 3 projects that many had predicated their bids to the WHF based on developing and expanding networks of energy advice and support:

"I think the partnerships have been established for many, many years. When I first joined the project, it was my aim and goal to produce as many partnerships as possible. Some of them were already there. They just needed strengthening. I think as a result of the Cat 3 money, have we made new partnerships? I think we've made new partnerships with communities [...] the big areas of new partnerships have been where the Cat 3 funding has allowed [us] to make links with the local parishes, over 60s clubs, women's institutes, those kinds of groups on the ground." Category 3 project manager

Category 3 projects also had different starting points in this process. Some were looking to expand comprehensive pre-existing referral networks even further, as shown in the quotation above, while others were attempting to set up services and partnerships more-or-less from scratch. Developing relationships with partners beyond what could be termed the 'usual suspects' of energy advice delivery was also a prominent theme in interviews with Category 3 projects – most notably health and social care actors, but also schools and emergency services (e.g., Fire and Rescue). As noted in Section 2.6, projects experienced challenges in doing so, especially with health and social care actors, but many reflected that WHF funding had underpinned positive engagement with new partners that would continue to be cultivated in the future.

Partnerships were, on the whole, identified as beneficial and desirable for the delivery of fuel poverty and energy efficiency projects, and added significant value to their work.

What counted as 'value' in this respect was conceptualised in multiple ways by projects. In terms of financial value, evidence from project interviews shows that partnership working unlocked access to additional match or gap funding (see Section 2.8 below), delivered additional financial benefits to beneficiaries through linking first-time central heating system recipients to income maximisation services, and reduced project costs through enabling more efficient working practices, data sharing and problem resolution – all of which have implications for staff time and resources.

The forms of experience and knowledge brought to projects by different partners was also highlighted as extremely important, such as challenges facing specific communities or vulnerable groups, and the ways in which project delivery had to be adjusted to take this into account; as one project put it, *"our customers come with quite complex, kind of, requirements and needs that, again, one partner*

cannot deliver all those, kind of, requirements, and therefore you look to see which other partners can do that." Partners typically had their own networks and relationships which could be tapped for the benefit of WHF projects, such as the connections that local installers sometimes had with companies that could help with loft clearances, or pathways through which charities could access grants, prepayment meter vouchers, and debt advice. As summarised by one project, *"partnerships are critical for what we're doing."*

2.3. Match and gap funding

This section examines the range and extent of sources from which projects secured match and gap funding for their WHF projects. As described elsewhere in this report, a primary aim of the WHF was to enable local authorities and RSLs to unlock match funding totalling £350mn. This section evaluates how successfully projects were able to blend funding streams to deliver multiple co-benefits to beneficiary households, as well as the challenges, successes and longer-term impacts of doing so.

As discussed in more detail in Section 2.5, the eligibility criteria of the WHF were designed to mirror those of the Energy Company Obligation and the Fuel Poor Network Extension Scheme. Accordingly, it is not surprising that the majority of projects, especially local authorities working in privately owned properties, discussed these funding streams.

With regard to FPNES, it should be noted that although gas connections are a necessary first step to the installation of gas central heating systems under Category 1, it is more accurate to describe WHF Category 1 funding as unlocking FPNES vouchers; as without confirmed funding for a gas central heating system to be installed, it is not possible to leverage FPNES. It is notable that many projects considered FPNES almost unworthy of discussion; it was often seen as a smooth, unintrusive part of the funding process that was accessed without significant issues. Category 1 projects that commented on the ease of FPNES were often partners with organisations licensed by Ofgem to aid its delivery, such as Communitas. The use of a licensed organisation, *"embedded within other gas networks"* and with substantial experience of facilitating gas connections, was in other words considered important by many projects. Projects approached this in different ways; for some, organisations like Communitas were named partners in Category 1 and Park Homes bids, while others preferred to develop what they described as *"a good working relationship"* with licensed partners, to draw upon when required. This demonstrates the value and utility of mediating organisations between first-time gas central heating projects and the GDNs.

However, some projects experienced challenges in relation to FPNES. The most significant challenge was in rare cases when the FPNES voucher did not cover the full cost of the gas connection. This was experienced by some projects at an individual household level, and by some as an issue with area-based schemes that required economies of scale to make substantial gas network extensions financially viable. Some projects were able to secure gap funding from elsewhere to cover the shortfall, but others were not able to do this, resulting in the installation being cancelled or the household being asked to contribute:

"We've had a very good return with the vouchers, I think, probably 80 to 90% of our clients had vouchers. The majority will fund the whole gas connection, but I think we've lost one or two who couldn't afford to pay for the gas connection. And we've not even remotely offered to pay for the gas connection, you know, if they can't fund it then there is nothing we can do about it, so we do have to walk away from them." Category 1 and Category 2 project manager

One project explicitly linked gas connection costs to questions of spatial energy injustice, questioning whether it was justifiable that some households in 'difficult to connect' semi-rural areas could not receive a gas connection because the value of the FPNES voucher was insufficient.

In addition, although not possible to substantiate, one project surmised that delays they had experienced in confirming FPNES vouchers was partially as a result of increased demand, some of which had been generated by the WHF. As this project put it, *"they were working with a number of different housing associations, I understand, as part of the Warm Homes Fund at the time, so I think they were struggling capacity-wise."* Although there is insignificant evidence from other projects to suggest this caused wider delays to project delivery, it does raise an important point: that in order to facilitate the delivery of fuel poverty projects at scale, mediating organisations (which play a small but important role) must be adequately resourced. Early in the WHF, Ofgem also removed the Index of Multiple Deprivation from the FPNES eligibility criteria, which led to projects removing IMD from their suite of eligibility pathways entirely: *"We can't give someone a boiler and then say, oh, we can't connect you to the gas network."* Despite this, it should be emphasised that the majority of projects who discussed FPNES did so positively, and most experienced no issues with its delivery.

ECO, on the other hand, was experienced by projects in a far more mixed way, with some accessing ECO funding straightforwardly, but others experiencing considerable difficulty in obtaining it.

Access to ECO funding was meditated in a similar way to FPNES, with contractors and, where included in the project, energy suppliers facilitating access to ECO funding for WHF beneficiary households. Indeed, projects that described ECO funding as accessible and straightforward were often those partnered with, or having their delivery managed by, energy suppliers. As two projects working directly with energy suppliers explained:

"There was, within the scheme itself, a requirement for air source heat pumps, obviously for the property to be brought up to the required standards beforehand. And I believe a number of air source heat pumps attracted loft insulation and things like that, at the same time. As far as the actual ECO is concerned, I think it was more how ECO was attracted from [the energy supplier] itself played a part in the actual costs, keeping the costs within an acceptable level as well." Category 1 and Category 2 project manager

"What we've been able to do is, because we had [the energy supplier] driving this process and wanting to be involved, what we've done is make sure that, as the body that would be providing the ECO, they make sure they blend so that there is no charge to the occupant for this scheme." Category 1, 2, and 3 project manager

As the latter quote demonstrates, when ECO funding could be straightforwardly accessed, it significantly enhanced the value of delivery; both to the project and to the household. It helped to ensure that no household contributions were typically required for the full arsenal of necessary measures to be installed, and extended the potential reach of WHF funding.

However, ECO was more-often-than-not discussed by projects as a challenge that had caused considerable difficulties for their WHF delivery.

Almost always, this was narrated as due to the perceived complexities and bureaucracy associated with ECO itself, as well as its changing nature. Most prominently, the UK Government's decision to exclude oil boilers under the first-time central heating element of ECO3, and to restrict its delivery to a very specific bracket of households within the 'broken heating system cap' [4], caused significant challenges for projects intending to deliver oil boilers under Category 2. Ultimately, many Category 2 projects were able to renegotiate their oil targets or increase the proportion of heat pumps they were contracted to deliver. However, as one project put it, the removal of oil from ECO left a large gap in support, whereby *"you had these properties that weren't really suited to anything else that could be funded within the funding that we had available. They were left in a bit of a no-man's land where there weren't any affordable, workable solutions for them that was going to take them out of fuel poverty."* Relatedly, the decision to restrict the ECO3 measures allowed in privately rented dwellings posed a challenge for some projects, because it limited the spend that could be tapped from ECO for measures installed in the private rented sector.[5]

Changes to ECO requirements caused problems for projects in other ways, such as through ECO's perceived complexity and bureaucracy. To quote one project interviewee at length,

4. A cap which limited the number of replacement heating system upgrades (e.g., boiler replacements) due to them being broken down and unable to be economically repaired.

5. Specifically, changes to ECO3 limited the financial contributions that ECO could make to privately rented properties with an EPC Rating of F or G. Furthermore, amendments made to MEES in 2015 included a £3,500 cap on the amount landlords were required to spend to improve the energy efficiency of their properties.

"The ECO funding element got very complicated because I think in autumn last year, yes, in October [2020] we were informed that the ECO rating is changing, and that in order to claim ECO there had to be additional property requirements. So, you know, a property had to have cavity wall insulation or loft insulation up to a certain standard in order to claim that. That then added time and complexity, and our contractors also then had – they moved over to the new powers of accreditation. And it meant that any property that was going to apply for ECO funding had to have a retrofit assessment, which added yet more complexity because the heating sub-contractor that we used didn't have that in place, so it took them some time to get a retrofit assessor and a coordinator so that they could have all the documents. So, in order to claim the ECO funding, which is only a small proportion of the cost per property, there was suddenly all of this complexity, and it was delaying some jobs by, sort of, three or four months." Category 1 project manager

A different project described this challenge more simply, noting that *"ECO is not the easiest scheme in the world to submit for,"* and that due to PAS2035 requirements being introduced, *"it's a very long process to put a property through ECO [...] I'd think twice before trying to build ECO into any sort of business case or funding model in the future, just because from ECO theoretically being available, there's a big gap between it actually turning up."* Clearly, projects that experienced difficulties with ECO perceived it as taking up a disproportionate amount of resources for what was often a limited contribution to overall funding; it should also be noted that projects perceived that the forthcoming transition to ECO4 would do little to ameliorate these issues. However, it is also clear that some projects – usually through partnerships with energy suppliers and/or contractors that were experienced with new and forthcoming ECO regulations – were able to use ECO successfully and straightforwardly. In future, projects looking to deliver ECO should replicate these arrangements to the greatest degree possible.

Beyond FPNES and ECO, projects made use of a wide range of other funding sources, which are summarised in Table 2.2.

Funding source	Description	Uses
Better Care Fund	NHS fund supporting local systems to integrate health and social care, to deliver better outcomes for people and carers	- Match funding to set up a single-point-of-contact health and housing service - Topping up installation funds to prevent cold-related non-elective hospital admissions
CCG funding	Direct funding from public health bodies to support health and housing priorities	- Topping up installation funds where a household occupant has a cold-related health condition, but where WHF and ECO funding did not meet the full cost of necessary measures
City Deals	Strategic national investment in city regions across GB to generate regional economic growth and specialisms	- Funding the installation of battery storage and solar PV technologies on a small proportion of homes receiving WHF-funded ASHPs
Disabled Facilities Grants (DFG)	National government funding for home adaptations and facilities for disabled people	- Providing home adaptations in addition to heating systems funded by the WHF
Energy Redress Fund	A GB-wide fund distributing penalty payments from companies in breach of Ofgem rules, usually energy advice programmes	- Extending the length and scope of Category 3 projects by match-funding energy advice and support programmes
Gas Safety Trust	A charity providing grant funding, advice and support to organisations focusing on different elements of gas safety in the home	- Funding free boiler servicing as part of the Category 3 offer to beneficiary households
Green Homes Grant Local Authority Delivery (GHG LAD)	A national government scheme funding energy efficiency upgrades	-Funding solar PV measures in beneficiary homes receiving heating system installations through the WHF
Home Energy Efficiency Programmes for Scotland: Area Based Schemes (HEEPS ABS)	A devolved energy efficiency scheme developed and administered by the Scottish Government	- Funding energy efficiency measures in beneficiary homes, especially in remote rural areas where ECO is insufficient to fund necessary works (e.g. solid wall insulation)
Internal home improvement capital budgets	Internal capital spend allocated by Local Authorities and RSLs to improve social housing stock	- Match-funding WHF projects in their entirety - Funding smaller measures identified as necessary to improve homes' safety and energy efficiency (e.g. shower upgrades)
Nest	A devolved energy efficiency scheme developed and administered by the Welsh Government	- Funding energy efficiency measures in beneficiary homes
Domestic Renewable Heat Incentive (DRHI)	A national government scheme incentivising renewable heating by providing quarterly payments over seven years to eligible households	- Building successful business cases for the installation of ASHPs in social housing - Assigning DRHI rights to third-party contractors to improve the financial viability of project delivery
Warm and Healthy Homes Fund	A fund administered by National Energy Action to provide small grants to eligible organisations to support fuel-poor households	- Funding boiler replacements as part of the Category 3 offer to beneficiary households
Warm Home Discount Industry Initiatives (WHD II)	An obligation placed on energy suppliers to deliver specific activities to help fuel-poor homes, often but not exclusively energy advice and support	- Enabling the delivery of energy advice and support to beneficiary households, in parallel to the installation of first-time central heating systems

Table 2.2: Sources of match and gap funding for WHF projects.

As Table 2.2 shows, a wide range of match and gap funding sources were utilised by projects.

Furthermore, the uses of match and gap funding were not always consistent across projects; some projects used funding from the same source for different purposes, and some projects used funding from different sources to provide similar services. The approaches can be split into four primary funding types:

- **Ensuring basic project viability and business case.** Similarly to ECO, alternative funding sources were drawn upon to build successful business cases for implementing WHF projects. Typically, funding of this kind was drawn from internal capital budgets

allocated by local authorities and RSLs for energy efficiency upgrades, but it also included the Domestic Renewable Heat Incentive for Category 2 projects, which was often described as critical to making workable business cases for heat pump installations.

- **Enabling WHF funding to go further.** Several projects were able to bring in additional sources of funding, such as Better Care Fund contributions, which could be used in specific circumstances to offset or reduce the WHF contribution required for certain interventions. This enabled projects to calculate and put forward larger target numbers of installations for their WHF projects, thus extending the reach of WHF funding. This was relevant for all projects, including Category 3 projects, one of which secured Energy Redress Funding to match-fund and maximise the number of households that it could advise.

- **Enhancing the customer offer.** Projects were able to use different sources of funding to install additional measures in Category 1 and Category 2 homes beyond the 'basics' of insulation and a heating system; these sometimes included solar PV, battery storage, or additional insulation over and above that which could be funded by ECO or internal capital spend. Similarly, Category 3 projects were able to draw funding from elsewhere to offer heating upgrades and insulation to beneficiary households, as well as smaller interventions such as boiler services and draughtproofing.

- **Enabling works and engagement.** Finally, projects were able to source funding for what are sometimes called 'enabling' or 'ancillary' works. These can include loft clearances to enable loft insulation upgrades, rewiring electrics to enable the safe installation of an ASHP, or the costs of hotel stays during disruptive home upgrades (e.g. solid wall insulation and ASHP). Projects were also able to source funding for wraparound care and advice, especially for vulnerable households that needed additional support and instruction with a new heating system.

Importantly, and similarly to FPNES and ECO, the role of project partnerships in identifying and accessing funding sources was critical. For example, in Table 2.2, the involvement of suppliers in project management and delivery meant that those projects were able to access Warm Home Discount Industry Initiatives (WHD-II), given that energy, and health and social care partners were sometimes pivotal in securing access to match and gap funding from the Better Care Fund or local CCGs.

There were three key themes on the general ease with which WHF funding could be blended with parallel funding streams:

Firstly, WHF funding unlocked investment that would otherwise not have been accessible.

Although some interviewees noted that their projects would have continued without WHF funding, albeit at a smaller scale, the majority reflected that their projects (and the match funding they secured to do it) would not have been possible without the WHF:

"We wouldn't have done that programme at that time without the Warm Homes Fund funding. After the picture shifting, so now with more emphasis on decarbonisation, EPC band C, things like that. I couldn't really say for certain because we're not in that situation. But at that time this programme wouldn't have happened without the external funding." Category 1 project manager

"We wouldn't have been able to do very much self-financing, even though we are quite committed as an organisation to doing this." Category 2 project manager

Secondly, there were multiple benefits and added value of merging funding streams that offered heating upgrades, insulation, as well as energy advice and support.

Most prominently, projects observed how their Category 1 and/or 2 interventions were significantly strengthened by their ability to offer households Category 3-funded advice and support after their intervention. This was discussed in several ways. For some projects, Category 3 funding was essential for offering forms of guidance and support that some vulnerable households needed to receive heating installations:

"Even though our side, on Cat 1 and Cat 2, is about putting the measures in, we are putting the measures in, but we also have to do a lot of support, both before and after, especially when you're working with people who are vulnerable and unsure and may need other support. So, it's great to have other support just built in. You need that […] Without the additional support we're able to add, through Cat 3, [some households] just wouldn't have been able to have the install, they wouldn't be able to deal with it, either because of health issues or just worry over the upheaval." Category 1 and 2 project manager

"Quite a lot of the times, the people that we're dealing with are low-income, vulnerable, clients. They don't have, sometimes, the capacity to manage the work. We knew that we needed to provide that extra support if we were going to get this project, or most of our projects, done. So, from the start, Cat 3 was going to be integrated into both of them." Category 1 and Category 3 project manager

In addition to providing crucial advice and information to vulnerable residents about their new heating systems, partners highlighted how Category 3 funding had enabled advice-based support and measures that had benefitted their clients financially. For example, one partner discussed how, through Category 3, they had been able to provide advice on fuel debt reduction to households in arrears:

"I've got a figure here; around about £700 was the average debt that got written off. It was in thousands, I think, for some properties. Yes, a big difference to some of the guys. Especially when … If a debt is hanging over them, they always feel – You don't feel as if you can get out from underneath it. I think that's a major benefit for the tenants. They suddenly get a new gas central heating system that can heat the property, and they're not having to worry about their debts." Category 1 and Category 3 project manager

In all of these cases, Category 3 funding was presented as an essential aspect of providing a holistic service to households that focused on the installation of new heating systems and tackling other drivers of fuel poverty (e.g., low income, debt) simultaneously. Furthermore, other benefits of Category 3 funding were also highlighted by projects, such as encouraging changes in energy efficiency behaviours, or being able to offer households advice and support when they were ineligible for measures (e.g., through ECO, which sometimes meant installations were not financially viable and did not proceed). Indeed, it is noteworthy that some projects which were not in receipt of revenue funding for broader advice and support, either through Category 3 or alternative sources (e.g., the Energy Redress Fund), reflected that it detrimentally affected the services they were able to provide for households. As one project narrated, "we underestimated how much liaison it was going to be and how difficult it was going to be for our frontline staff really. […] when we were initially putting that together, we didn't make a connection between Category 3, linking it in with a project within Category 1 and Category 2 […] that was my error really. I think we missed a trick on that."

Thirdly and finally, blending funding streams and synchronising different funding cycles to ensure project sustainability was a perennial challenge.

The WHF was often seen positively in this respect by projects, having provided funding over several years, especially to Category 3 projects. In contrast, some schemes funded by the UK Government, such as the GHG LAD, were described as too *"short and sharp"*; as one project put it, *"[we've] been putting in bids in for LAD 1B, LAD 2, LAD3, and it's just ridiculous."* A second project interviewee from a housing association described being involved in planning asset management transitions over a 30-year period, and consequently, *"being told in December that there is a pot of money that you have to spend by April doesn't really help me."* Accordingly, and with specific reference to blending funding streams, WHF projects encountered challenges in sustaining their programmes where (for example) they were based on three core pots of funding with different timeframes and spend deadlines attached; especially when regulations or eligibility for one or more of these pots was changed (e.g., with ECO). When one core pot of funding ended and could not be replaced, the inevitable outcome was that projects simply ceased:

"[Our project] has come to an end, there's no money to do it, basically, because […] ECO alone isn't enough, you need something else. So, without something else to complement ECO, central heating funding won't work. It would stop." Category 1 and Category 3 project manager

Funding streams that offered long-term certainty to local authorities and RSLs, and their partners, were in other words seen as important for ensuring that fuel poverty programmes could continue.

2.4. Identifying and targeting beneficiary households

This section investigates what types of households the WHF projects targeted, and the methods employed to do so. It uses data from project surveys to understand who was targeted, and project interviews to pinpoint three primary pathways

to reach households. These three pathways were: 1) analysing available data to understand where households they were targeting were likely to be found, 2) using various forms of marketing and engagement to raise awareness of their scheme, and 3) developing relationships with partners and networks to drive referrals of households into their projects.

Figure 2.2 below shows that the most targeted group of households by projects were fuel-poor households in general, and households on low incomes and/or means-tested benefits. Projects also targeted homes with low energy efficiency standards.

It is not surprising to see that projects targeted households in these ways, especially as low incomes and low energy efficiency standards are primary drivers of fuel poverty. Beyond these key groups, projects were also targeting by tenure, and by specific vulnerabilities such as age, disability, ill-health, and households with children. Only four projects said they did not specifically target particular groups.

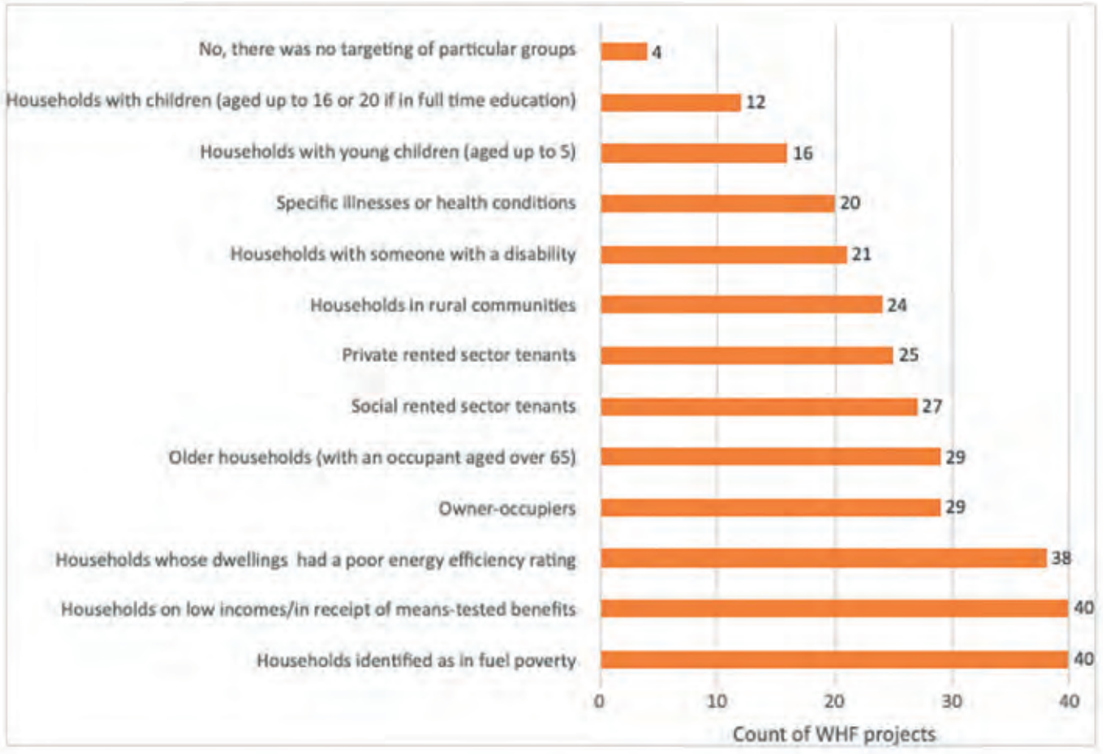

Figure 2.2: The main groups targeted by WHF projects, as reported in the project survey (n=54).

Three main ways of targeting and reaching households were identified:

Firstly, various different kinds of data were used to identify and understand the locations of potentially eligible households.

A starting point for many projects was publicly available statistics on fuel poverty and deprivation, published in different ways by the national and devolved governments of England, Scotland, and Wales. These statistics are published at Lower Super Output Area (LSOA) level (or equivalent in Scotland), which means they can help to pinpoint areas of high fuel poverty prevalence and multiple deprivation at a relatively granular geographical scale. However, no projects we interviewed described using fuel poverty or deprivation data in isolation. In contrast, projects analysed several datasets in tandem, to produce a layered picture of where within their geographical remit eligible households might be found:

"So, initially, when we got the funding, we started using the Index of Multiple Deprivation, the bottom 25%, and then basically using – Welsh Government have a postcode database linked to it. So, we used the postcodes and did EPC searches on properties. So, I think we went through in all, over a period of time, about 7,000 EPCs, identified a number of properties using solid fuel or electric or no heating at all." Category 1 and Category 2 project manager

"Yes, so we've got some data from EPCs and from some work we've done. We have got an energy strategy. We know the areas where there is gas and where we've got households that are more likely to not be connected. So we know, roughly, and those areas where household eligibility is more likely as well. We've got the LSOAs, with a higher percentage of fuel poverty, and the household income data as well." Category 1 project manager

As these quotations demonstrate, a common second step for projects was to identify areas of high fuel poverty prevalence and/or multiple deprivation, and then examine the EPC certificates of properties in those areas. This was considered a useful way of identifying homes with low energy efficiency ratings in places where household occupants were more likely to have a low income.

Several projects undertook additional processes of data matching and triangulation to try to narrow down their primary areas of focus. Most notably, private data held internally by local authorities, housing associations, and other delivery partners enabled projects to focus on households and areas where ineligibility was less likely. For example, projects working in partnership with GDNs used off-gas maps to identify households in semi-rural areas that would not be ineligible for Category 2 installations due to their close proximity to the gas network, while others collaborated with private sector housing teams in local authorities to obtain lists of privately rented properties, which were then crosschecked with *"the EPC register [and] our selective licensing data, identifying [EPC] F and G [rated] electrically heated properties."*

Some projects also had lists of 'spillover' households from previous fuel poverty projects that they knew were likely to be eligible for the WHF. For instance, one project said they had *"80 to 100 names"* on a list that had applied for funding through a previous DECC fuel poverty scheme, but were not able to receive installs through that scheme due to funding constraints. Finally, a small number of projects had tried to partner with charities to obtain lists of households most likely to be at risk from living in a cold home, or with the most to gain from the installation of a first-time central heating system. In one notable interview, a project narrated working with the National Concessionary Fuel Scheme (NCFO) to identify households in areas of high multiple deprivation with solid fuel heating: *"I had to do a data sharing exercise with the NCFO and one of the government bodies [...] the NCFO [then gave] me all the postcodes of everybody that gets the free coal, it's in the right IMD areas; and then we wrote to them, and that's been a good source of referrals, which was a little bit unique."*

Housing associations and other RSLs operated slightly differently to projects led by local authorities focusing primarily on owner-occupiers. This was because they maintain databases containing granular information about the heating type, energy efficiency, and history of their properties. This enabled housing associations and RSLs to generate lists of properties that were likely to be eligible for the WHF by filtering and querying their internal asset management databases. As one project summarised:

"We have an asset management database. So, in terms of our housing stock, we've got about 38,000 properties. But for each property, we have a database which has all the different components

within that property. And, obviously, the heating system is one of those. So every property is identified in terms of whether it's got gas heating or electric heating or whatever it may have. Each component has a recognised lifecycle. We know when the component was installed and when it's next due to be renewed. So, using our database, we've been able to identify properties where we have electric storage heating, which is what we focused on for this project, and narrow that list down." Category 1 project manager

Different housing associations and RSLs had different ways of prioritising properties they identified through their asset management databases. As noted above, some would focus on areas of high fuel poverty prevalence or multiple deprivation, while others concentrated on heating type, looking at solid fuel heated and storage heated properties.

It is noteworthy that, for the majority of housing associations and RSLs interviewed by the evaluation team, tenant vulnerabilities were often secondary to the characteristics of the property during processes of identification and prioritisation. In other words, potentially eligible properties were typically selected with little to no investigation of the characteristics or vulnerabilities of tenants themselves. One project made this explicit, noting that *"we always took an asset-based approach, rather than taking a customer-based approach, just to make sure it's fair."* In one sense, taking this approach was underpinned by the assumption that social housing properties with poor energy efficiency ratings and no central heating systems were a close proxy for fuel poverty; one project, again, made this explicit when they suggested that *"we just went more off the property type really and what the heating system was in that property […] because obviously we're a social landlord, I think we knew a high likelihood that they'd be in fuel poverty because they're usually on low incomes."*

A final noteworthy finding was the extent to which projects supplemented and qualified their processes of data analysis with other forms of knowledge. In some cases, projects were wary of the "blunt" nature of fuel poverty, multiple deprivation, and other area-based statistics, and attempted to supplement these statistics with experiential, qualitative forms of knowledge. These forms of knowledge were described as emanating from actors that were active in communities, especially long-standing council employees and installers. One project, for example, discussed how their analysis of multiple deprivation data did not reveal the reality of small pockets of deprivation that were present in some rural areas:

"It's interesting in our area because we've got [this rural area] for example, that [doesn't] have any areas in the bottom 25% nationally for IMD, for example. That's where the local knowledge from the council really helps, because although there might not be an LSOA area that qualifies as being in the bottom 25%, there will be pockets of deprivation more locally than that in amongst [this area]: farmhouses where there is rural poverty and Park Homes as well, and things like that." Category 1, 2 and 3 project manager

A second project argued that local installer knowledge was critical to understanding the practicality and feasibility of delivering projects, because they understood the challenges of different kinds of housing stock in areas of multiple deprivation:

"A lot of people get it, to my mind, backwards; they pick an area and then hope that an installer can make it work, and then find out it's not working, that it costs a fortune and stuff. We've always had successful schemes that have been quite efficient, but, you know, we have worked very close with installers. It's their business to know. They've got to find the work. They've got waiting lists in various areas. They've done work in parts of the district, and they know where, you know, there are suitable house types for certain types of installation." Category 1 project manager

Overall, projects typically perceived that data analysis was a useful starting point for identifying eligible households, but that it was insufficient on its own. Once lists of households or different geographical areas were identified, most projects moved to the next stage: marketing and engagement.

Secondly, three main forms of marketing and engagement were used: universal, indirect, and direct targeting.

Universal approaches can be defined as forms of marketing whose goal was to reach as many people as possible in a particular geographic boundary; these encompassed advertising the scheme in local radio and print media, as well as on local authority websites and social media platforms. Housing associations and RSLs also made use of universal methods, such as including details of their schemes in tenant newsletters, or posting information on their websites and tenant portals. Indirectly targeted methods were those aimed at specific locations or spaces that projects considered it likely eligible households would visit. These included libraries, bus stops, community centres, schools, foodbanks, GP surgeries, and leisure centres, within which projects would place leaflets or posters advertising the scheme, or deliver short engagement sessions to specific groups (e.g. to new parent support groups in community centres). This was viewed as a resource-efficient way of reaching eligible households in large numbers without spending large sums of money on borough-wide campaigns. Finally, direct marketing and engagement involved activities that were targeted at specific households who had been identified through processes of data analysis. These included methods such as enclosing scheme information with council tax letters sent to lower-band households, which were perceived as more likely to be living in fuel poverty; direct mailouts to households; and simple door knocking.

Thirdly, variegated referral networks and partnerships to drive scheme uptake.

In most cases, these processes of identification and referral were narrated as occupying a parallel track to processes of data analysis and direct marketing. Put differently, several projects described a twin-track approach to targeting eligible households: 1) using forms of data analysis to identify and then engage with potentially eligible households; and simultaneously 2) using the knowledge, networks and reach of partner organisations to generate referrals of eligible households. As noted in Section 2.2 above, there were several different kinds of organisation that were described as potential or actual referral partners, including charities, energy suppliers, health and social care services, emergency services, installers, internal departments within local authorities, and energy networks.

Referral networks between these organisations and WHF projects did not follow a simple formula – some organisations were formal partners on WHF projects with a defined role to generate referrals, especially for Category 3 projects, while others were part of informal referral networks in particular places that had existed for years prior to a WHF project beginning. At its broadest, the perceived value of referral networks with these organisations was premised on the notion that they frequently come into contact with the most vulnerable people in society; they are thus well placed to refer households that might be in the deepest fuel poverty, and have the most to gain from WHF support.

Projects reflected on the various successes and challenges of these different targeting methods. Figure 2.3 shows that the majority of projects perceived that their methods and approaches to identifying suitable households worked either extremely well or very well, with no projects responding that their methods did not work well at all.

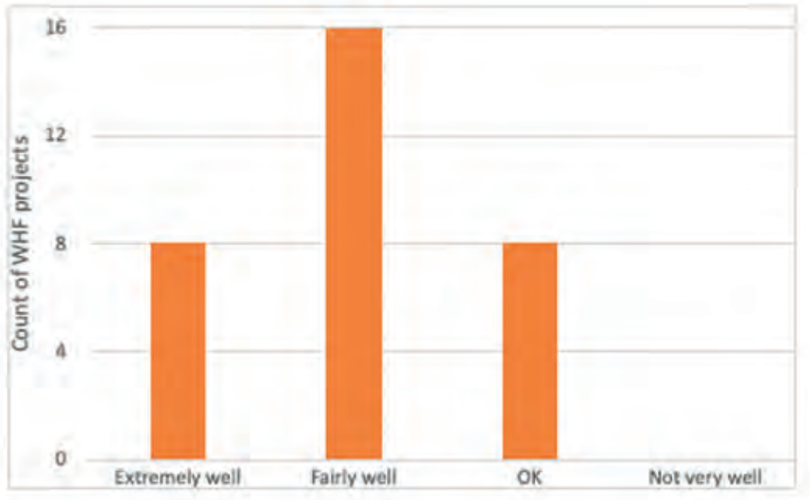

Figure 2.3: Projects' views on how well their methods of targeting and identifying suitable households worked (n=54).

While the majority of projects used all three methods – data analysis, marketing and engagement, and referral networks – to identify, target and process eligible households, their relative strengths and weaknesses were appraised in different ways.

A notable finding is that referral networks based on relationships with partner organisations were often described as the most effective way of reaching the most-in-need households. As two projects put it,

"I would say in terms of external partners that the relationships are really beneficial because actually probably most of our successful referrals probably come through those external – well a bit of both, some come through Council referrals. So, if there are vulnerable customers who they are already working with, we get referrals that way and the others mainly come from external partners. Even when we've done, kind of, some direct marketing, the majority of referrals, the successful ones, still come from those partners." Category 1 project manager

"But yes, quite a lot of the referrals that we get are from frontline staff, so from GPs, health visitors, district nurses, but also other partners, and we get referrals of those people who are vulnerable, those people who are struggling; they're on low income, they're living in cold and damp properties." Category 1, 2 and 3 project manager

Simultaneously, referral networks were also described as challenging to construct and maintain. As noted in Section 2.2, the most successful referral networks had been built up over time by WHF projects. Working with referral partners over several years had germinated and enabled strong networks defined by trust, shared determination, and interpersonal relationships between different actors, but other projects without these historical ties had to commit considerable time and resources to developing referral partnerships. An important question for future energy efficiency schemes is therefore how to balance the need for swift, reliable delivery through established referral networks, with the need to support some places to develop and sustain these networks over time.

A common challenge was the mismatch between data analysis and the situations they encountered 'on the ground'.

As one project summarised following a discussion of different forms of off-gas and multiple deprivation mapping exercises, *"you realise that the data is a bit out of date compared to what's going on, on the ground."* To address this issue, projects were often insistent that data analysis must be paired with different forms of experiential and qualitative knowledge, including engagement with local actors such as council officers, charities, community groups, and installers, as described above. One project, for example, said that *"I'm not keen on using [data analysis] as the sole way to target areas, I think for me we do use a lot of local knowledge to target areas"*; and a second agreed that fuel poverty projects should not *"rely on data because there's nothing like actually seeing what's going on in someone's home."* A key learning to take forward, especially for local authorities targeting owner-occupiers and the private rented sector, is therefore that iterative processes of appraising data alongside local knowledges is important, to ensure that fuel poverty programmes are effectively and efficiently targeted at eligible households.

Projects also experienced difficulties in generating and securing interest from rural areas. As one project narrated at length:

"It's strange because we know we've got rural deprivation and we know we've got houses out there which will need central heating. We've done everything. We've done press releases, newsletters, engaged with GP surgeries, tweeted websites. Over the last couple of years we've been doing a big campaign with bus and train stations. We've done these posters and had them put up on the bottoms of the timetables at about 80 different bus and train station billboard-type things across the whole of the county. We figured that people in rural areas will probably be using – well, the fuel-poor people will probably be more likely to be using the buses into the bus stations and the trains and what have you. We've had that going for two consecutive winters now. We've been sending out letters, leaflet dropping. We've sent leaflets out through a lot of primary schools to lots of areas and we've sent leaflets to all the libraries. We've just done so much promotion, but we just don't really know why the rural contingent haven't put their hands up for it so much." Category 1, 2 and 3 project manager

For another project that had also experienced challenges in rural areas, these were attributed to a number of perceived characteristics of rural areas, such as digital exclusion, an ageing population, and social isolation.

Experiences of engaging with the health and social care sector were mixed.

Several projects had engaged at different levels with the health and social care sector, especially with hospitals, social services, flu jab clinics, mental health services, occupational therapists, and adult social care actors. However, establishing meaningful relationships with, and generating referrals from, these actors was invariably described as challenging. Projects gave a number of explanations, such as the turnover of frontline staff in the NHS; the large numbers of people who work in health and social care settings; limited resources, and health and social care workload issues; data sharing and GDPR concerns; and finally, the large list of pre-existing priorities that different health and social care professionals have. As a consequence, several projects reflected in interviews that *"we haven't had many referrals through from the GPs"* or that *"health referrals have always been low."*

Even projects that had established good working relationships with senior managers at NHS Trusts and local CCGs explained that they had found it difficult to translate these relationships into referrals, with one noting that *"for a few years now, we've had agreement at CCG level to promote schemes through a GP, but when it gets actually down to practice level, at the moment, they won't do it"*; and a second agreeing that strategic agreement *"isn't always translated [...] down to frontline staff, who are busy delivering services."* The challenge, as summarised by one project interviewee, *"is how do I get a health professional to care about what is fuel poverty for them, and why should they care? What are the benefits of having a healthier, warmer patient for them?"*

Some projects did share examples of successful working relationships with health and social care services, which had been constructed with painstaking care over several years. For two projects, the key was to focus on pulling levers at strategic and operational levels of the health and social care sector to drive awareness and cultural change from the top-down and bottom-up. For one project, this involved frequent engagement with NHS Trusts and CCGs, as well as delivering training to frontline NHS staff and related professionals. The second project emphasised the importance of embedding energy advisors in hospitals to pick up referrals in situ:

"One of our caseworkers rotates between the hospitals, and this was a new way of working when we got the Warm Homes Fund [...] and then the pandemic hit and then she couldn't be in the hospitals anymore. But what was good was that she'd established those relationships before the pandemic, and she had the NHS email address. So, they were still emailing patient details to her to make contact with, even though she wasn't based in the hospitals." Category 3 project manager

This quotation hints at the development of strong referral networks with health and social care actors who were in receipt of Category 3 funding and used part of their funding with the specific objective of establishing closer relationships with the sector. For those projects without significant revenue funding, the time and resources necessary to conduct this work were unfeasible. We can conclude that to generate positive referral relationships between fuel poverty programmes and the health and social care sector, specific funding and resources are likely to be necessary, and this should be considered by future energy efficiency schemes.

2.5. Eligibility criteria

At its simplest, the WHF eligibility criteria were fourfold:

- **Affordable Warmth Benefits,** whereby one or more household occupant is in receipt of a means-tested benefit.
- **ECO Flex,** whereby the household qualifies for assistance through meeting its local authority's flexible ECO eligibility criteria.
- **Fuel Poverty,** whereby the household has had a fuel poverty assessment carried out and was deemed to be fuel poor.
- **IMD,** whereby the household lives in a LSOA which is in the top 25% of most deprived areas in the country.

The WHF criteria were designed primarily to mirror criteria used in other government fuel poverty schemes, primarily FPNES and ECO.

This was deemed essential for the WHF to work successfully – primarily to align the installation of first-time gas central heating systems with the required gas connection, provided at no cost to the household through FPNES; and because all those receiving a heating system installation should be

provided with suitable insulation, which in GB is typically (but not always) funded through ECO. Importantly, ECO can also provide match funding for first-time central heating systems. Accordingly, synchronising the eligibility criteria in this way was intended to unlock and maximise the value that other fuel poverty schemes could add, as well as enabling projects to access funding for all the measures required to lift a household out of fuel poverty. These criteria were also adopted for Category 3 projects, with the intention that households receiving advice and support could also be provided with measures funded through ECO and FPNES (e.g. loft insulation) as part of a single streamlined customer journey.

The introduction of Park Homes to the WHF operated slightly differently. As revealed in interviews with Park Homes projects, they predominantly used adjusted ECO Flex declarations to stipulate that Park Homes were eligible regardless of occupant or dwelling characteristics. This ensured that heating systems could be offered to all Park Homes beneficiaries on a given site without eligibility being determined and conferred on each individual household. Put differently, Park Homes eligibility operated with an area-based focus, similarly to how some Category 1 and Category 2 projects used ECO Flex or IMD to conduct area-based projects on certain housing estates or tenements.

This section discusses projects' experiences and reflections regarding the eligibility criteria used by the WHF. It begins by presenting projects' overall assessment of these criteria. It subsequently examines the projects' observations and perceptions of the suitability of each criteria type for targeting fuel-poor homes, and the ease (or difficulty) with which they were operationalised and used in practice. The section then discusses challenges related to wider criteria (especially ECO and FPNES). Note that this section does not link eligibility criteria to energy modelling data or outcomes for households; this analysis is presented in Section 3. Instead, this section is a narrative of projects' experiences of the eligibility criteria.

Overall, a majority of projects considered the WHF eligibility criteria to be effective.

Of 32 projects that answered the question,

- 14 said project eligibility criteria worked or were working extremely well;
- 15 said they worked or were working fairly well;
- Three said they worked or were working OK.

Positive comments on the overall structure and operation of the fourfold eligibility criteria included that *"it was so much easier […] they had a much wider eligibility criteria than the match funding did"*, and that *"I wouldn't say I could fault it. It's directing the funding at the point of most need."* Some projects also contrasted the WHF eligibility criteria favourably with other schemes they had worked on, particularly in terms of its simplicity and how it linked with other national schemes.

Affordable Warmth Benefits was a successful eligibility criterion for targeting households technically defined as fuel poor (see Section 4.1.4). Projects operationalised this in two main ways:

Firstly, they used initial household contact points to enquire whether an occupant was in receipt of means-tested benefits, before gathering evidence (e.g. a DWP letter, bank statement) to verify this. Secondly, and more rarely, projects utilised data matching with government or regulator records to establish that a particular address was in receipt of means-tested benefits. However, as one project that used this method reported,

"In order to qualify them under that route, we do a data match with Ofgem. Our biggest problem is that is that the addresses often do not match up because we have got 242 High Road, Flat A, B, C, D, E, F, G, and somehow the database lists them differently. We have had a lot of problems matching people up to the database. We take evidence of their benefits, so we get around it that way." Category 1 and Category 3 project manager

The Affordable Warmth Benefits criterion was designed to mirror the benefits eligibility in ECO, to simplify the process by which households could receive support from both the WHF and ECO. Project interviewees who commented on this generally found the process simple and beneficial, with one noting that *"we can do first-time central heating if the customer is on ECO3 benefits, and that is consistent across all of ECO3."* In this way, projects used Affordable Warmth Benefits and ECO Flex interchangeably, and often did not see a practical difference between the two; one project said, for instance, that their primary means of approving eligibility was by checking benefits, but that these households would then be formally brought through on their ECO Flex pathway. Another interviewee agreed, stating that "I think ECO Flex tends to work quite well and the benefits element works quite well, because then it mirrors the work with ECO as well." However, some projects perceived that Affordable Warmth Benefits did allow some higher-income households into the scheme, who, in their view, were not fuel poor:

"What does really annoy me is that people can qualify because they've got an appropriate Affordable Warmth Benefit, but actually when you add their income up they've shedloads. I've had a couple recently, and because they get Industrial Injuries benefit they qualify [… but] when you add the whole household income in – I had one recently who had £37,000 going into that property, but they've got an Affordable Warmth Benefit so they qualify, they're not exactly vulnerable with that amount going into the property." Category 1 project manager

"I think it's a difficult one is that one, because … some of the assessments that you're using, you're not necessarily … some of the benefits are not necessarily fuel-poor homes. So, yes, I would say there would be benefit tweaks to be made on some of the qualifying benefits." Category 1 project manager

As suggested in these quotations, respondents believed that an income cap or a tightening of the benefits defined as Affordable Warmth Benefits would help to ensure the criteria better targeted fuel-poor households. However, when reflecting on this comment, it might be prudent to consider the circumstances within a home which might mean its energy vulnerability is increased, while not technically meeting the definition of fuel poverty. For example, if a household member has a health condition or their mobility is affected, their required energy use might be higher than would otherwise be the case.

ECO Flex criteria were linked closely to Affordable Warmth Benefits, but used in a more varied way by projects, the majority of whom were complimentary about its utility and focus.

Perhaps unsurprisingly, ECO Flex's flexibility was often highlighted as its main strength, particularly as ECO Flex statements could be adapted to meet the aims and objectives of a project while still conferring eligibility for ECO itself. Specifically, some projects had tweaked their ECO Flex statements to bring them in line with the WHF, with one Category 1 project, for example, saying that *"we covered the gaps [in eligibility] by writing it into our Statement of Intent so that they qualified for ECO Flex by virtue of not having a mains gas connection."*

Similarly, other projects had deliberately included area-based criteria in their ECO Flex statements to target specific wards or areas of high multiple deprivation, or to ensure that blocks of flats where half of households were eligible through an alternative pathway could all receive an installation, thus improving the economy of scale and making the works viable. Projects also commented that ECO Flex was an effective way of targeting and conferring eligibility on households that were fuel poor but not in receipt of means-tested benefits. One project that had used a combination of Affordable Warmth Benefits and ECO Flex said, *"if it was just benefits, it would miss such a huge number of people who are on a low income, in fuel poverty, vulnerable, are suffering, but not quite hitting the threshold to claim the benefits."* Interestingly, there were far fewer projects who discussed their ECO Flex statements in relation to targeting the most severely fuel-poor homes, or those most at risk through living in a cold home. Although some projects did discuss their ECO Flex statements in terms of targeting the most vulnerable (e.g. cold-related illness, children under five, older persons), discussions of its usability and practicality were more common.

There were few observations by projects regarding the weaknesses or limitations of ECO Flex, but some projects had faced challenges in administering it as an eligibility pathway. For example, projects that involved consortia of multiple local authorities experienced challenges stemming from inconsistent interpretations of ECO Flex statements. As one project manager delivering a complex, multi-local authority project observed, *"all the local authorities that have got in on the project agreed on a statement of intent (SOI) initially and said, 'These are the thresholds. This is what we think …' Which is a great idea, but […] it is about how each of those districts interpreted those SOIs when it came to the crunch."* The interviewee continued that in future, they would *"be having a wider conversation at the same time, where possible, with all of the councils, saying, 'We need one flex or one statement of intent that covers gas connections for community schemes, flexible customer eligibility …'"*

The fuel poverty pathway was relatively successful at targeting and conferring eligibility on fuel-poor households, as modelled by the evaluation (see Section 4.1.4). However, projects tended to focus on its practical challenges.

Projects using this pathway typically performed multiple kinds of calculations to determine if a household was fuel poor, as defined by the official definition in England. These ranged from 'back of the envelope' calculations of Low Income High Costs (LIHC) status, to the use of online fuel poverty calculators and external fuel poverty modelling consultants. However, the overriding experience of projects using this pathway was that conferring eligibility was complex and difficult. The most cited reason was that obtaining all the household information necessary to conduct an accurate fuel poverty assessment was challenging, especially when it had to be acquired from a vulnerable person:

"I've got to do a fuel poverty calculation [...] that's quite complex because it asks for things like current expenditure, month expenditure on energy and different outgoings. And there is a lot of information to obtain from a customer, which is not necessarily available." Category 1 project manager

"The fuel poverty assessment was probably a bit trickier, it's just more time-intensive and also requires, from a GDPR point of view, obviously requires tenant consent. So that's tricky then if we can't get consent. So that potentially means that you've got some properties that aren't eligible, which is quite frustrating." Category 1 project manager

In interviews with projects, a further challenge relating to the definition of fuel poverty was also discussed. Projects working in England described the transition from LIHC to Low Income Low Energy Efficiency (LILEE) fuel poverty definitions as disruptive to their eligibility-conferring process, while projects in Wales and Scotland discussed challenges in working with their specific national definitions of fuel poverty. Wales and Scotland both use variants of the classic '10%' definition of fuel poverty, whereby at its simplest, a household is deemed to be fuel poor if it is required to spend over 10% of its income on energy costs. Projects in Wales and Scotland also experienced difficulties operationalising this definition and making it work practically on the ground, with one project, for example, noting wryly that elderly or vulnerable households might need to be turned away with a message of *"sorry, you're not fuel poor because you're only spending 9.8% of an income on energy bills."*

Finally, the IMD criteria polarised WHF projects.

Projects were generally acutely aware that households living in the top 25% of deprived LSOAs were not necessarily fuel poor, and some refused outright to consider it as an eligibility criterion for this reason, even if they could not bring a household through their project in any other way. Instead, several projects used IMD as an entry point for targeting fuel-poor households, as discussed in the context of area-based targeting in Section 2.3.5. These projects would use the IMD eligibility, but only after they had satisfied themselves through other checks or processes that the household was likely to be fuel poor and/or vulnerable. For example, one project in Scotland targeted highly deprived areas, but did not select households for inclusion in the project if they met Scotland's Energy Efficiency Standards for Social Housing (EESHH); and a second project, utilising IMD for an area-based project, monitored household incomes through the engagement process to ensure that *"the large proportion of them fall into the government's current eligibility of below £30,000 joint household, which we'd always expected because we know it's a low-income area."* These processes and checks reassured projects that higher-income households would not be conferred eligibility through the IMD.

However, other projects made different arguments in favour of using IMD as eligibility criteria. Aside from it being simple to manage and implement, some projects were insistent that IMD was essential for setting up area-based schemes where there were known to be high levels of deprivation and vulnerability, such as in old council estates or tenement blocks:

"I think they're very good criteria because they give you a number of options, that make it easier to set up a geographical-based scheme. And sometimes, you just need to target the area to get an effect. I mean, you can go down the route of trying to target things as closely as possible, but then, you lose the ability to really do a whole area, and do the work efficiently, if you see what I mean, in some cases." Category 1 and 2 project manager

In a second example, one project made an argument for seeing area-based schemes and eligibility criteria as connected to broader social objectives related to regeneration, community enhancement, and quality of life. To quote at length:

"We're talking about estates like [Estate X]. People live in [Estate X] because they've got connections to the area, or they can't afford to live anywhere else. So, either they've got their family there to look after the kids while they go out and work part-time or on a low wage, or that's the only place they can afford to live [...] you're going to have a few people striving or looking to improve themselves and looking to move out, but still living on relatively low wages. Or you're going to have people genuinely on low wages and, you know, who are the most vulnerable. And both of those people, you know, should be addressed by schemes like this, and the idea that the odd person who is on £30,000 gets to get the scheme as well, I think is irrelevant, for all the savings it does them, all the good you can do by just doing a complete area-based, you know, free scheme or whatever." Category 1 project manager

In other words, in this line of reasoning, area-based schemes, facilitated by IMD, create social value (e.g. local regeneration, localised economic benefits, and improved health and wellbeing at a population level) for localities over and above individual household-level impacts – the benefits of which exceed the cost of conferring eligibility on a small proportion of higher-income households. As this interviewee also noted, different approaches could be taken if higher-income households were identified in a similar scheme, such as offering a proportion of funds towards capital measures instead of the full grant.

2.6. Challenges of delivering the WHF

This section examines some of the challenges encountered by WHF projects during the delivery of their work, including some of the ways that they mitigated and attempted to overcome them. It focuses in detail on eight challenges identified by projects.

Figure 2.4 below shows the main challenges that were encountered by WHF projects. Managing installation delays was the most frequently reported challenge, followed by issues with contractors and the supply chain; challenges relating to the Covid-19 pandemic; identifying suitable households; engaging with residents; project administration; and the range of measures permissible under the programme. Of these, the challenges of identifying suitable households have been covered in Section 2.3.5, and the range of measures permissible under the programme will be discussed in Section 2.3.10. The rest of this section focuses on the other challenges highlighted in Figure 2.4, as well as others discussed in project interviews.

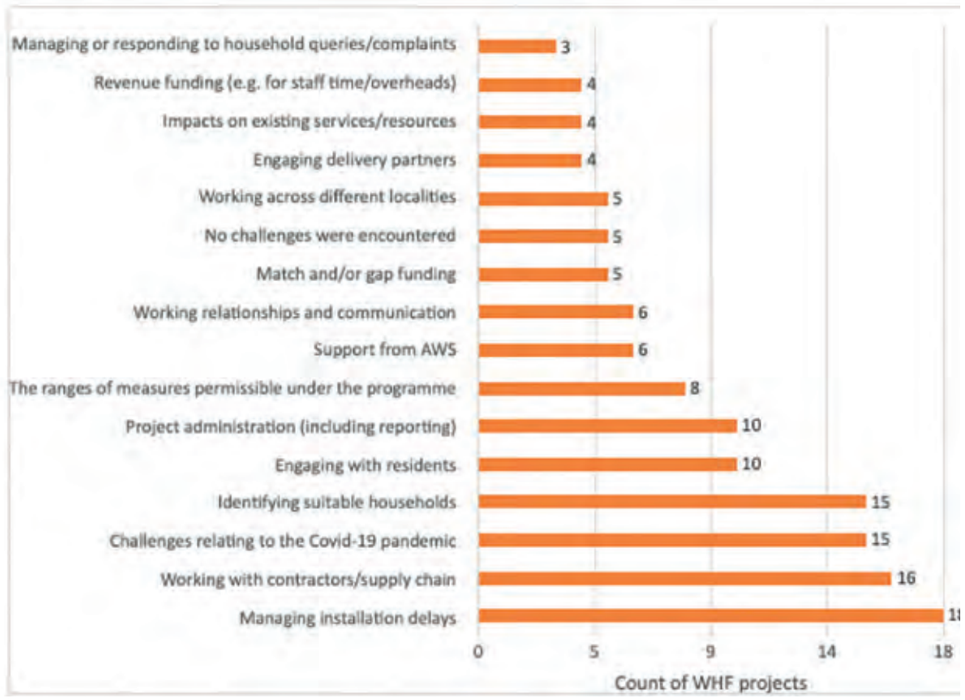

Figure 2.4: Main challenges experienced by WHF projects (n=54). Note: the question allowed multiple responses, so the total count is greater than 54.

Managing installation delays was the most frequently reported challenge.

In project interviews, it became clear that installation delays for Category 1, Category 2, and Park Homes projects had a range of causes. Some installation delays were closely connected to other challenges, such as Covid-19, contractors and the supply chain, or engaging with vulnerable households; this topic will be discussed below. However, two main reasons were given by projects for installation delays: gas connections, and metering appointments.

A key part of Category 1 and Park Homes projects was the connecting of new homes or sites to the existing gas network, a process necessarily mediated and arranged by the relevant GDN. Several projects experienced delays with this process, but in different ways. Some projects found the timelines for new gas connections disruptive to their overall projects, commenting that this placed pressure on their ability to deliver installations within agreed timeframes:

"And the one thing we're finding with the gas connections is, the delay now with the gas connections, that's adding to our timescale. So, you know, we get the people signed up, and initially it was about six weeks to put a gas connection in, it's gone to 12 to 14 weeks now, so that's thrown our programme out completely." Category 1 project manager

"There was quite a long waiting period, much more than expected. It wasn't really factored in. Some of the works, we waited, I think, six months from application to the gas connections going in, which was a long time and we hadn't anticipated it being so long, particularly when their website would say everything will be completed about – I think it was quoted at about 12 weeks at one stage, so I think it was a bit misleading." Category 1 project manager

Some projects had experienced delays with other parts of the gas connection process, such as the time it took to receive quotes for extensions, price negotiations, or contract sign-off. Projects emphasised that gas connection delays were not always a problem in and of themselves, but became an issue when they caused slippage to other parts of the project. As one interviewee described, *"we wanted to get the gas infrastructure in, and then you've got to get the metering in, and then you've got to get your heating installed. Getting all the dominoes lined up between, because it's different parties altogether […] wasn't as straightforward as we would have wanted."* Other projects suggested that gas connection delays sometimes affected the confidence of project partners, thus jeopardising working relationships and overall delivery. It should be noted that most projects attributed little to no fault to GDNs for these issues; they recognised that demand for gas connections and the prioritisation of emergency works often took precedence, with one project for example stating that *"they've got a limited capacity and I think they were inundated."*

Delays in metering appointments and installations were also commonly discussed in project interviews. One project, for example, described a *"backlog of installations where they had got a gas connection but were waiting on a gas meter, so we therefore couldn't progress to doing the installation"*; while a second noted that *"there was a big delay with metering installation as well […] over six months to put a meter in."* As with gas connections, metering delays typically pushed heating system installations back further, and resulted in delivery timelines becoming significantly backloaded, as the first quote above indicates. Reflecting on gas connection and metering delays, projects noted that one way of overcoming these delays was to work closely with GDNs and suppliers at the bid application and set-up phases of the project, to ensure trust, efficient channels of communication, and good working relationships were established for commencing delivery. One project, for example, reflected that "at the point of application we should have probably set out and done a procurement exercise to identify a preferred utility partner."

Engaging some vulnerable households was a common challenge identified by projects.

Projects discussed this in two main ways: the first related to households' characteristics that made engagement and recruitment challenging, and second concerned aspects of heating system control and management that some households found difficult to understand. Regarding the former, projects discussed various examples of how they attempted to engage with households characterised by specific vulnerabilities, such as acute mental ill-health, drug and alcohol use, or vulnerabilities such as visual impairment. To give two examples:

"There are a lot of elderly people and there is quite a few people with mental health issues who had reported to the council their landlord hadn't provided them good heating. Then when it came down to it, they wouldn't allow anybody in. We've engaged different people to help them but sometimes you just can't help them." Category 2 project manager

"The general needs was a different challenge, a different type of clientele. Engaging with those customers was much more difficult. And that's not because of the project, that's just because of the type of customers […] and it became difficult to engage with those types of customers […], despite you're trying to engage with them as much as you could – and we were still doing that right up to the end." Category 1 project manager

Other examples of challenges associated with vulnerable household engagement concerned issues with hoarding, which prevented access by surveyors and engineers, and refusal to book or honour appointments to conduct post-installation EPCs. Projects that reflected on these challenges, or had proactively taken steps to mitigate them prior to their project commencing, discussed the value of expert and trusted third-party agencies to mediate communication and engagement with households, such as Citizens Advice Bureaux. One said, for example, that *"we did partner with the CAB, the local CAB […] where they offered our customers on this estate, sort of priority assessment."* Housing associations also frequently noted the value of Tenant Liaison Officers [TLOs] to this engagement, with one commenting that *"we've got something in place which is the [TLO] will have a chat with the residents, and that's why the RLO always confirms with them the installation date and if they're happy with it before we give the okay to [the installer]."* In these examples, regardless of precisely who it was, the presence of a trusted partner or employee who could constructively and independently engage with households was important, especially if they were trained to recognise and understand vulnerability appropriately 'on the ground', and thus ensure that projects could adapt and respond to clients' needs.

Relatedly, projects discussed challenges in communicating and demonstrating to vulnerable households how to use their new heating systems effectively. This will be dealt with again in Sections 3.5 and 3.10, but it was recognised by some projects as a major challenge. One project, for instance, commented:

"Behaviour is a massive thing, how people – particularly when they've had an oil or gas boiler, and they're used to just whacking the heating up. People don't understand and you go in there because they're reporting high bills, and actually they've turned the thermostat up to 24 degrees […] we try our hardest to tell them they just need to leave it and not touch it. But there's just that human element, which unfortunately, we can't control." Category 2 project manager

This was referred to by another project as people's "creature habits", which were often difficult to change through advice, instruction and explanation. Other projects reflected that, as Section 3.10 will investigate, there needed to be *"much more interaction with the actual person in the house, the end user"* regarding heating practices, and *"more of an educational input […] educating the customers how to use"* their heating system. This challenge was more frequently encountered by Category 2 projects, who discussed the ways in which they attempted to communicate how an ASHP operated differently to an oil boiler, for example. As Section 3.10 will explore, the most successful examples of heating system advice and instruction were often when support was provided at each stage of the installation process (e.g. pre, post, and during installation) by trusted project officers and engineers at the same time – both of whom understood the 'stickiness' of heating practices.

Covid-19 was noted as a challenge by a majority of projects whose delivery coincided with the pandemic.

The pandemic caused disruption to many if not all aspects of projects' working practices, encompassing engagement with residents, staffing and resources, health and safety, the supply chain, and project management. Projects particularly explained that the ways in which they could engage with households were restricted by social distancing requirements and the need to protect both households and staff members from contracting the virus. Category 3 projects that were working in the community, such as delivering advice sessions in community centres or visiting clients in their homes, were often forced to move much of their project delivery to telephone advice, with one saying, for example, that *"we agreed to deliver a programme, and then just as it was all agreed and people were employed to go out and do face-to-face visits, then Covid hit […] Things that would have normally only been done face-to-face, we have developed methods of doing it over the phone."* Category 1, Category 2, and Park Homes projects were also unable to visit people in

their homes to carry out surveys or installations, at least at the beginning of the pandemic; and they found that even when working practices were amended to protect vulnerable householders and social distancing rules were relaxed, people were often unwilling to grant entry to their home. It was suggested by some projects that this was or would be a continuing problem, with one project interviewed in summer 2021 saying that *"even now I would say that there are people who may not be coming forwards, even because they don't have confidence in people going back into their own home."* It is feasible that some of those most resistant to face-to-face or in-home engagement may have included those who had been required to 'shield' for health reasons, and might thus be among the most vulnerable to the effects of cold homes (e.g. those with serious respiratory conditions).

Beyond household engagement, the Covid-19 pandemic caused multiple delays across relevant supply chains, as project partners (e.g. installers, energy advice agencies) experienced shortfalls in labour supply and materials. One project commented that *"there has been quite a material supply issue, so there have been periods of time where we haven't been able to access heat pumps for several weeks […] and then there has been a lot of issues with labour […] there aren't actually enough installers to go round at the best of times, and we're not in the best of times, because we've got people having to self-isolate all the time."* As discussed in a previous report by NEA[6], there was a period at the beginning of the pandemic where GDNs prioritised essential and emergency works only, exacerbating pre-existing delays to gas connection timeframes. Finally, projects described what could be termed internal challenges relating to the Covid-19 pandemic, such as producing and signing-off risk assessments prior to projects recommencing; senior members of project delivery staff being seconded to lead different aspects of Covid-19 response in local authorities; or communication being disrupted by the forced cessation of face-to-face project meetings. Interestingly, some projects perceived Covid-19 as an unstoppable force, while others narrated in detail attempts they had made to continue delivery in spite of it:

"My team worked around the clock, continuously, providing the high-risk vulnerable customers updates around gas connections, gas meters, putting in the assurance that the scheme is still going to go ahead, putting protocols into place so that we were able to overcome barriers that the government were putting into place." Category 1 and 2 project manager

"We have been able to make arrangements for [people] to go and stay with a family member for a few days, while we are doing the work. And to make sure that we do a deep clean after the work has finished. It is adding time to the, time and complication to the installation, but it is not actually stopping us from going ahead, and delivering what we said we were going to do." Category 1 project manager

Issues with the supply chain and contractors posed challenges for projects at different points.

These challenges were often linked to other challenges already discussed, such as the Covid-19 pandemic and its impacts on labour and material supply, or gas connection delays. However, the state of the supply chain in Great Britain was evident, especially for installation contractors and the availability of materials, such as heat pump units and meters. A perceived surge in demand for gas connections, noted by some projects as a likely reason for gas connection delays, was perceived as having a knock-on effect on heating system installation contractors. As one project described, *"myself and umpteen other people across the country all needed gas installed, which put a massive pressure on the delivery arm [of my contractor]."* Other projects experienced issues with contractors being unable to source material and labour in rural and remote areas, which often resulted in contractors from elsewhere in the country being appointed to fulfil contracts. This, however, brought challenges such as *"the difficulties of working in an area you didn't know, and also the difficulties of being able to secure local labour to carry out the specialist installs that we were doing."* More broadly, projects reflected on a *"shortage of skilled staff"* in the heating and installation industry, with one explicitly connecting this to gendered barriers to access, education and training, for women seeking to develop careers in the sector.

Reporting processes were a significant challenge for some projects.

Projects had mixed experiences with the WHF reporting processes. Some said of the reporting procedure that "it didn't take very long and it was quite simple to use." Others, however, had experienced challenges regarding the granularity of data that was required for reporting, the timing of reporting that placed pressure on resources at the end of each quarter, or perceived changes in reporting requirements across the lifespan of their project. For projects that discussed these challenges in detail, it became apparent that those who had subcontracted delivery to third parties, especially for Category 3 projects, experienced the most difficulty. This was because they were required to report at the end of each quarter, but there were sometimes delays in the transfer of information between the third party and the body responsible for reporting (i.e. the local authority or RSL). As one project put it, *"on the Category 3, I have struggled because we're working with a third party, and it depends how quick they can get them through to me."* Some projects had pre-empted this challenge by setting up bespoke database queries and secure data transfer processes, which automatically generated reporting data for a given timeframe in the format that was required.

In addition, some Category 3 projects reflected on a perceived gap between the outputs requested by WHF reporting processes and the outcomes they had achieved for beneficiaries. For example, one Category 3 project stated that:

"When we're reporting, they really want us to focus on the financial outcomes, it is very financial-outcome heavy. Whereas we've got all this other data that I really want to kind of give them and say, 'Look how many single parents there are, how many people with mental health problems there are, how many people with this, how many people have said that they feel less anxious after our support' – all that sort of thing that I'd love to report back to them, there's nowhere on their reporting form for us to do that." Category 3 project manager

Other projects similarly highlighted that they felt non-financial outcomes were underappreciated in WHF data returns, such as onward referrals to other fuel poverty schemes, or advice on switching supplier that was not immediately acted upon, and so could not be recorded as a verified financial saving. It was recognised by projects that quantifying non-financial outcomes was a considerable challenge, and potentially subject to abuse; one project noted the risks of *"creative accounting"* that might inflate the social return on investment generated through giving energy advice. Projects also acknowledged that the evaluation in which they were taking part was a rigorous way of determining the non-financial outcomes of fuel poverty programmes. Nonetheless, it was suggested that some form of outcome *"that includes engaged people rather than just monetary value would be beneficial,"* as one project summarised.

2.7. Household withdrawals

The delivery of programmes like the WHF inevitably entails the withdrawal of some households that had initially signed up with projects to receive measures. In the household fieldwork for this evaluation, no research was conducted with households that eventually withdrew from the delivery process. To help understand the prevalence and reasons for household withdrawal, a significant part of the research with projects was intended to explore their experiences and perceptions of household withdrawals, as well as any steps they took to mitigate and reverse them.

A significant number of projects experienced withdrawals at multiple stages of the customer journey.

As shown in Figure 2.5 below, the most common time for withdrawals to take place was at the assessment for measures or advice stage, following by the application stage. A slightly smaller number of withdrawals took place just prior to delivery of advice or installation.

6. NEA (2020) Fuel Poverty Monitor 2019-20.

Figure 2.5: Withdrawals experienced by WHF projects, disaggregated into when withdrawals were experienced, as reported in project surveys (n=54). Note: multiple responses were allowed, so the total count is greater than 54.

Table 2.3 below summarises the main reasons given by projects as to why households had withdrawn from the delivery process. It shows that projects had experienced a wide range of reasons given by households for withdrawal.

Reason for withdrawal	Explanation
Aversion to gas	Households withdrawing from Category 1 projects because of an aversion to gas heating, primarily for perceived safety reasons.
Climate	Households withdrawing from Category 1 projects because they perceived gas central heating as detrimental to the climate, and therefore did not want to use it for heating.
Clutter or hoarding	Households with hoarding or clutter issues, who were unable or unwilling to make necessary clearances to allow heating installations, especially if limited support was available to help (e.g. from family, from projects).
Covid-19	Households shielding, or more generally not wanting surveyors or installers in their homes.
Fear of scams	Households withdrawing because they believed that the provision of a free heating system could only be a scam, and would not engage with attempts to explain that it was not.
Household contributions required	In cases where the full cost of an installation could not be covered by the project, households withdraw because they cannot afford a contribution to cover the cost difference to enable the installation to go ahead.
Landlord engagement in the private rented sector	Landlords withdrawing from prospective or planned installations because of cost, engagement challenges, or other issues.
Medical reasons	Household members undergoing medical treatment (e.g. operations, or terminally ill), and unable or unwilling to engage with the delivery process as a result.
Preference of incumbent heating types, especially coal	Households unwilling to move away from coal systems, both because of cost (e.g. in receipt of free coal from the National Concessionary Fuel Office [NCFO]) and emotional attachment (e.g. the coal system being a link to past in ex-mining communities).
Property disrepair	Households being forced to withdraw because the property is in such a state of disrepair that the installation cannot safely proceed.
Refusing winter installation dates	Households refusing installation dates over the winter, which was closely linked to not wanting disruption at the coldest time of the year.
Tenancy access issues	Housing associations and RSLs struggling to maintain engagement with tenants that had initially opted into their project, resulting in them being removed from the list of beneficiaries.
Upheaval and disruption	Households withdrawing because of the perceived upheaval and disruption associated with major retrofit works to the home, especially among older households.

As Table 2.3 shows, many of the reasons for withdrawal experienced by projects were closely linked to household vulnerability, such as ill-health, age, and susceptibility to Covid-19. In addition, several of the reasons noted in Table 2.3 are linked to issues of (mis)trust of different actors, particularly landlords, installers, and project personnel more widely. Finally, withdrawals because of perceptions surrounding the disruption and upheaval required for an installation to take place were significant, as this was the most common reason for withdrawal mentioned by projects.

There are three main ways that projects sought to prevent scheme withdrawal. Firstly, the use of trustworthy middle actors to mediate engagement and raise levels of trust; secondly, to address and mitigate the perceived extent of disruption to households; and thirdly, private sector landlord engagement.

Regarding the first of these themes, projects discussed how having trusted intermediaries to manage the engagement process was a successful way of preventing household withdrawals.

One project, for example, was working with a charity supporting older people. This project emphasised that because the charity was often managing engagement with residents, it enabled a level of

trust to be established that prevented withdrawals, to an extent that other project partners could not have achieved:

"I think the fact that you have got a charity that generally looks out for the elderly, I think that adds a little bit of weight to, you know, some of the clients that are a little bit maybe sceptical. So you have got a charity that can back up the, you know, 'We are there for your best interests. This is not a scam. This is not people trying to hoodwink you into something that you do not want.' […] I think you get to a certain age in your life where you just say, 'I have done this all my life, I am not going to be told differently. I am certainly not going to be told differently by a young whippersnapper like you.' That kind of thing does come into play. But I think we stand as good a chance, if not a slightly better chance than anybody else, because we have got the charity." Category 1, 2 and 3 project manager

In addition, interviewees suggested that trusted intermediaries are often best placed if they are from charities and third-sector organisations, because they are perceived as neutral and not interested in profiting from an installation or advice delivery process. Importantly, however, interviewees from this project also emphasised that what constitutes a 'trusted intermediary' will be different for different client groups. Later in the interview, one interviewee from this project explained that while the presence of a charity supporting older people was imperative for engaging with that client group, it had sometimes been detrimental for engaging with younger vulnerable groups.

Housing associations and RSLs emphasised that TLOs were often the perfect trusted intermediary to prevent withdrawals. One project said, for example, that TLO engagement in the days leading up to the installation date would sometimes 'catch' households that were considering withdrawing from the scheme, *"but they're [the TLO] pretty persuasive at getting [people] where they need to be."* Interestingly, one housing association also noted that word of mouth among tenants was a useful if informal way to prevent withdrawals, underpinned by delivering good-quality installations to early adopters. This project used evidence (e.g. photographs, tenant testimonies) of installs from early in the project to persuade interested tenants of the benefits of joining the scheme, and encouraged tenants who had received an installation to talk to fellow tenants who were neighbours. As they explained, they went from

"People refusing, [to] phoning up and saying, 'I was speaking to my neighbour. I've seen the pictures. Your TLO has been about. Can I go back in the programme?' We went from a high refusal rate to a very low refusal rate, to the point where the only people that we weren't doing installs for were generally folk who had a serious illness." Category 2 project manager

Overall, this evidence shows that positive engagement from trusted intermediaries prevents withdrawals, but also that what constitutes a 'trusted intermediary' needs to be carefully considered to maximise the possibility of building trust and good relations with different vulnerable groups. A trusted intermediary can be a charity, a TLO, or a neighbour, and utilising these relationships can be a successful way of maximising the delivery of heating systems in vulnerable households.

Secondly, some projects had focused on the possibilities of upheaval and disruption, and took steps to minimise real or perceived disruption during the installation process.

Interestingly, housing associations and RSLs were the projects that discussed this most positively. These projects had, for example, liaised with tenants to arrange for them to stay in hotels while their installations were taking place, to minimise their experiences of disruption; or they had delivered installations in empty social housing 'show home' properties, to demonstrate the ease of the process, and the benefits to thermal comfort, affordability and health that would follow for the tenant. Being able to tap additional gap funding and resources to facilitate these kinds of engagement was crucial, as one project explained, with reference to resolving a hoarding problem that would have otherwise resulted in a withdrawal:

"We've even gone an extra mile where we've gone there to do the survey for the installation and the whole house is full completely – you can't hardly move in any room – and what we've done is we've actually helped with the resident and a removal company to put items in storage to finish the installation, and then the removal company then redelivers all their items back to them. Because you go into some lounges and they've got so much shelves full of books, you can't move at all in there. And some of them in the bedroom, you could hardly even move. So, we've gone an extra mile, liaising with the RLO, the resident and the removal company in assisting, so that the contractor can have a clear run for the installation." Category 1 and Category 2 project manager

These examples demonstrate the importance of ensuring that additional resources are built into projects, to focus on and engage with households that might withdraw because of issues beyond their control. Moreover, this evidence illustrates that issues of upheaval and disruption should not necessarily be seen as related to perceptions of disruption, but stemming from broader vulnerabilities which can be engaged with and addressed.

Thirdly and finally, projects delivering installations in the private rented sector experienced withdrawals from landlords they were trying to engage.

Generally, projects noted that engaging with private landlords was a serious challenge, with one summarising that *"they are difficult to engage with, essentially."* Others said the challenge with private landlords was not necessarily initial engagement, and that the point of withdrawal often came when landlords were informed a capital contribution would be required for the installation to proceed. As one project explained, *"it's not so much engagement, they'll come because they think there is money, but when they realise they have to pay towards it they're not keen on it, that's the problem with landlords."* A second project concurred, noting that *"sometimes it was cost, because although we are offering them a good deal, it's still clearly a fairly inflated price compared to what their mate Bob, down the road, can stick it in for."* Some projects also noted some of the challenges of tenant engagement in the private rented sector, specifically tenants not engaging because they were afraid of upsetting their landlord, or because they did not expect to live in the property for long.

However, some projects experienced success with landlord engagement, and explained some of the reasons why they felt this had occurred. Often, the key to landlord engagement was what one project referred to as a 'carrot and stick' approach, whereby the project would work closely with private sector licensing enforcement teams inside local authorities to guide landlords on Minimum Energy Efficiency Standards (MEES) regulations, while at the same time engaging constructively with landlords themselves over the project offer:

"I guess that is, we have sort of always tried to work with the Private Licensing Sector, but I am sure you are aware it is really hard to engage the private rented sector, it is just a really tough one. The mixture of the carrot and the stick, as I often think of it, is us offering grant funding and support with the installation, and then the Licensing Teams were trying to enforce MEES and other legisl – you know, licensing requirements – means the mixture of those two approaches seems to push landlords into actually doing something, and the tenants usually accept it, because it is making improvements to their home." Category 1 and Category 3 project manager

"I think one of the things that really helped with landlords was the minimum energy efficiency standards. Our internal team referred a lot of landlords to me. I was managing our MEES project at the same time as the Warm Homes Fund. They referred a lot of landlords to me whose properties were F and G rated. So one of the things I was able to use to sort of engage them more was around the legislation, that they had to have a minimum of an E, and our private housing team had a pot of funding that they could also utilise, not to fully fund but to fund quite a majority of it. And it helped, whilst MEES was running, to be able to say, 'We can give you some additional money, and if your tenants are on any type of benefits or meet our ECO Flex, we can give you even more money, and we can fund as much of it as we can.' So we did get, I think it was around 27 homes from the MEES project, and that was purely through being able to give them additional funding." Category 1 project manager

These experiences suggest that, to successfully deliver projects in the private rented sector, it is necessary to balance enforcement and positive engagement in order to persuade landlords to part-fund the installation. Local authority projects looking to engage in the private rented sector should seek to engage with wider internal actors in private sector teams, to boost referrals and successfully convert landlord interest into completed installations.

2.8. The outcomes and impacts of funding on delivery organisations

This section discusses the impacts and outcomes of delivering the WHF on project delivery organisations. It became clear in interviews with projects that beyond the impact of their delivery on beneficiaries, there had been substantial and positive

impacts for the organisations themselves. Projects spoke of these successes as major outcomes that had supported their development and growth as organisations and as delivery partnerships; they can be split into four groups of outcomes.

The first outcome for projects was how delivering the WHF enabled them to establish and expand internal resources, processes, delivery mechanisms, and partnerships.

The most prominent way this was discussed was in terms of the recruitment and retention of new staff members, who had been employed initially to deliver a WHF project but were able to be kept on after the project ended. In some cases, this was because projects had learned that delivering schemes like the WHF was much more efficient and effective with additional resources, and they therefore took steps to ensure this resource was maintained beyond the end of their WHF project. For example, two housing associations explained that they previously did not have TLOs to support the delivery of energy efficiency schemes. They both employed a TLO for the first time on their WHF project, which persuaded them of the value of the role, and led to them retaining the staff member after project completion:

"The person that is our resident liaison or tenant liaison officer has been absolutely brilliant. I think without her it just wouldn't have happened; we wouldn't have met the targets we would have done […] They were fairly new for how we deliver heating programmes; they were dedicated to this project. We didn't traditionally have a dedicated RLO for heating schemes, whereas now, off the back of this, now on all of our other heating schemes we do that as well. Even if it's a gas to gas replacement, we will have an RLO function, which is good." Category 1 project manager

"We were obviously accessing tenants that don't normally engage with us. So, we're picking up a lot of historic issues, as well. So, it worked really well, and that's actually rolled in now, that [TLO] position – that was basically like a trial thing for us as a liaison. It's now a permanent position. It worked that well." Category 1 and Category 3 project manager

Other projects had used the outcomes and outputs of their WHF project to justify the appointment of new staff to support energy efficiency delivery. One project, for example, had been convinced of the necessity of employing a retrofit officer *"to make sure we get the best out of the fabric-first approach"*; and as another project explained, delivering the WHF also led successful business cases for the expansion of financial and administrative teams:

"I put a business case together a couple months ago, probably six months ago, around trying to get a funding officer in my team. And one of the streams was putting in the Warm Homes Fund to try and build that case up to say, 'This is how much funding we've received. This is potentially what the future looks like.' So we got that signed off and I've now got a new person on my team who manages funding. So in that sense, [the WHF has] definitely helped get us extra resources." Category 2 project manager

Beyond the retention and recruitment of new staff, projects also discussed positive outcomes of delivering their WHF projects for pre-existing staff members. In these interviews, delivering the WHF was referenced almost as a type of continuing professional development, which had enabled staff to learn new skills, take on new roles and responsibilities, or sharpen their understanding of fuel poverty and how best to address it. For instance, one interviewee said: *"I think I've learned a lot more around fuel poverty […] especially since delivering the Warm Homes Fund"*; and another reflected in detail on their development across their project delivery:

"I learned a lot. It was a good learning exercise for me. I mean I was just glad to be a part of it, to be honest […] as far as learning goes, I mean yes, I learnt loads because it was the first sort of thing I'd been in to. There were some things that I did that I could have probably done better. There were other things that I might have done differently had I had a go again, but we got there." Category 2 project manager

Finally, projects discussed broader outcomes of their WHF projects in relation to resources, capacity, and ability to deliver. Reflecting on the WHF, some projects emphasised that it had enabled them to build relationships, referral networks, and trust with partner organisations that would continue into the future. One project, who described needing to start from scratch with their referral networks due to changes in their organisational structure, narrated how much of their time was spent germinating and constructing relationships with small charities and 'grassroots' organisations that frequently come into contact with vulnerable people in remote rural areas. As the WHF project concluded, they reflected that these relationships would be important to the delivery of future fuel poverty schemes:

"In terms of Cat 3, the successes have been the new partnerships we've made through communities and parishes across [the county]. There are real grassroots groups which we would never have reached had we not had this funding and access to extra staff." Category 3 project manager

A second project described how delivering their interventions had strengthened their relationship with local public health officials, who at the time of our interview were seeking ways to draw additional funding from public health budgets to financially support the project's expansion. For others, core relationships between project leads (e.g. Local Authorities, RSLs) and delivery management organisations had been cemented and strengthened as a result of WHF delivery. One project had secured funding from the Social Housing Decarbonisation Fund (SHDF) to continue their whole-house retrofit work, and described how the relationships between key partners, developed through the WHF, had allowed the establishment of a 'blueprint' for how they were approaching it and future work:

"Again, [the SHDF has] been a challenge, but that's been done through a partnership with [our delivery management organisation] as well. They're our delivery partner for that which again, we would have done a project of maybe 10–15 properties, whereas this is done on a larger scale. From that point of view I think we're in a good position. The establishment of this team has put us in a good position and I think it's a blueprint for how I think we want to move forward in the future." Category 1 and Category 2 project manager

In sum, it is clear that undertaking WHF projects has enabled delivery organisations to enhance their resources and capacity, and to solidify working relationships with key partners that are, and will be, platforms for the delivery of energy efficiency and fuel poverty schemes in the future.

A second key outcome for WHF projects was how delivery had contributed to, and in many cases refined, broader organisational priorities and strategies.

Perhaps most obviously, projects had channelled the experience of delivering the WHF to help senior decision-makers at their organisations develop fuel poverty strategies and objectives. One local authority, for example, explained that delivering the WHF had coincided with a planned review of their *"Fuel Poverty Plan"*. One aspect of their plan that was at stake was the extent to which they would support the installation of gas central heating systems in fuel-poor homes, which would potentially *"butt heads"* with the new *"Net Zero element"* of the plan. However, based on their delivery of a Category 1 project and the outcomes they had seen for fuel-poor households, the interviewee explained that first-time central heating would be retained:

"How we think that is going to play out is that it's going to say that we will still support the installation of gas systems where it's required. So where we've got a fuel-poor household, we're not going to rip out their gas system, and if gas is the most appropriate option for them, then that is what will be installed, irrespective of the Net Zero conversation, because it should be about the individual first." Category 1 project manager

In this example and others, what is important is not necessarily the specifics of the plan or strategy, but how delivering the WHF had allowed organisational fuel poverty strategies to be better informed by evidence of what was most effective at addressing fuel poverty in their specific contexts. Other projects were more modest, noting that delivering their WHF projects had contributed to pre-existing fuel poverty strategies and targets. Different projects explained how the WHF had intersected with several local authority objectives, such as reducing the proportion of social housing tenants with storage heaters, reducing fuel poverty, improving the energy efficiency of their housing stock, and (in projects where private rental properties were included) the enforcement of MEES regulations.

Housing associations that took part in interviews with the evaluation also discussed a similar but far broader set of outcomes for their organisations, linked to strategies and targets regarding housing stock sustainability, energy efficiency, and safety; as well as more general priorities involving housing stock maintenance and improvement. Housing associations face unique pressures in relation to these areas, particularly in improving the energy efficiency and safety standards of their stock. Several housing associations that took part in interviews highlighted how securing WHF funding had contributed to developing or ongoing strategies to improve energy efficiency, such as upgrading the heating systems of properties with storage heaters to make them 'Net Zero' compliant:

"Obviously, we've got about a third of our stock is rural, off gas. So that was our focus, was to kind of pretty much put heat pumps in all of those properties however quickly we can get them done, really. A plan is to do 720 heat pumps a year. So obviously the 212 that have been done – plus [a previous WHF project] as well – over 300 that have been done through the Warm Homes has massively contributed to kind of the future. But we've still got a significant way to go, I guess, in terms of trying to get 7,000 heat pumps installed." Category 2 project manager

"I suppose the other thing would be from our side, being able to remove those properties off electric heating and onto gas heating has helped us in terms of improving the energy efficiency of our stock as a whole. So our average SAP rating for the stock is bumped up every time we take an electric heater out and put gas heating in. The SAP ratings go up. So that's been beneficial for us. A lot of properties have moved from a D to a C, for example, which is good because one of our targets is to get all of our properties that are currently D and below up to C or above." Category 1 project manager

Beyond this, housing associations discussed other ways in which delivering their WHF programmes had contributed to broader organisational priorities. It was clear that some projects felt their delivery had enabled them to build positive, trusting relationships with tenants that would be beneficial to both landlord and tenant in the future, as well as enhancing their reputation as a responsible landlord:

"It has been a successful project from our point of view [...] we have rescued our reputation and some, I think, you know, built some really long-term relationships with customers that will stand us in good stead for the future. So, yes, from that point of view of view, it was a bit of a phoenix from the flames job." Category 1 project manager

More mundanely, interviewees from housing associations explained that improving the energy efficiency of their housing stock had wider positive impacts, such as making their homes easier to let, reducing the need for difficult and costly maintenance on old heating systems, and reducing the likelihood of mould and damp caused by ineffective heating damaging their properties. In Scotland, this included helping them to proactively meet existing or forthcoming regulations for social housing, such as the EESSH standards and the Scottish Housing Quality Standard (SHQS).

The third key outcome for WHF delivery organisations was that learnings obtained through the delivery of their projects has enhanced their ability to undertake large-scale energy efficiency and fuel poverty projects in the future.

Projects highlighted learnings on numerous different topics, which are summarised and explained in Table 2.4 below.

Key theme relating to delivering energy efficiency and fuel poverty projects	Explanation
Bid development	Projects gained experience in costing large-scale energy efficiency projects and writing grant applications in-house without relying on external consultants, which will improve their prospects of securing further funding for energy efficiency schemes.
Business case preparation and development	Projects learned how to construct business cases for unlocking internal funding from their own organisations, especially through using their WHF project as a source of necessary match funding, and highlighting how the impacts of their WHF project would be continued and enhanced with further financial support.
Causes and consequences of fuel poverty	Projects gained new knowledge on the links between fuel poverty and (e.g.) heating type, payment method, mould/damp, vulnerability, and wider climate and social objectives, enabling them to better target future projects and measure their impacts.
Communications and marketing	Projects gained experience in reaching vulnerable households and using different methods of promotion to increase scheme uptake, especially relating to low-carbon technologies (e.g. heat pumps), which will be funnelled into future schemes.
Data analysis and eligibility checks	Projects learned how to holistically analyse internal data (e.g. housing stock data) and public datasets (e.g. IMD, fuel poverty statistics) to target marketing and interventions more effectively at households living in the deepest fuel poverty.
Geographical and spatial aspects of delivery	Projects deepened their knowledge of fuel poverty and vulnerability within their specific geographical remit (e.g. local authority boundaries), and enhanced their understanding of how to more effectively deliver area-based schemes.
Household engagement	Projects gained experience and knowledge of different ways to engage with households. This included developing better ways of supporting households throughout their journey (e.g. advice, heating system use and operation, communicating regularly), and liaising with other relevant actors (e.g. family members, landlords).
Monitoring and evaluation	Projects learned the importance of assessing the outcomes of their scheme delivery for households, especially regarding wider impacts on the health system. Projects also learned how to set up effective monitoring arrangements with delivery partners that could be replicated and enhanced in future schemes.
Procurement	Projects had developed or enhanced their procurement frameworks through delivering their WHF project, or had learned of new ways to approach procurement to ensure future schemes were delivered more effectively (e.g. by procuring different types of contractors with different specialisms, to cover all aspects of energy efficiency delivery as and when required).
Roles and responsibilities	Projects gained experience and knowledge of the roles and responsibilities of different partner organisations throughout the project, especially in terms of project set-up, and how responsibilities were delineated and agreed prior to the commencement of delivery.
Scaling project delivery	Several projects had not delivered on the scale of their WHF project before, and gained experience – sometimes through errors they had made – on how to do so more effectively in the future. Other projects had delivered small-scale WHF projects that they felt had laid the groundwork for their ability and capacity to deliver larger schemes in
Technologies and measures for addressing fuel poverty	Projects gained experience and knowledge of the advantages and weaknesses of different technologies for addressing fuel poverty, including less commonly utilised technologies such as high-retention storage heaters.
Quality assurance	Projects learned the importance of conducting thorough quality assurance of works, independently of their main contractor or delivery partner; and the importance of having internal expertise on technical installation matters (e.g. a Clerk of Works) and retrofit coordination, to ensure good outcomes for households.

Table 2.4: Main learnings for WHF projects relating to the future delivery of fuel poverty and energy efficiency schemes.

Finally, projects highlighted that the fourth outcome of delivering their WHF project was that it had helped them to apply for and/or secure further funding for fuel poverty and energy efficiency schemes.

In project surveys,

- 19 respondents – exactly one-third of all survey respondents – had applied for and/or been successful in securing additional funding; 15 of these had secured additional funding, three had applied, and one had both secured funding and applied for further funding.

Survey responses show that projects had secured a mixture of capital and revenue funding from alternative sources. In addition:

- Of the 19 respondents who had applied for and/or been successful with further funding applications, 15 said delivering their WHF project had significantly helped them to do so.

- More specifically, nine said that delivering their WHF was an important part of applying for and/or securing funding, while seven said they would not have applied for and/or secured further funding if they had not delivered their WHF project.

Similarly to the match and gap funding that had been tethered to their WHF projects, interviewees described an eclectic range of sources from which they had secured additional funding after the completion of their projects. These included national and devolved government schemes, such as the GHG LAD, the SHDF, and the Home Upgrade Grant Scheme (HUGS). In addition, wider sources of grant income were being tapped to deliver (or prospectively deliver) fuel poverty and energy efficiency schemes, such as through Innovate UK, the UK Government's City Deals framework, or funding available through local hospital trusts or CCGs. Finally, several projects, especially housing associations, had secured further internal capital and revenue funding to continue, expand or develop their WHF projects.

Reflecting on how delivering their WHF project had affected these opportunities, projects explained the ways in which it had set them up for the future:

"It's helped us all to build our confidence, working with each other, apart from anything else. But also, because we've got the established processes in place, and that established partnership, then because of the short-term nature of funding, and the quick turnaround on funding applications, we've got that structure already there. Which, if we hadn't have done the Warm Homes Fund, and set up our collaboration agreement, we wouldn't have that established process already. So, it's definitely put us in a strong position." Category 1 and Category 3 project manager

"We have a project that has been live, late June I think it started […] it is linked in with Warm Homes Funding, in the sense of we have done it off the back of the Warm Homes Fund programme. So we are actively marketing across all of our schemes, in order to see what additional services we can offer." Category 1, 2 and 3 project partner

As these examples show, some projects had developed working relationships, structures and processes that enabled them to respond to new grant opportunities quickly and effectively, while others had developed 'spin-off' schemes from their WHF project, focusing on different aspects of fuel poverty and energy efficiency. For some projects, delivering their WHF project had led them to encounter new or unrecognised issues facing households within their remit (e.g. mould and damp affecting tenants), and they had developed new areas of work to address them.

2.9. Park Homes

Lastly, this section summarises the key findings related to the delivery of the WHF's Park Homes projects. Although the majority of themes discussed in these interviews were similar to those with other projects (e.g. on partnership working), the unique nature of Park Homes projects necessitates some analysis of their specific successes and challenges. The key learnings and themes concerning Park Homes projects are shown in Table 2.5 below.

Key finding	Explanation
The necessarily area-based nature of Park Homes projects means that regular communication with residents, both individually and through residents' forums, is particularly important.	This ensures that residents are kept informed of project progress, even if the project is in a phase of relative inactivity, and enables questions to be asked and answered quickly. Having the support of a 'resident champion', someone living on site who is willing and able to support the project with resident liaison and communication, is especially valuable.
Support and buy-in from the site owner is critical, and projects need to adapt their approach to engagement based on the ownership of the site.	For one project, building support among residents was important for securing the support of the site owner, as was communicating to the owner that their Park Homes would be easier to let and have less risk of resident turnover if they had gas central heating installed. For a second project, the site owner had previous experience of converting another of their sites to mains gas, which led them to support the project from the beginning.
Park Homes projects are necessarily challenging, and close partnership-working between local authorities, the delivery consortium, and the funder is critical for addressing challenges collaboratively and effectively.	For one project, internal licensing and environmental health teams were the gatekeepers to successful engagement with residents at the beginning of the projects, especially because they already had pre-existing connections to the sites and their residents' associations. For a second project, successfully meeting and addressing challenges was described as dependent on the close working relationship between all project partners, including the WHF.
There are numerous hidden costs and challenges associated with Park Homes projects, including gas run complications, flue specifications, and meter box installation locations.	Projects looking to undertake Park Homes projects should engage closely with experienced local authorities, funders, and residents, to map out possible challenges that have cost implications prior to the bid submission phase. Projects and funders also need to work together to map out and understand the scale and size of hidden ancillary costs, and how best to work them into project budgets.
Other Park Homes infrastructures may present obstacles to delivery, especially a lack of connection to mains drainage disrupting meter box placement and installation.	Because some Park Homes sites are not connected to mains drainage, there is a greater risk of flooding. This has implications for different parts of the installation process, especially the location of meter boxes and meters. At minimum, an investigation of possible flood risk is therefore recommended, and raising meter boxes above ground level may be required to avoid subsequent issues.
Early and enthusiastic support from the relevant energy networks is essential for the smooth delivery of Park Homes gas connection projects.	Energy networks should, where feasible, be built into the project funding application and specification prior to the project beginning. This does not only apply to GDNs who played roles in Park Homes projects for the WHF. Although no heat pumps were installed at Park Homes as part of the WHF, it is highly likely that any future projects of this sort will require similar support from the relevant DNO.
ECO Flex is an effective mechanism for enabling Park Homes projects, especially through the creation of a bespoke SOI that can confer eligibility on the site as a whole.	Ensuring works can be delivered to whole sites through a bespoke SOI can help to gain the support of residents and the site owner, and removes the need to verify the income and eligibility of each Park Home individually, which can consume precious resources.

Table 2.5: Summary of main findings of research with Park Homes projects.

3. What was the difference made? The impact of the Warm Homes Fund on beneficiary households

3.1. Introduction

This section turns to an analysis of the impacts of the WHF on its beneficiaries. It discusses the impacts of the programme across nine key indicator groups:

- Subjective fuel poverty, including its disaggregation by vulnerability
- Energy rationing practices
- Domestic space use and the use of the home
- Heating system control
- Mould and damp
- Energy affordability
- Health and wellbeing
- Energy capabilities and advice provision
- Overall beneficiary satisfaction

As in the previous section, findings from survey fieldwork with households are integrated throughout, to support and illustrate the points made. Illustrative quotations from household interviewees are also used.

3.2. Impacts on subjective fuel poverty and thermal comfort

This first section examines the impacts of the WHF on subjective fuel poverty and thermal comfort. To do so, it focuses on one item from the household questionnaire that aims to measure the subjective fuel poverty status of a household pre- and post-intervention. Subjective fuel poverty is a measure of fuel poverty using the subjective view of the household rather than the official definition, and is based on a question asking respondents whether or not the home can be kept comfortably warm in winter or when it is cold outside. This allows the establishment of a subjective indicator for fuel poverty, based on the broad definition of fuel poverty utilised in the Warm Homes and Energy Conservation Act of 2000, which states: *"a person is to be regarded as living 'in fuel poverty' if he is a member of a household living on a lower income in a home which cannot be kept warm at reasonable cost."*[7] In other words, the use of a subjective fuel poverty indicator enables an understanding of the WHF's impact on fuel poverty 'from the bottom up', which can complement insights from the energy modelling analysis and other findings from the householder research.

The remainder of the section is divided into two subsections. The first examines the broad trends in household survey responses with respect to subjective fuel poverty. The second disaggregates these findings according to different socio-demographic and vulnerability-based indicators (e.g. age, health, tenure), to analyse whether the impacts achieved by the WHF are more or less prevalent for different vulnerable groups.

3.2.1. Key findings on subjective fuel poverty

To assess whether WHF beneficiary households could keep their homes warm in winter or when it was cold outside, a subjective question was included in questionnaire used to survey households, worded as follows:[8]

Before you received your new measures, could you keep your whole house warm when it was cold outside?

Figure 3.1 below shows that 64% of respondents replied 'no' to this question; 18% replied 'yes', and 17% replied 'yes, but it is hard for me'. This final option was included as a recognition that some households may be able to keep their homes warm at different times of the year, month, or depending on factors such as Universal Credit payment cycles or hours worked. Figure 3.1 shows that 76% of Category 1 households and 69% of Category 2 households responded 'no' to this question, suggesting that interventions under these categories were well targeted at those struggling the most to keep their homes warm. Furthermore, 46% of Category 3 respondents replied 'no', and only 10% of Park Homes respondents replied the same. However, a much higher proportion (27%) of Category 3 and Park Homes respondents replied 'yes, but it is hard for me'.

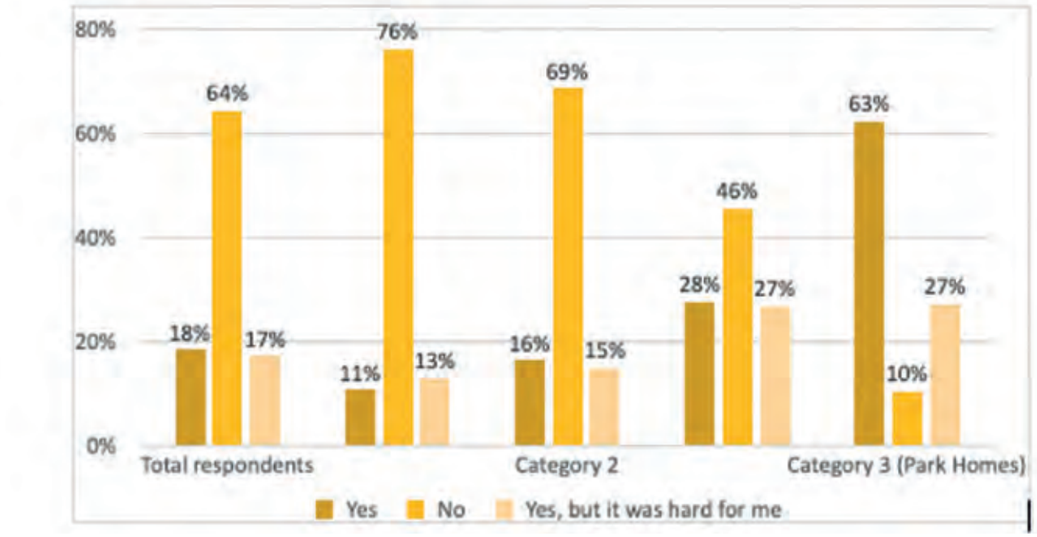

Figure 3.1: Responses to the questionnaire item 'Before you received your new measures, could you keep your whole house warm when it was cold outside?', disaggregated by WHF funding category.

Figure 3.2 shows that different reasons for why they could not keep warm at home were given by respondents who replied 'no' or 'yes, but it is hard for me'. Overall, cost was the most prevalent reason noted, with 37% of total respondents choosing this option. Next, 35% of respondents said it was because their heating system was broken or not working well, and a slightly smaller proportion (28%) attributed it to their house not keeping the heat in well. There were small but significant differences in responses to this question depending on Category. Notably, Category 1 respondents were more likely to attribute not being able to keep warm at home to a broken or inadequate heating system, whereas respondents from all other categories were more likely to cite cost. Almost half of Category 3 respondents attributed it to cost, which reflects the deeper levels of financial vulnerability, debt and precarity that Category 3 respondents were experiencing prior to receiving support (see Section 3.7 below).

7. Warm Homes and Energy Conservation Act (2000).

8. The question was asked identically across all four WHF categories, apart from Park Homes recipients, for whom the word 'house' was replaced with 'Park Home'.

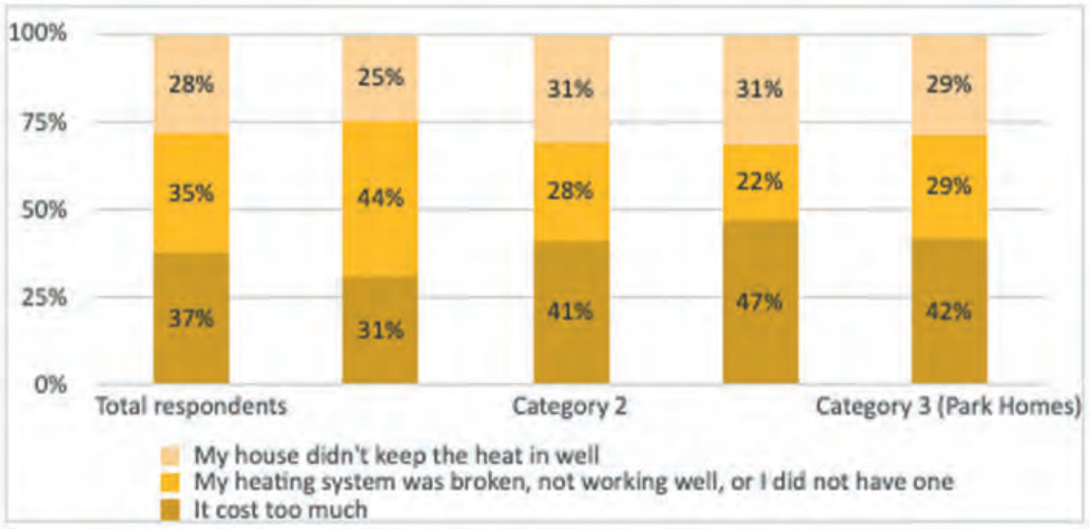

Figure 3.2: Reasons given by questionnaire respondents as to why they could not keep their homes comfortably warm when it was cold outside, pre-intervention. Note that this figure only includes those who responded that they could not do so, or could only do so with difficulty, in Figure 3.1.

Following the pre-intervention subjective fuel poverty question, respondents were then asked:

Since you received your new measures, can you now keep your whole house warm when it is cold outside?

Figure 3.3 shows that a reversal took place in the proportion of respondents able to keep their homes warm post-intervention: 76% of respondents said that they now could, with 13% responding 'no' and 11% responding 'yes, but it is hard for me'. Figure 3.3 shows that over 80% of Category 1, Category 2, and Park Homes respondents felt able to keep their homes warm post-intervention. However, approximately half of Category 3 respondents replied 'yes': a far smaller proportion.

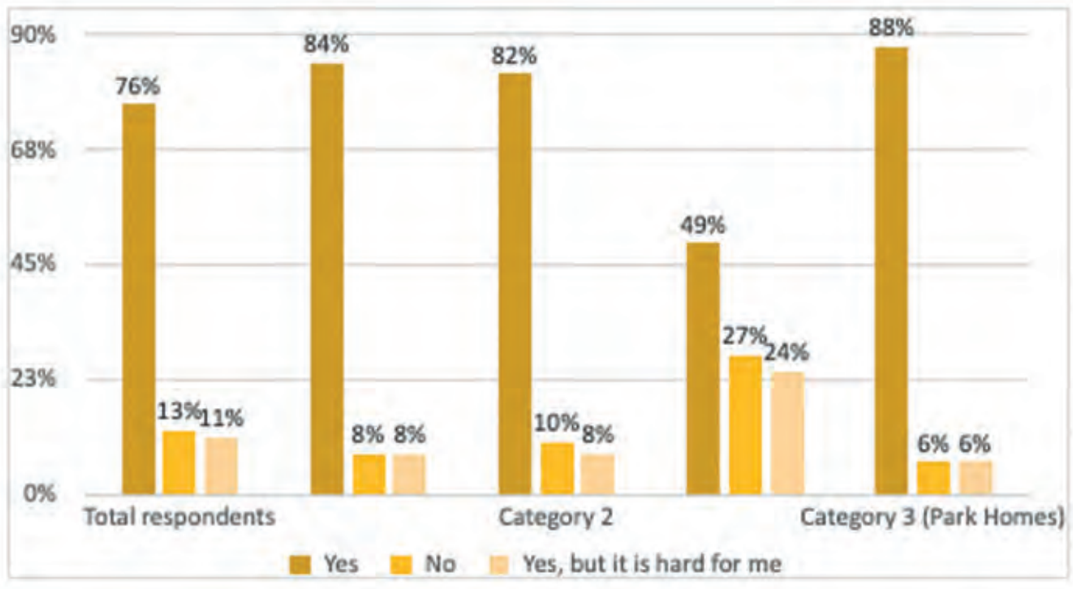

Figure 3.3: Responses to the questionnaire item 'Since you received your new measures, can you now keep your whole house warm when it is cold outside?', disaggregated by WHF funding category.

Figure 3.4 below presents these findings differently by emphasising the change in the proportion of respondents replying 'yes' to the subjective fuel poverty question pre- and post-intervention. The most marked improvements were experienced by Category 1 and Category 2 respondents, with increases of 73 percentage points and 66 percentage points respectively. Smaller increases are observed for Category 3 and Park Homes respondents, of 21 percentage points and 25 percentage points respectively, albeit from a high starting point for Park Homes respondents. This suggests that Park Homes interventions helped the minority who could not keep warm prior to their intervention to obtain equivalence with other site occupants that could. Regarding Category 3, the findings suggest that for many, receiving a WHF-funded intervention was not sufficient to enable them to keep their homes warm afterwards.

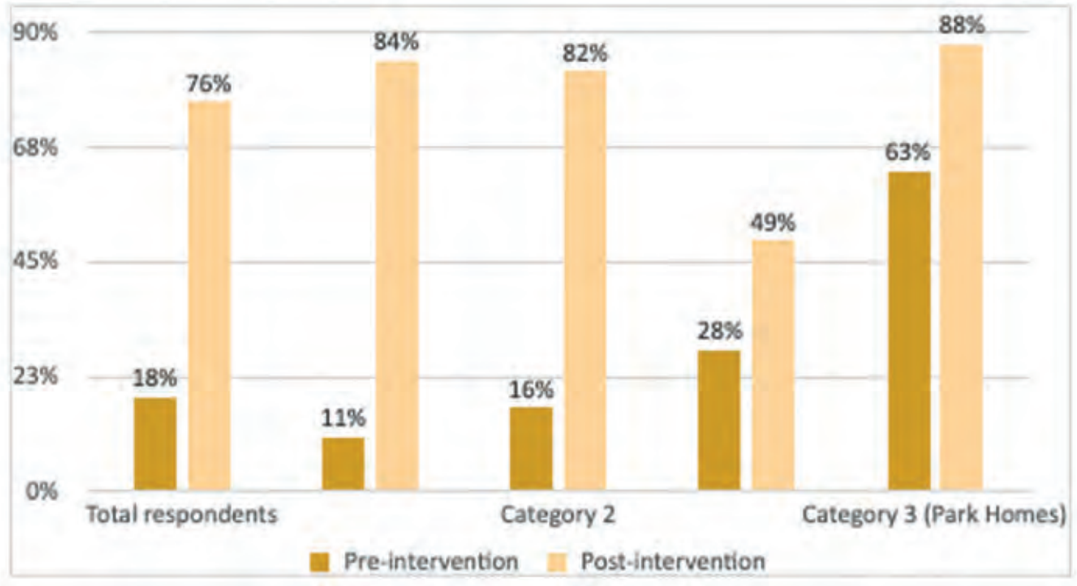

Figure 3.4: Change in the proportion of questionnaire respondents replying 'yes' to the subjective fuel poverty question, pre- and post-intervention.

Figure 3.5 below shows that for respondents who could not keep their homes comfortably warm post-intervention, the main reasons shifted from pre-intervention. Only 11% of respondents attributed not being able to do so to a broken or inadequate heating system. Accordingly, the main reasons cited were cost (49%) and their home not keeping the heat in well (40%). It is notable that, although a small proportion, 16% of Category 1 respondents and Category 2 respondents cited a broken or inadequate heating system as the reason they could not keep their homes warm, despite their new heating system installation. As will be discussed in more detail elsewhere in this section, it became apparent during interviews with Category 1 and Category 2 households that the main explanation for this was the perceived adequacy of the advice they received about heating system use, control, and operation during and after their installations. This emphasises a point that this section will return to again: it is critical that this advice is provided consistently and in a way that is tailored to the needs and requirements of the household.

More broadly, this evidence shows that cost and energy efficiency were the key barriers preventing a small proportion of WHF beneficiary households from being able to keep their homes warm post-intervention. It suggests that in these cases, more needed to be done to support households to access energy efficiency upgrades, increase their incomes, and/or reduce their running costs. This topic will be addressed more thoroughly in the energy modelling analysis.

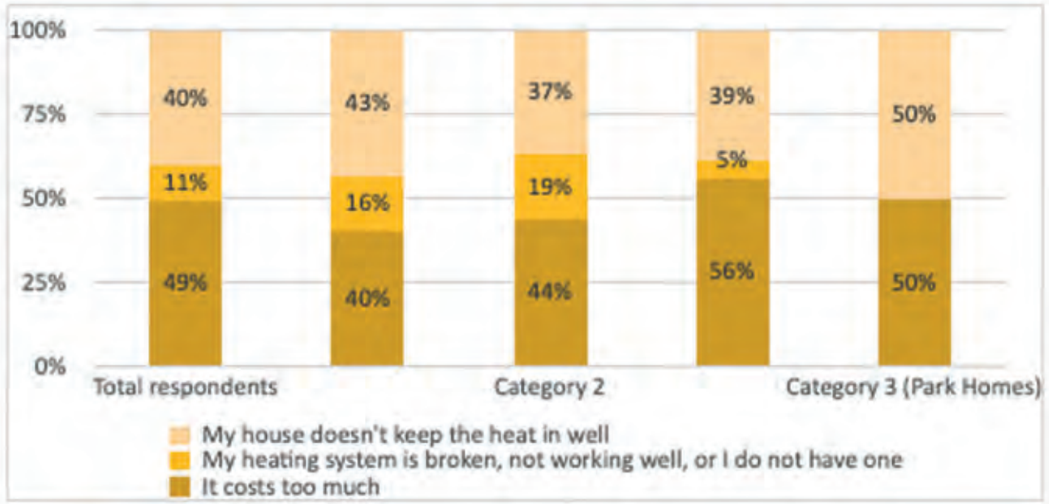

Figure 3.5: Reasons given by questionnaire respondents as to why they could not keep their homes comfortably warm when it was cold outside, post-intervention. Note that this figure only includes those who responded that they could not do so, or could only do so with difficulty, in Figure 3.3.

In addition to questions on subjective fuel poverty, two further items were included on the questionnaire to measure improvements in thermal comfort for WHF beneficiaries. The outcomes of these questions reinforce the findings of the subjective fuel poverty questions, that more marked improvements were experienced by Category 1 and Category 2 respondents. Figure 3.6 below shows that 96% of Category 1 respondents said the temperature in their home is now more comfortable than it was before, while 89% of Category 2 respondents replied the same. In contrast, 55% of Category 3 and Park Homes respondents said the temperature in their home is now more comfortable than before, and 39% of respondents from both categories said it 'stayed the same'. For those who did not experience improvements, for a significant proportion of Park Homes respondents, this is because, as shown above, the temperature in their home was already considered comfortable. For Category 3 respondents, this is likely to signify the continuation of a temperature not considered comfortable for just under half of respondents. Overall, 84% of respondents said the temperature in their home is now more comfortable than it was before.

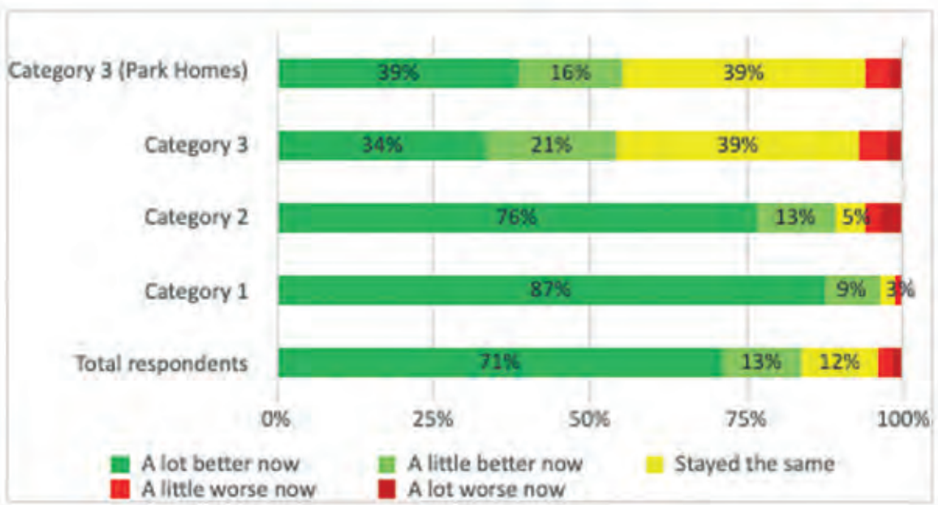

Figure 3.6: How comfortable the temperature in questionnaire respondents' homes was post-intervention, disaggregated by WHF funding category.

Lastly, Figure 3.7 below shows that 79% of Category 1 respondents said their homes keep the heat in better now than before, with 72% of Category 2 respondents replying the same. Similarly to the previous question, 36% of Category 3 respondents and 40% of Park Homes respondents said their homes keep the heat in better now than before, with over 50% of respondents from both categories replying that there had been no change.

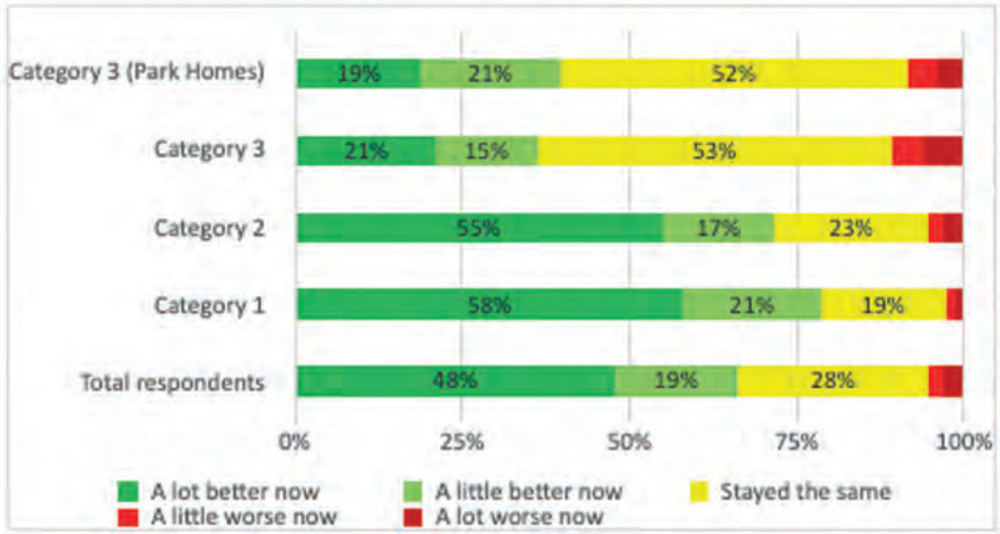

Figure 3.7: How well questionnaire respondents' homes keep the heat in post-intervention, disaggregated by WHF funding category.

Overall, these findings suggest that the most substantial improvements in subjective fuel poverty and thermal comfort have been achieved for Category 1 and Category 2 beneficiaries. It is also suggests that for the smaller but not insignificant proportion of Park Homes beneficiaries who could not keep their homes warm pre-intervention, receiving WHF support has enabled them to do so afterwards – thereby acting as a 'leveller' of sorts, to bring the majority of Park Homes on each site up to a similar standard of thermal comfort. For Category 3 beneficiaries, the evidence shows more limited but nonetheless important improvements to thermal comfort and subjective fuel poverty. For many, however, it is likely that receiving support from a Category 3 project was not sufficient to enable them to keep warm and well at home.

3.2.2. Disaggregation of findings by vulnerability and other factors

This section disaggregates responses to the subjective fuel poverty question on the household questionnaire by several factors linked to vulnerability, and from the energy modelling dataset. Specifically, the section covers the possible links between subjective fuel poverty and:

- Age
- Household size
- Tenure
- Household income
- EPC bands (pre- and post-intervention)
- Eligibility criteria
- Technical fuel poverty status (LILEE)

These factors are treated in turn. Note that although it is a key vulnerability, health is treated separately in Section 3.8.

3.2.2.1. Age

As noted by BEIS in its analysis of the latest fuel poverty statistics, the relationship between age and fuel poverty can be analysed in two different ways.[9] Specifically, with respect to the:

- Age of the oldest member of the household
- Age of the youngest member of the household

Figure 3.8 below shows that households where the age of the youngest member was 16–24 reported the highest levels of subjective fuel poverty pre-intervention.

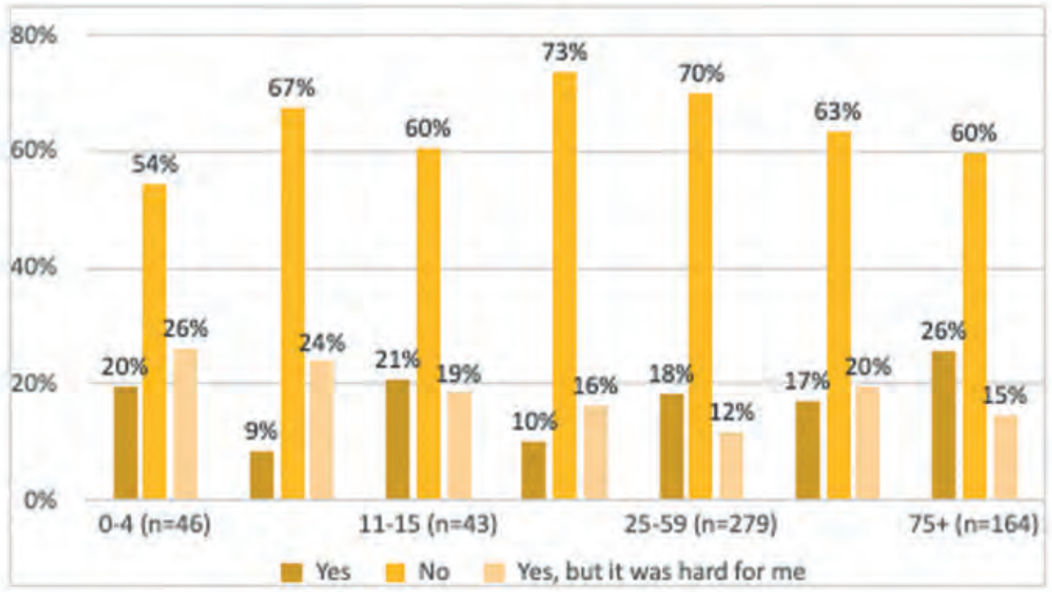

Figure 3.8: Responses to the questionnaire item 'Before you received your new measures, could you keep your whole house warm when it was cold outside?', disaggregated by age of the youngest household member.

Figure 3.9 below shows that the most substantial improvements in subjective fuel poverty post-intervention were reported by households where the youngest member of the household was aged 60 or above. The proportion of respondents replying 'yes' to the subjective fuel poverty question in these groups increased by approximately 60 percentage points. In contrast, the proportion of 0–4 households replying 'yes' to the subjective fuel poverty question rose the least, by 52 percentage points.

9. BEIS (2022) Annual Fuel Poverty Statistics in England, 2022 (2020 data).

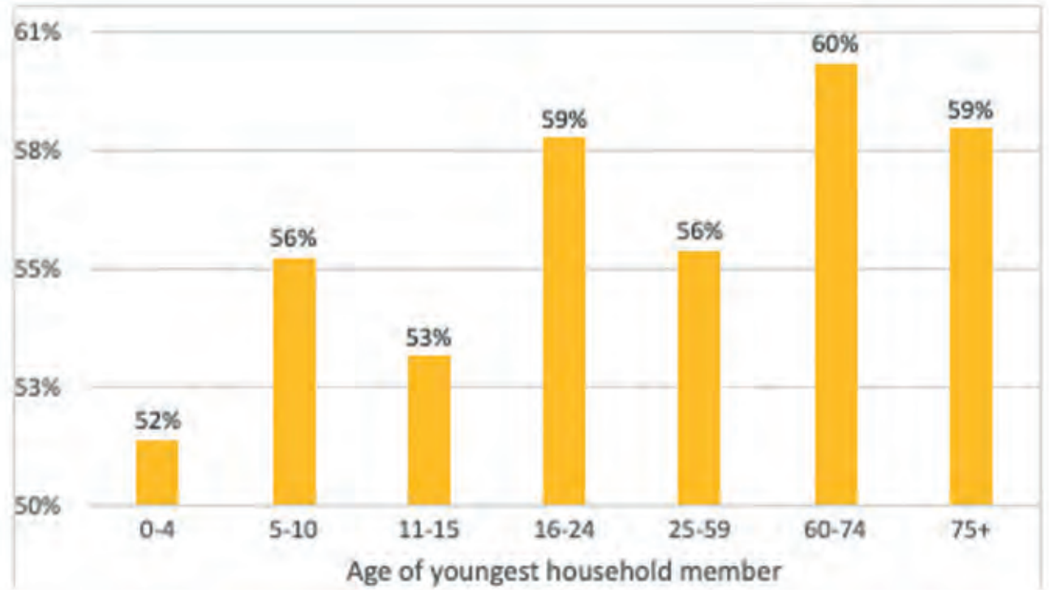

Figure 3.9: Percentage point increases in the proportion of questionnaire respondents replying 'yes' to the subjective fuel poverty item, disaggregated by age of the youngest household member.

Regarding the oldest member of the household, Figure 3.10 below shows that households where this person was aged 25–34 reported the highest levels of subjective fuel poverty pre-intervention.

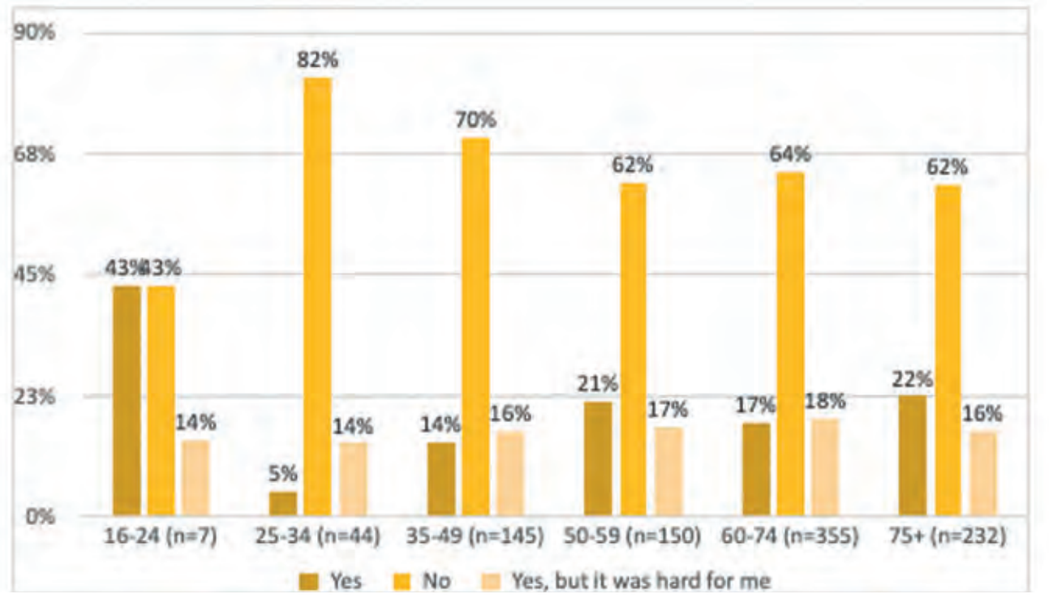

Figure 3.10: Responses to the questionnaire item 'Before you received your new measures, could you keep your whole house warm when it was cold outside?', disaggregated by age of the oldest household member.

Figure 3.11 below shows that the most substantial improvements in subjective fuel poverty post-intervention were reported by households whose oldest member was aged 25–34.

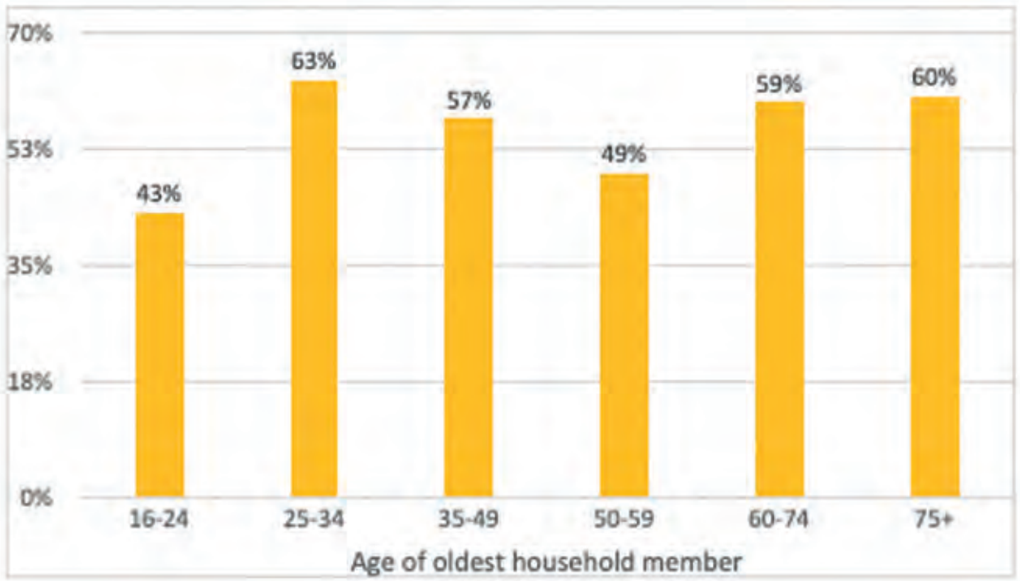

Figure 3.11: Percentage point increases in the proportion of questionnaire respondents replying 'yes' to the subjective fuel poverty item, disaggregated by age of the oldest household member.

3.2.2.2. Household size

Nationally, households with three or more occupants are more likely to be living in fuel poverty than households with one or two occupants.[10] Fuel poverty statistics published for England by BEIS show that 12.6% of single-occupancy households were living in fuel poverty in 2020, as were 10.1% of households with two occupants. As the household size moves to three, the proportion begins to increase: 14.8% of households with three occupants, 16% of households with four occupants, and 26.9% of households with five or more occupants were living in fuel poverty in 2020, according to the BEIS statistics.[11] Larger households require more energy to be able to meet the needs and requirements of all household occupants, which explains this trend.

10. BEIS (2022) Annual Fuel Poverty Statistics in England, 2022 (2020 data).

11. BEIS (2022) Annual Fuel Poverty Statistics in England, 2022 (2020 data).

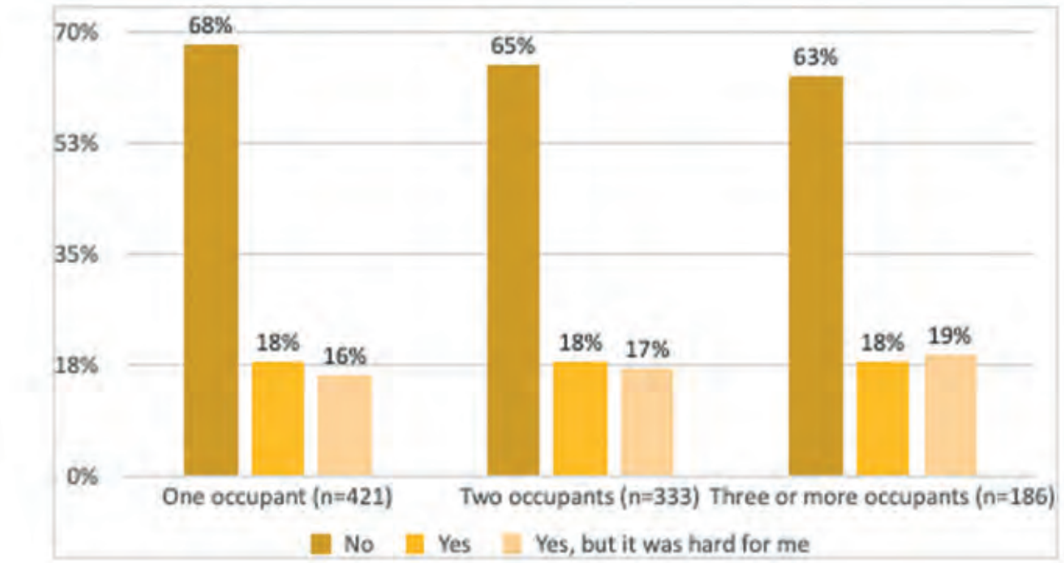

Figure 3.12: Responses to the questionnaire item 'Before you received your new measures, could you keep your whole house warm when it was cold outside?', disaggregated by household size.

Among survey respondents, there was a very small number of responses from households with four or more occupants. We can therefore consider any differences in pre-intervention subjective fuel poverty status and outcome by comparing findings for single-occupancy households, dual-occupancy households, and households with three or more occupants. As Figure 3.12 above demonstrates, there were no observable or statistically significant differences in pre-intervention subjective fuel poverty status between these groups. Figure 3.13 below similarly shows marginally different but statistically insignificant differences in outcome by household size.

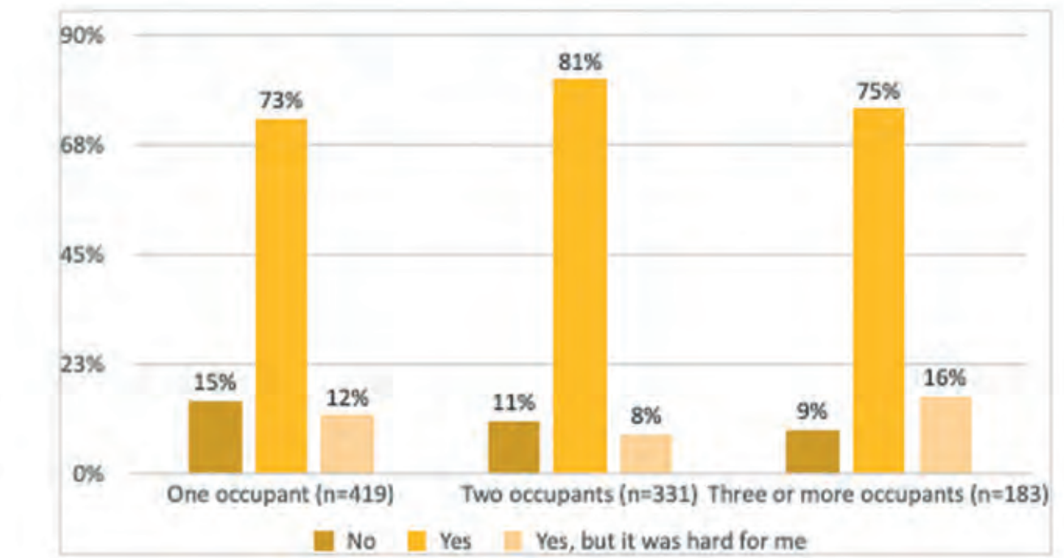

Figure 3.13: Responses to the questionnaire item 'Since you received your new measures, can you now keep your whole house warm when it is cold outside?', disaggregated by household size.

3.2.2.3. Tenure

Regarding housing tenure, WHF operational data (n=48,474) shows that, once aggregated into the broad categories of social housing, owner-occupier, and private rental, social housing properties were the most common form of housing tenure to receive support from the WHF. Figure 3.14 below shows that social housing properties made up 48% of WHF beneficiaries, with owner-occupiers comprising 37% of all beneficiaries. Beneficiaries living in private rental accommodation were fewer in number, making up 15% of the total.

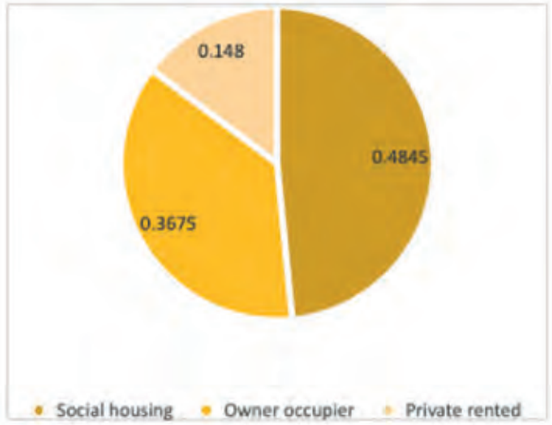

Figure 3.14: Tenure split of households supported through the WHF.

National statistics show that, within England, 25% of those living in privately rented homes are in fuel poverty, as are 18.7% of those living social housing. Private rented homes account for 35.4% of all fuel-poor households, and social housing accounts for 23.8%. Correspondingly, 40.8% of fuel-poor homes are owner-occupied.[12] Viewed in comparison to the tenure of households supported by the WHF, this shows that private rental properties make up a smaller proportion of WHF beneficiaries than national statistics would suggest need support. In contrast, this indicates that social housing properties are potentially overrepresented among WHF beneficiaries, comprising roughly half of all beneficiaries, despite accounting for less than a quarter of fuel-poor households in England. These findings reflect some of the difficulties and challenges experienced by WHF projects in targeting and engaging with the private rental sector, which were discussed in more detail in Section 2.

With respect to subjective fuel poverty, Figure 3.15 below shows that pre-intervention, private rental sector respondents were more likely to reply that they could not keep their homes comfortably warm, with 71% of respondents selecting this option. Next, 61% of social housing tenants replied the same, as did 69% of owner-occupiers. However, these findings were not found to be statistically significant.

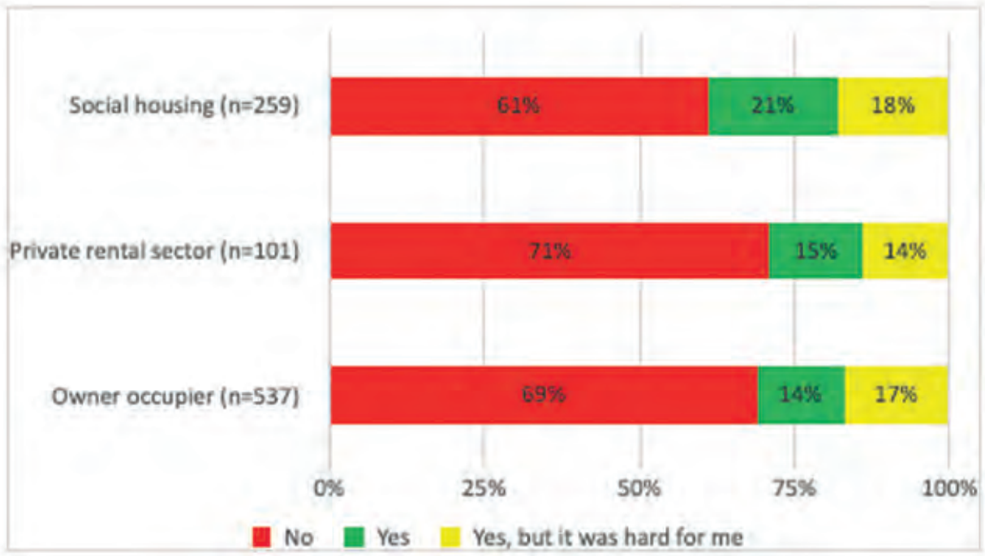

Figure 3.15: Responses to the questionnaire item 'Before you received your new measures, could you keep your whole house warm when it was cold outside?', disaggregated by tenure.

12. BEIS (2022) Annual Fuel Poverty Statistics in England, 2022 (2020 data).

Post-intervention, this pattern was similar. Figure 3.16 below shows that 78% of owner occupiers were able to keep their homes comfortably warm post-intervention. Furthermore, 73% of social housing respondents replied the same, with a slightly smaller proportion of private rental sector respondents, 70%, also doing so. **Again, these findings were not found to be statistically significant. However, the underrepresentation of private rental sector tenants among WHF beneficiaries as a whole, when compared to national statistics, suggests that while interventions in the private rented sector have been largely successful, more may need to be done in future programmes to target interventions at this group in a way that is proportionate to need in the sector.**

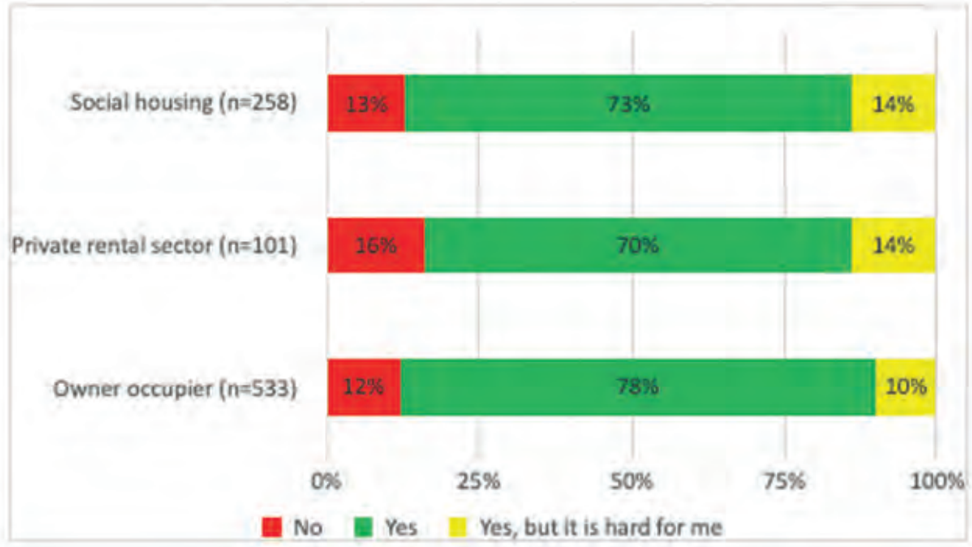

Figure 3.16: Responses to the questionnaire item 'Since you received your new measures, can you now keep your whole house warm when it is cold outside?', disaggregated by tenure.

3.2.2.4. Household income

Low household income is one of the core drivers of fuel poverty, as it shapes the occupants' ability to afford the energy they need to adequately heat and power their homes. Figure 3.17 below shows that the majority of respondents were living on an annual household income of £16,010 or less, with 42% reporting an annual household income of less than £12,000 and a further 22% with between £12,001 and £16,010. Figure 3.17 shows that Category 3 respondents were more likely to be living with a household income of less than £12,000, whereas Park Homes respondents were more likely to have a household income of between £12,001 and £16,010. Overall, responses indicate that low annual household income, especially below £16,010, was prevalent among the sample.

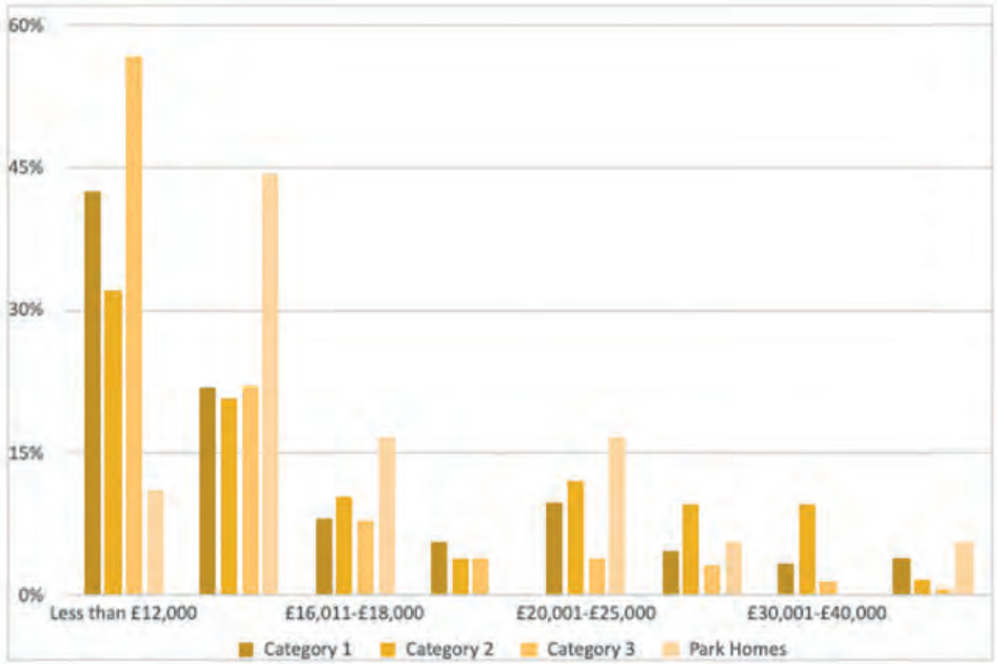

Figure 3.17: Income profile of household questionnaire respondents, disaggregated by WHF funding category.

When examining the relationship between income and subjective fuel poverty, it is helpful to collapse annual income bands into two categories: £16,010 or below, and over £16,010. £16,010 is a helpful distinguishing number because it is the one used in fuel poverty programmes (such as ECO) to confer eligibility under affordable warmth designations.[13] Figure 3.18 below shows that marginally better outcomes have been achieved for respondents with an income of over £16,010. The proportion of respondents able to keep their homes warm in this category post-intervention increased by 64 percentage points, whereas the proportion of those who could keep their homes warm in the £16,010 or below category post-intervention increased by 57 percentage points. This difference is small and was not found to be statistically significant, but could suggest that a small proportion of households require support to improve their incomes, as well as the energy efficiency of their homes and heating systems, if they are to be lifted out of subjective fuel poverty through an intervention.

13. See, for example, The Electricity and Gas (Energy Company Obligation) Order 2014. Schedule 1, Affordable Warmth Group Eligibility.

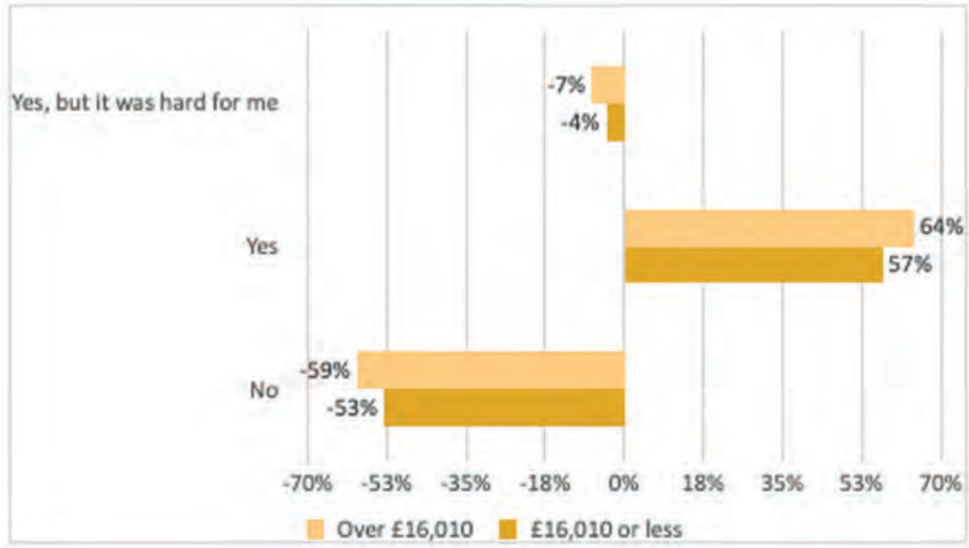

Figure 3.18: Percentage point changes in responses to the subjective fuel poverty question post-intervention, disaggregated by income.

3.2.2.5. EPC bands

WHF operational data (n=22,986) shows that the majority of Category 1, Category 2, and Park Homes beneficiaries had pre-intervention EPC bands of D or E, together accounting for two-thirds of all beneficiaries (see Figure 3.19). EPC band F homes comprised 18% of beneficiaries, with the worst-performing homes, those in EPC band G, making up 7% of WHF beneficiaries. Furthermore, 8% of beneficiaries were living in an EPC band C home prior to their intervention, and would therefore not be considered fuel poor under the LILEE indicator. Although shown as 0% in Figure 3.19 (due to rounding), a very small number of beneficiary homes, 66 in total, were EPC band A or B.

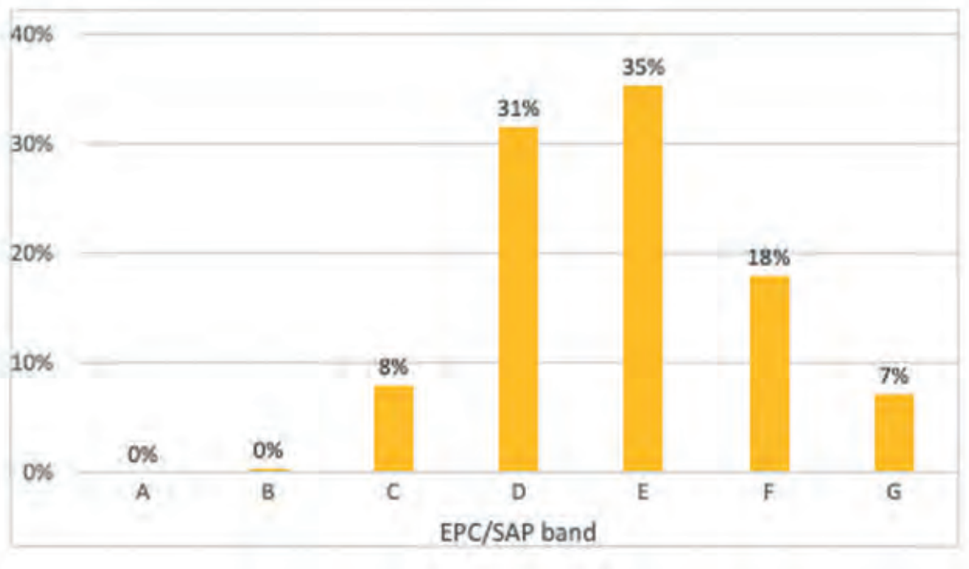

Figure 3.19: Pre-intervention EPC/SAP band of homes supported through the WHF.

Figure 3.20 below shows that there were small but statistically insignificant differences in subjective fuel poverty depending on pre-intervention EPC band. Notably, 79% of respondents with a pre-intervention EPC band C reported being unable to keep their home comfortably warm, representing the highest of all EPC bands.

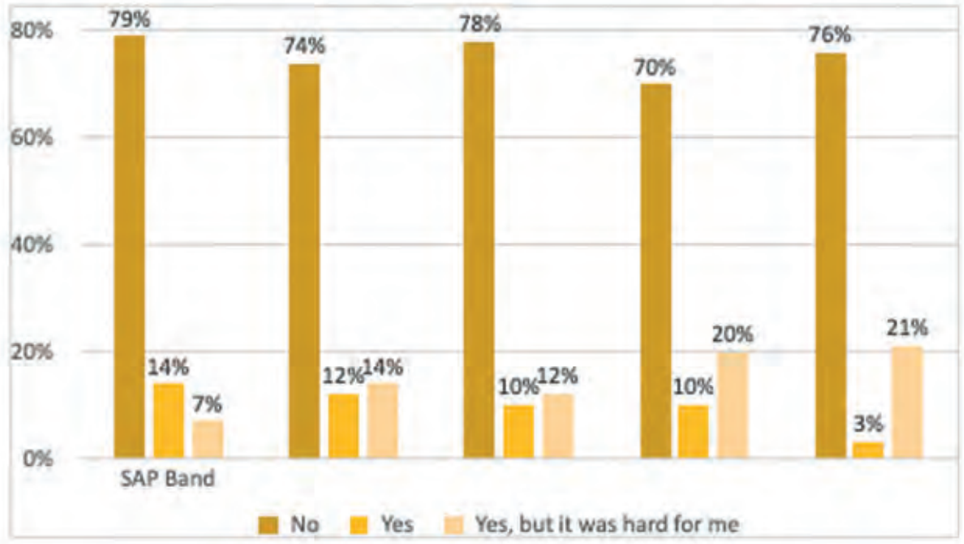

Figure 3.20: Responses to the questionnaire item 'Before you received your new measures, could you keep your whole house warm when it was cold outside?', disaggregated by EPC band of the beneficiary home.

Furthermore, Figure 3.21 below shows that post-intervention, Category 1 and Category 2 beneficiaries whose homes had been improved to EPC band C or above were marginally more likely to report being able to keep their homes warm. However, the difference is small, and the finding not statistically significant.

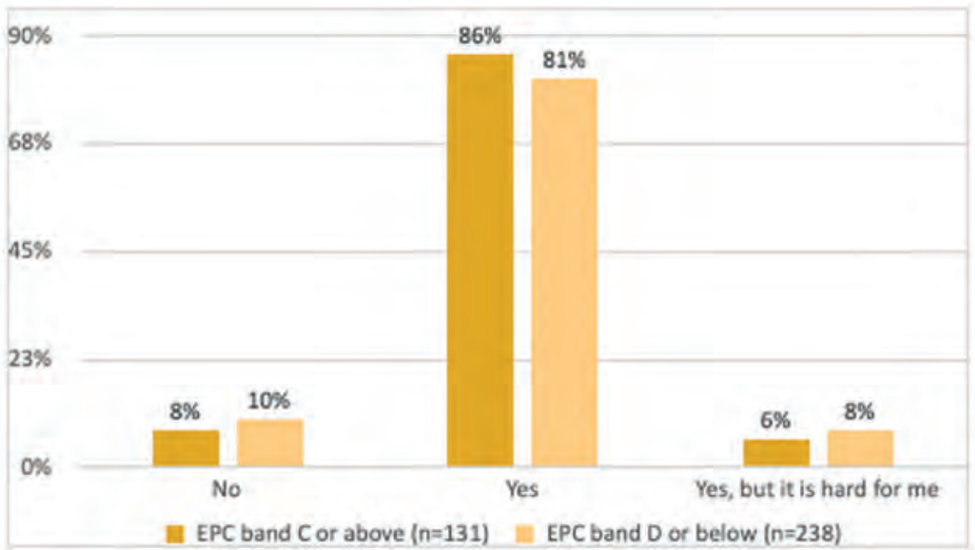

Figure 3.21: Responses to the questionnaire item 'Since you received your new measures, can you now keep your whole house warm when it is cold outside?', disaggregated by whether the home was EPC band C or above, or not, post-intervention.

3.2.2.6. Eligibility

Four eligibility criteria were utilised by the WHF, defined as follows:

- Affordable Warmth Benefits, whereby one or more of the household occupants is in receipt of a means-tested benefit.
- ECO Flex, whereby the household qualifies for assistance through meeting the local authority's flexible eligibility criteria.
- Fuel Poverty, whereby the household has had a fuel poverty assessment carried out.
- Index of Multiple Deprivation (IMD), whereby the household is located in a Lower Super Output Area which is in the top 25% of most deprived areas in the country.

WHF operational data (n=48,619) suggests that Affordable Warmth Benefits and Fuel Poverty were the most commonly used eligibility pathways across all four WHF funding categories, each comprising approximately a third of all beneficiaries. ECO Flex and IMD were the pathways used for 14% and 16% of WHF beneficiaries, respectively (see Figure 3.22 below). A small proportion (2%) of households had other eligibility pathways defined in WHF operational data.

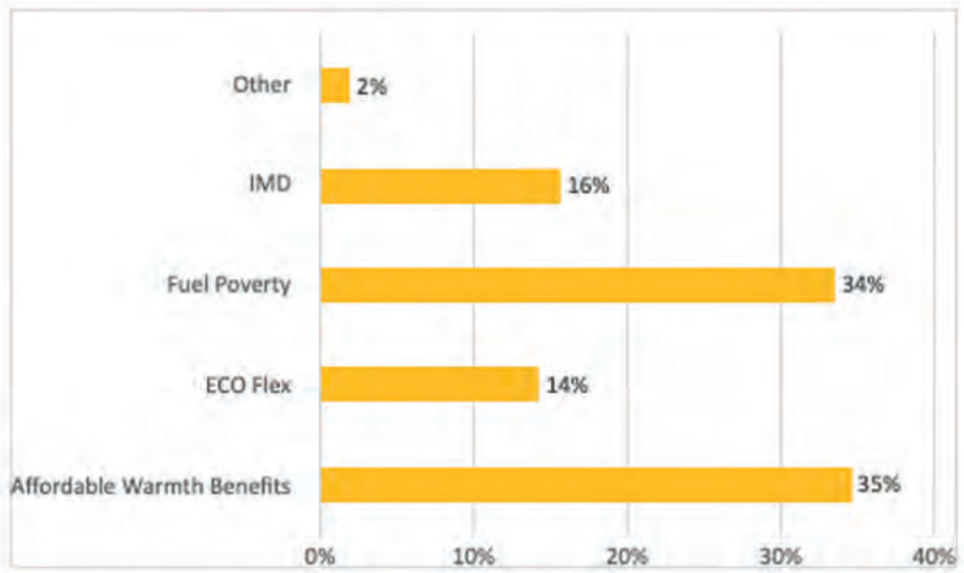

Figure 3.22: Eligibility pathways for households supported through the WHF.

In terms of eligibility criteria, there were no significant differences in subjective fuel poverty, depending on which eligibility pathway had been used to confer eligibility. Figure 3.23 below shows that while respondents who had been brought into the WHF through ECO Flex were less able to keep their homes warm pre-intervention, findings on any associations between eligibility criteria and subjective fuel poverty were not found to be statistically significant.

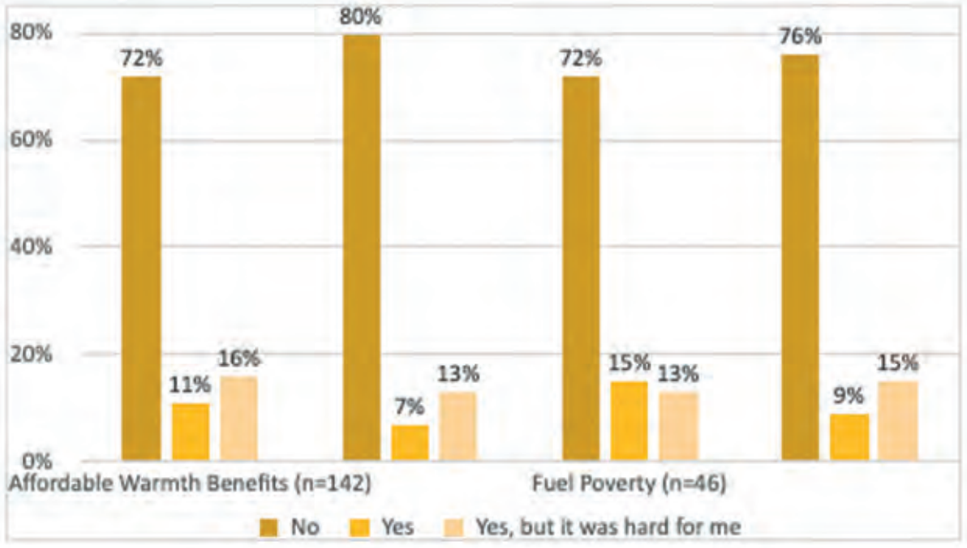

Figure 3.23: Figure 3.16: Responses to the questionnaire item 'Since you received your new measures, can you now keep your whole house warm when it is cold outside?', disaggregated by eligibility pathway.

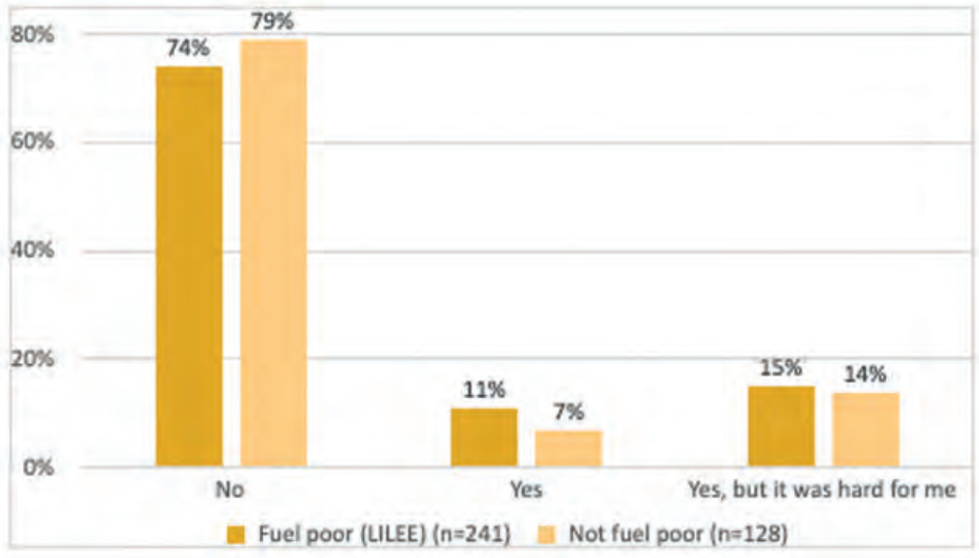

Figure 3.24: Responses to the questionnaire item 'Since you received your new measures, can you now keep your whole house warm when it is cold outside?', disaggregated by whether a recipient was defined as fuel poor or not fuel poor by the LILEE metric pre-intervention. Note that this figure applies to Category 1 and Category 2 households only.

3.2.2.7. Technical fuel poverty status (LILEE)

Finally, it is interesting to compare the subjective fuel poverty indicator to the technical fuel poverty indicator (LILEE) used in the energy modelling analysis. It could be hypothesised that those defined as fuel poor under LILEE will be less able to keep their homes warm pre- and post-intervention. However, analysis of merged household survey data and energy modelling data for Category 1 and Category 2 beneficiaries does not support this hypothesis.

Figure 3.24 below shows that pre-intervention, households defined as fuel poor under LILEE were more able to keep their homes warm pre-intervention: 11% of LILEE respondents replied that they could do so, compared to 7% of those not defined as fuel poor under LILEE. These differences are small, however, and should not be interpreted as statistically significant. Nevertheless, they show that a significant proportion of respondents that would not be captured by the technical definition of fuel poverty (LILEE) were struggling to keep their homes warm prior to the installation of their new heating system.

This analysis holds when considering the post-intervention findings. Figure 3.25 below shows that there was effectively no difference in responses to the subjective fuel poverty item on the questionnaire, depending on whether beneficiaries were defined as in or out of fuel poverty (LILEE) after their intervention had taken place.

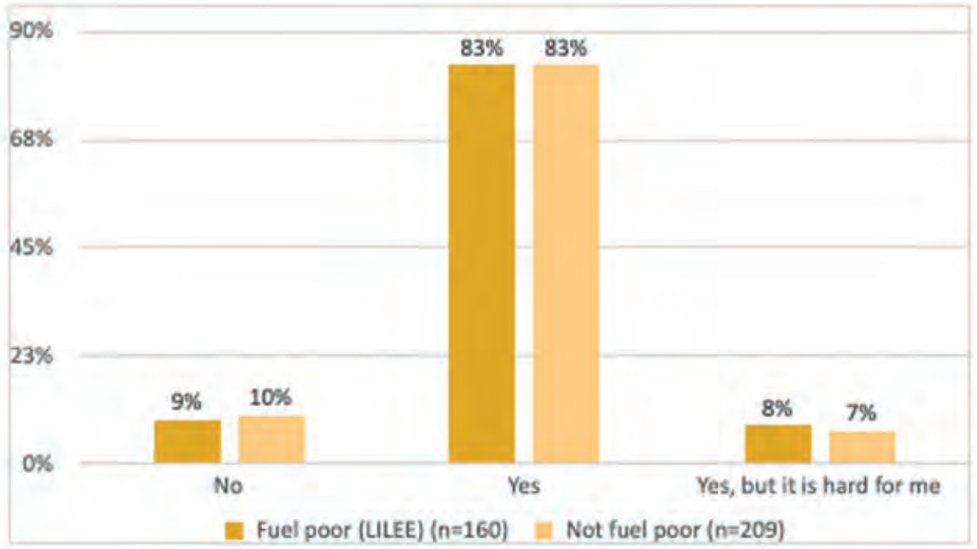

Figure 3.25: Responses to the questionnaire item 'Since you received your new measures, can you now keep your whole house warm when it is cold outside?', disaggregated by whether a recipient was defined as fuel poor or not fuel poor by the LILEE metric post-intervention. Note that this figure applies to Category 1 and Category 2 households only.

These findings raise the potentially interesting question of how well a technical fuel poverty indicator (LILEE) reflects the subjective lived experiences of fuel poverty before and after an energy efficiency intervention; they also suggest that there is perhaps a need to consider multi-indicator approaches to measuring fuel poverty and assessing the delivery performance of energy efficiency programmes.[14] This question is considered in detail in the corresponding blueprint.

3.3. Impacts on energy rationing practices

This section discusses the impact of WHF interventions on the prevalence and intensity of energy rationing practices and coping tactics. It is now well established that fuel poverty and energy vulnerability are closely connected to practices of limiting household spending on heat, food and other essentials (e.g. childcare items). This is sometimes referred to as the 'heat or eat' trade-off, but is better defined as a more complex arrangement of rationing practices that stem from household budgets existing in a continual state of precarity and uncertainty.[15] The 'heat or eat' trade-off is therefore less a binary choice between one essential and another, but a recognition that energy and food consumption have an inherent elasticity and flexibility that can be controlled and limited by households. Accordingly, energy and food are among the first forms of household consumption that are rationed to save money if a household is experiencing financial difficulty. In addition to rationing heat and other household essentials, it is also recognised that fuel-poor and vulnerable households will often engage in alternative practices to offset the negative impacts of rationing. These are sometimes referred to as 'coping strategies' or 'coping tactics'. A significant impact indicator of fuel poverty programmes is therefore the extent to which rationing practices and coping tactics have reduced after an intervention.

14. Such approaches are being developed in Europe, such as in the Netherlands, and discussed in academic literature. For example, see Middlemiss, L., Mulder, P., Hesselman, M., Feenstra, M., Tirado Herrero, S. and Straver, K. (2020) Energy poverty and the energy transition: Towards improved energy poverty monitoring, measuring and policy action; Therna, J. and Vondung, F. (2020) EPOV Indicator Dashboard: Methodology Guidebook; Castaño-Rosa, R., Solís-Guzmán, J., Rubio-Bellido, C. and Marrero, M. (2019) Towards a multiple-indicator approach to energy poverty in the European Union: A review, Energy and Buildings 193: 36–48.

15. Snell, C.J., Lambie-Mumford, H. and Thomson, H. (2018) Is there evidence of households making a heat or eat trade off in the UK? Journal of Poverty and Social Justice 26 (2). ISSN 1759–8281

Figure 3.26 below shows that respondents from all WHF funding categories were cutting back on their heating prior to their intervention. For instance, 41% of all respondents said they were cutting back on their heating 'all or most of the time', and 38% said they did this 'some of the time'. These findings are relatively uniform across all categories, with a slightly higher proportion of Category 3 respondents reporting that they rationed their heating 'all or most of the time' (47%). Park Homes respondents were far less likely to report this, with a smaller proportion of 15% saying that they ration their heating 'all or most of the time'. Half, however, reported doing so 'some of the time'.

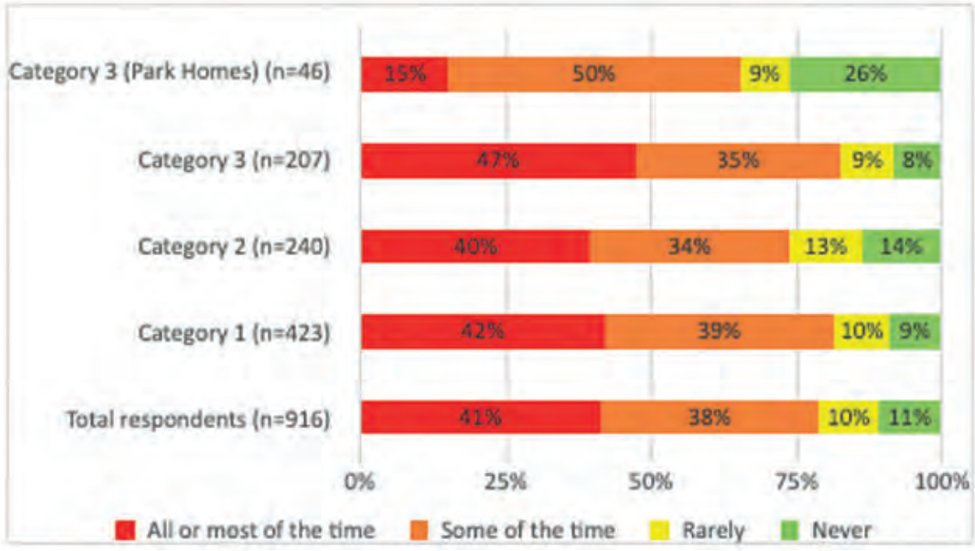

Figure 3.26: Responses to the questionnaire item 'How often in winter or when it was cold outside would you have your heating on lower or less often than you would have liked so that your energy bill was not too high?' pre-intervention, disaggregated by WHF funding category.

These findings are buttressed by evidence from the household interviews. Category 1 and Category 2 interviewees frequently discussed having the heating on lower or less often than they would like, to save money; noting for example that *"you would think, 'okay, no it's not really that cold, I'll just leave them off' to kind of keep the costs within reasonable bounds."* As discussed elsewhere in this section, the drivers for heat rationing practices were complex, propelled by inefficient and difficult-to-use storage heaters and low household incomes. Interviewees also discussed the range and extent of coping tactics they would engage in to try and stay warm without needing to use their heating, such as using duvets, blankets, and multiple layers of clothing; using unserviced and potentially dangerous appliances to space heat (e.g. cookers in kitchens); or staying in bed for several hours across the day. Some interviewees also discussed what could be termed practices of 'evacuation', whereby they would visit the homes of friends or family, or spend time in public spaces such as pubs to avoid being cold at home. As discussed in more detail in the next section, heating only one room and spending as much time as possible there was also a common coping tactic mentioned by interviewees.

Category 3 interviewees also discussed pre-intervention practices of cutting back on heating. For example, one interviewee discussed not using their heating system because their boiler was old and inefficient, *"so, basically, all I'm using is my electricity for my lights, my record player and stuff, and I've got a gas cooker."* A second Category 3 interviewee concurred, describing how *"I have to switch the heating off or the water off if it's on too long. I know it's on automatic but sometimes if I'm not using it I'll switch it off just to save a little bit."* In many cases these practices were driven by financial vulner-

ability and low household incomes, but were also linked to wider factors such as household composition and disability. For instance, one family of four, composed of two adults, one adult child, and one pre-teen child, described cutting back on their heating to avoid using energy and potentially falling into debt. However, this had multiple negative ripple effects, such as making home schooling more difficult for their pre-teen child during the Covid-19 pandemic. Beyond these examples, it is noteworthy that Category 3 interviewees also mentioned the use of secondary heating appliances to heat specific rooms, which will be discussed more in the context of domestic space use in the next section.

As the last quotation in the previous paragraph indicates, interviewees also discussed rationing hot water as well as heating to save money. Specifically, households reported cutting back on practices that require hot water, such as bathing, showering, and washing the dishes. One interviewee, for example, said that they would limit their own use of hot water to ensure that their elderly mother had enough to meet her needs throughout the day: *"Of a morning when I was getting ready for work, I got used to washing in cold water."* Other interviewees discussed how they would boil dishwater in their kettle to obtain hot water to avoid using their heating and mains water supply; *"we just used to use the dishwater and boil the water in a kettle if we wanted it."* In a similar way to heating, the drivers of these practices were complicated, but often related to the inefficiency or inadequacy of immersion heaters or solid fuel water-heating systems. For example, one interviewee said that their immersion heater was so inefficient that *"you've got to run about two gallons of water off before you get any hot water through,"* thereby wasting electricity and water in the process. A second interviewee agreed, noting that *"if I wanted a bath I had to leave it on for a good two hours."*

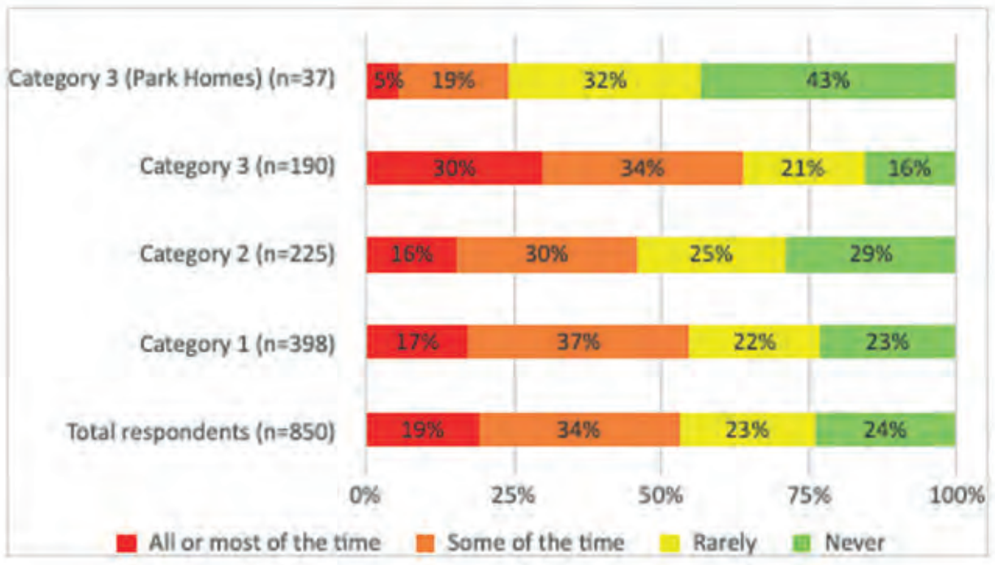

Figure 3.27: Responses to the questionnaire item for how often respondents 'Didn't buy, or bought fewer things that were really essentials (e.g. food, fresh fruit/veg, clothes etc.)' pre-intervention, disaggregated by WHF funding category.

Figure 3.27 above also shows that food and other essentials were commonly being rationed by Category 1, Category 2, and Category 3 respondents. Specifically, 19% of all respondents said they were cutting back on food and essentials 'all or most of the time', and 34% said they were cutting back 'some of the time'. The pattern observed in Figure 3.26 is largely repeated here, with Category 3 respondents more likely to report rationing food and essentials 'all or most of the time' (30%). Similarly, Park Homes respondents were less likely to report rationing food and essentials, with 19% saying they do so 'some of the time' and only 5% doing so 'all or most of the time. Furthermore, 43% of Park Homes respondents reported 'never' rationing food or essentials.

Category 1 and Category 2 interviewees discussed a wide range of household essentials that they would cut back on to save money. Food rationing was manifested in households tightly controlling their spending at weekly or monthly supermarket shopping trips, or shopping only at perceived budget supermarkets. One interviewee said that:

"I don't shop in Tesco or anything like that […] I tend to shop in Aldi and Lidl because the cost is, there is a big difference […] and then, I wouldn't have an odd takeaway or something, I don't do that anymore because it is quite expensive to do that."

Other interviewees commented that they would cut back not so much on food, but on other costs that were perceived to be essential: *"Car servicing, buying clothing, haircuts, stuff like that."* Cutting back on transport costs and school costs were also noted by some interviewees, with one remembering that *"there was always a choice between whether we had heating or whether we were able to have a new school uniform."*

Notably, interviewees further revealed that they would cut back on food and essentials, to enable them to afford to heat and power their homes to a level appropriate for their health and medical needs. It is widely recognised that households with illnesses, disabilities and cold-related health conditions require a more substantial level of heat and power than other households, and therefore have higher required fuel costs to stay warm and well. This is sometimes referred to as a 'satisfactory heating regime', which in one articulation is "23°C in the living room (zone 1) and 20°C in other rooms (zone 2), for 16 hours every day" for households where at least one member is aged 75 or older, or at least one member has a long-term sickness or disability. In contrast, for households classified as non-vulnerable "21°C in the living room (zone 1) and 18°C in other rooms (zone 2) for nine hours a day during the week and 16 hours a day during the weekend" is deemed to be satisfactory.[16] Based on these definitions, satisfactory heating regimes are more expensive to achieve for vulnerable households, all else being equal. Correspondingly, some interviewees reported cutting back on food and essentials to try and afford to keep their home (or parts of it) at a temperature they needed. For example, one interviewee said that *"we shopped where it was cheapest because obviously the warmth came first with my wife's [health conditions …] and so we had to obviously cut down on what we spent on other things"*; and a second concurred that *"because I suffer from poor circulation, my legs get really, really cold, and so on, so I'd have to sacrifice other things to make sure that the electricity was on."* However, as noted in Section 3.8 below, this had other health consequences, specifically for diet and healthy food consumption.

For Category 3 interviewees, practices of cutting back on food and essentials were also prevalent. Interviewees discussed the difficult trade-offs they would have to make between affording different essentials, which for some were driven by low household incomes that were shaped in part by what were perceived as inadequate state welfare benefits. For example, one Category 3 interviewee described a continual process of 'juggling' different outgoings, depending on when payment deadlines were due, as well as requesting reduced payments from their energy supplier to help them to be ableto afford other household essentials. Another interviewee discussed cutting back on food and clothing, as well as energy usage over the winter period:

"Yes, you just cut back generally in food and clothing, it is the winter and so therefore you're in the house, well I'm in the house all day anyway. In fact what I did was wear more clothes and use the blanket to keep warm."

16. Scottish Government (2020) Scottish house condition survey: 2019 key findings. Fuel Poverty.

For Category 3 interviewees, cutting back on energy costs to keep food and other essentials within the realm of affordability was also commonly discussed. As noted previously, these practices were not reducible to the commonly noted 'heat or eat' trade-off, but involved complex forms of decision making and 'juggling' different payment cycles and outgoings to try and make ends meet.

After intervention, the frequency and severity of rationing practices reduced significantly. It is useful here to focus on changes in the proportion of respondents who reported rationing heat and essentials 'all or most of the time'. This is because households that ration heating and hot water persistently are more likely to live in homes that are continuously cold, and are therefore more likely to develop cold-related physical and mental ill-health. Likewise, persistently cutting back on food and other essentials can point to dietary deficiencies and acute financial vulnerability in everyday life.

Figure 3.28 shows that the proportion of total respondents rationing their heating 'all or most of the time' reduced by 20 percentage points, from 41% to 31%. The majority of these reductions were reported by Category 1 and Category 2 households, which reported reductions of 23 and 25 percentage points respectively. The proportion of Category 3 respondents rationing their heating 'all or most of the time' reduced by 12 percentage points, indicating that post-intervention, approximately one-third of Category 3 beneficiaries were still frequently engaging in harmful rationing practices. The proportion of Park Homes respondents rationing their heating 'all or most of the time' reduced by 8 percentage points, from 15% to 7%.

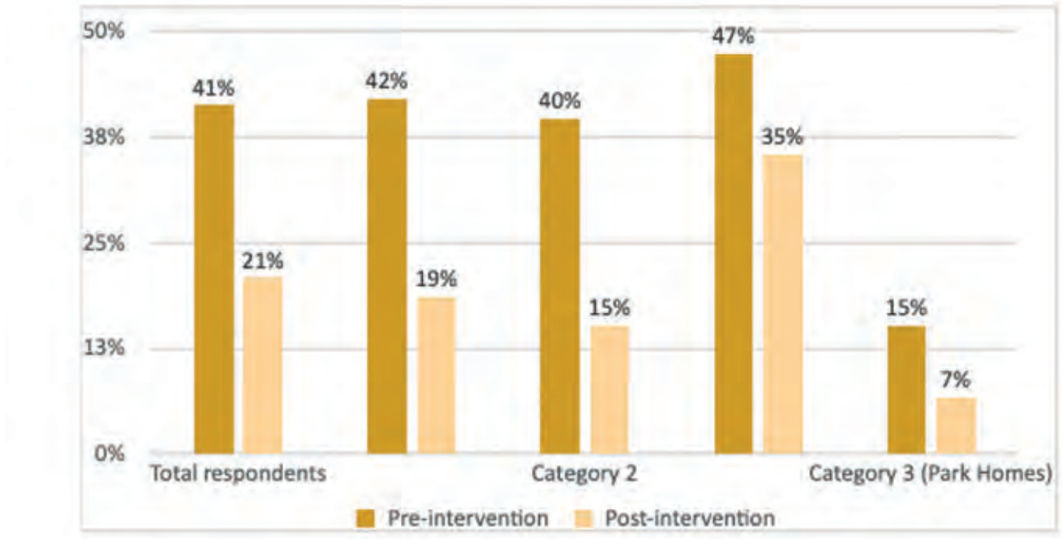

Figure 3.28: Change in the proportion of respondents reporting they rationed heating 'all or most of the time', pre- and post-intervention.

A similar pattern is observed in reported reductions in the rationing of food and other essentials. Figure 3.29 shows that the proportion of total respondents rationing food and essentials 'all or most of the time' declined by 7 percentage points, from 19% to 12%. As in Figure 3.28 above, the majority of these reductions were reported by Category 1 and Category 2 households, which both reported reductions of 8 percentage points. The proportion of Category 3 respondents rationing food and essentials 'all or most of the time' reduced by 4 percentage points, meaning that post-intervention, just under 30% of Category 3 beneficiaries were still frequently rationing food and other essential household items. The proportion of Park Homes respondents rationing food and essentials 'all or most of the time' reduced from 5% to zero.

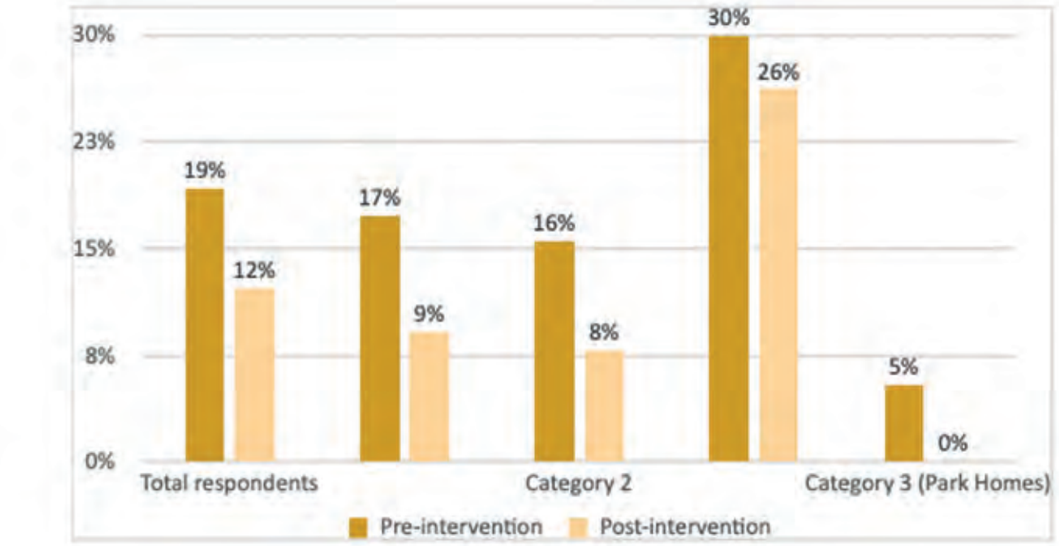

Figure 3.29: Change in the proportion of respondents reporting they rationed essentials (e.g. food, hygiene products) 'all or most of the time' pre- and post-intervention.

As Figure 3.29 above suggests, it is interesting to focus on some of the reasons why reductions in energy rationing practices were not prevalent among Category 3 beneficiaries. A common theme when this was discussed in interviews was persistently low household incomes and high outgoings, which were not or could not be addressed through an advice-based intervention. One interviewee, for example, said that after their intervention,

"I'm still struggling, because I'm not working at the moment, you do struggle. I can understand families struggling with kids and that, I really can, because I'm on my own I'm alright, and I can go a couple of days without electric, do you know what I mean? Or gas, and then I can wait for some money, but if you've got kids and you've got to feed them and cook for them then I can see, people that have got more responsibility than me, they'll be in trouble."

However, there were examples of positive improvements to the frequency and severity of rationing practices among Category 3 beneficiaries, but many were still worried about the precarity and vulnerability of their financial situations. For example, in reference to a monthly direct debit, one interviewee noted:

"I don't think I pay enough. I pay £38 a month. I'm worried sick that this is not going to be enough. I mean, again, when I was on Universal Credit, it was all I could possibly afford. You know, it sounds daft, but the month that I paid that and paid the TV licence, I went without food anyway. Touch wood, I can afford food now, but as I say, when I was on Universal Credit, the month that I paid the television licence, which was just up for £40 a month and the £38 on energy, well, I always went at least a week without food. I always did. Touch wood, I'm okay now."

This evidence suggests that for Category 3 beneficiaries, improvements in the intensity of rationing practices did occur but were sometimes perceived as temporary; and that due to ongoing precarity, the possibility of needing to ration more frequently in the future was always present.

3.4. Impacts on domestic space use and the use of the home

In addition to impacts on the severity and prevalence of energy rationing practices among WHF beneficiaries, there were further impacts on what can be termed 'domestic space use' and the use of the home. Previous research has highlighted the ideal values that are positively associated with home, or what could be described as the things that make homes homely. These include home as a place that

offers privacy, security, comfort, independence, safety, control, relaxation, and belonging.[17] However, for fuel-poor and vulnerable households, home can too often be a place of exclusion and entrapment, failing to meet their needs and requirements, and creating feelings of alienation and resentment towards the home itself.

Among WHF beneficiaries, this was manifested most clearly in the extent to which they did not use or did not fully use the majority of rooms in their home because they were too cold. Instead, they would spend much of the day occupying only one or two rooms, and focused their efforts on trying to make these rooms as warm, comfortable and bearable as possible – a practice sometimes referred to as 'spatial shrink'. Mostly, but not always, this would be the living room or lounge, but interviewees also described only heating the downstairs of their homes and not the upstairs. As interviewees described:

"To be honest with you, when we were in the sitting room, we'd just have the gas fire on and the door closed, and all the other rooms weren't heated."

"The only [heater] that was any good was the one in the lounge. The rest of the property was always cold. We only tended to use the ones in the rooms that we were using, i.e. the lounge and our bedroom. The kitchen, we never used; the hallway, occasionally; and the other bedroom, never; and the bathroom, never, because of the cost."

"I mean, there was no real heat in the house. I had one night storage heater downstairs, which gave me reasonable heat. That was it, really. The rest of the house was best to stay out of in the winter."

However, the necessity of using different rooms of the home to perform different practices (e.g. cooking, going to the toilet) meant that interviewees would periodically have to leave rooms that were warm and enter cold ones. These experiences were described as galling; one interviewee said that *"if you walked into the kitchen, it'd be stone cold"*, while a second recalled that *"I had put a towel rail in the bathroom to try and help there, because there is no storage heater in there, but you just felt cold when you opened the door."* Some interviewees described the 'preparation' that was required to leave the main heated room and go elsewhere in the house, which often involved adding layers of clothing or pressing a hot water bottle to the body:

"It's okay when you're in the room with the wood burner, but then when you go into that a colder room, you know, you feel like you've got to wear a dressing gown and, you know, warmer stuff really."

Others would prepare for using different rooms of the home by trying to pre-emptively heat them for when they were likely to be used, for example by moving plug-in radiators around the home. On the other hand, some interviewees had developed ways of moving household practices that would normally take place in other rooms of the home into the single heated room. This included instances of sleeping in the living room, going to bed early to watch TV in the evening, or families sleeping together in the same room or bed to keep each other warm. It should be emphasised that these practices were prevalent among Category 3 interviewees as well as Category 1 and Category 2 interviewees, even in situations where central heating systems were present. For example, two Category 3 interviewees described their experiences as follows:

"We didn't use the front room. We just used the kitchen when we had to, but didn't have any heating on in there, and just heated up two of the bedrooms. And my daughter stayed in my room."

"I can keep warm by turning off the central heating in the rooms that are not in use […] it's working but it's working for me and not for the house, does that make sense? I couldn't afford to have the central heating on because it will be too expensive, so I only have it on in the rooms if I'm in them, do you know what I mean?"

It should also be emphasised that for the majority of interviewees who discussed these practices, they were experienced as mentally exhausting, demeaning, and, to a certain degree, dehumanising. Aside from this, there is evidence that leaving and entering rooms that are heated to polarised temperatures (e.g. warm to extreme cold) is a health risk, particularly with respect to cardiovascular disease. For instance, studies have found that a 1°C drop in living room temperature results in a 1.3mmHg rise in systolic blood pressure, and a 0.6mmHg rise in diastolic blood pressure amongst those aged 65–74. Accordingly, leaving one room and entering a cold(er) room can be associated with repeated acute rises in blood pressure and potentially chronic hypertension.[18]

Category 1 and Category 2 interviewees experienced partial or complete reversals in these situations following the installation of their new heating systems. As they put it:

"It doesn't matter which room you go into, the property is warm which is a huge – it takes a lot of getting used to […] because we are normally used to walking out of the heating into a freezing cold room, so obviously the difference is that the full property is warm […] we can go into whatever room we want now, and it is all the same temperature."

"It's cut down on condensation on the rooms that we weren't using that we didn't put the heating on, obviously because of the bills. And we'd go in there and there was a lot of condensation on the windows. Now, because we have the bungalow, it's only a small bungalow, but because we have it all the same temperature all the way through so we can freely go from one room to the other, it's cut down a lot on the condensation."

As these quotations suggest, because previously unheated and unused rooms were now heated to a comfortable temperature, beneficiary homes as a whole were described as more pleasant and amenable places to spend time in. They became places where privacy, security, comfort, independence, safety, control, relaxation, and belonging could be achieved.

In turn, this led to wider impacts that interviewees highlighted and discussed. For one interviewee, having a home that was warm in every room prevented them from going to bed early to stay warm when their husband was working away:

"I think just being warm makes you feel … I like to spend more time sat downstairs now. My husband works away all week, so I tended to, rather than keep it warm downstairs, to go to bed and sit in bed with covers on so I'd stay warm, but now I spend a lot more time, well, normally, I spend a lot more time downstairs than I used to."

A second interviewee described being confined to the downstairs of their home due to disability, but would in addition only stay in their living room and not access any of the other downstairs rooms, because they were cold. This included a 'middle room' and a porch, the first of which contained a computer. Post-intervention, both rooms were able to be used again, which the interviewee discussed as follows:

"The middle room I have a suite in, it is like a sitting room, I have also got a computer in there. I have got a chair in the corner now next to the radiator where I sit and meditate, I call that my cosy corner. I had a little […] heater in my porch but I could only put that on for a few hours now and again. Whereas now with the radiator in the porch I can go in there as well."

Although interviewees did not make an explicit link between the indoor temperatures of different rooms and health conditions, one interviewee did touch on the ways that being able to heat all the rooms of their home had potentially improved their partner's COPD:

"I'd put [the improvement] down to the heating. The fact that he can go in any room now and be warm. You know, before, in the winter, he spent most of his time in the living room. Only really went upstairs either to use the bathroom or to go to bed. So it's made a big difference in that respect."

Finally, opening up the home beyond single heated rooms was described as having a tangible impact on social relationships and socialising. Previously, some interviewees described not inviting friends or family members to their home because they were embarrassed that most of the rooms were not heated; especially the bathroom, which visitors to the home may have to use. Another interviewee said that living in one room of the home placed pressure and stress on their relationship with their children. As they put it,

"It's just made the house really liveable because what we were having to do was, in the evenings, we'd all be in the lounge because that's where we'd put a fire on, light the fire, and all just huddle around there. But now, we can spread out a bit more, and the boys are happier to go to their own beds, whereas they wanted to sleep with me before, with hot water bottles. So, it has enabled us to use the dining room more to eat our dinner, and to go up to bed, and they'll sleep in their own beds. So, yeah, it has, yeah."

This sense of new heating system installations 'making the house really liveable' is an appropriate way of summarising this impact. For several interviewees, the links between comfort, contentedness, happiness, personal expression, and home have been re-established through their interventions, allowing them to live in places that fulfil the social norms of what a home should be like in an ideal society.

17. Ellsworth-Krebs, K., Reid, L. and Hunter, C.J. (2015) Home -ing in on domestic energy research: "House," "home," and the importance of ontology, Energy Research & Social Science 6: 100–108.

18. NEA (2017) Connecting Homes for Health: Bringing affordable warmth to vulnerable off-gas households, p.24.

3.5. Impacts on heating system control

This section examines changes and improvements in the WHF beneficiaries' ability to control their heating systems and indoor temperatures. Category 1, Category 2, and Park Homes beneficiaries were eligible for measures, in part, because they were without a central heating system, and were instead reliant on different kinds of storage heaters and solid fuel heating systems to try and keep their homes warm. These energy-inefficient and expensive heating types were often the primary driver of fuel poverty for beneficiaries. In addition, a difficulty that was expounded by numerous Category 1, Category 2, and Park Homes beneficiaries was how problematic their heating systems were to control prior to their WHF intervention. Control is here interpreted as a socio-technical practice that involves multifarious interactions between the user or user(s) and the heating system infrastructure – interactions that are shaped by skills, knowledge and experience, as well as wider relevant factors such as dwelling type.[19]

Interviewees with storage heaters in their properties frequently described them as difficult (if not impossible) to control effectively. It is important to note that storage heaters are heterogenous in terms of their age, efficiency and settings, and interviewees explained how their attempts to make their storage heaters release heat in certain ways and at certain times were constantly thwarted.

Most often, this was because of the inflexible ways that storage heaters draw in electricity during the night and release it as heat during the day. One interviewee summarised that *"you have got to bear in mind that you cannot just switch a storage heater on. You have to put it on the day before for it to charge up overnight, and then it gives off heat the following day."* However, interviewees also described several factors that had to be considered when planning and preparing how they would charge their storage heaters for the next day. This included looking at the weather forecast to gauge how warm or cold the next day might be, which would in turn influence their use of the heaters; and attempting to time storage heater charging and use according to when they expected to be in the home, or would use certain rooms the following day. This was not described as a simple process, and would more often than not result in perceived heat waste or their heaters dissipating their heat too early, thus leaving the home cold for the rest of the day. As interviewees put it:

"[They were] rubbish, absolute rubbish. It was nice and warm when you got up in the morning but by nine o'clock at night it was cold because they'd lost all their heat."

"They were in every room. I suppose it gave us control that we could select the bedroom and the living room but they were very inefficient and by four o'clock, whatever heat they'd had would have disappeared anyway."

"They were okay but you just couldn't control them, could you? That's the biggest downfall with them, is you can't control it. If it suddenly turns cold you can't turn them on, and if it turns hot you can't turn them off. So that's the problem with them […] If it suddenly turns cold, you can't turn them on. So they were very uncontrollable."

Several interviewees also talked about storage heating in a binary way of *"you kind of, either had them on or you didn't"*, leading to rooms that oscillated between the extremes of uncomfortably warm in the morning or uncomfortably cold in the afternoon and evenings: *"If it suddenly turns cold you can't turn them on, and if it turns hot you can't turn them off."* The uncontrollability of their storage heaters led some to try to find workarounds or hacks, such as using secondary heating appliances later in the day, or trying to adjust the settings in the morning to prevent the heat from dissipating too early in the day. As one interviewee summarised, however, trying to modify the settings on storage heaters was rarely successful: *"I never actually quite worked out how [to do it], it didn't seem to make that much of a difference."* Where they were present in beneficiary homes, immersion heaters for heating hot water were typically described in similar terms.

These issues, combined with the affordability of the electricity needed to charge them to a sufficient level, meant that the most common response from interviewees was to simply not use their storage heaters at all, or to concentrate on trying to work a storage heater in one room and then spending as much time as they could in that room, as discussed in the previous section. This was exacerbated in situations where interviewees had recently moved into a social or private rented property with storage heaters that they had not encountered previously:

"I don't know if they were old ones or something that had not been replaced in a while but, when I put them on […] you're meant to use them overnight aren't you? And then the heat comes out throughout the day. I did that one of the first nights that I moved in, and it used I think about £9 electric. And there was just no way I could afford that every night so I couldn't use them."

Solid fuel fires and LPG heating systems were also discussed as near-impossible for beneficiaries to control, although for different reasons.

First and foremost, interviewees who had solid fuel systems prior to their intervention discussed the physical and mental labour associated with controlling and using their heating. As one interviewee put it, *"a coal fire does require work."* Notably, older interviewees with solid fuel heating systems, many of whom had been using the same or similar fuel types for decades, often reflected on how carrying, refilling and managing solid fuel systems were becoming more difficult as they aged. One said, for instance, that *"I'll be 80 in a few months' time and I was starting to find it extremely hard to carry the coal up the path and storing the coal, I mean, in the garden and things."* Asked to elaborate on how they used the coal system, the interviewee continued:

"Well, a coal fire is completely different to gas, meaning that you have got to do a certain amount of work with a fire in regards to you come down in the morning. You've got to get the fire going again because it is usually dead. You've got to shake it, get the ashes out, then there is a matter of going down the coal shed, getting your coal. Also, you've got to feed the fire two or three times a day, so that is all work which you don't have with gas, I mean […] As I've just said, I'm 80 in a couple of months and it is starting to get a bit heavy carrying a bucket of coal up a matter of 40 yards, say, 30, 40 yards."

Other interviewees highlighted how the work required to get a fire going would be more difficult at different times of day, especially in the evenings when it was colder. One interviewee, who had just reached the age of 70, described coming home in the evening, tired and in need of warming up, and often not having the energy to go through the methodical process of getting her wood burner going. As she said:

"I'm 70 now. Sometimes, if I've gone out and I've come back […] at the end of the day which is when you want the fire on, sometimes I didn't have the energy to put that on […] I'd come in tired and sit down. The house would get colder and colder and colder and I wouldn't have the energy to light the fire so … I could've caught hypothermia, I could've done that. I would think, 'Oh my God, I'm getting too cold to do anything here.' I'd have to go to bed and warm up in bed."

For Park Homes interviewees, control (or a lack of it) was discussed in a markedly similar way. Older Park Homes residents tended to experience little to no issue with their heating systems in terms of their technical use and operation, but described how they found the physical labour of carrying, connecting up, and disposing of heavy LPG bottles increasingly hard. One interviewee noted that this was worst in the winter, where they would have to leave their Park Home in the cold and dark to connect and adjust LPG bottles to their supply.

As these different interviewee testimonies show, issues related to control and controlling storage heaters, LPG heating systems and solid fuel heating systems were common, and often negatively impacted on the thermal comfort, wellbeing and domestic space use of WHF beneficiary households prior to their interventions taking place. They would not release heat in the rooms or at the times their users desired, and would struggle to maintain comfortable temperatures as the day wore on. The uncontrollability of these systems would lead to them simply being switched off or not used, with households resorting to different kinds of physical and mental labour that were invariably described as exhausting and, more often than not, futile. In other words, controlling these heating systems was a constant battle that was rarely if ever won by the householders themselves.

Evidence from the household survey shows that there were significant improvements in WHF beneficiaries' ability to use and control their heating systems following their intervention.

As Figure 3.30 below shows, 77% of respondents said that there were improvements in how easy their heating system is to use after their intervention. In addition, these improvements were more prevalent among responses from Category 1 and Category 2 beneficiaries, with 93% and 79%, respectively, replying that they had experienced improvements. In comparison, 44% of Category 3 respondents and 49% of Park Homes respondents had experienced improvements.

19. For an example of this approach, see Larsen, S.P.A.K., Gram-Hanssen, K. and Marszal-Pomianowska, A. (2019) Smart home technology enabling flexible heating demand: implications of everyday life and social practices.

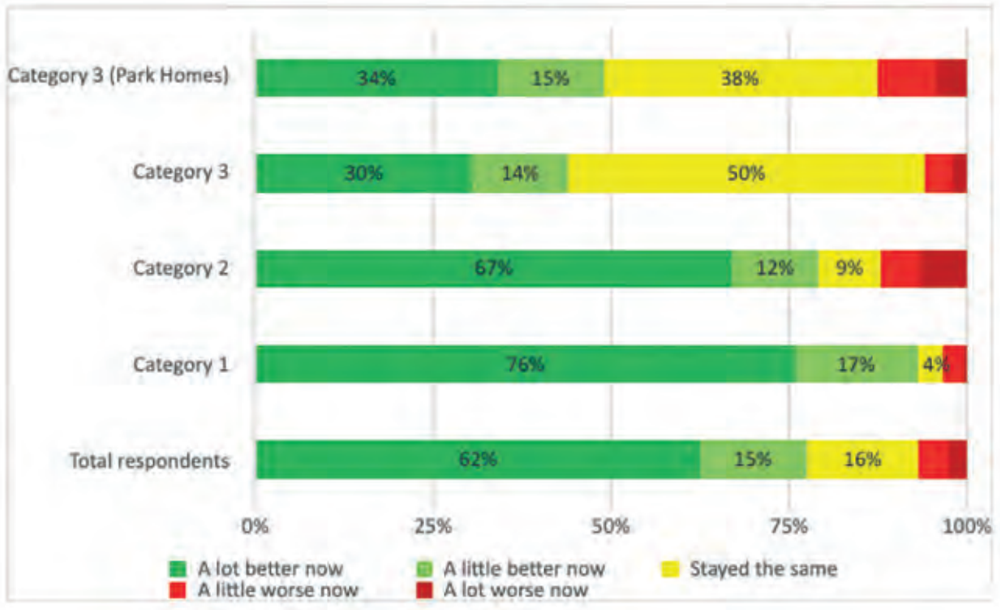

Figure 3.30: How easy questionnaire respondents' heating system is to use post-intervention, disaggregated by WHF funding category.

Furthermore, Figure 3.31 shows a similar pattern: 79% of respondents reported that they have more control over their heating system than they had before. Again, these improvements were more prevalent among responses from Category 1 and Category 2 beneficiaries, with 93% of Category 1 respondents and 81% of Category 2 respondents replying that they have more control over their system post-intervention. Likewise, 47% of Category 3 respondents and 46% of Park Homes respondents have experienced improvements.

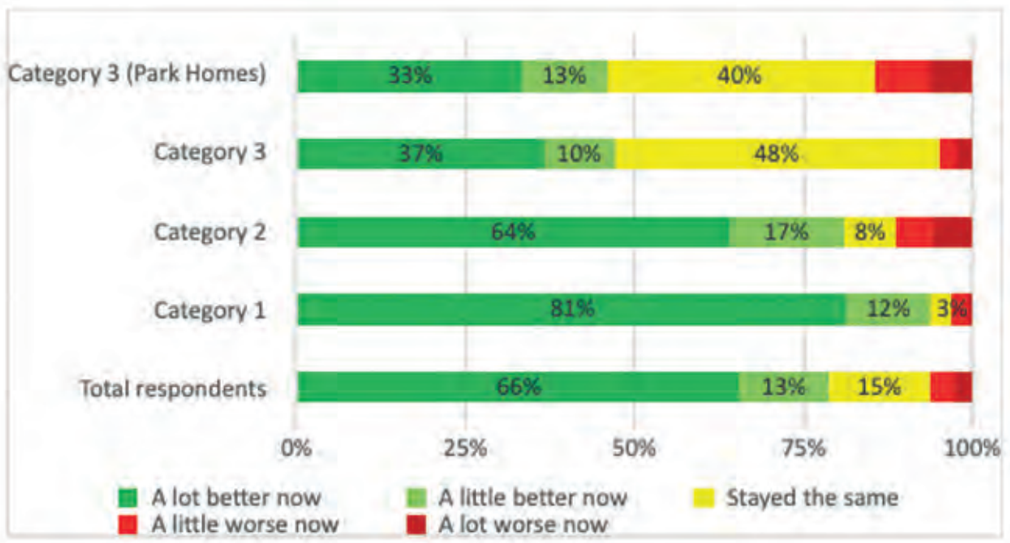

Figure 3.31: The amount of control questionnaire respondents feel they have over their heating system post-intervention, disaggregated by WHF funding category.

In interviews, the recipients of first-time central heating installations discussed how replacing their storage heaters and solid fuel heating had dramatically improved the control they felt they had over their homes. The installation of improved heating controls, especially thermostats and timers, were credited by interviewees with granting them control over their home environment.

A common theme across all household interviews was the adaptability and flexibility that new heating controls conferred. In contrast to storage heaters and solid fuel systems, the installation of timers and thermostats enabled beneficiary households to explore different configurations of warmth in different places in their homes, and at different times of day. Some referred primarily to the ability to manually adjust the temperature in their homes with a thermostat, noting that this was the main way they controlled the heating, and that they would do so multiple times a day. In these instances, the heating would be adjusted according to different sensory cues, or the social patterns that determined when parts of the home were being used:

"There's just a thermostat on the wall, and I just turn it to the temperature I want it, and that's how I run it. He told me I could pre-set it but I would get up at such varied times. Sometimes, I get up at 5:30 because the boys have woken up early, and sometimes, it's 7. So, I didn't really want to pre-set it. He showed me how to do it, but it's all really straightforward, yeah."

"With the storage heaters, it used to be timed to come during the night. Now, my central heating is timed to come on during the day. Obviously, when I've been out, it's lovely and warm when I come home. Even though I still don't have it on the bedrooms, in all the other rooms it's definitely on."

Other interviewees described how they relied on the programmability and autonomy of their heating controls to set the level and timing of heating in their homes. This was perceived positively precisely because it removed the need for manual adjustment and physical labour, which many had highlighted as an issue with their previous heating systems. In such cases, the constant battle with storage heaters described in previous paragraphs was replaced by a peaceable feeling of contentment and control, especially as interviewees learned to trust their new system to effectively meet their needs without human intervention. As two interviewees explained,

"[The heating] won't come on unless the room is cold enough, that kind of thing. So, you are not having to keep adjusting, or do anything very much. It will adjust according to the temperature of the room."

"You program it for temperatures, day and night temperatures, and you can have a period of inactivity, and you can choose how long the water heats up for and how many times a day. So it's all programmable, once you get to know it."

However, as noted above, it was the possibility and potential of controlling the heating system in different flexible ways that underpinned feelings of control. Prior research by NEA into smart home technologies introduced the concept of autonomy with control, which refers to the ways that heating system controls function independently but can still be manually overridden or adjusted by their users.[20] Previously, storage heaters in particular were typically experienced as overdetermining the thermal comfort of the home; interviewees, in other words, felt that they had no say over the ways their heaters operated and released heat into different rooms, and when they did so. In contrast, the ability to adjust and experiment with their new heating controls tipped the balance the other way, enabling and empowering interviewees to feel that they determined and could shape their own levels of thermal comfort. As one interviewee explained, it also enabled them to be responsive to external factors, such as the weather:

"Yes. I set it on a certain temperature, 19° I usually set it on, and then it just keeps the house to that temperature. If I find it's too hot … The upstairs rooms, in summer, they get sun. If I find it's too hot I turn it down. If I find that it's not warm enough then I turn it up. It's as easy as anything, really, to use. […] It's too hot coming on in the middle of the night. Again, I would adjust it so that … It's fine, it seems very easy to do […] I've just adjusted it now to 19° again because it was a bit cooler."

"Yes. I did find, through trial and error, there is a facility on it that – Generally, there is a base temperature which is set and which it always maintains at. You can turn the temperature up to whatever you want, as high as it will go, and you can then set it, so that that overrides the system, just for six hours. But then, after six hours, it goes back. Which we have done. We discovered that a while back."

20. NEA and Newcastle University (2022) Critical factors for the adoption of smart homes for energy efficiency.

Another important theme discussed by interviewees was their new heating systems' ability to meet instant demand. As shown earlier in this section, interviewees with storage heaters or solid fuel systems often found that supply could not effectively meet demand at short notice. Demand for heat and hot water in the evenings was thwarted by the way storage heaters and immersion heaters work, or by the need to attend to and feed a solid fuel fire to get it going. In contrast, interviewees highlighted that they no longer had to arduously anticipate and plan for when heat and hot water might be required in certain rooms:

"With a coal fire, if the fire is dead, you've got to wait until it energises itself. I…] Whereas gas, you are warm almost in about 15 minutes."

"Oh, yes, you had to turn [the immersion heater] on, and if you wanted a bath you had to put it on – Say you wanted a bath when you got in, you had to put the – We had it on an hour every morning to keep it warm, but if you wanted a bath you had to, say, put it on another hour at night to warm up before you could have a bath. But now you can just have a bath, can't you?"

"We don't have to plan because you've got to have the heat – them on through the night to have the warmth through the day, so you don't have to plan that anymore."

"It's been smashing, in that we have a system that works, is affordable, and you can be reactive, like, 'It's cold tonight, we'll put the heating on.'"

Although most discussions with interviewees regarding heating system control were extremely positive, two issues were identified. These will be examined consecutively in the remainder of this section.

Firstly, some interviewees did not have the skills, capacities or confidence to successfully experiment with how to use their new heating systems in a way that worked for them.

As discussed above, several interviewees discussed how they tried experimenting with their heating controls, settings and timers. For most, this process was perceived positively, and indeed many described enjoying their experience of getting to know their new heating system and what it was capable of. However, a smaller number of interviewees did not view this positively, and were frustrated with the amount of time it had taken them to understand how to effectively use their systems:

"I think it's taken a little while to, kind of, get used to it and program it according to my needs and also what I can afford. And we had a particularly cold winter this last winter, so that did take a little sorting out."

More importantly, some interviewees had not, some months after their installation took place, learned how to control their system in a way that met their needs and requirements. It is noteworthy that this issue was raised primarily by older interviewees, who described themselves as struggling to understand the controls and the new technologies that were installed alongside their heating system:

"There are two time switches, which there shouldn't be, according to someone from the council, and they are not synchronised properly. Well, I've had the electrician many times, and I was supposed to be having one just at the start of the lockdown, and of course, it had to be cancelled, but I'm waiting for them to come and sort that out. It is not helped by the fact that I'm 83, and I don't really understand these tiny miniature computer things on the wall, so I can't fix it myself."

"And we just put it to – just do it manually each day and then when we go to bed, just switch it off, because we couldn't figure out how to do it … how to set it all up so it comes on automatically. I know a couple of other people who have got central heating and they do the same thing because they can't – you know, it's too complicated."

"We've read the instructions but we didn't feel any the wiser, really. I'm happy with it, you know, I'm happy to do it just manually."

As these quotations show, interviewees who described having difficulties with the finer details of their heating controls typically reverted to setting their temperature manually on a regular basis, even though they understood there were ways of timing and enhancing their use that they felt excluded from.

Secondly, some interviewees felt that their heating systems had been set up by installers in a way that was not optimal for their own needs and requirements, and that they had not been adequately consulted as to their preferred temperatures and timings.

In these cases, interviewees discussed how engineers had pre-set their heating controls, likely in a way set out in manufacturers guidelines. However, interviewees narrated that some installers had not taken the time to properly confer with them about whether manufacturers' settings were appropriate for their needs, or had not explained how to change the initial settings if they wished to. This resulted in some turning to friends and family for help with their settings, or requesting that the installers return to show them how to use their controls properly:

"They set it up and explained a bit. I think they went to set up – they set it quite high, and I wasn't sure about that. Then it came to the lockdown time, I wasn't going to ask them to come back out and check, you know? I just felt there was a – it was soon after that there was the problem."

"My son came out and I said to him, 'The room upstairs, can you understand the controls? Can you sort it so that I can have this turned down a bit?' It was something like 21 degrees. I wanted it at, sort of, 16½, 17 is probably quite nice. He [did], but I wasn't that sure whether he had done it right or not, but it worked anyway, what he did. Because, other than that, I kept having to turn down the control in the hall."

As will be discussed again in the context of household satisfaction in Section 3.11, **this evidence emphasises that while heating control was greatly enhanced for the majority of interviewees, some did not receive adequate advice and support with understanding their heating controls. This was particularly the case for vulnerable households that required more help to be able to confidently operate and control their systems**. Ways in which this can be achieved will be addressed in more detail in the blueprint.

3.6. Impacts on mould and damp

Research has shown that in cold indoor conditions, the air within a home is more likely to contain moisture. When moisture comes into contact with cold surfaces (e.g. windows), condensation occurs and mould growth often develops.[21] In addition, the presence of damp is highly likely to encourage the growth of mould and bacteria in homes; this is important because damp and mould are associated with a range of physical and mental health issues. For example, research has found that damp and mould within the home are associated with a 30–50% increase in respiratory problems; and asthma, allergic symptoms and upper respiratory tract infections have been associated with living in a damp home with mould, especially for young children.[22] Furthermore, damp and mould within a home can cause significant stress, in terms of being unable to maintain a clean house that has recurring and visible mould, being embarrassed to invite people into the home where visible mould or the smell of damp is present, and causing additional worry for the health of family members.[23] As a result, damp and mould growth are categorised under the Housing Health and Safety Rating System (HHSRS) as a hygrothermal condition (i.e. a condition related to how heat and moisture travel through a building) that can cause harm to the health or safety of an actual or potential household occupant.[24]

Interventions targeted at fuel-poor households have been shown to reduce damp and mould. One study, for example, found that the installation of a new heating system tended to eliminate damp and mould, thus preventing children's health from deteriorating further. A second study demonstrated that feelings of shame, disgust, and an inability to dry clothes inside the home due to the actual or latent presence of damp and mould, were reversed by first-time central heating installations.[25] This leads us to a consideration of the prevalence of damp and mould among WHF beneficiary households, and the extent to which WHF interventions were able to negate or reverse the negative consequences of damp and mould where they were present.

Although no items on the questionnaire related to damp and mould, household interviewees commonly discussed it as a problem in their homes. As discussed in Section 3.5, mould and damp were often prevalent in parts of the home that could not be adequately heated because of inefficient or broken storage heaters; but some interviewees described mould and damp as present across their entire home. As two interviewees recalled:

21. NEA (2017) Connecting Homes for Health: Bringing affordable warmth to vulnerable off-gas households.
22. NEA (2017) Connecting Homes for Health: Bringing affordable warmth to vulnerable off-gas households
23. NEA (2017) Connecting Homes for Health: Bringing affordable warmth to vulnerable off-gas households
24. See Shelter (no date) HHSRS definition of hazards.
25. NEA (2017) Connecting Homes for Health: Bringing affordable warmth to vulnerable off-gas households

"We had damp, we had mould [...] I would say across the whole house. Mainly upstairs, bathroom, bedroom [...] it was all over the place, even across the landing upstairs, there was some mould."

"[It was] freezing in the winter. Not just the fact that it was cold, there was always condensation. So in the kitchen we had black mould. Along two of the walls in the bathroom, we had black mould. Then in my bedroom, there was black mould and damp. Even in the living room, actually, surprisingly, even though it had the wood fire, in that end corner, at the edge of the house and the outside, that had damp problems as well."

One Category 3 interviewee also described how the prevalence of damp and mould in their home was closely linked to tenancy relations and poor landlord practices of repair and maintenance, and that this had prevented a prior resolution to it. They described how their landlord was

"In complete denial. I've had outside friends and family in certain trades come and check things over. And when you tell him about something, 'It's condensation.' And you're going, 'Condensation would be at the top, this is all growing from the bottom.' There is no sign of condensation at all in the property, it is rising damp. And the rendering needs redoing, but he won't have any of it."

Although few interviewees discussed mould and damp in the context of health, they did highlight other consequences of it, especially for their clothing and washing practices. For example, interviewees said that *"our clothes, particularly in the smaller bedroom, were going mouldy,"* or that *"a couple of canvas shoes that I didn't wear very often, I discovered they had mould spots on them."* This had led to interviewees throwing clothes away that had been affected by mould, accompanied by significant frustration and embarrassment. Another interviewee narrated a dilemma concerning how to dry their washing in their relatively new home when it was cold outside (meaning a washing line could not be used). They initially tried a clotheshorse, but found it contributed to damp, and that because of the cold indoor temperatures, the clothes would rarely dry effectively. *"So you'd end up sometimes washing the washing twice because it hadn't dried and it smelt,"* which as well as being exasperating, was perceived as a waste of electricity.

In an attempt to address the development of damp and mould, interviewees described trying out several different 'ad hoc' mitigation strategies, such as painting over walls, using convection heaters and dehumidifiers, and applying mould remover sprays. However, interviewees said that this was usually a futile battle, primarily because the extremely cold temperatures in different parts of the home guaranteed the swift return of mould and damp. The constant smell, sight and 'feel' of damp and mould was accordingly referred to as a 'constant drag' on mental wellbeing in the home. As one interviewee remembered,

"It's not like it was a major thing, but you could just smell in the room that it was damp. Then automatically it's not pleasant. So you go into the bathroom to have a shower and you think ... The steaminess of the room and there's damp and mould mixed in with that. It wasn't a pleasant feeling or a pleasant smell."

Further evidence of the links between mould and damp, cold indoor temperatures, and humidity levels is provided by the technical monitoring arm of the evaluation. Data loggers placed inside beneficiary homes monitored temperature and relative humidity. High values of relative humidity are problematic precisely because they are associated with mould growth, and the UK Government's Building Regulations on Ventilation (Part F) state that the suggested average monthly maximum humidity for domestic dwellings during the heating season is 65%, weekly is 75%, and daily is 85%.[26] A second study concluded that maintaining relative humidity levels between 40% and 60% would minimise adverse health effects relating to relative humidity.[27] However, data logging analysis shows that pre-intervention, the humidity levels of some homes were far in excess of the recommended levels; as shown in Table 3.1.

	Average (mean) relative humidity across a 24hr period	Maximum relative humidity across a 24hr period	Number and proportion of loggers showing humidity in excess of 60%
Category 1 (n=41)	51.8%	81.8%	7 (17%)
Category 2 (n=15)	55.9%	68.5%	5 (33%)

Table 3.1: Relative humidity in Category 1 and Category 2 homes.

Post-intervention, the majority of interviewees with damp and mould issues experienced reversals of their prevalence. For example:

"Yes, all the condensation has gone. We used to have a lot of condensation. That has gone. We had mould in the small bedroom and the bathroom. That has gone. So it has cleared up most of those issues around the damp, obviously."

"You used to feel the walls, they would be wet. There's nothing like that [now]."

"It certainly doesn't smell damp anymore. There used to be this awful smell of damp and it doesn't smell anymore, so I'm presuming that's helped to dry it out. The wall that was damp in the top room is dry now. So whether or not we still have a damp problem, I don't know, but it's dry. So that's the main thing."

The removal of damp and mould in the home, especially through Category 1 and Category 2 interventions, helped interviewees to alleviate the stress, shame and embarrassment associated with constantly smelling, feeling, and fighting mould and damp. One said, for example, that:

"Now we have the windows open because it gets oo warm [...] there's no mould and damp, and the house just feels genuinely pleasant. [...] It's actually enjoyable to be in the house over winter. The house feels warm rather than damp, cold and kind of murky, and just really waiting for summer so we can air it all out again."

Interventions had also removed the necessity of using dehumidifiers and convection heaters to attempt to dry clothing; interviewees associated this not only with improved hygiene, but also affordability, through not having to run expensive electrical appliances to dry their washing. Notably, some interviewees who had not previously experienced damp or mould linked their first-time central heating installations to the cessation of continual practices of mould prevention. *"There wasn't ever any mould,"* one interviewee remembered, *"but I always felt that [...] you had to take care to keep it aired, keep windows open, keep the door open so that it didn't get kind of damp and mouldy. But that's not a consideration now."* As this evidence shows, one of the most significant impacts of WHF interventions on damp and mould has been to remove the need for households to undertake different practices related to airing, drying and ventilation; practices that were invariably described as tiresome, frustrating, and ultimately fruitless. This is before considering the physical health impacts of removing mould and damp from beneficiary homes, which is discussed in Section 3.8.

3.7. Impacts on energy affordability

This section analyses the impacts of WHF interventions on energy affordability. Findings from the household survey, illustrated in Figure 3.32 below, allow changes in running costs to be considered from the perspective of the beneficiary. Figure 3.32 shows that modelled changes in running costs (see Section 4.1) have translated into self-reported improvements in energy affordability, especially for beneficiaries of Category 1 interventions. It shows that 53% of Category 1 respondents reported that they find their energy bills a lot easier or a little easier to afford now, compared to before their intervention. Furthermore, 21% felt that there had been no change, 14% reported that their energy bills were more difficult to afford now, and a further 13% felt it was too early to make a definitive judgement.

26. UK Government (2022) Ventilation: Approved Document F.

27. Arundel, A.V., Sterling, E.M., Biggin, J.H. and Sterling, T.D. (1986) Indirect Health Effects of Relative Humidity in Indoor Environments, Environ Health Perspect 65: 351–361.

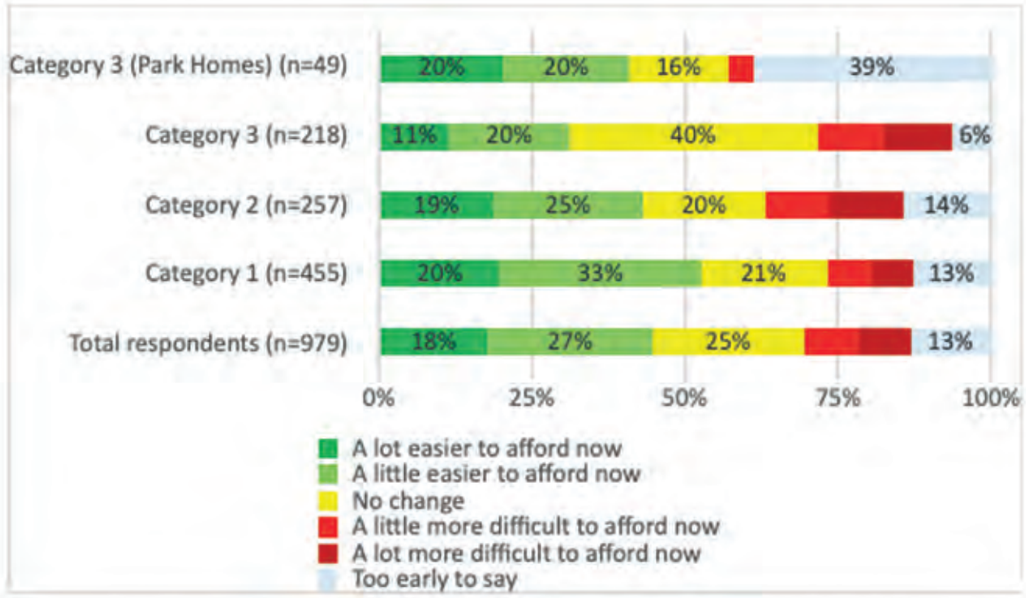

Figure 3.32: Responses to the questionnaire item 'How easy or difficult do you find it to afford your energy bills (gas, electricity, oil etc.) now compared to before you received […] support?', disaggregated by WHF funding category.

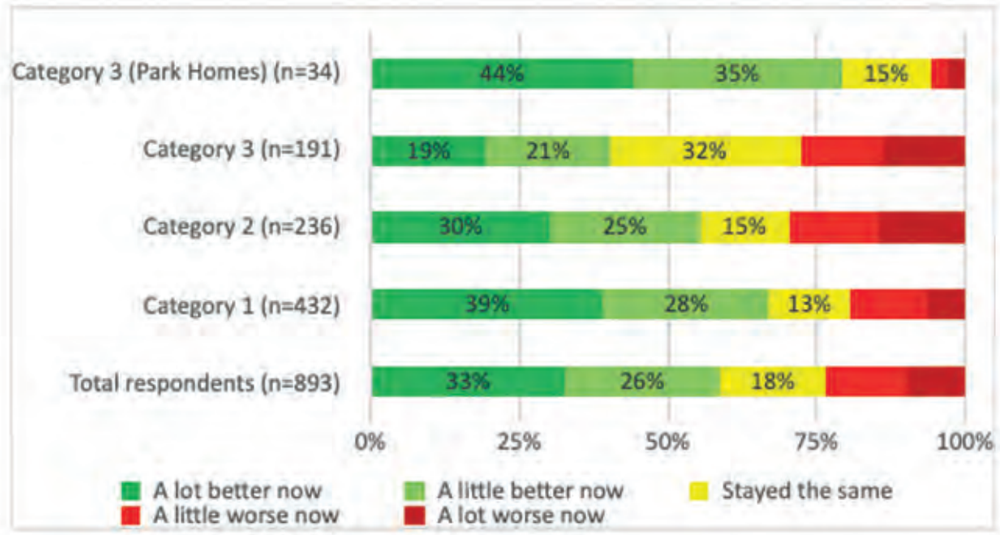

Figure 3.33: The cost of questionnaire respondents' energy bills post-intervention, disaggregated by WHF funding category.

The findings also suggest that Category 2 and Category 3 (Park Homes) beneficiaries have experienced improvements to energy affordability: 44% and 40% of Category 2 and Park Homes respondents said their energy bills are easier to afford now, and 21% and 16% of Category 2 and Park Homes respondents respectively stated that there has been no change. Notably, 39% of Category Park Homes respondents said that it was too early to make a definitive judgement on the interventions' impact on energy affordability; this may reflect the time taken to confidently compare LPG heating prices with the prices of mains gas, given that some respondents reported paying for their LPG in bulk, in clubs with their neighbours, or directly from the park site owner. Finally, Category 3 interventions were reported as having a smaller impact on energy affordability, with 31% reporting improvements and the most common response being 'no change'.

Figure 3.33 above considers the question of energy affordability from a different angle, showing respondents' views on changes to the cost of their energy bills. This is not precisely the same as energy affordability: the cost of energy bills may have decreased, but they may simultaneously have become less affordable due to wider changes in household circumstances (e.g. changes in household income). Figure 3.33 shows a similar pattern to the previous figure, specifically that Category 1 households have experienced reductions in energy bills to a greater degree than Category 2 and Category 3 households. However, Figure 3.33 also indicates that Park Homes beneficiaries reported the most substantial improvements in their energy bills, with 79% reporting that they were a lot or a little better now than they were before. The reasons and possible explanations for this will be considered in the qualitative analysis below.

Interviewees with beneficiaries confirmed the range and extent of affordability improvements enabled by WHF interventions. In interviews, beneficiaries were asked if they had experienced changes to the cost of their energy bills, and if they had, to quantify them to the best of their understanding. Interviewees explained this in different ways: some accounted for their energy bills by commenting on how much their direct debit was per month, while others discussed weekly costs or the amount they topped-up prepayment meters in a given timeframe. Table 3.2 below consolidates these findings into an estimated pre- and post-intervention annual bill for a sample of Category 1 and Category 2 beneficiaries. These figures are necessarily estimates drawn from interviews with households, and should not be taken as literal as they have not been verified (e.g. through examination of energy bill statements). Some interviewees also distinguished between heating bills and energy bills as a whole. However, the findings show the range and extent of energy bill decreases enabled by the WHF, in beneficiaries' own words. To provide additional context and breadth, Table 3.2 also presents the modelled running costs for the same household.

Household Category and Wave	Estimated pre-intervention annual bill	Estimated post-intervention annual bill	Annual bill decrease (%)	Pre-intervention modelled running costs	Post-intervention modelled running costs	Modelled running cost decrease (%)
Category 2, Wave 2	£2,340	£1,560	33%	£1,904	£1,638	14%
Category 1, Wave 2	£1,920	£920	52%	£2,405	£835	65%
Category 1, Wave 2	£2,160	£1,164	46%	£2,078	£1,002	52%
Category 2, Wave 2	£1,650	£1,080	35%	£2,693	£1,712	36%
Category 2, Wave 2	£1,200	£792	34%	£1,596	£1,277	20%
Category 1, Wave 2	£1,800	£840	53%	£3,831	£1,714	55%
Category 2, Wave 2	£1,920	£1,440	25%	£2,035	£1,449	29%

Table 3.2: Changes in energy affordability and modelled running costs for a sample of Category 1 and Category 2 homes.

In interviews, beneficiaries reported not only that their energy bills are lower, but also that they are easier to afford than prior to their intervention.

There were several different ways that interviewees discussed this. Most notably, they explained how their energy bills have reduced simultaneously with their increased thermal comfort and control over their heating systems. This demonstrates that beneficiaries are paying less for a higher standard of warmth, and are no longer underheating their homes in the ways discussed in Section 3.3 above:

"However, the bills, they've come down a lot. I'm amazed actually because we were never heating it. It's set now at 21, the temperature. We're getting that. We'd never heat it to 21 before. It's quite incredible. We were like, 'Oh my God, what's the bill going to be like?' but the bill has gone right down. They told us we're using, and this is in the winter months, £150 worth of electric, bearing in mind we use the tumble dryer and the washing daily as well because we live in Wales."

"It's fantastic. We don't even have to have it on too high and it heats the whole house really, really quickly. And the cost. I mean, I think we were paying … I'm trying to think what it was, something like £70 for gas and electric. Which is obviously, like, half the price of what we were and we were still in debt when we were paying the £150. So it's saved an awful lot of money."

Other interviewees preferred to discuss the affordability of their energy in terms of unit usage. As the quotation below shows, some had calculated how much their unit usage had decreased following the installation of their new heating system, which resulted in a corresponding drop in energy costs:

"[My bills are] down a lot. I was using roughly 400 units of electricity, I'll be reading it again this weekend for the end of February, at the end of January I used 274 units of electric. No, it wasn't, I think it was 174 and I used just 2 or 3 units less of gas. With my gas now I have four bedrooms mildly heated, three rooms downstairs heated with radiators, plus my bathroom and my porch. The room the boiler is in is upstairs so the boiler heats the room, there isn't a radiator in it, it takes the cold air off."

Beneficiaries' experiences of positive changes to energy affordability were also discrete depending on their payment method. Several interviewees who disclosed paying by direct debit commented that although they had received new heating systems, their direct debits to their energy supplier had not immediately changed. Due to the efficiency of their new systems, they quickly built up higher credit balances. One interviewee, for example, received a bill based on an extrapolation of historic use; when corrected, this added over £200 of credit to their account:

"On Thursday, whatever, last week, I got an estimated bill. I pay monthly for my direct debit, and because we'd always used more electric because of the immersion heater – I don't know, because all we had were the gas heaters. Everything's electric more or less. I thought, 'That's a lot.' They said whatever for the gas. It's the first real bill that I feel as though I've had, but we've been away for a month as well. They'd overcharged me £200, so that's off last year's bill because we'd estimated it, what we'd probably use, last year, this time last year, but we have been away for a month. I read [the meters] for them and sent them to them, and they said I was £200 and something. I was only £13 in credit, but I'm 240 something pounds in credit now."

In parallel, interviewees with prepayment meters noted visible and welcome differences in the rate at which their credit declined after their heating system installations:

"I think the boiler has made a big difference because of course your immersion heater was – you've got that on, and your electricity meter was going round, whizzing round. So it's saved a lot of money in that respect."

Category 3 beneficiaries in particular discussed the knock-on impacts of being unable to afford to pay for their energy bills on debt accumulation, and how their interventions had helped them to reduce their levels of arrears with energy suppliers and other utilities.

The experiences of one interviewee epitomised this trend. In arrears with their energy supplier, they described attempting to contact the supplier to agree a repayment plan as difficult and ultimately futile, summarising that:

"I got into such a headache over it. To the point of tears […] And in the end, it did end up going to a debt collector, because they still weren't letting me pay when I tried to pay. But thankfully, when I tried to explain it to the debt collector, they were like, 'Yes, we've had a lot of them that do that, they won't let you pay and then put it onto a debt collector.'"

Following support from a Category 3 project, which included consultation between a caseworker and the energy supplier, and the threat of an escalation to the ombudsman, an affordable repayment plan was agreed. The interviewee described this as *"amazing […] in the end I ended up paying £45 a month."*

Although Figure 3.32 shows that a significant number of survey respondents reported no change to the affordability of their energy bills, interview data indicates that these respondents often did not consider this an issue. Instead, they perceived it as paying the same amount of money as before, but for a much higher standard of warmth.

As with previous findings, interviewees explained this in slightly different ways. For some, they had taken advantage of the positive aspects of their new heating systems and warmed their homes for longer, resulting in a balancing-out of higher usage and higher efficiency. Others had not yet experienced any affordability changes, but perceived that they would as they learned more about how their new system would meet their needs. Importantly, some interviewees narrated that the affordability of their energy had not changed although they finally had a system that met their health-related needs for additional warmth. In other words, they could finally heat their homes to the level they required for good health and wellbeing, and were satisfied that this was costing around the same as their previous heating type (e.g. storage heaters). This was the case for one interviewee who was not sure whether their energy costs would turn out to be the same or slightly higher than previously:

"I need to turn the heating off and only have it on certain times, but I've been a bit more generous because I'm used to constant heat, if you like […] because I've got multiple sclerosis, I'm very sensitive. That's why I don't keep the house cold. I like to have about between 20 and 22 degrees in the house – in

the bungalow. So, it has been on a little bit more. That's why there's, I suppose, a little bit more cost to my energy bills."

Beyond changes to affordability, interviewees also reported that their new heating systems had delivered an enhanced ability to control, monitor and forecast their energy usage and associated costs.

For instance, one interviewee described using a smart meter to check how much the new heating system was costing them. The enhanced controls that were fitted alongside their heating system meant that, if the smart meter was showing that their daily heating spend had exceeded a certain amount, they would simply turn it down to keep their costs under control:

"There's like a thermostat in the hallway. You can turn your hot water off if you wanted to. You can turn the heating up and down, which I do sometimes during the day. If I think it's getting a bit warm, and my smart meter is telling me it's getting a bit dear, I just go and press a button and it goes down and the electric goes off so I'm saving money."

Category 3 beneficiaries who had received support with smart meter installations also reported an enhanced visibility over their energy costs, enabling them to stay within a prescribed budget more easily:

"We probably use, I'm guessing, about £2 to £2.50 a day – if that – on the electricity. We can monitor that, because we see it every day, don't we? It goes up […] It's giving you an amount of money. I suppose, in a way, [it helps] because you know what you're using. What you tend to do is turn the lights off. 'What's that plugged in for?' It's that sort of thing. You're turning things off all the time. I suppose that's the idea […] It's a good idea. It does make you stop using things, to be fair. You're turning things off."

Lastly, for interviewees whose energy bills had become less affordable, evidence suggests that the main reasons were the financial impacts of global crises, specifically the Covid-19 pandemic, which began in March 2020, and increases to the price of domestic gas and electricity, which began in October 2021 through the first of several increases to the energy price cap in Great Britain.

In Figures 3.34 and 3.35 below, responses to the questions on energy affordability changes and energy bill changes are disaggregated by the household survey fieldwork wave. Both Figures show the same overall pattern, namely that the WHF interventions' positive impacts on the affordability and cost of energy slowly decreased in Wave 2 (2021 fieldwork) and Wave 3 (2022 fieldwork). Figure 3.34 shows that a notably higher proportion of Wave 3 respondents said that their energy bills were worse following their intervention (35%), compared to Wave 2 (16%) and Wave 1 (11%). Similarly, Figure 3.35 shows that a higher proportion of Wave 3 respondents said that the affordability of their energy bills was worse following their intervention (28%), compared to Wave 2 (10%) and Wave 1 (12%). Summarised, this means that impacts of WHF interventions on energy affordability were less substantial in the final wave of fieldwork, which took place in the late winter and spring of 2022.

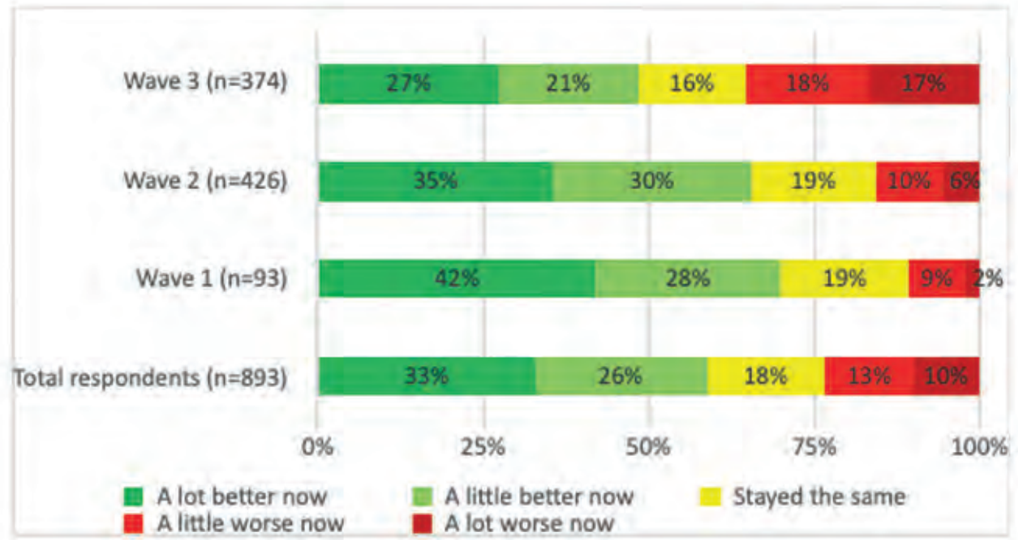

Figure 3.34: The cost of questionnaire respondents' energy bills post-intervention, disaggregated by fieldwork wave.

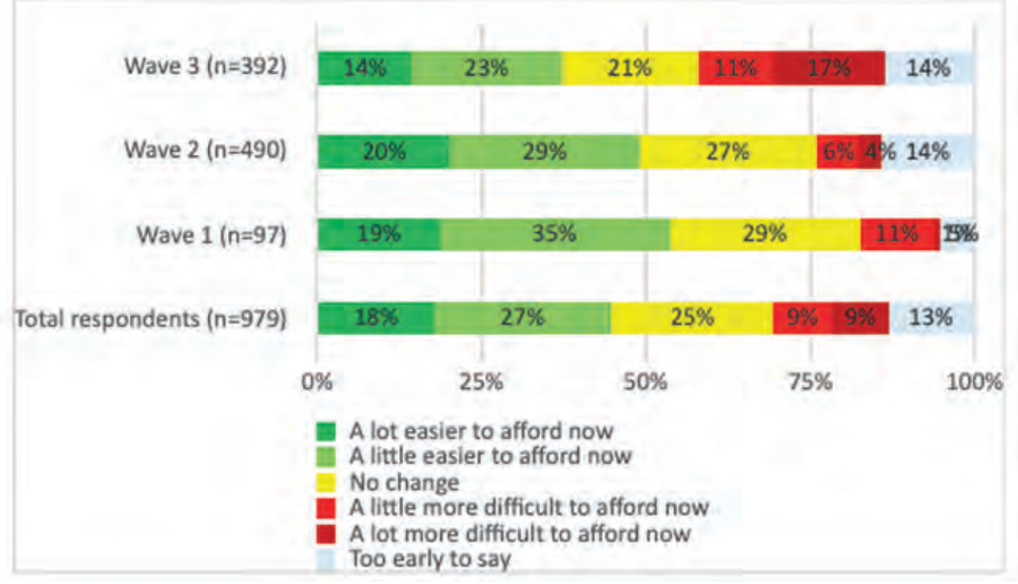

Figure 3.35: Responses to the questionnaire item 'How easy or difficult do you find it to afford your energy bills (gas, electricity, oil etc.) now compared to before you received […] support?', disaggregated by fieldwork wave.

These findings are corroborated by interviewee testimony from Wave 3 of fieldwork. For example, one interviewee commented on the unfortunate timing of their installation in the midst of energy price increases:

"It's just timing really; the price increase has come at the worst time. We'd just had it all fitted and starting to enjoy it, and the prices are shooting up."

Notably, this interviewee was highly satisfied with all aspects of their new heating (an ASHP), describing how it had improved their thermal comfort, domestic space use, and the amount of control they have over their system. The only negative aspect of their experience they discussed was the affordability of the system, which was attributed to rising electricity prices. This was reflected in other interviews that took place immediately after the price cap increase in April 2022. One interviewee, for instance, said that although they did not know how much their bills would increase, they expected it to be significantly less affordable than before. They also expected that the April 2022 price increase might reverse the positive affordability changes their system had produced immediately after its installation in late 2021:

"I'm using a lot less, yes, overall over the electric and the gas. As I say, working out the money it cost me last month, it cost less even with the initial price increase [...] I'm expecting to go a bit more with the April increase."

Importantly, however, interviewees who had experienced elevated energy prices from October 2021 and April 2022 sometimes reflected on the counterfactual scenario, or what their energy bills might have been had they not had their new heating systems installed:

"But had we not had [the system installed], [our bills] would have been in excess of £200, so it's been a real reassurance really. We're really enjoying having a house that we can wear a t-shirt in. It's mad."

A second interviewee, when asked about how much they thought they'd be paying from April 2022 on their old gas fires and storage heaters, also responded:

"Well I probably wouldn't be able to put them on as often [...] I can tell you it has gone up by about a third and I was paying £97 a month, so roughly £130 a month I would have been paying maybe if I had used the same amount."

This evidence shows that even in cases where energy affordability had not been improved by new heating system installations, interviewees recognised that they would now be paying even more if those installations had not taken place. Furthermore, as emphasised elsewhere in this section, this would also have meant inadequate thermal comfort, heating system control, and a restricted use of domestic spaces, in addition to higher energy costs. In other words, for Wave 3 beneficiaries, energy affordability was typically the only negative outcome of their intervention, and it was not attributable to the intervention itself, but to externally driven increases in energy prices.

Beyond this, some other reasons were given by Category 1 and Category 2 beneficiaries for why their energy affordability and energy costs had not improved. These were:

- In cases where beneficiaries had moved from a solid fuel system to a central heating system, and previously were able to obtain solid fuel for free or very cheaply (e.g. from wood foraging, or where the beneficiary obtained free coal through the National Concessionary Fuel Scheme).
- In cases where the home had previously been severely underheated, and was now heated by a central system that could not be rationed in the same way as storage heaters.
- In cases where households had received ASHP installations, but had not been adequately supported to change away from an Economy 7 tariff to a more favourable rate.

3.8. Impacts on health and wellbeing

Living in a cold home is connected to range of respiratory, cardiovascular and musculoskeletal conditions,[28] as well as mental ill-health, and it is well established that cold indoor temperatures exacerbate pre-existing illnesses. Previous research has demonstrated the links between cold homes and these conditions, and a recent systematic review of evidence from across the globe concluded that fuel poverty is associated with *"poorer general health, poorer mental health, poorer respiratory health, more and worse controlled chronic conditions, higher mortality, higher use of health services and higher exposure to health risks, with worse results for vulnerable groups across dimensions of inequality."*[29] The National Institute for Health and Care Excellence (NICE) has also repeatedly stressed the importance of addressing the health risks that are associated with cold, energy-inefficient homes.[30]

Previous research has also shown that the installation of new heating systems in fuel-poor homes can lead to positive health outcomes. For example, the Central Heating Programme evaluation in Scotland found that 40% of recipients who had previously reported respiratory, circulatory or rheumatic health conditions said the condition had improved post-intervention.[31] Similarly, around 40% of households that received support through the Warm and Healthy Homes Fund programme reported that their physical and/or mental health improved following the installation of their measures.[32] In NEA's Connecting Homes for Health project, 82.7% of participants agreed or strongly agreed that aspects of their physical health were affected by being unable to keep warm at home, before receiving a first-time gas central heating system. A year after installation, this had reduced to 7.2%.[33]

Consequently, one of the key impact indicators in this evaluation is to assess whether beneficiaries experienced any improvements to their health following their WHF intervention, and the extent to which they attributed any improvements to the support they had received.

3.8.1. Cold-related health conditions among household survey respondents

To begin an analysis of the health impacts of the WHF, this section examines household health before any intervention was received.

Approximately four in five respondents were living in a home where at least one occupant had a cold-related health condition.

Out of all valid responses (n=832), 23% said they or members of their household had no cold-related health conditions, and 77% of respondents said that they did. Note that this figure does not include respondents who noted the presence of other health conditions and illnesses that are not typically associated with cold homes.

Figure 3.36 below also shows that over half of survey respondents were living in a home where at least one occupant had multiple cold-related health conditions.

Furthermore, 23% of respondents reported having one cold-related health condition in their home, and 54.7% of respondents reported having more than one. Across all valid responses (n=832), 1,710 unique cold-related health conditions were recorded, indicating that **on average, WHF beneficiaries had two cold-related health conditions per household**.

28. NEA (2018) Under One Roof; and NEA (2017) Connecting Homes for Health: Phase 1 Review.

29. Ballesteros-Arjona, V. et al. (2022) What are the effects of energy poverty and interventions to ameliorate it on people's health and well-being?: A scoping review with an equity lens, Energy Research and Social Science 87: 102456, p.1.

30. NICE (2015) NICE Guideline NG6: Excess winter deaths and illness and the health risks associated with cold homes.

31. NEA (2018) Under One Roof, p.20.

32. NEA (2018) Under One Roof, p.20.

33. NEA (2020) Connecting Homes for Health: Executive Summary, p.9.

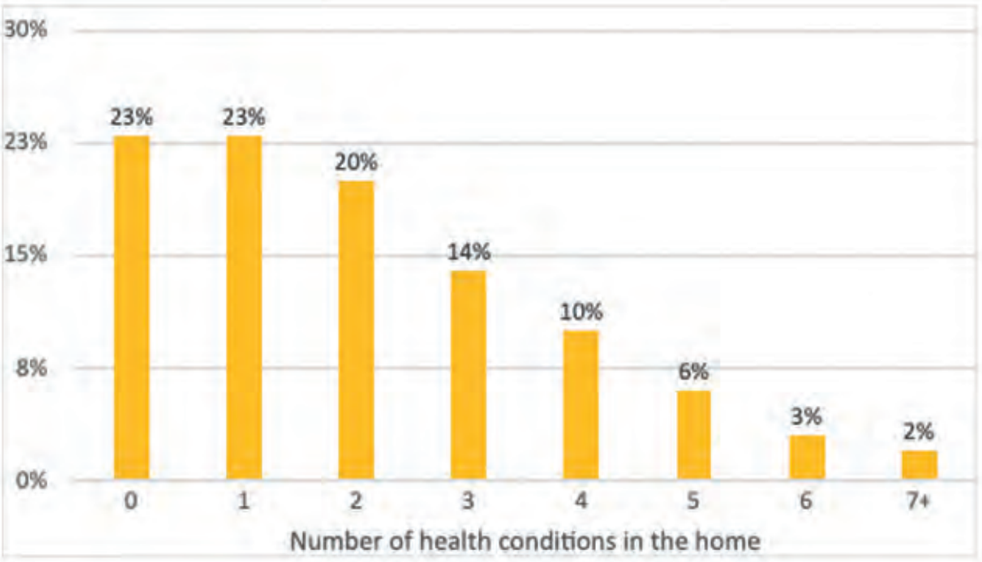

Figure 3.36: Proportion of questionnaire respondents with one or more cold-related health conditions in the home, pre-intervention.

Category 2 beneficiaries were more likely to report that an occupant of their home was living with a cold-related health condition.

Figure 3.37 below shows that 84% of Category 2 beneficiaries reported this, compared to slightly lower proportions of Category 1, Category 3, and Park Homes beneficiaries.

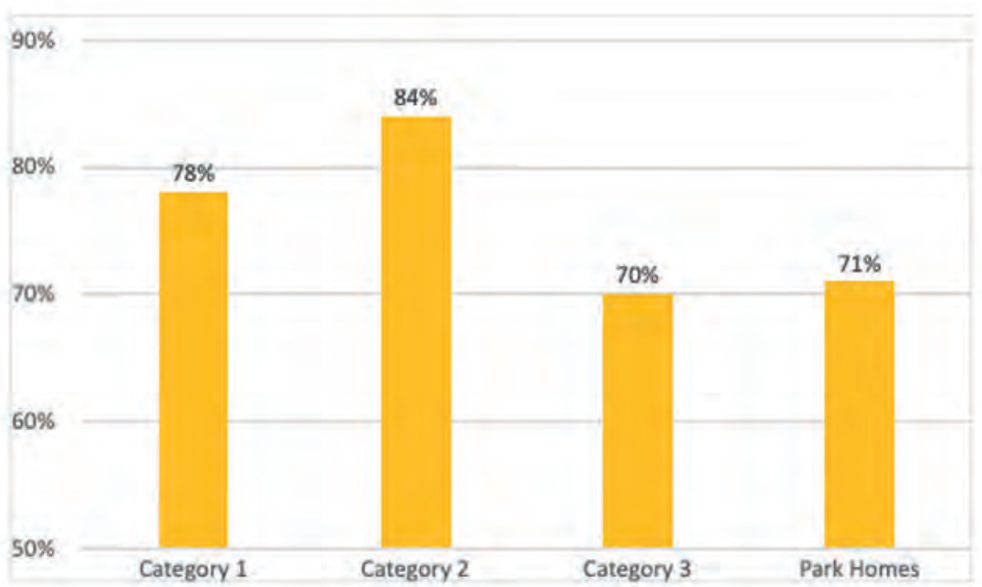

Figure 3.37: The proportion of questionnaire respondents with a cold-related health condition in the home, disaggregated by WHF funding category.

In addition, households with an annual income of £18,000 or less were more likely to contain an occupant with at least one cold-related health condition.

Specifically, 83% of households with an income of £18,000 or less reported a cold-related health condition, compared to 66% of households with an income of above £18,000. This provides evidence that targeting interventions at low-income households is more likely to also support households with a cold-related health condition present, and vice versa. Households in Wales were also the more likely to contain an occupant with a cold-related health condition; 89% of respondents from Wales replied that they did, compared to 83% in Scotland and 75% in England.

The cold-related health conditions experienced by respondents are shown in Figure 3.38, indicating that the most prevalent were those related to respiratory and musculoskeletal conditions, as well as to mental ill-health.

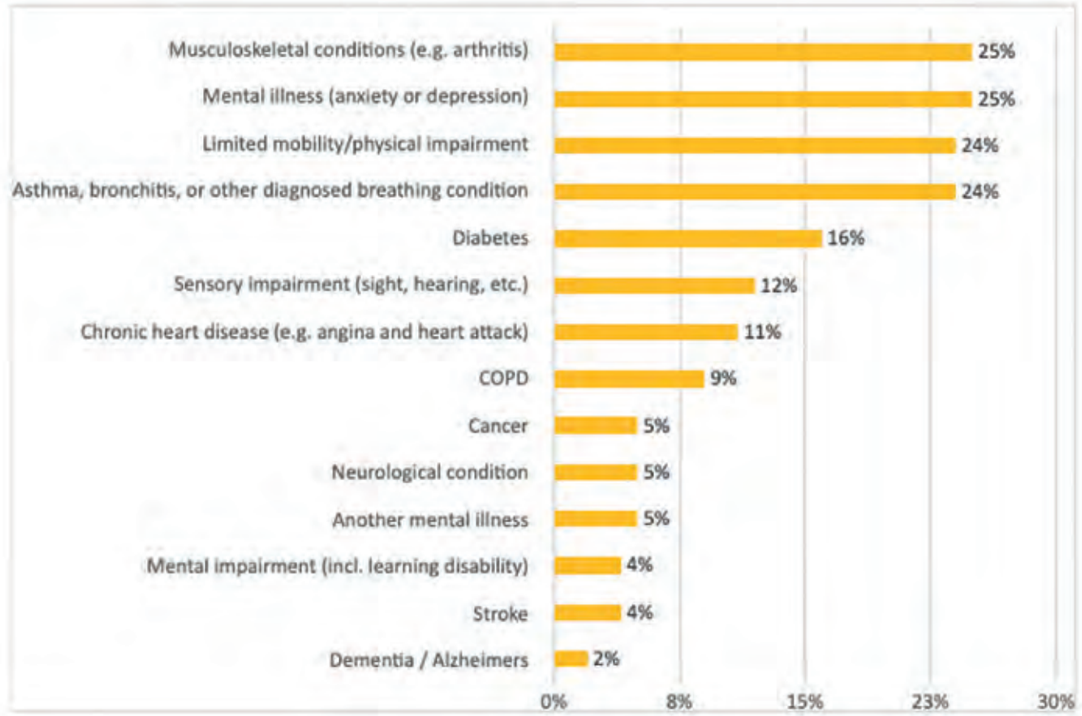

Figure 3.38: Prevalence of specific cold-related health conditions in WHF beneficiary homes (n=832).

Overall, this evidence demonstrates that the WHF has been well targeted at households with cold-related ill health, and/or facing an increased risk to their health from living in a cold home.

3.8.2. Unhealthy homes

There is abundant evidence that cold-related health conditions are developed or exacerbated by living in a cold home. Figure 3.39 below shows that, overall, **58% of respondents agreed that not being able to keep warm at home affected their physical health**, or the physical health of someone living in their household. Figure 3.40 shows that a lower proportion **(44%) of respondents agreed that not being able to keep warm at home affected their mental health**, or that of someone living in their household. Notably, Park Homes respondents were far less likely to reply that living in a cold home affected their health; this is partially explainable by the finding in Section 3.2, that a relatively higher proportion of Park Homes respondents could keep their homes warm prior to their intervention.

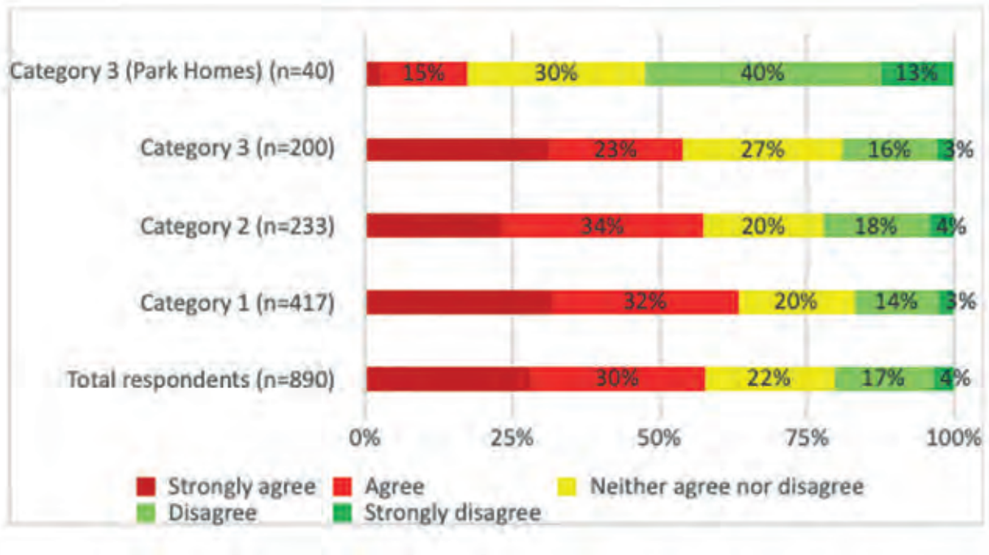

Figure 3.39: The extent to which questionnaire respondents agreed or disagreed with the statement 'You were unable to keep your home comfortably warm in winter or when it was cold and this affected your physical health, or that of someone who lives with you', pre-intervention, disaggregated by WHF funding category.

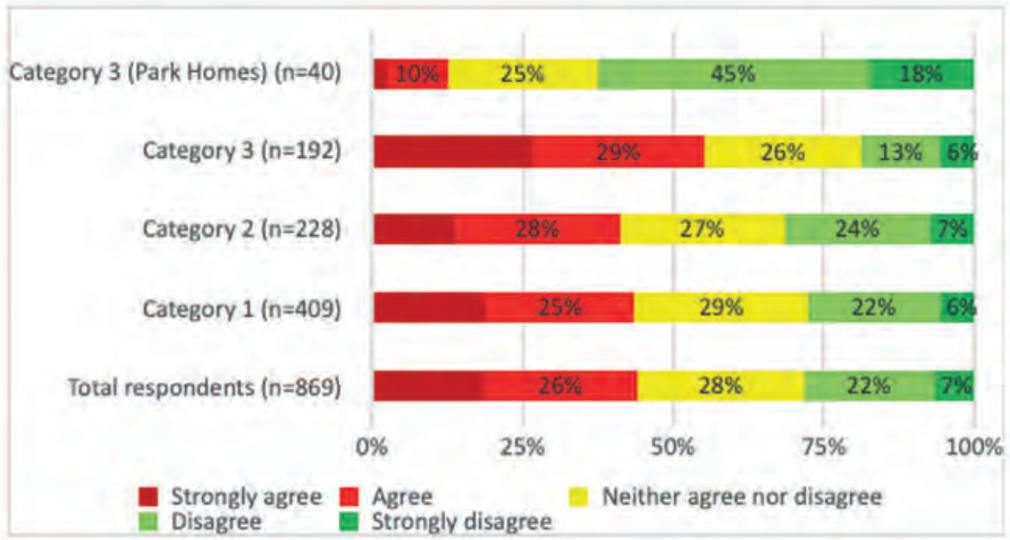

Figure 3.40: The extent to which questionnaire respondents agreed or disagreed with the statement 'You were unable to keep your home comfortably warm in winter or when it was cold and this affected your mental health, or that of someone who lives with you', pre-intervention, disaggregated by WHF funding category.

These findings are starker when disaggregated by those who reported a pre-existing cold-related health condition. **Of respondents who disclosed a physical health condition, 64% agreed that living in a home they could not keep warm made their condition worse. Moreover, of respondents who disclosed a mental health condition, 76% agreed that living in a cold home made their condition worse.**

Together, this evidence shows that a majority of WHF beneficiaries with pre-existing cold-related health conditions found that their conditions worsened or were exacerbated by not being able to keep their homes warm. Even among respondents who disclosed no health conditions, a sizeable proportion said that their health was being impacted by living in a cold home prior to their intervention.

In household interviews, several interviewees described the range and severity of their health conditions, and how they were impacted by living in a cold home pre-intervention. As suggested by Figure 3.38, the most common illnesses discussed by interviewees were respiratory and musculoskeletal conditions. Asthma, COPD, and other pre-existing diagnosed breathing conditions were all described by interviewees as being made worse by the cold prior to their interventions:

"I have asthma, yes […] at times when it is extremely cold it does affect it a lot, do you know what I mean? Because obviously your body is trying to work extra hard to – yes, it does affect me. It can do, especially when it is extremely cold, yes."

"It affected my health. If I went into a cold room I'd cough a lot, breathing in the cold air and things like that."

Interviewees described that it not was not just that the cold that inflamed pre-existing respiratory conditions. Rather, some interviewees emphasised that they felt their breathing and respiratory issues had primarily been caused by growing up in fuel poverty or living in a cold home for several years, sometimes decades. One interviewee, for example, noted that her son was likely to have had asthma prior to moving to their current home, but that they had not noticed it until after they moved:

"He didn't have asthma, well, he probably did have asthma before we moved here, but it wasn't diagnosed until we've moved here. So I'd say it's probably a direct comparison. We came here for fresh air, and there are less cars, which is wonderful,

just because of the area that we're in. But his asthma wasn't as apparent when we were in Nottingham, compared to when he moved to here and was living in a cold, damp house."

A second interviewee also felt that respiratory issues had emerged for their children because of persistent mould and condensation in their home:

"So the condensation and the mould and everything was just horrendous; it was running off the walls […] that's really caused health problems; bad chests and everything, because the mould in one of the bedrooms was really bad as well […] the three boys are all in the same bedroom."

These quotations demonstrate that prior to receiving a WHF intervention, a substantial number of households were having their pre-existing respiratory illnesses exacerbated by living in a cold home, and that living in a cold home was causing (at least partially) new respiratory conditions to develop, especially for young children.

Similarly, interviewees with pre-existing musculoskeletal conditions and limited mobility described the exhausting impact the cold had on their day-to-day lives at home:

"Before we had the central heating in, if I get cold, if I'm having a rheumatoid arthritis attack, I've got inflamed joints and things, the cold, it does me no favours at all."

Furthermore, some interviewees discussed how difficulties with movement and mobility at home, combined with cold temperatures, would also have an adverse effect on their mental wellbeing. Cold temperatures were commonly associated with feelings of being trapped and unhappy at home because it restricted the amount of space in the home that could be beneficially used, and prevented householders from being able to move comfortably from room to room. As one interviewee described,

"I suppose the cold and the damp just made you, sort of, ache. If it got really bad, I would have steroid injections, which eased the pain but yes, just the general cold just makes your bones ache. So, yes. It made you miserable, really, if the house was cold."

Several more interviewees described living with a cold-related physical health condition as *"very depressing"*, with one thinking *"back to the cold house, and how miserable it [was], and how depressing it [was]."* Another interviewee concurred that it was not typically their arthritis that suffered when they were cold at home, *"but mentally, you know, it can make you feel quite low […] cold can make you feel quite low."*

More broadly, the ways in which the cold impacted on mental health were not typically discussed by interviewees in terms of formally diagnosed conditions (e.g. depression, anxiety). Instead, interviewees mentioned a broad range of ways in which living in a cold home affected their mental wellbeing.

A prominent theme in household interviews related to mental wellbeing was the time relatively healthier household occupants spent worrying about the health of more vulnerable family members, such as elderly parents or children. For example, one interviewee said they were

"Permanently worried about my mother's health obviously, and the fact that it was just such a cold, cold house. I can't even describe how cold it was. My mother's is probably one of the warmest bedrooms, and the bedroom I sleep in, it had damp on the wall, and as I say it's a massive bay window at the front. An old Victorian house, there was no heating in that room at all, and in winter you would wake up and this sounds a bit like wartime, but you know, we had ice on the inside of the windows."

A second interviewee described being constantly worried about the health of their child because she could not afford to have their storage heaters on to a level that would meet their heating needs. Reflecting on a first-time central heating installation, the interviewee commented that now *"I don't have to worry about if the house is cold, telling [my son] to put a blanket on because I can put the heating on without the worry of not being able to afford to pay for it."* For these and other interviewees, **they worried that cold temperatures would have damaging health impacts on members of their family, and described this as contributing to the deterioration of their own mental health and wellbeing**.

Closely connected to this were feelings of shame, stigma and embarrassment that were experienced by some interviewees prior to receiving support.

Specifically, interviewees who talked about feeling ashamed often did so in the context of not being able to provide a warm, safe home for their children, and they emphasised that this had a damaging impact on their own social, emotional and psychological wellbeing. One interviewee, a single parent with a young baby in a private rented property, described receiving visitors to her home: *"When people come round and its freezing, and your baby's just wrapped up in loads of blankets, I don't know, I felt like I never had a proper excuse."* One Category 3 interviewee described moving into a new home without a central heating system, and consequently feeling ashamed and upset about not being able to fulfil their basic needs in day-to-day life, such as washing, having a bath, and meeting societal norms of hygiene and cleanliness. Other interviewees said that *"it makes me feel a bit of a failure for my son and things […] I should be able to keep the house warm"*, or that *"I couldn't even provide a warm house for my children, and that made me feel rubbish."* As this evidence shows, **these interviewees felt a burden of blame and responsibility for not being able to provide a warm home for their children, which had a constantly negative impact on their mental wellbeing, feelings of self-worth, and relationships with others.**

Finally, **several interviewees described the stress and mental burden of attempting to juggle wider household spending and budgets, including their energy costs**. One interviewee, for example, discussed how *"I really used to have sleepless nights thinking of if anything happened or if anything went. As I say, you know, the washing machine packed in or anything like that, it would've been a matter of having to take out a loan to replace it."* As Figure 3.40 shows, Category 3 respondents were more likely to agree that living in a cold home affected their mental health, and Category 3 interviewees discussed a wider range of challenges relating to financial insecurity and precarity, including energy debt. For example, one Category 3 interviewee described the powerlessness they felt when an unaffordable debt repayment plan was set up by their energy supplier: *"That's what they said had to happen."* For interviewees such as this one, many were navigating complex and stressful experiences of household expenditure and budgeting while being forced to cut back on their energy use and other essential goods; this had highly detrimental consequences for their mental health and wellbeing. As another Category 3 interviewee with a prepayment meter also said:

"The electric would send me a message saying, 'You need to top-up.' My gas and electric are on the same thing. And there was no money. And it was like, 'Where am I going to get any money from?' … And I was getting really depressed with it all. I really felt like I couldn't cope anymore."

In summary, **there is evidence that four-fifths of WHF beneficiaries were living with a cold-related health condition prior to receiving support from the WHF, and a majority of these were having their conditions exacerbated by not being able to stay warm at home. Even for those who did not disclose cold-related health conditions, the impacts were substantial. Respiratory, musculoskeletal, and issues related to mental (ill-)health and wellbeing were the most frequently discussed in household interviews, with many interviewees explaining that their health was locked into a vicious cycle of decline and deterioration due to not being able to stay warm at home**. With this in view, the next section discusses the impacts of WHF interventions on beneficiaries.

3.8.3. Healthy homes

Figures 3.41 and 3.42 below shows how respondents described the general physical and mental health of their household after installation, compared to before. **Figure 3.41 shows that post-intervention, 48% of respondents reported that their physical health is better now than before, and Figure 3.42 indicates that 39% of respondents stated that their mental health is better now.** Figures 3.41 and 3.42 show that health improvements were more common in Category 1 households, with a much smaller proportion of Park Homes respondents reporting positive health impacts. This is explainable in the context of Park Homes respondents reporting relatively fewer health conditions overall, as shown above.

These figures are slightly higher for those who disclosed pre-existing conditions. Of respondents who disclosed a mental health condition, 47% said their mental health is better now than it was before, compared to 35% with no disclosed mental health condition in their household. Similarly, of respondents with a physical health condition, 50% said their physical health is better now than it was before, compared to 44% without any physical health conditions in their household.

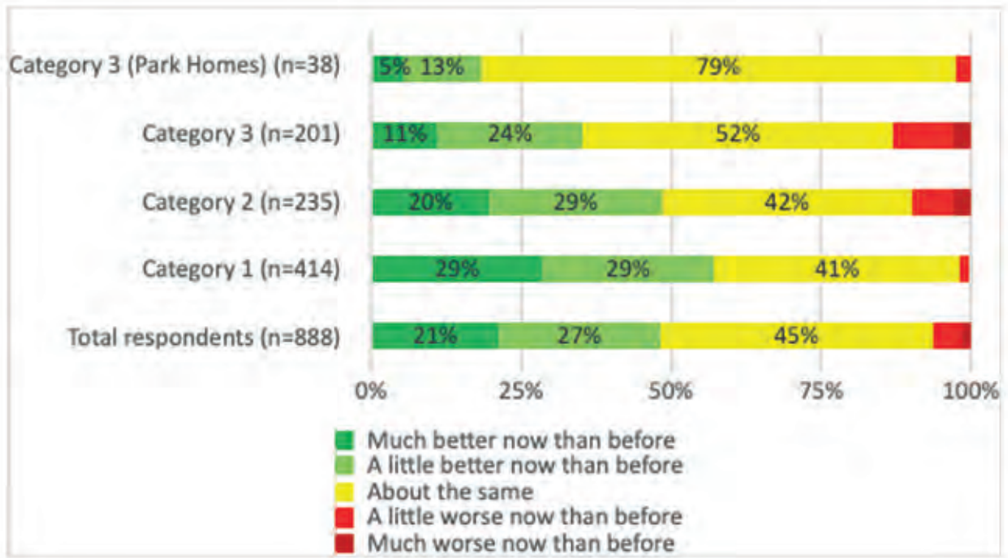

Figure 3.41: Responses to the questionnaire item 'Compared to before you received your health and energy-related support, how would you now describe the physical health of your household in general?', disaggregated by WHF funding category.

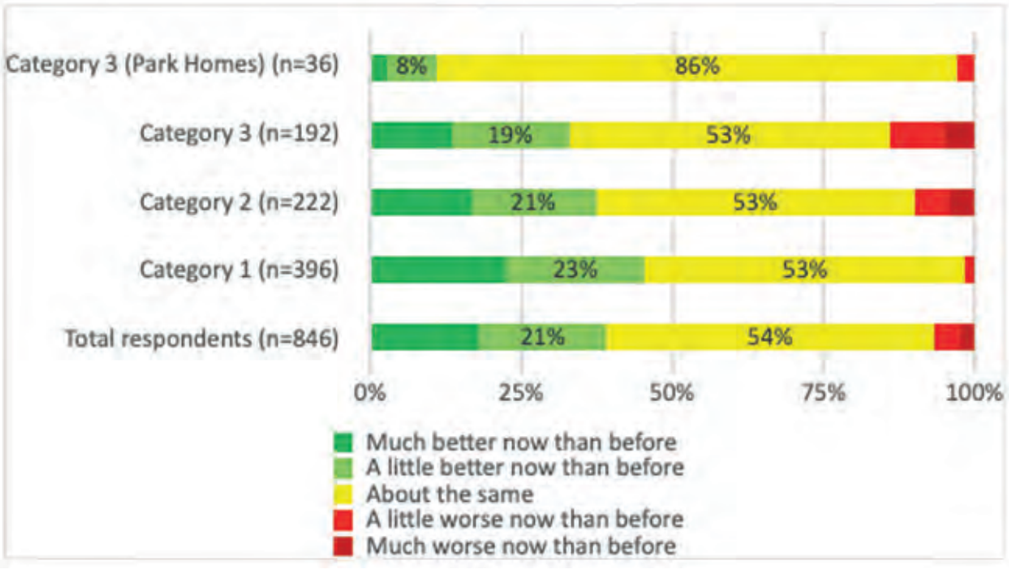

Figure 3.42: Responses to the questionnaire item 'Compared to before you received your health and energy-related support, how would you now describe the mental health of your household in general?', disaggregated by WHF funding category.

Self-reported changes in health conditions are sometimes not directly attributed to the impact of a fuel poverty intervention such as those delivered by WHF projects. Instead, changes (especially when negative) are sometimes more likely to be perceived as due to deteriorations in chronic or longstanding conditions, or caused by other factors that households consider beyond the reach of what a fuel poverty intervention can achieve. Table 3.3 below therefore shows the extent to which respondents who experienced improved physical or mental health related these changes to the support they received from their respective WHF projects. **Approximately three in five respondents across all three categories thought it was probable or very probable that their physical and/or mental health improvements were attributable to their WHF intervention.** A further three in ten thought that it was possible. Put differently, of those who reported positive health improvements, only one in ten believed that the WHF had not in some way influenced the changes they had experienced.

	Very probably or probably	Possibly	Total
Physical health	58%	30%	88%
Mental health	59%	31%	90%

Table 3.3: The extent to which questionnaire respondents thought positive changes in their physical and/or mental health were attributable to the support they received through the WHF.

A further item on the questionnaire provides additional evidence for the impacts of WHF interventions on mental health and wellbeing. Table 3.4 below shows results from the WEMWBS items. WEMWBS refers to the Warwick–Edinburgh Mental Wellbeing Scales, which were developed by academic researchers and health practitioners to enable the measurement of mental wellbeing in a given population.[34] The full WEMWBS has 14 items, but for the purposes of this evaluation five items were chosen and included in the household survey, to provide a measurement of any improvements in mental wellbeing after a WHS intervention.

	Average (mean) pre-intervention WEMWBS score	Average (mean) post-intervention WEMWBS score
Category One	14.2 (n=438)	16.5 (n=438)
Category Two	15.5 (n=237)	17 (n=234)
Category Three	12.6 (n=202)	14.3 (n=203)
Park Homes	17 (n=38)	17.1 (n=41)
All respondents	14.3 (n=915)	16.2 (n=916)

Table 3.4: Pre- and post-intervention WEMWBS scores.

34. Warwick Medical School (2021) The Warwick-Edinburgh Mental Wellbeing Scales – WEMWBS.

Table 3.4 shows the WEMWBS score pre- and post-intervention for each WHF funding Category. The score is correlated to the level of wellbeing – that is, a higher score indicates better wellbeing, and a lower score indicates poorer wellbeing. A positive change is revealed in the scores for Category One, Category Two, and Category Three, with Category One beneficiaries reporting the most significant change. Similarly to results presented earlier in this section, there was little to no change in the wellbeing scores for Park Homes respondents. Furthermore, the higher pre-intervention Park Homes score provides further evidence that these respondents felt their health was not being significantly affected by their home environment prior to their WHF intervention. **Overall, this evidence shows that there has been an improvement in mental wellbeing for WHF beneficiaries after their interventions took place.**

Evidence from household interviews supports the finding that the WHF has directly led to improvements in physical and mental health for beneficiaries.

In the previous section, it was shown that the respiratory, musculoskeletal and mental health of beneficiaries were being negatively impacted by living in a cold home that could not be adequately kept warm. Interviewees reported positive changes to multiple conditions, as detailed below.

Interviewees with respiratory conditions described several positive impacts of their WHF intervention, including better and more comfortable breathing, less frequent inhaler usage, and fewer flare-ups of pre-existing conditions such as asthma and COPD.

In other words, interviewees did not typically refer to their respiratory conditions as improving in a medical or epidemiological sense, but that they found it far more comfortable to live in their homes and manage their conditions because it was now warm. Regarding inhaler usage, interviewees described how *"I rarely use my inhaler now"*, and that *"[my wife] hasn't needed the inhaler anywhere near as much. She used to get very, very breathless just going up the stairs, and I think a lot of that was because she was constantly chilled."* Other interviewees explained different ways in which their respiratory conditions had improved following a first-time central heating intervention:

"Well, my breathing's a little bit better, as I was saying, and when you were sleeping at night without the heat, without the house being … You know, some nights, I woke up before my … I think it's, kind of, so swollen, and so on, which, since I got that, I haven't had that."

"And also my partner, he's got COPD, so it has been better for him […] I'd put it down to the heating. The fact that he can go in any room now and be warm. You know, before, in the winter, he spent most of his time in the living room. Only really went upstairs either to use the bathroom or to go to bed. So it's made a big difference in that respect."

"I have diabetes, asthma. I have had pneumonia. I have a lot of underlying health problems. I think being cold all the time didn't help. The black mould, that didn't help because that didn't help the asthma, but it seems like, in the bathroom especially, it seems to be clearing up, or it seems like it's drying up, it's weird. I haven't had nowhere near as many problems with my asthma since having it fitted […] it's definitely just the central heating [that has improved it] because nothing else has changed. The whole house is a lot warmer, happier, and healthier, due to having the central heating fitted."

There is also evidence from household interviews that WHF interventions have made it easier for beneficiaries to manage long-standing musculoskeletal conditions and mobility issues, with interviewees reporting that they now find it easier to move around their homes, use their heating systems, and feel less pain on a daily basis.

As two interviewees summarised:

"It's made a huge difference because I have arthritis. So, if I do get cold it makes my arthritis worse. So I think having it generally warm throughout the house made a big difference to that in the winter."

"I'm a little bit more comfortable with my rheumatoid arthritis. Because, if you get cold, you stiffen up a little bit, but if you're warm, you relax more."

Moreover, other interviewees related improvements in their musculoskeletal health directly to the difficulties they had with previous heating systems. As discussed in Section 3.5 above, several interviewees found their prior solid fuel heating appliances difficult to manage because of the physical labour required to chop wood, clean out ashes, and carry bags of coal. For interviewees with limited mobility or musculoskeletal conditions, these difficulties were exacerbated, causing pain and inflammations. In contrast, interviewees that received first-time central heating systems reported that because they no longer needed to manually attend to their fuel type in this way, their musculoskeletal health was improving:

"I've got arthritis in the other hip now, one knee, and spinal stenosis which is like when the bottom vertebrae start rubbing together and keep trapping nerves […] it wasn't comfortable because arthritis doesn't like the cold. I did have a coal fire but a few years ago I had a fall. If I wanted to clean the fire out I could maybe kneel down but I wouldn't be able to get back up, so I haven't used the coal fire for four years now."

Positive impacts on musculoskeletal conditions were also experienced by Category 3 beneficiaries. For instance, one Category 3 interviewee described living with multiple musculoskeletal problems that had been exacerbated, in previous years, by a double hip replacement. As the interviewee discussed,

"I've had two hip replacements and I've got a pin in place in my ankle so I don't walk very well, I've got arthritis in my spine so I walk with a stick; I can't go out on my own because I've got a balance issue as well, I fall down quite easily, put it that way […] I know when it's cold because they kick in […] it doesn't bother me in the heat at all, but the cold is drastic [for my hip joint]."

Following support to apply for and secure the £140 Warm Home Discount rebate, the interviewee reflected on her first winter with the rebate as follows:

"I can definitely say that I've had the heating on for longer this winter than ever, just because I have felt the cold more. I think it's an age thing, you're getting older and you do feel the cold more […] if you're warm you feel a lot better in yourself rather than sitting freezing, and the arthritis doesn't hurt half as much in the summer as it does in the winter when you're cold."

Interviewees also reported variegated positive impacts on their mental health and wellbeing; they described how receiving support from the WHF had enabled them to feel more in control of their costs and household expenditures, improved their feelings of safety and security at home, and allowed them to worry less about how living in a cold home was affecting them and their family.

As in the previous section, no interviewees disclosed any impacts of their WHF intervention on formally diagnosed mental health conditions, such as anxiety or depression. Instead, testimony from household interviews supports the finding that the general mental health and wellbeing of beneficiaries has been significantly improved (see Table 3.4), in various ways and for various reasons.

For instance, interviewees who previously felt ashamed and embarrassed that they could not provide a warm home for their children or other family members talked about how receiving a first- time central heating system effectively reversed these feelings:

"Yes, it's just one less thing to worry about and it was a massive thing. It was a massive thing that I was worried about back then. Not being able to keep my baby warm, but, like it's just a massive relief off your back when you don't have to worry about that anymore."

"It made me happier. I don't feel so desperately unhappy when I am down. So, it has had the effect that when I'm feeling really low, I don't hit that rocky awfulness. For the last year, this has been, since the heating has been in, which could be – I have had lows but nothing really overly concerning […] I feel like I am in control of my home, not just flailing around wildly."

Moreover, one interviewee narrated how they were worried and anxious that their old storage heaters would pose a fire risk for the whole household, including a child. The interviewee described the impact of a Category 2 installation as follows:

"What I can't state enough is it reduces your anxiety, it really does and that's the big thing with it. It's the safety aspect because it's a safe system. There are no naked flames anywhere in the house or anything. There is no problem of carbon poisonous gas or anything like that. You're less worried about the mould. You're less worried about the bill. The effect on your mental health is a lot. We're not on to my teenager anymore. He just keeps his [radiator] on all the time and it's fine."

Category 3 interviewees, particularly those experiencing acute financial vulnerability, or who were involved in difficult and stressful conversations with their energy suppliers regarding affordability and debt, described how having the support of an energy advisor or

caseworker significantly alleviated their stress and worry.

For example, one interviewee, over the age of 75 and struggling financially, described the long-term support they received from a Category 3 project with several energy-related issues as a 'lifeline':

"Yes. [The caseworker] really was my lifeline, to be honest. So helpful. So nice. I really couldn't have got through those months without him. That sounds a bit dramatic, but it was awful. We lie in bed at night and all you can think of is, 'Bloody idiot. Idiot. Idiot. How can I get rid of them? Oh.' So, I mean, [the caseworker] took that stress away, to some extent, although you still worry about things. I mean, you imagine in your own life, if you have had all of these difficulties – at 87, as well, you know, you don't take things and just let it go off of the top of your head. You have to think them out, try and think through them, and [the caseworker] actually was my lifeline."

A second interviewee who was in arrears to their energy supplier and struggling to reach a resolution independently, described how a Category 3 project had supported them with their energy bills and low-cost energy efficiency measures:

"When it came to the bill side of it, it definitely helped, that was a great relief. I think I did get more exasperated about the situation when I had been helped to have thermal curtains to cover the front and the back door, to try and help keep some heat in and stuff, and then that wasn't working. Because obviously it was like trying to fix the problem and then finding that it's unfixable. So, that got worse over time."

A final example, from an interviewee who received support with prepayment meter top-up vouchers, illustrates the impact that energy advice and support can have on the alleviation of depression and anxiety.

"Your depression is always better if you are warm and you are not sat there freezing. Then you can't move. Then when you try and move you have got no energy and everything hurts. With the vouchers everything could be at the same temperature, like a nice comfortable temperature. It really did help."

Notably, in these cases and others it was often the reassurance that they were no longer having to confront issues and challenges alone that was described as significant; having an energy advisor or caseworker who would advocate on their behalf and support them through difficult situations was very important – not only for resolving their situation in general, but for their mental wellbeing too.

A final point in relation to mental health and wellbeing is that several interviewees discussed their interventions in terms of opening their home up to them, or making their house into a home.

Underpinning these discussions were observations that, previously, much of their home had been effectively uninhabitable; too cold, damp and mouldy to use safely and comfortably. This led to feelings of entrapment within certain rooms, or more generally in a home that was not pleasant, relaxing or safe. Different interviewees commented on how first-time central heating system installations had reversed these feelings:

"My middle room, before I had my electric fire in there, I couldn't sit in there in winter because there was a draught down the open staircase […] whereas now with the radiator in the porch I can go in there as well. […] I have a suite in, it is like a sitting room, I have also got a computer in there. I have got a chair in the corner now next to the radiator where I sit and meditate, I call that my cosy corner […] I said I feel as though my world has doubled in size because I don't often get out, so really this downstairs floor is pretty much my whole world."

"I think what happened with the heating, what that's done for me, is made my home feel homely, and not like I'm living in someone else's house. It's made it feel like I belong here. Given me a sense of ownership of my house, and made things easier for me because it was just one massive thing to me, having a cold house."

As these quotations show, **what this means is that WHF interventions have helped turn beneficiary homes into spaces that previously did not embody what a home should be: warm, comfortable, relaxing and peaceable, with a correspondingly positive impact on mental health.**

3.8.4. Additional health impacts

In interviews with beneficiary households, three further health impacts were highlighted that will now be briefly discussed.

Firstly, evidence shows that WHF interventions are preventing the development or exacerbation of health conditions for young children, by enabling them to grow up and live in a warm home.

Prior research has consistently demonstrated that fuel poverty is associated with a wide range of negative physical and mental health for children, especially respiratory ill-health, bullying and stigma at school, increased school absence through hospital attendance or ill-health, lower than average weight gain and dietary deficiency, and social isolation.[35] Itis clear that in many cases, WHF interventions have probably prevented the development or exacerbation of these issues for young children, from babies to adolescents. For example, one interviewee described living with electric storage heaters with a new-born baby:

"When I had the electric storage heaters, my son didn't have his own room. Just because even if I did let him go in his own room it'd be too cold and I wouldn't be able to trust not waking up and looking to my and checking his temperature. I'd have to go into the other room and … I just wouldn't have been able to do it. He'd have to always be next to me."

As this quotation indicates, the interviewee's temporary solution to her son not being able to sleep in his own room because of the cold was to bring him into their bed. The interviewee perceived that this was dangerous due to the risk of accidental smothering, but felt that they had no option. Now, on the other hand, *"he's got his own room and I don't have to worry about the temperature."* In this case, growing up from birth in a cold home would have significantly heightened the risk of the baby developing breathing problems and other cold-related health issues, which have now potentially been prevented.

A second interviewee discussed a similar example, living in a home with inadequate storage heaters. As the interviewee explained:

"Before, I had storage heaters, they didn't work. I've got two young kids so it was absolutely freezing […] when the kids are cold, it was really bad, and they wouldn't want to get out of bed in the morning because they could see their own breath. My son had a wee, this might be a bit too much information, had a wee, and he goes, 'Mummy, my wee is on fire.' I was like, 'What are you talking about?' And he goes, 'Smoke coming off my wee.' It was the steam because it was so cold in the bathroom."

However, after a Category 1 intervention, the interviewee described an entirely different experience of home for their children:

"It's just made the house really liveable because what we were having to do was, in the evenings, we'd all be in the lounge because that's where we'd put a fire on, light the fire, and all just huddle around there. But now, we can spread out a bit more, and the boys are happier to go to their own beds, whereas they wanted to sleep with me before, with hot water bottles. So, it has enabled us to use the dining room more to eat our dinner, and to go up to bed, and they'll sleep in their own beds."

Furthermore, a third interviewee had decided not to have children precisely because they were aware of the health and wellbeing risks of bringing up a child in a cold home – a decision they described as extremely upsetting:

"I don't have children. But it was definitely something like, I do not want a child in this house with this problem. So you put life on hold, because you don't want to go ahead and bring a baby in and then have them bathing in a bathroom that's full of black mould, or preparing their food in a kitchen that you have to bleach the cupboards every six months."

Later in the interview, the interviewer asked whether receiving a WHF intervention had changed their view on this. The interviewee laughed and replied that it was *"not immediately on the plans, but it's not a concern now, when it happens it happens and I'm not worried about that."*

Beyond these three examples, other interviewees testified that their children had become less anxious and stressed, happier and more vibrant around the house, and less affected by other health conditions they had. A particularly noteworthy final example is from an interviewee whose son had asthma and autism, a combination which made everyday life very difficult in cold temperatures:

"I think it was difficult because my son with him being autistic, he'll only have certain brands of things and so they are always a bit more extensive, and he always knew if you tried to switch things or … it wasn't an option to really reduce costs in, sort of, the food area. So it was just, sort of, other things that we could cut costs on because of the heating […] he's asthmatic

35. NEA and Food Foundation (2022) Impacts of food insecurity and fuel poverty on child health this winter.

as well, so obviously that didn't help being in the cold. Yes. That had an impact. And the fact that he does have sensory, sort of, problems, or he does feel things more than we might feel. So he might be more, you know, he'll feel the cold more than what I would or, noise, you know, he doesn't tolerate it as well as somebody else might."

As the interviewee continued, receiving a more energy-efficient heating system that was cheaper to run freed up space in the household budget for them to more easily afford the types and brands of food that their son required, and reduced the discomfort their son felt in cold temperatures due to his autism and asthma. Together, this **evidence shows that the impact of the WHF on the health, happiness, and wellbeing of young children has been substantial, and has reduced the potential of the development or exacerbation of cold-related illnesses in this particularly vulnerable group.**

Secondly, there is evidence that the WHF has enabled improvements in diet and nutrition that have had a positive impact on the physical health of beneficiaries.

Cutting back on food to meet energy costs is a practice associated with fuel poverty risk, and it is more widely recognised that households with low incomes are more at risk of developing type 2 diabetes as well as associated diabetes[36] complications. One interviewee explained the connection between their WHF intervention, diabetes, and diet as follows:

"You know, it improved my diet, as such, because eating fish, and so on, at one time, buying fish was so expensive that you just had to pick up some frozen stuff, and so on […] at one time, I was diagnosed with diabetes, type 2 diabetes [and] I do know that my [blood] sugar levels have gone down [now]."

Similarly, while it is not viable to directly evidence this, it is possible that reducing energy costs through a WHF intervention has led to improved diets for some older beneficiaries, which may have reduced their risk of developing diabetes and similar health issues in the future.

Finally, there is evidence that WHF interventions have facilitated safer home environments for beneficiaries with dementia.

One householder took part in an interview with the evaluation team on behalf of his mother, who was the primary beneficiary, but could not take part in an interview herself due to ill-health. The interviewee talked about his mother's life, and how *"she was actually very active up until being in her late 70s, but she developed Alzheimer's and she's less active now. She doesn't walk very far. So it was really important to keep her warm, that was my main concern."* However, as the interviewee's mother's dementia progressed, this became increasingly difficult because she would forget to plug in and switch on their portable electric heaters in the morning, *"and she would be sat there in the cold."* At the other end of the day, *"if I was ill and I wanted to have an early night, my mother might forget to unplug the radiator and it would be left on all night."* As these quotations show, the mental labour of attempting to keep his mother warm and safe was exacerbated by plug-in radiators that could only ever be on or off, and had to be adjusted manually. After a first-time central heating system with a timer was installed, the interviewee commented that *"just to have it set so that it comes on and goes off when it's supposed to, [the weight off] her shoulders is massive."*

3.9. Impacts on energy capabilities and advice provision

This section investigates the role of advice provision in shaping and generating impacts for WHF beneficiaries. It focuses on two key themes that emerged from research with beneficiaries: 1) the role and importance of holistically combining the delivery of energy advice and capital measures to households in one intervention; and 2) the impact of Category 3 interventions on energy capabilities. Each theme is examined in turn in the subsections that follow.

3.9.1. Blending energy advice and capital measures

Previous research has suggested that delivering energy advice and capital measures together as part of one streamlined customer journey tends to result in more optimal outcomes for households than delivering one or the other in isolation.[37] This is because it can address multiple drivers of fuel poverty in one intervention (e.g. low income, through income maximisation and energy (in)efficiency through replacing inefficient boilers).

The importance of holistic delivery has been noted already in Section 2, where WHF projects commented on the added value associated with having access to Category 3 funding, alongside funding for capital measures through Category 1 and/or Category 2. The WHF projects' perceptions of the benefits of this approach are substantiated in findings from the household survey.

The questionnaire distributed to Category 1 and Category 2 beneficiaries included an item asking if respondents had received any additional forms of energy advice alongside their installation. The forms of advice asked about were:

- How to save or reduce how much energy you use at home;
- How to manage or better understand your energy bills;
- How to keep warm and healthy at home;
- Information about switching energy supplier or tariff;
- How to manage or reduce any fuel debt;
- Other financial advice.

Further to these six closed responses, an 'Other' box was included for respondents to note any other forms of energy advice they had received.

Based on responses to this item, a simple division can be made between Category 1 and 2 beneficiaries who also received energy advice as part of their intervention, and those who did not. Any differences in outcomes between these two groups can then be examined and their statistical significance assessed.

Figure 3.43 below shows an observable difference in how better or worse beneficiaries felt the cost of their energy bills was post-intervention, depending on if they had received energy advice or not. Most notably, 44% of respondents who received energy advice described the cost of their energy bills as 'a lot better now', compared to 30% who had not been given such advice. Altogether, 28% of respondents who did not receive energy advice described the cost of their energy bills as worse than before, compared to 16% of those who had received it. This finding has statistical significance ($p=<0.05$), and some association, if not direct causation, can be made between receiving energy advice and energy affordability post-intervention.

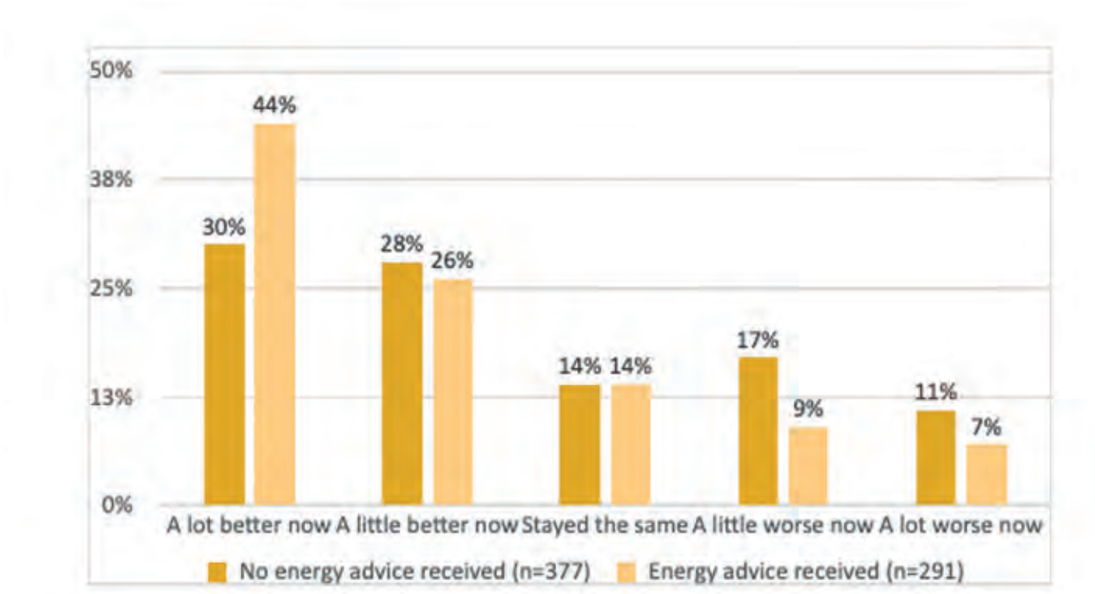

Figure 3.43: The cost of Category 1 and Category 2 questionnaire respondents' energy bills post-intervention, disaggregated by whether or not they received energy advice.

36. Tatulashvili, S. et al. (2020) Socioeconomic inequalities and type 2 diabetes complications: A systematic review, Diabetes and Metabolism 46 (2): 89–99.

37. NEA (2018) Health and Innovation Programme: Social Evaluation Report.

This finding is supported by an additional item on the questionnaire, asking how easy or difficult beneficiaries found it to afford their energy bills post-intervention. Figure 3.44 below shows that beneficiaries who received energy advice are more able to afford their energy bills post-intervention, a finding that also has statistical significance.

Furthermore, 60% of respondents who received energy advice reported finding their energy bills easier to afford now, compared to 41% of respondents who did not receive energy advice. Similarly, 13% of respondents who were given energy advice find their energy bills more difficult to afford now, compared to 21% of respondents who did not receive it.

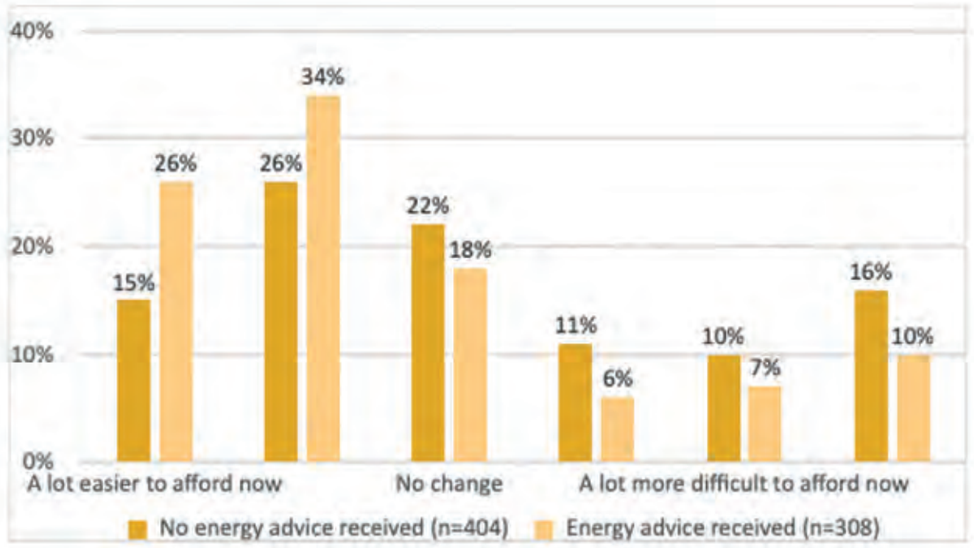

Figure 3.44: Responses to the questionnaire item 'How easy or difficult do you find it to afford your energy bills (gas, electricity, oil, etc.) now compared to before you received [...] support?', disaggregated by whether or not they received energy advice. Note that this includes Category 1 and Category 2 respondents only.

Though it is not found to be statistically significant, other comparisons point towards the same finding. For example, Category 1 and Category 2 respondents that received energy advice were marginally better able to keep their whole homes warm post-intervention, and were more likely to describe the temperature of their home as better now than before.

Similar analysis of responses to the survey of Category 3 households support this finding. In a parallel way to the survey of Category 1 and Category 2 households, Category 3 respondents were asked if they had also received any capital measures, either as part of or separately from their WHF-funded intervention (e.g. boiler replacement, insulation, first-time central heating system, solar PV). Another division can therefore be made between Category 3 beneficiaries who also received capital measures installations, and those who did not. Differences in outcomes between these groups can then be examined in the same way as for Category 1 and 2 beneficiaries.

Figure 3.45 below shows that Category 3 respondents who received capital measures interventions were almost twice as likely to report being able to keep their whole homes warm post-intervention. Specifically, 66% of respondents who received capital measures interventions said they could, whereas only 37% of respondents who did not receive capital measures replied the same. Notably, 29% of Category 3 respondents who did not receive capital measures responded 'Yes, but it is hard for me', suggesting that their advice-based intervention had partially tackled the drivers of their inability to keep warm, but not all of them.

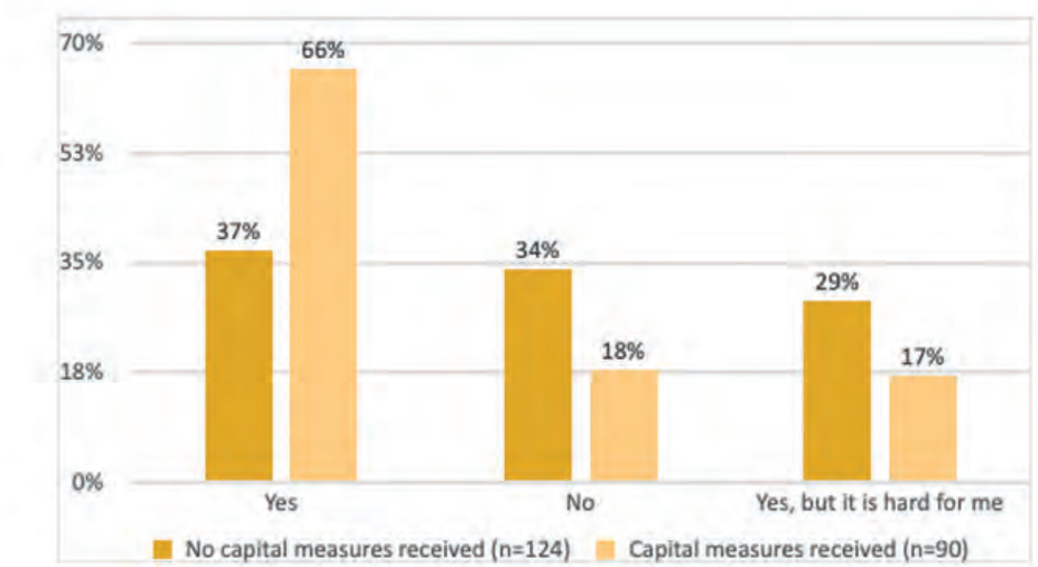

Figure 3.45: Category 3 responses to the subjective fuel poverty question post-intervention, disaggregated by whether or not respondents also received capital measures.

Moreover, Figure 3.46 below shows that Category 3 respondents who received capital measures interventions were significantly ($p=<0.05$) more likely to report that the five questionnaire items relating to thermal comfort at home were better now than they were before.

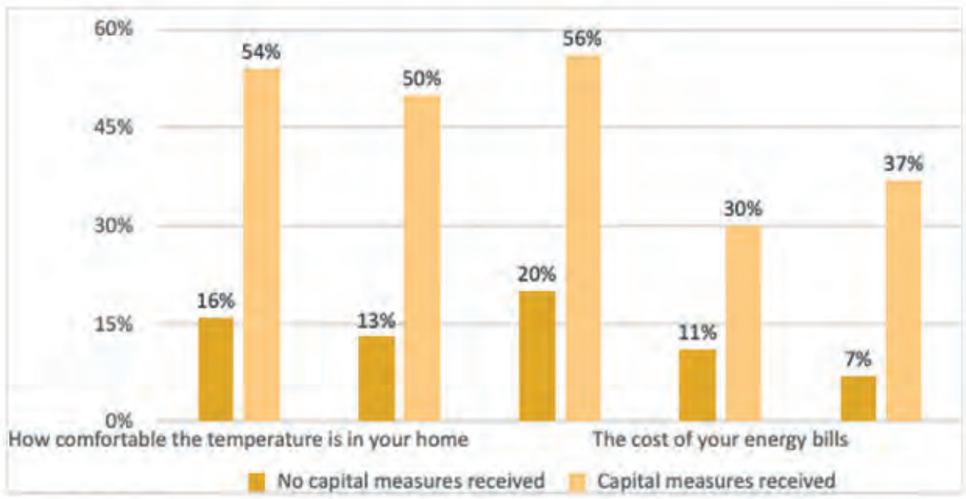

Figure 3.46: The proportion of Category 3 respondents who replied that each statement item was 'a lot better now than it was before' they received their intervention.

In interviews with WHF beneficiaries, it was often difficult for interviewees to discuss the differences in outcome depending on the different kinds of interventions they received. This is primarily because they were unable to compare their actual experience (e.g. receiving a first-time central heating system and energy advice) with a hypothetical experience with some components removed (e.g. receiving first-time central heating only). However, some did touch on this theme. One interviewee who received a Category 1 intervention noted the importance of advice they received about gas safety, secondary heating appliances, and smart meters; they linked this to no longer using their secondary gas fire, and having better control over their energy use through a smart meter installation. A second interviewee had received a Category 3 intervention, which included energy advice, a boiler service, and fixing a broken cooker. When asked if they could attribute their improved thermal comfort to any one part of their intervention, they responded that *"no, it was the boiler service and, also, obviously they mended my cooker. And they looked at the radiators."* While this was not a capital measures installation as such, it shows that interventions focused on heating-system efficiency were sometimes perceived as the most impactful part of a Category 3 intervention.

Overall, these findings show the importance of delivering energy advice and capital measures interventions together, as part of a journey that the recipient experiences as streamlined. Ways in which this can be enabled in future energy efficiency and fuel poverty programmes will be considered in the accompanying blueprint.

3.9.2. Energy capabilities and the additional impacts of Category 3 interventions

This subsection explores the impacts of Category 3 interventions on energy capabilities. It begins by illustrating the kinds of advice and support that Category 3 beneficiaries received, before moving on to considering evidence from the qualitative interviews. Specifically, the analysis of qualitative interview data focuses on those outcomes and findings not discussed elsewhere in this section, and which were more or less unique to Category 3 respondents.

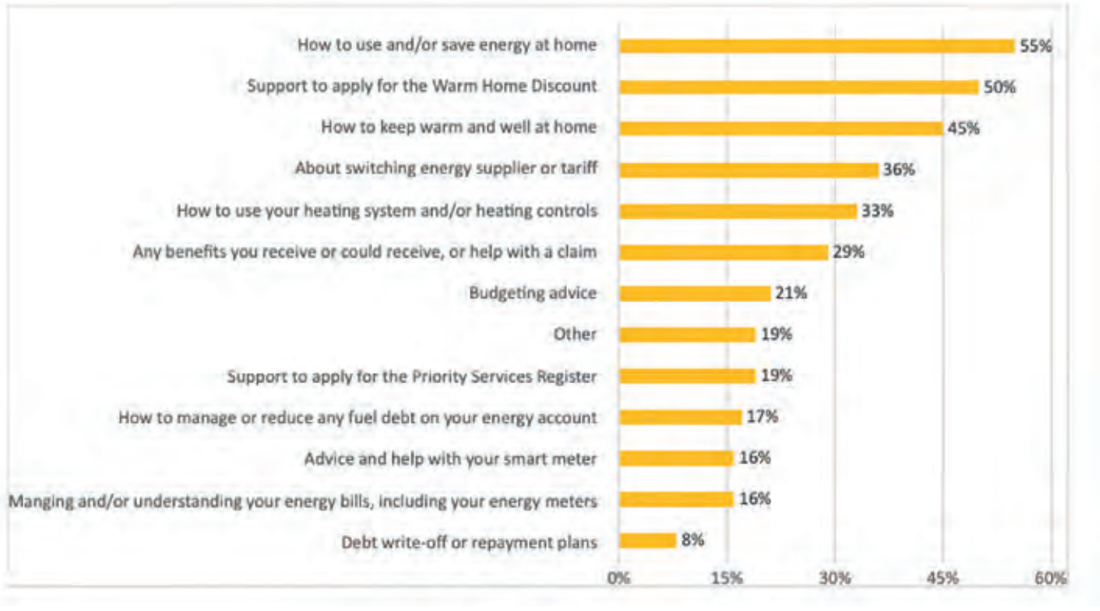

Figure 3.47: Types of advice and support received by Category 3 questionnaire respondents.

Figure 3.47 above shows that the most common form of advice received by Category 3 respondents was how to use and/or save energy at home (55%), closely followed by support in applying for the Warm Home Discount (WHD) (50%), and how to keep warm and well at home (45%). Around a third of respondents received advice about switching energy supplier or tariff (36%), or how to use their heating system and controls (33%). Debt write-off and repayment plans were the least commonly referenced form of advice (8%).

In addition, Table 3.5 below shows the number of different kinds of advice received by Category 3 respondents. It should be noted that some of these categories may have in practice or delivery been blurred, or that some respondents may have considered advice on (for instance) how to keep warm and well at home as being similar to how to use and/or save energy at home. Nonetheless, Table 3.5 shows that there was a large variance in the number of advice topics covered by Category 3 projects, but also that the most prevalent result was one topic only.

Number of advice topics covered in intervention	Proportion of respondents (%)
1	23%
2	18%
3	13%
4	11%
5	8%
6	6%
7	5%
8	4%
9	3%
10	2%
11 or more	2%

Table 3.5: The number of distinct energy advice topics that Category 3 questionnaire respondents r ecalled receiving advice about.

Qualitative interviews with Category 3 beneficiaries revealed three prominent themes, as follows.

Firstly, **there is evidence that the advice and support provided through Category 3 projects helped beneficiaries to better understand their energy use in the home and how to save energy, which led directly to improvements in thermal comfort in some cases**. For example, one interviewee received advice about how to accurately set their thermostat and draughtproof their property using simple, easy-to-implement methods. As the interviewee noted,

"[They showed me] the ideal thermostat temperature and things. And keeping the windows covered with curtains, to help keep heat in, when it got cold. And [they] also helped me get some thermal curtains over my front and back doors, just to try and help keep some heat in the property."

Secondly, **it is clear that in cases where good outcomes were achieved, the forms of communication utilised by caseworkers, energy advisors, and other Category 3 delivery personnel were imperative to gaining the trust of beneficiaries, and ultimately delivering advice that was effective**. As one interviewee explained, patient, tailored and non-judgemental forms of triage and advice provision enabled beneficiaries to feel respected and comfortable in explaining their situations:

"If anything, it was nice to actually sit down and speak to somebody that I could be open and truthful with and they could understand, and not be shameful, and work through the process and give more positive ideas of what I can do."

Furthermore, Category 3 funding also enabled projects to create multiple points of contact with specific beneficiaries where this was necessary. In contrast to a hypothetical model whereby service users are supported and then 'discharged' from an energy advice service, interviewees appreciated the time that caseworkers took to stay in touch and update them on the different forms of support that might have become available since they were last in contact. One interviewee, for example, had been supported at different points in their life by a charity funded through Category 3. They described their experience with this charity as follows:

"They're always there, they always get back to you, and they always provide you with sound advice and clearly run through processes. They make it so simple for you. You understand what they're explaining. Some of these documentations that come through, it's like they're trying to catch you out. When you speak with [the charity], and go through, they make it so simple."

A second interviewee from a different Category 3 project discussed a similar experience of regular contact and the trusting relationship their caseworker established with them:

"Yes, and they were very good, because the man that was helping us kept ringing and texting back as well to see whether everything was okay, if there was any more support he could possibly give us, if everything went how it was supposed to go. He was there for me if I needed the extra support, yes."

This evidence shows the benefits of providing projects with long-term funding for advice provision, and also ensuring that projects are appropriately resourced to enable caseworkers to 'check in' with beneficiaries to see if their situations have continued to improve or, contrarily, deteriorated.

Thirdly and finally, **interviewees discussed support they received to resolve disputes with energy suppliers as being especially impactful, especially on their mental health**. Several interviewees received support from a caseworker because they were struggling to interact with their energy supplier. More often than not, interactions with energy suppliers were described as difficult by interviewees, either because of the predominantly digital modes of communication used by suppliers, or because they felt they were being treated unfairly but did not have the capabilities to argue their case on their own. For example, one interviewee said that *"I don't do confrontation very well, I don't deal with it very well. And [the energy supplier] didn't seem to want to negotiate with me."*

Accordingly, caseworkers were described as 'taking on' energy suppliers, by advocating on behalf of their clients, and resolving complex situations that interviewees would not have been able to deal with on their own without experiencing harm or detriment. For instance, one interviewee had complained to their energy supplier about being treated unfairly, but received no response to the complaint after a certain period of time had passed. Their caseworker organised a three-way phone call with the supplier to resolve the complaint, and later (successfully) referred the case to the ombudsman:

"We had a three-way conversation with [the energy supplier], and [the caseworker], and me, and all of that was all sent to the ombudsman. I have got about a six-page letter which – I couldn't read all of it, but it turned out that the fault was with [the energy supplier]."

As discussed in Section 3.8, it should be highlighted that situations involving disputes with energy suppliers were experienced as distressing and occasionally dehumanising by interviewees, which led to negative impacts for their health and wellbeing. As one interviewee summarised,

"[The caseworker] He really was my lifeline, to be honest. So helpful. So nice. I really couldn't have got through those months without him. That sounds a bit dramatic, but it was awful."

Summarily, in addition to the evidence from Category 3 beneficiaries integrated elsewhere in this report, **these findings show that Category 3 projects had unique and sometimes lifechanging impacts on beneficiaries that went beyond the provision of financial support (e.g. income maximisation), or onward referrals for heating system or energy efficiency improvements**.

3.10. Impacts on environmental awareness, knowledge and sustainability

There is evidence of environmental impacts that the WHF has generated for beneficiaries. The household survey of households from all categories contained two relevant questions, related to energy use in the home, and the extent to which receiving a WHF intervention had stimulated wider sustainable and environmentally friendly behaviours.

Figure 3.48 below shows that, overall, three-quarters of respondents agreed with the statement 'You are more interested in how energy is used in your home and how you can save energy' after receiving their intervention. This finding is split fairly evenly across WHF funding categories, as Figure 3.48 shows.
In addition, 57% of respondents agreed with the statement 'You are more interested in how you can be more sustainable in other ways (e.g. travel, food, etc.)' after receiving their intervention (see Figure 3.49). This suggests that receiving a WHF intervention is stimulating wider energy-efficient and sustainable behaviours among beneficiaries.

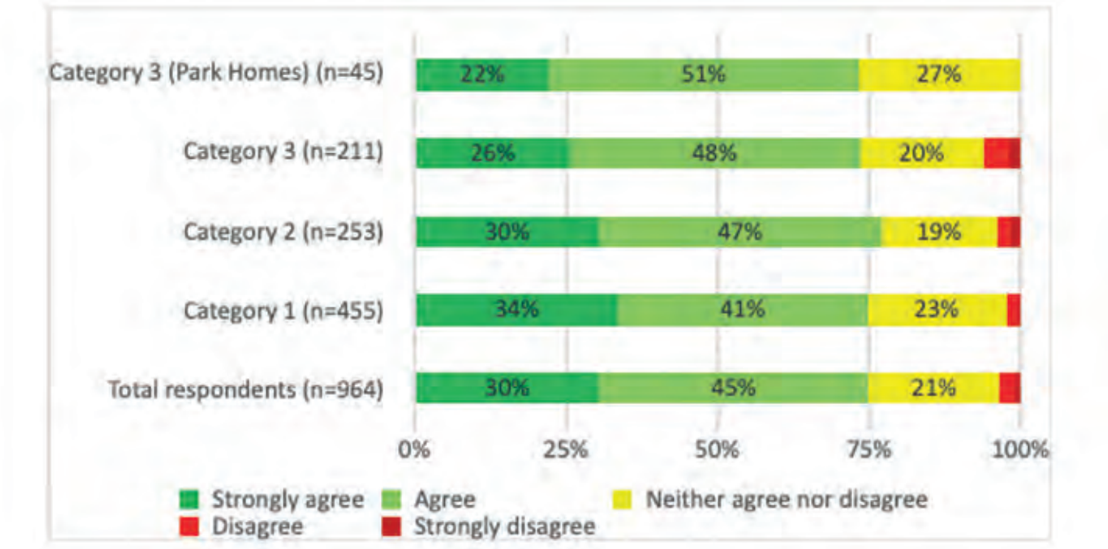

Figure 3.48: The extent to which questionnaire respondents agreed or disagreed with the statement 'You are more interested in how energy is used in your home and how you can save energy', disaggregated by WHF funding category.

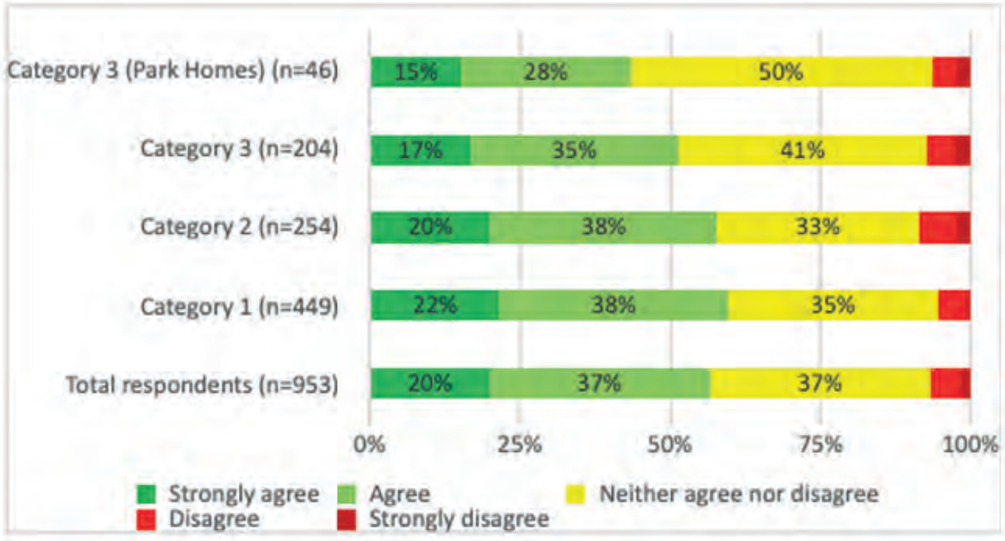

Figure 3.49: The extent to which questionnaire respondents agreed or disagreed with the statement 'You are more interested in how you can be more sustainable in other ways (e.g. travel, food etc.)', disaggregated by WHF funding category.

In interviews with beneficiary households, three themes relating to the environment and sustainability were discussed by interviewees.

The first theme was that some interviewees displayed strong environmental awareness, but felt that they were not able to heat their homes in a way consistent with their values, due to factors outside their control.

Interviewees who discussed these themes tended to comment on their awareness of climate change and how they could contribute to reducing carbon emissions, stating, for example:

"We moved [here] from Nottinghamshire originally, we wanted to find a bit where we could have some land. So with the property it is 11 acres, and we wanted to live in a more sustainable way. We went through the whole process with our last houseWe had a tiny garden, but we were growing fruit and veg. We had solar panels on the roof. We had proper walls, and they were insulated, but it just wasn't really doing much. We knew that we were limited without the land to be able to live more sustainably. We needed garden space. Basically, we wanted land so that we could try and keep it as natural as possible."

"I'm always trying to get A-rated energy appliances and stuff like that. Like, everything is A-rated, and I got quite good stuff to try and cut the cost of the electric down […] to help the environment."

In addition, it is noteworthy that some interviewees felt that their previous heating systems, which they typically had little control over or could not afford to replace on their own, were in conflict with their stated values. For example, one interviewee described moving into her social housing property, which previously had a wood burning stove. The interviewee remembered: *"I wasn't given the chance to say, 'No, I really don't want this [heating system]'. I suppose I possibly could have done, whether I would have been successful in protesting, I don't know."* Other interviewees perceived that the fumes and air pollution associated with their wood, coal and oil heating types were bad for the environment, but that they had little agency over replacing their heating systems, due to either cost or tenancy issues.

Accordingly, **the second key theme was that receiving a WHF intervention often enabled beneficiary households with strong environmental values to heat their homes in a way they felt was good for the environment and not detrimental to the planet**.

In other words, the evidence suggests not so much that receiving a WHF intervention led directly to the cultivation of environmental sensibilities among beneficiaries, but that interventions supported households that were already trying to be more environmentally friendly in their everyday lives. For example, one interviewee said that, early in the lifespan of the relevant WHF project, they were offered an oil system, which they refused:

"Well the other thing that we wanted with the air source heat pump, because we were actually offered an oil-fired system, and we said, 'No.' Because we've not got gas on the property. We're only electric. And the whole point of moving here and being sustainable is you don't want to be reliant on fossil fuels. So going to oil just seemed to really defeat that, because hadn't the funding run out, or something, for the air source heat pump? So we said, 'If it's not the air source heat pump then we are not interested. We don't want to go back to more fossil fuels.'"

In contrast, this interviewee and others described their happiness and satisfaction with receiving ASHP installations through Category 2 projects, precisely because it aligned with their pre-existing values, and allowed them to heat their homes in a way they perceived to be environmentally friendly:

"I had obviously ticked [on the questionnaire] that mental health and satisfaction were increased slightly by having the new system. Part of that was that I felt I was, kind of, doing my bit by having a much greener, alternative system put in, you know, that would be using less energy and not using oil or gas."

"We can always create electrics in the wind or the water, so I was just thinking it was really good for the environment, do you know what I mean, rather than burning a wood burner."

For other interviewees, receiving an ASHP installation was seen as a first step towards further improvements they wanted to make to their homes, such as installing solar PV, and these interviewees even commented that they were disappointed that their WHF projects were unable to offer them solar PV as part of their intervention. Nevertheless, this shows that replacing solid fuel systems with an ASHP was perceived extremely positively by some interviewees. As one put it, *"not going ahead with the oil-fired system, it's a really big thing for us."*

Furthermore, this finding is not just applicable to households that replaced solid fuel systems with ASHPs. One interviewee, for example, described being happier with an ASHP than their previous storage heaters because it was more efficient and therefore used less electricity. As they commented, this was a satisfying experience because the ASHP *"is very economical and less hard on the environment […] we don't have to be burning all that electricity just to keep the place warm."* Another interviewee received a gas central heating installation through a Category 1 project, and said of their new system that *"it's comfortable, it's efficient, and […] it's clean, obviously."*

However, **the third and final key theme is that, in different ways, interviewees perceived the current policy and energy efficiency funding landscape in the UK to be insufficient to support clean heating technologies**.

One interviewee, for example, explained that after their ASHP installation they had switched to a supplier offering a 'green' electricity tariff, be*cause "it was supposed to be a good price but it's turned out to be the opposite, the same price as it was before."* Another interviewee agreed, linking this explicitly to the price of electricity, and arguing that *"I think there's got to be some sort of incitement for people who green their heating [to] have cheaper electric."* One of these interviewees agreed with the notion of national and/or devolved governments attempting to make electricity prices cheaper by moving some energy policy costs from the electricity bill into general taxation, as a way of addressing high electricity prices. It should be noted that both of these interviewees took part in the third wave of fieldwork in Spring 2022, and were therefore experiencing increased electricity prices that were making running their ASHPs challenging.

Another interviewee discussed the high capital costs of ASHP technologies, commenting that they would not have been able to afford the installation without the support received from their WHF project. They suggested that *"if your boiler is a certain age or if it's condemned, then I think you [should] get a grant which reduces the cost quite a lot."* Afterwards, the interviewer informed the interviewee of the forthcoming Boiler Upgrade Scheme (BUS), which although not yet announced was in the process of being finalised at the time of the interview. The interviewee complimented this scheme, saying *"I think it should be encouraged."* Later in the interview, this interviewee also commented that social housing providers should be more proactive in helping their

tenants to access low-carbon heat, and argued that new homes should *"be built with, kind of, greener alternatives."* It is remarkable that in these conversations, interviewees were not aware of the policy context surrounding (for example) the BUS or the Future Homes Standard (FHS), but nonetheless identified the key barriers and enablers that these schemes and pieces of regulation are seeking to address. More broadly, the key finding is that environmentally driven interviewees were hugely satisfied they had been given an opportunity to access clean heat, and wanted that opportunity to be extended to others less fortunate than themselves.

3.11. Overall beneficiary satisfaction

Finally, in addition to the positive impacts this section has demonstrated for beneficiaries, householder satisfaction was consistently high.

3.11.1. Survey findings

Figure 3.50 below shows that overall, 88% of beneficiaries were satisfied with the scheme they had received support from. Where applicable, four in five beneficiaries were satisfied with the quality of work undertaken in their home, and 77% of beneficiaries were satisfied with how their WHF-funded scheme communicated with them. Where applicable, 71% of beneficiaries were satisfied with the quality of the advice they received.

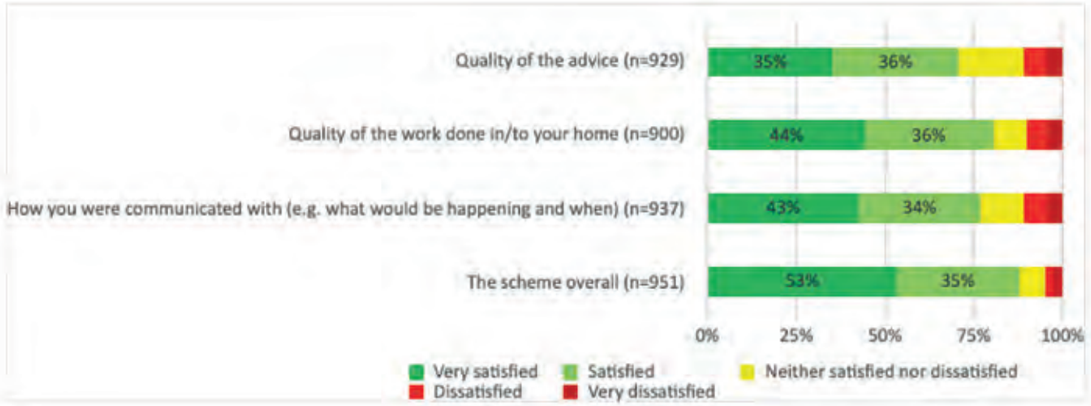

Figure 3.50: The extent to which questionnaire respondents were satisfied or dissatisfied with four specific aspects of their experience, disaggregated by WHF funding category.

When disaggregated by WHF funding category, some small differences in satisfaction emerge. Figure 3.51 shows that 93% of Category 1 beneficiaries were satisfied overall, 86% of Category 2 beneficiaries were satisfied overall, and 84% of Park Homes beneficiaries were satisfied overall. The lowest levels of overall satisfaction are found among Category 3 beneficiaries, with 81% of respondents satisfied overall.

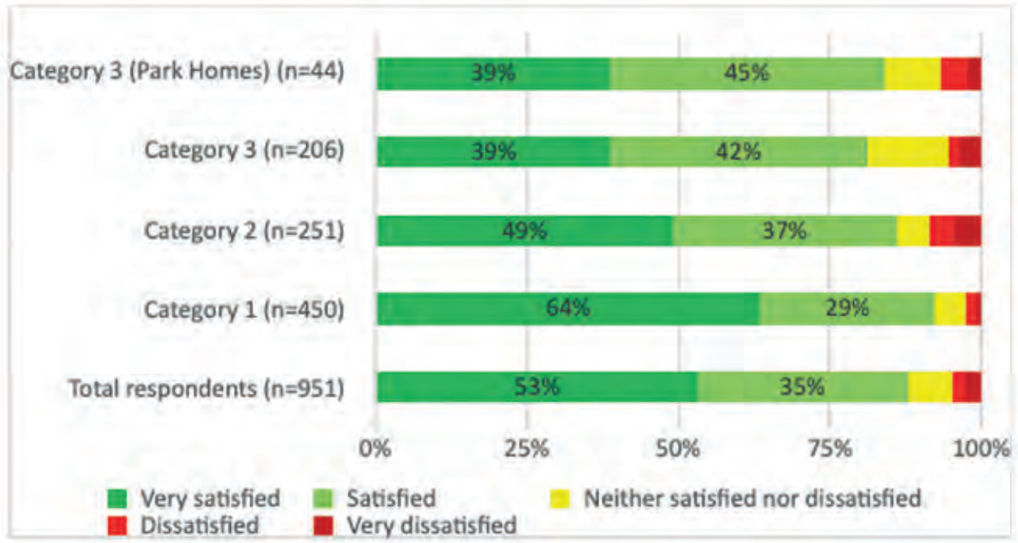

Figure 3.51: Questionnaire respondent satisfaction overall, disaggregated by WHF funding category.

Furthermore, Figure 3.52 below shows that there were small differences in how satisfied beneficiaries were with the quality of the advice they received. Category 3 respondents were the most satisfied with the advice, which might be expected given the advice-based nature of Category 3 interventions. Three-quarters of Category 1 beneficiaries were also satisfied with the quality of the advice they received, but smaller proportions of Category 2 and Park Homes beneficiaries were satisfied with their advice provision: 58% and 59% respectively. The reasons for this will be explored below. In contrast, Figures 3.53 and 3.54 below indicate minimal differences in respondents' satisfaction with communication and the quality of works done to/in beneficiary homes.

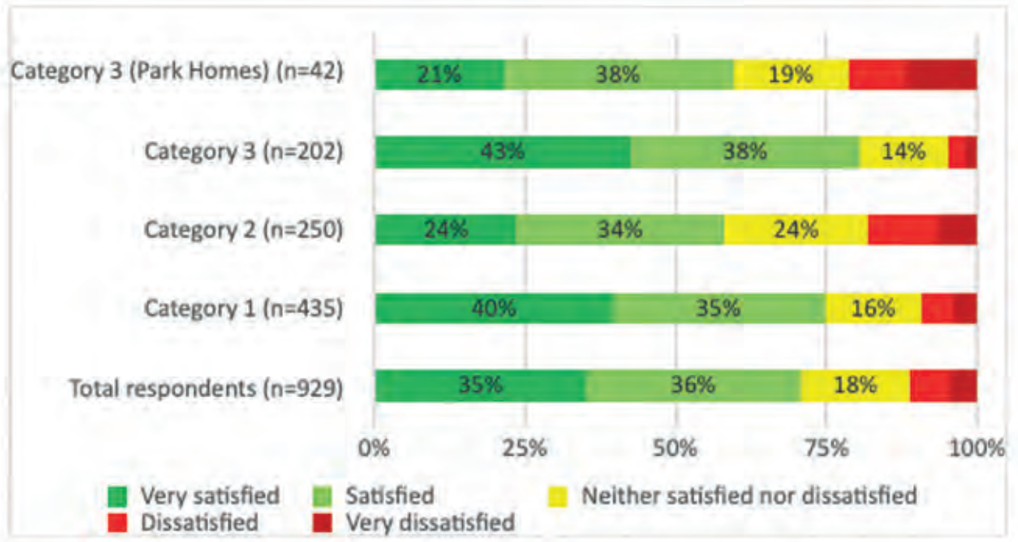

Figure 3.52: Questionnaire respondents' satisfaction with the quality of the advice they received.

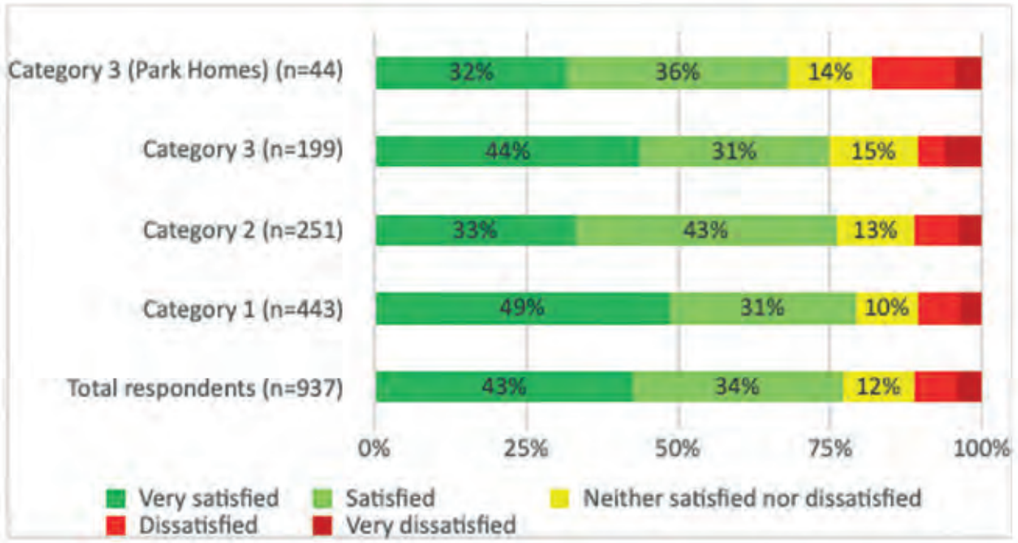

Figure 3.53: Questionnaire respondents' satisfaction with how they were communicated with.

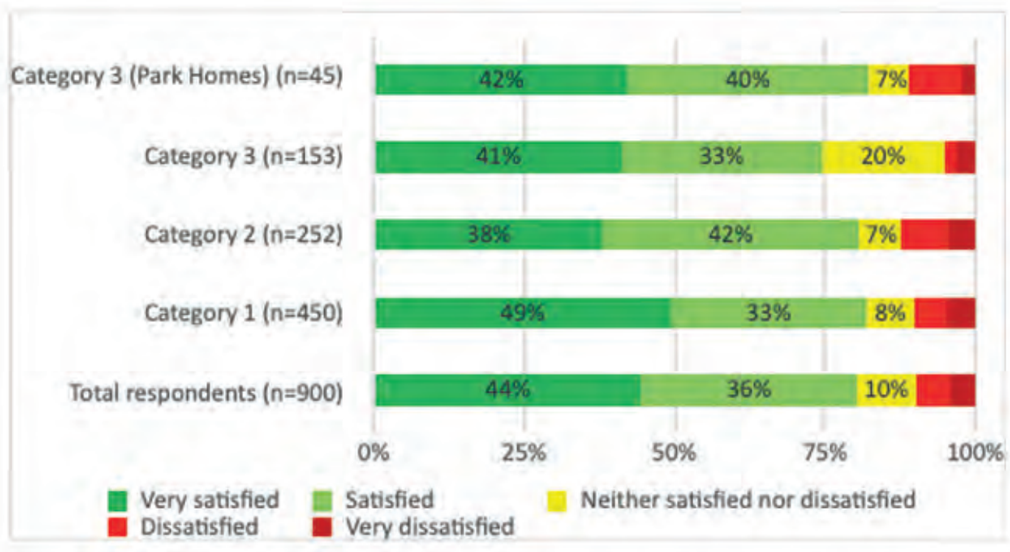

Figure 3.54: Questionnaire respondents' satisfaction with the quality of the work done in/to their home, disaggregated by WHF funding category.

3.11.2. Insights from household interviews

When asked to reflect on how satisfied they were with the services they had received, the majority of household interviewees were extremely positive about different aspects of their experience.

Households that had received first-time central heating installations frequently commented on the clean, professional nature of their surveyors and installation teams, praised the quality of the installations undertaken, and complimented WHF projects' communication processes as informative and straightforward. Some examples of positive householder experiences are as follows:

"The people who came to do the work, installation, you couldn't grumble at all. They worked hard and they worked well, and they done a very nice job. There's no bodge-ups anywhere, it's all nice, neat and tidy. They never made a mess, it was all very good, very well done, very well installed."

"I thought the whole thing was fantastic, from start to finish. Nothing about it made me unhappy. The chaps that came in and did it were great. The person that came in and did the talk to me, to explain it all, and then clear up afterwards, was fantastic. The company that did it […] were really friendly and lovely, but professional. Not like in-my-face or anything, just really nice. Yeah, the whole thing was brilliant. I tell everyone about it."

"Yes, there was one lady, I can't remember her name, but I remember she was very helpful, and she just walked me through the process again and again. So, yes. And then when the installer came to install it, they were quite nice, they were good, you know. So, all around, I think it was all positive. I don't think there was anything negative about it."

However, as Figures 3.50–3.54 show, there were some beneficiaries who were dissatisfied with the services they received from projects. For beneficiaries that received first-time central heating installations, household interviews show that two main issues were responsible for dissatisfaction, which can be summarised as 1) aesthetic and cosmetic aspects of their installation, and 2) issues related to the broader advice, support and communication delivered alongside their installation.

Regarding aesthetic and cosmetic aspects of first-time central heating installations, it was clear that some households perceived that parts of their home environment were disrupted or damaged during their installations, and this was not resolved to their satisfaction by the project.

For example, some interviewees commented that piping had been left exposed on internal and external walls, flooring had not been properly put back, and holes and marks on walls had been left after the installation was completed. It is noteworthy that although they expressed dissatisfaction, the majority of interviewees who commented on cosmetic issues recognised that they were minor inconveniences that came with the territory of a first-time central heating installation:

"Obviously all the carpets had to be pulled up, but they couldn't be pulled up properly. So they had to cut them all. So we still have, like, cut carpets all over the upstairs, but we will replace them eventually. But, yes, it's just silly things, but like I say, I'd rather live with half the wallpaper off and the carpets cut than not have the central heating. So, yes, I'm more than happy."

However, some interviewees considered the cosmetic issues with their homes to be more fundamental than a minor inconvenience. One interviewee, for example, was left with exposed piping in their kitchen and external to their home, and narrated their installation experience as follows:

"They couldn't work out where the corner was, so we sort of have a drill hole that they then filled in, because they put it in the wrong place. And it's now, I would say, six inches – if you're sort of looking into a corner, it's six inches from the corner and then it was two pipes have come right down the full length of the wall, which weren't covered […] So then just to leave us with two, I don't know, 10–11 foot copper pipes coming the full length of the kitchen wall […] as you walk in the kitchen from the front door, it's the first thing you see, it's on the wall facing."

As this interviewee and some others remarked, these cosmetic issues were more important than the term 'cosmetic' might suggest. Instead, they were viewed as impeding the liveability and cosiness of their properties by constantly marring their experiences of living in and moving around their home. These experiences demonstrate the importance of ensuring that central heating installations are planned and carried out to the highest standard. When significant disruption is inevitable as part of an

installation, it is also vital that project have additional gap funding to be able to correct any aesthetic or cosmetic problems that may occur and are left outstanding after an installation is completed. Lastly, such cases show the need for consistent quality assurance practices and clear channels of communication between projects and households post-installation, to ensure that any issues are identified and rectified in a timely manner.

Regarding broader advice and communication, several interviewees commented that different aspects of their experience were affected by what they felt was inadequate post-installation support. The most common negative experience raised by interviewees was a lack of adequate advice about how to effectively use and operate their new heating system. Many households in receipt of first-time central heating installations had never had such systems before, and several initially struggled to understand how to use them in a way that worked for them:

"The thermostat in the house, that is a bit of an enigma for me. I mean, that was my only criticism of the firm, that when they finished, they just left. They said, 'There are all the papers.' I thought they would hand over and explain things a bit for me, and they didn't do that."

"The only part that was really let down was after they installed the heating system, they kind of just installed it and left. Then I think it was maybe a week or so later we had a little issue with it, and in the end I think we ended up Googling it. They did send an engineer out, but we'd already Googled it and figured it out by the time that he arrived. It was something that if we were shown how to use it in the first place … But literally they just packed up all their stuff and then they were gone. We were initially expecting someone to stay behind and show us how to use it. I was like, 'Okay, maybe they're just packing up their tools because it's the end of the day, and someone will come back tomorrow and show us how to use it.' But no, they just left. But we had Google manuals and things like that."

"We have asked various people, the engineers who have come and fitted it, the plumbers, whatever you call them, people from the company that originally set the thing up. One says, 'You don't touch anything, you'll fry its brain if you do.' And the others are, 'You can set individual temperatures by the thermostatic valves on the radiators.' Okay, but it doesn't have thermostatic valves on the radiators […] It would have been so much better, this is the only complaint I've got really, that if somebody had spent half an hour with us at the very beginning, it would have cut out all the confusion that we've had."

As these quotations demonstrate, households that receive support through fuel poverty schemes will sometimes require additional support in order to use and operate their heating systems effectively after installation. Although Figure 3.52 shows that, in most cases, households were generally satisfied with the standard advice provision from Category 1, Category 2, and Park Homes projects, a significant number of respondents and interviewees had been left feeling uncertain and unsupported. In addition to these quotations, several other interviewees described being left with difficult-to-understand manufacturer instructions, and felt that projects had not incorporated sufficient time and resources to help them understand their new heating systems. This shows that consistent practices of post-installation advice and support are essential if all households are to make best use of their new heating systems. This is not only vital for ensuring that households feel comfortable and confident, but also for the efficiency and affordability of their energy bills; if new heating systems are not being used optimally, they may be more expensive to run, and lead to the warmth needs of householders being only partially met.

Figure 3.52 shows that Category 2 households were the least satisfied with the quality of the advice they received, and household interviews highlighted several additional issues that were specific to the use and operation of ASHPs, such as:

- The nature and operation of low-temperature heat pump systems were sometimes at odds with how beneficiary households were used to heating their homes (e.g. in short bursts with gas boilers or storage heaters), and occasionally resulted in the systems being switched off entirely.

- Households were sometimes not offered advice on switching supplier, alongside their heat pump installation, and were therefore unable to access the most suitable electricity tariffs for their heat pump (e.g. switching away from Economy 7, where storage and immersion heaters were replaced).

- Households were sometimes not consulted during the survey prcess, which on occasion resulted in radiators and external heat pump units being installed in places the householder considered impractical or detrimental. In particular, noise caused by the placement of external heat pump units directly outside bedroom windows was noted, and more than one interviewee experienced disrupted sleep and poorer mental health for a significant period of time before the unit was moved to a more appropriate location.

Beyond this, interviewees also highlighted unique aspects of their installation experience that were dependent on the specific features of their home or their different energy service requirements. For example, one interviewee who received an ASHP to replace a solid fuel fire noted that *"I should've got the fire taken out and the chimney blocked off."* Later in the interview, the interviewee noted that they would have appreciated some advice from their project about how best to do this, saying *"I think I would've had a better understanding of what it would mean"* if this advice had been available. Other interviewees said they wished they had been told more about the warranty and guarantees of their new heating systems, including servicing requirements. For instance, one commented: *"I don't know if I'm responsible for having it serviced or if for the first two years they will deal with it."* A final interviewee described being given *"loads and loads of information"*, but could not access it because they were visually impaired: *"[I'm] waiting for a cataract operation so I'm struggling to read."*

Notably, some examples of best practice were given by other interviewees who had good experiences, or who described their own needs as very specific. In many cases, interviewees described that installers had taken a significant amount of time post-installation to ensure they understood how to use their new heating system, sometimes making multiple follow-up visits to check that no problems had arisen and that the householder was comfortable:

"The young men who actually fitted it, because obviously we've never had anything to do with central heating, they were really knowledgeable and gave us loads of advice on 'turn this down, turn that bit up, turn this off'. So they knew. If I asked a question say about turning the radiator lower in my bedroom than the others, which I didn't know about, they knew what to say and told us what to do. I just felt so comfortable asking them questions and they'd know the answers."

Some projects had designed specific processes for post-installation advice and instruction, such as arranging for a project officer to attend the property at a later date with the installer present as well. This was particularly noted by interviewees in social housing projects, who described the 'double team' of the TLO and installer being present at the same time to answer questions about the heating system and provide advice on different aspects of it:

"There is lots of advice. The delightful girl at [the housing association] actually has redone the instructions and made them much simpler to understand than the ones that came with the system. The lads who installed it have been really good on taking you through the controls."

Together, this evidence points to the central role of post-installation advice and support in enabling households to optimally use and feel confident with their new heating system. This will be addressed more specifically in the blueprint, which will describe and analyse in more detail some of the options for delivering effective post-installation advice and support.

4. What were the costs and benefits?

4.1. Fuel poverty status modelling outputs

4.1.1. Introduction

This first section provides an analysis of the data produced through the energy modelling methodology, as detailed in the methodology annex. In addition to examining the changing fuel poverty status (measured under the LILEE metric) and running costs for Category 1 and Category 2 households pre-and post-intervention, it investigates the effects of rising fuel costs and the extra measures that might be required to lift all WHF beneficiary households out of fuel poverty.

Prior to this, the section gives some explanatory context of the fuel poverty definition utilised in the modelling analysis. This is necessary because the definition used in England changed midway through the evaluation, and different definitions are used in the devolved nations of the UK.

4.1.2. Defining fuel poverty

The definitions of fuel poverty used across Great Britain and Northern Ireland have undergone several changes over the last two decades. The first official definition was the 10% definition, suggested by Brenda Boardman in her 1991 book *Fuel Poverty: From Cold Homes to Affordable Warmth*.[38] In this definition, a home's occupants were deemed to be fuel poor if they were required to spend more than 10% of their income on their home's energy running costs.

As an indicator it had the important characteristic of being easy to understand and measure, and so was used as the de facto standard throughout the 2000s. However, being a simple ratio, it was prone to being skewed by running costs and incomes that deviated significantly from the average; this led to certain dwelling and occupant types being excluded from being categorised as fuel poor (for example, small dwellings with low running costs and multiple occupants).

In 2011, Professor John Hills published a review of the definition of fuel poverty;[39] he proposed that the standard should be changed, so a household is fuel poor if paying their required energy running costs places them in poverty (<60% median household income). This definition was termed Low Income High Cost (LIHC) and put succinctly, defines people in fuel poverty as having higher than (national) average running costs, and if they were to pay these costs, their residual income would be below the poverty line. This definition was subsequently adopted in England, although the devolved governments of Scotland, Wales, and Northern Ireland retain variants of the initial 10% definition.

Conceptually speaking, the LIHC definition improves upon the 10% definition because it more closely relates the causes of fuel poverty to high running costs, but as a practical measure it has been cumbersome to use. Principally, to assess a dwelling and its occupants' fuel poverty status, the median national running costs have to be known; and as this amount is generally calculated two years in arrears from the English Housing Survey, workaround methods are required for a LIHC fuel poverty calculation in the present.

In England, the LIHC definition was replaced in 2021 by the Low Income Low Energy Efficiency (LILEE) standard, primarily due to the LIHC's impracticality. This replaced the running-cost requirement with one based on the home's energy efficiency (as defined in SAP) – which is further described in Section A5 of the methodology annex – thereby overcoming the 'historical status' problem. Being based on SAP, LILEE also improved the practicality of the definition, as many homes now have an EPC from which their energy efficiency can be known.

Initially, the evaluation intended to use the LIHC definition in the energy modelling analysis, given that at the conception of the evaluation, this was the definition used in England. However, to reflect the changing official definition of fuel poverty in England, the final analysis presented in this section uses the LILEE standard. The LILEE definition is not without imperfections, and it could be argued that it fails to accurately reflect the changing status of fuel poverty in the UK as of 2022 because it is only minorly affected by fuel prices,[40] which have risen significantly between October 2021 and December 2022 (see section 4.1.8. below). Nevertheless, it is the most appropriate definition for this analysis. Indeed, one of the strengths of the multi-method approach taken by the evaluation is that it enables fuel poverty to be understood from the perspective of the household (i.e. subjective fuel poverty, as in Section 3.2), as well as the technical perspective of the official LILEE definition.

The change from LIHC to LILEE at the midpoint of the evaluation however required the modelling methodology to be updated. This had little impact on the overall results as the effects of the changed definition were mostly redistributive. It became possible for smaller homes that could never have been deemed fuel poor under LIHC to qualify as fuel poor under LILEE. This was balanced by larger homes moving in the other direction, qualifying under LIHC but no longer meeting the LILEE criteria. The reason for this is straightforward; the running cost criteria in LIHC is replaced in LILEE by one based on SAP, which is a measure of the running cost per unit of floor area. As the running costs are naturally proportionate to the area of a dwelling, SAP factors out the differences and treats properties on a similar basis with respect to area.

The definition change had no effects on other areas of the evaluation. The technical definition has no bearing on occupants' perceptions of fuel poverty and as there was no change to the way that running costs were modelled; the economic analysis was similarly unchanged. The change in definition provided a modelling challenge, but ultimately had little bearing on the evaluation overall.

4.1.3. Characteristics of modelled homes

Before examining the results of the modelling, it is useful to firstly comment upon two important features of the energy modelling dataset that are related to the dwelling type. These are the age of dwellings in the dataset, and the types of heating system present in each dwelling.

Figure 4.1 below shows that most of the dwellings included in the energy modelling dataset were built prior to 1966. This is unsurprising, primarily because the age of a dwelling has a major effect on how energy-efficient it is. However, the observably flat tail of more modern homes is more surprising, especially the presence of homes built after 2006. This is because all of the dwellings in this last age band fall into EPC band C or above, meaning that under the LILEE definition, they would never qualify as fuel poor.

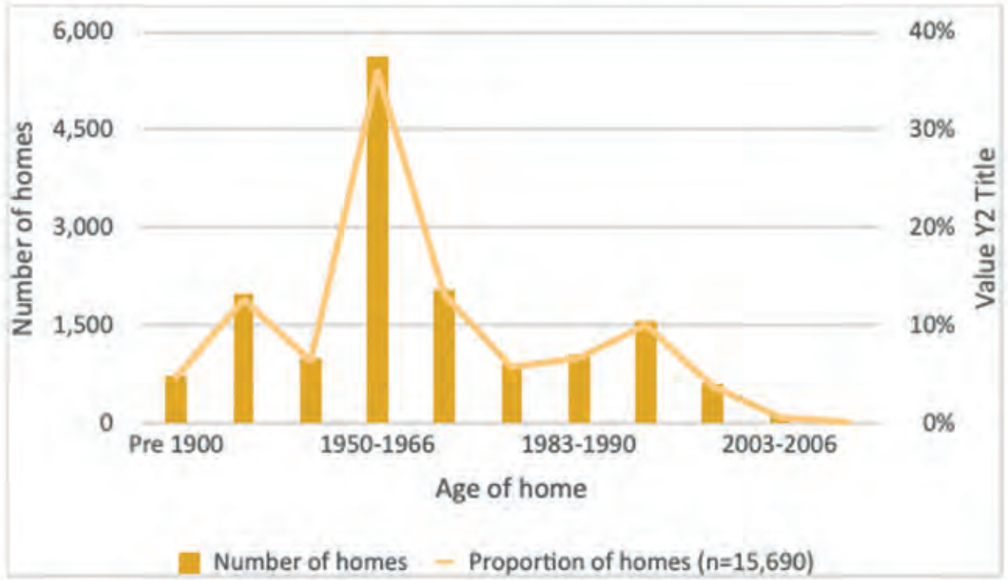

Figure 4.1: Age of modelled beneficiary homes, expressed as both the number of homes (left axis) and proportion of homes (right axis).

38. Boardman, B. (1991) Fuel Poverty: From Cold Homes to Affordable Warmth. Belhaven Press..

39. Hills, J. (2011) Getting the measure of fuel poverty: Final Report of the Fuel Poverty Review.

40. NEA (2022) NEA Fuel Poverty Statistics Explainer.

Regarding the heating system type, Figure 4.2 below shows that the majority of homes included in the modelled dataset had either storage heaters or room heaters prior to their interventions. A small number of homes had boilers (typically solid fuel systems) or no heating system at all. Post-intervention, the majority of homes in the modelled dataset had a boiler as their main heating type; the majority of these were gas boilers, with a small number of oil boilers from Category 2 interventions also included. Just over 3,000 homes with ASHPs post-intervention are included in the modelled dataset, as a result of Category 2 interventions, and 12 homes received interventions featuring high-retention storage heaters.

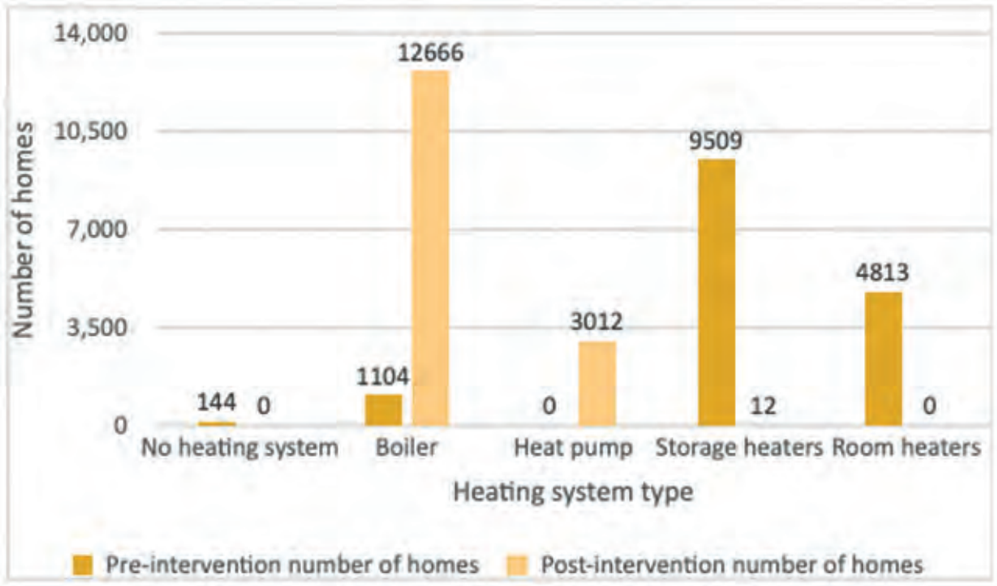

Figure 4.2: Heating system type of modelled beneficiary homes, pre- and post-intervention.

4.1.4. Energy performance, fuel poverty status, and running costs analysis results

This section begins the analysis of the energy modelling outputs. It firstly considers the energy performance of homes in the modelled dataset, before moving on to consider the running cost changes and fuel poverty status changes respectively. Finally, it considers environmental impacts by modelling the changes in CO2 emissions.

4.1.4.1. Energy performance

As Figure 4.3 below shows, the average SAP rating of the dwellings before any improvements were made was approximately 51, corresponding to SAP band E. This is far lower than the national average, which is around 60, indicating that in general the WHF was good at targeting inefficient homes. After making improvements, the average has risen to 68, one point below band C. Figure 4.3 also shows how the EPC band profile of homes in the modelled dataset changed as a result of making improvements. The main effect is movement from the E, F and G bands into the C and D bands.

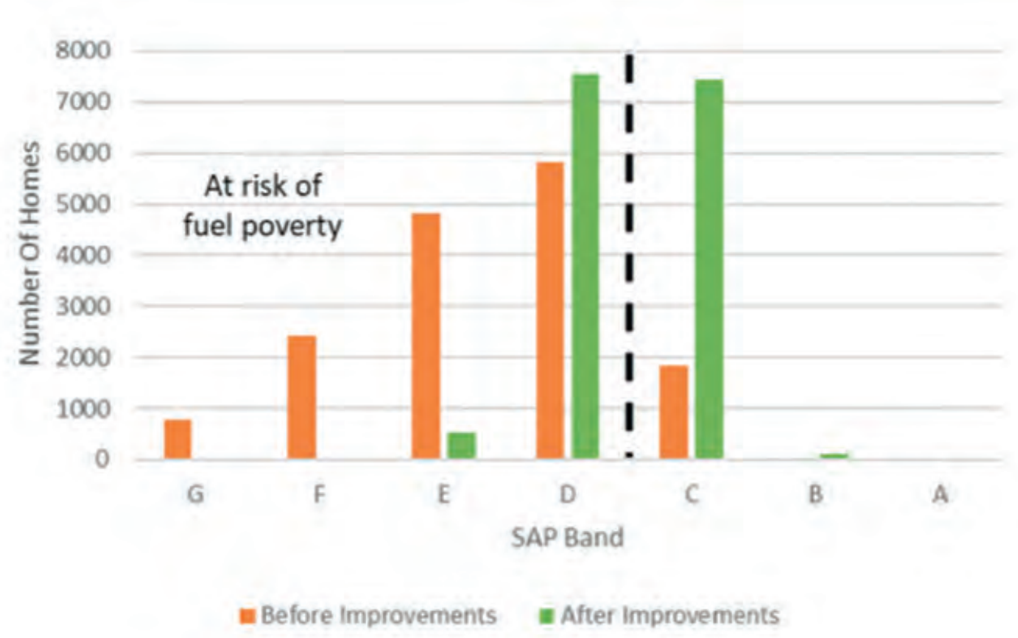

Figure 4.3: SAP band of beneficiary homes, pre- and post-intervention.

4.1.4.2. Running costs

The improvements made to recipient homes have had a substantial effect on their required running costs. Figure 4.4 below displays the running costs profile both before and after improvements were made. Before making improvements, 6,428 homes had annual running costs above £2,000, and after making improvements the number of homes left in this band was 460. In terms of averages, the mean annual running costs fell from £2,011 to £1,089, or in other words, on average the installation of a new heating system saved the households £922 per year.

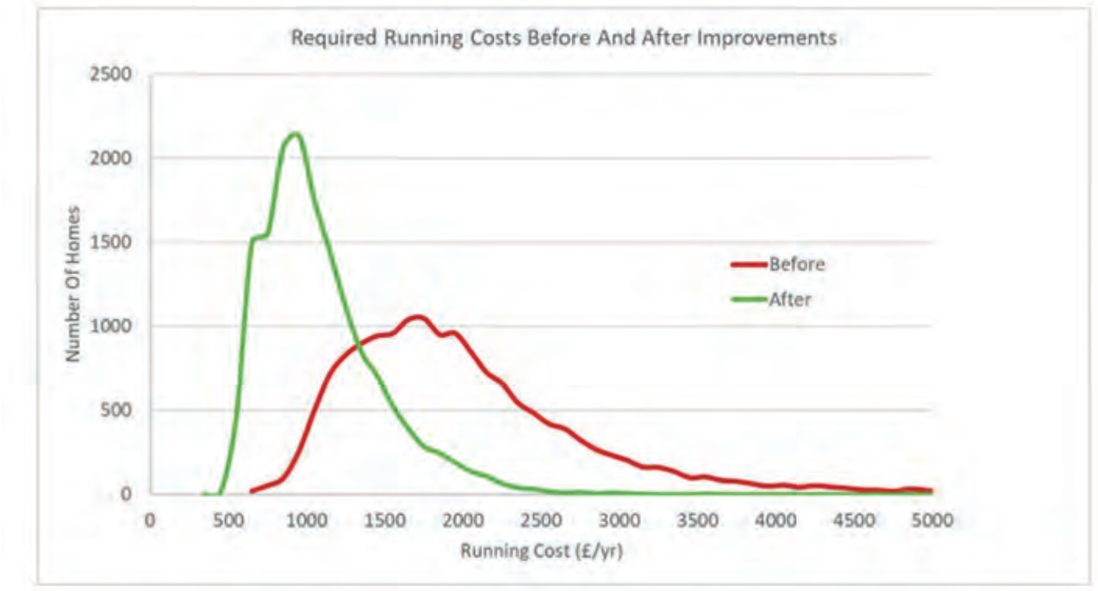

Figure 4.4: Running cost profiles before and after making improvements to beneficiary homes.

4.1.4.3. Fuel poverty status and fuel poverty gap changes

The fuel poverty status and gap of the 15,690 homes both before and after making improvements are shown in Table 4.1 below. Given the large drop in running costs due to the installation of more efficient heating systems, homes primarily move from the low energy efficiency brackets to the high energy efficiency ones. However, there are still approximately 5,500 homes left in the LILEE bracket even after improvements were made. Although the improvements caused a large drop in the running costs, the drop was not enough to move these homes into the LIHEE bracket. Nonetheless, even though these households are still technically fuel poor, the large drop in the average gap from £699 to £121 means that on average where a household is still fuel poor, its annual required running cost has dropped by almost £600, thus greatly reducing the severity of fuel poverty.

	Before Improvements		After Improvements	
Fuel Poverty Status	**Number Of Homes**	**Average Fuel Poverty Gap (£/yr)**	**Number Of Homes**	**Average Fuel Poverty Gap (£/yr)**
Low Income High Energy Efficiency	969 (6.2%)	NA	3,785 (24.1%)	NA
Low Income Low Energy Efficiency	**9,907 (63.1%)**	**699**	**5,668 (36.1%)**	**121**
High Income High Energy Efficiency	876 (5.6%)	NA	3,784 (24.1%)	NA
High Income Low Energy Efficiency	3,938 (25.1%)	NA	2,453 (15.7%)	NA

Table 4.1: Fuel poverty status and fuel poverty gap of beneficiary homes before and after improvements were made.

4.1.4.4. Carbon emissions

Finally, the modelling analysis shows almost no change in carbon emissions. Average CO2 emissions per home across all modelled homes increased from 2,746 kg/yr to 2,749 kg/yr. This is because the majority of heating systems that were replaced were electrically powered, predominantly storage and room heaters, and the majority of new systems were gas boilers. The electricity grid has decarbonised rapidly over recent years, and electrical systems therefore emit less carbon than gas ones. Furthermore, the installation of extra insulation measures and a sizable number of heat pump installations (3,012 in total in the modelled dataset) means that that average CO2 emissions per home have not risen more substantially. **It should be noted however, that that 2,749 kg/yr of carbon emissions is still substantially lower than the emissions produced by the average UK household, which are estimated to be 3,644 kg/yr.**[41]

Fuel poverty is driven by running costs and not carbon, and it should be noted that in the findings presented in Section 3, Category 1 (i.e. first-time gas central heating installations) had a consistently greater impact than other WHF interventions. Accordingly, the expenditure and investment in first-time gas central heating systems as a means of tackling fuel poverty is not without merit or impact, and the evaluation notes that a follow-on phase of the WHF focuses exclusively on low-carbon heating solutions, reflecting a desire to reduce CO2 emissions and fuel poverty simultaneously.

41. This figure is calculated from UK Government (2022) UK local authority and regional greenhouse gas emissions national statistics, 2005–2020. According to this data, 90,739 kt CO2e was the combined total of emissions produced by UK homes in 2020. Assuming there are 24.9mn homes across the country, this results in a figure of 3,644 kg/yr of CO2 on average.

4.1.5. Disaggregation of analysis by eligibility criteria

A property's eligibility for improvements as part of the Warm Homes Fund programme, based on four criteria, is analysed in this section. As discussed in more detail in Section 2.5., the four WHF eligibility criteria are: Affordable Warmth Benefits (n=5,193); ECO Flex (n=3,514); Fuel Poverty (n=2,930); and the IMD (n=4,040). The following analysis compares the fuel poverty indicator status of a property pre- and post-intervention, broken down by these criteria.

Based on receipt of Affordable Warmth Benefits (Figure 4.5), 96.5% of properties eligible for the scheme are classified as fuel poor using the LILEE measure pre-improvement (n=5,014). Post-improvement, 57.7% of the properties eligible based on the Affordable Warmth Benefits criteria remained in the LILEE classification (n=2,995).

ECO Flex is intended to help households who are not in receipt of a qualifying benefit, but who are living on a low income and are vulnerable to the effects of living in a cold home, to qualify for the programme. Based on ECO Flex (Figure 4.6), 31.6% of properties considered eligible for the scheme are classified as fuel poor using the LILEE measure pre-improvement (n=1,109). Post-improvement, 20% of the properties eligible based on the ECO Flex criteria remain in the LILEE classification (n=704). Compared to other eligibility criteria, a higher proportion of properties are classified as HILEE (n=2,283) or HIHEE (n=137) pre-improvement.

Using Fuel Poverty status as the criteria (Figure 4.7), 86.8% of properties considered eligible for the scheme are classified as fuel poor using the LILEE measure pre-improvement (n=2,542). Post-improvement, 52.4% of the properties eligible based on the Fuel Poverty criteria remain in the LILEE classification (n=1,534).

Based on the Index of Multiple Deprivation (IMD) (Figure 4.8), 30.6% of properties considered eligible for the scheme are classified as fuel poor using the LILEE measure pre-improvement (n=1,235). Post-improvement, 10.6% of the properties eligible based on the IMD criteria remained in the LILEE classification (n=430).

Households defined as HIHEE prior to their intervention primarily entered the WHF through the IMD and Eco Flex pathways. Of 876 modelled HIHEE homes that entered the WHF, 726 (83%) were brought in through by the IMD pathway and 137 (16%) were channelled through ECO Flex. This reflects the relatively higher incomes used in some ECO Flex statements, and the lack of an income qualifier on homes brought into the WHF through IMD.

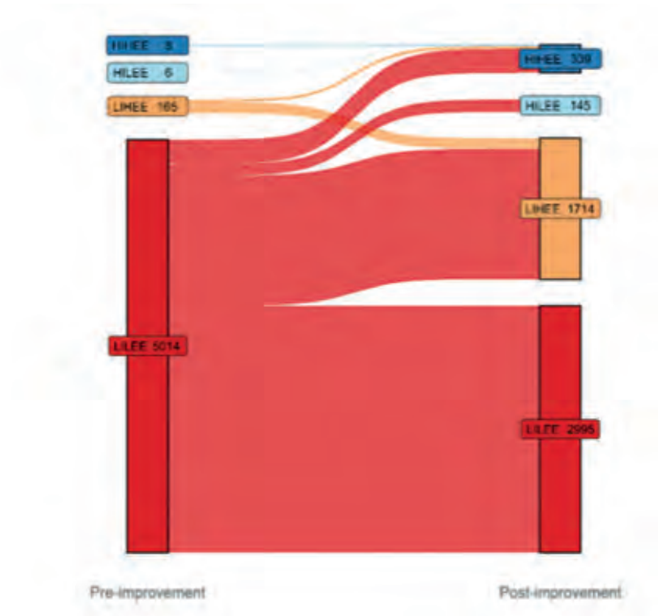

Figure 4.5. Pre-improvement and post-improvement in the LILEE fuel poverty indicator for properties eligible based on Affordable Warmth Benefits.

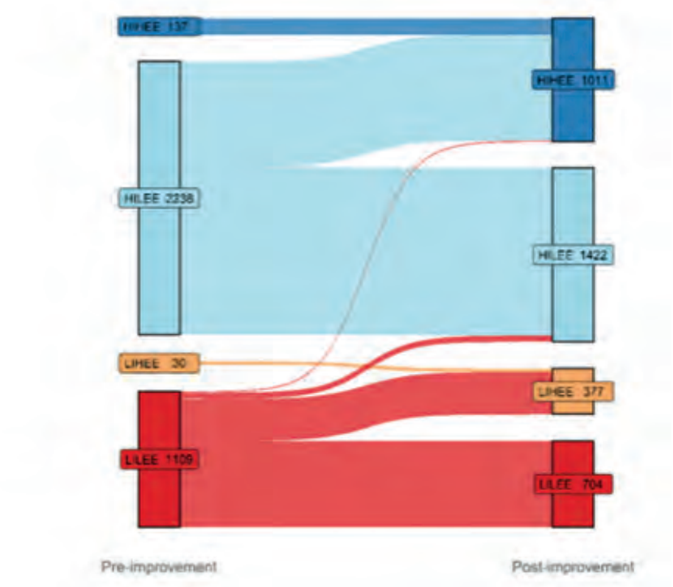

Figure 4.6. Pre-improvement and post-improvement in the LILEE fuel poverty indicator for properties eligible based on ECO Flex.

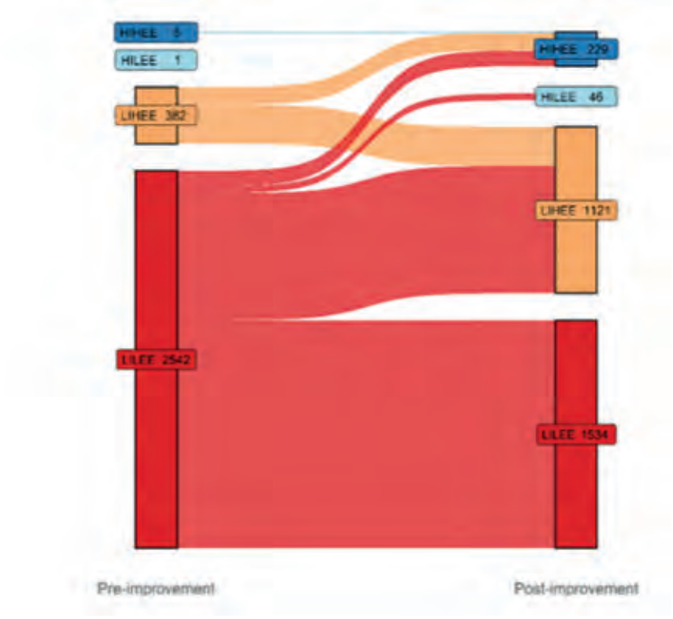

Figure 4.7. Pre-improvement and post-improvement in the LILEE fuel poverty indicator for properties eligible based on Fuel Poverty criteria.

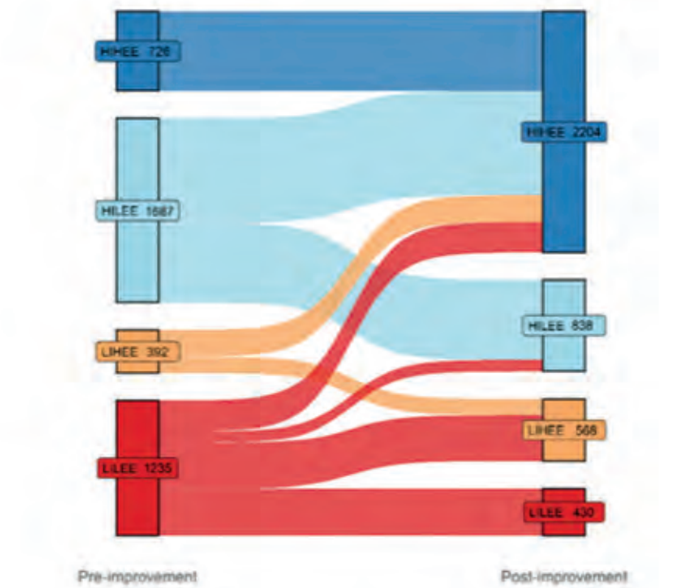

Figure 4.8. Pre-improvement and post-improvement in the LILEE fuel poverty indicator for properties eligible based on IMD criteria.

4.1.6. Spatial analysis of results

In addition to the energy modelling findings in the previous subsection, a core aim of the evaluation was to determine the extent to which the support has reached the households most in need, and any regional differences, specifically between England, Scotland, and Wales. This subsection therefore conducts a socio-spatial analysis of the energy modelling findings, including spatial mapping.

As noted in more detail in the methodology annex, data is typically aggregated to the Local Authority District (LAD) scale in the analysis. However, to enable a more fine-grained analysis in some cases, Degree Day Regions are also used to show the spatial distribution of interventions. There are 18 Degree Day Regions in Great Britain; these reflect the role of the external temperature in shaping energy use, particularly in buildings, or for heating energy use.

4.1.6.1. Properties receiving improvements

Of the full 15,690 homes included in the energy modelling analysis, 15,677 were included in the socio-spatial mapping analysis. Based on counts of properties (see Figure 4.9 below), improvements are spatially concentrated in several Local Authority Districts. The LADs with the highest number of properties receiving improvements as part of the scheme are Leeds (970), Cornwall (621), Liverpool (455), Wakefield (407), Argyll and Bute (395), Flintshire (277), Dorset (260), East Riding of Yorkshire (244), Perth and Kinross (244), Hambleton (236), and Leicester (229). These areas have a wide range of geographic characteristics, from large urban conurbations such as Leeds and Liverpool, to relatively rural areas such as Argyll and Bute, and Dorset.

The WHF programme design reflects how fuel poverty can be manifested in a range of settings in Great Britain, especially urban areas and rural areas where there are a higher proportion of older homes with solid walls. This makes them less efficient than those properties in suburban and residential areas, which tend to be newer.[42] This is in keeping with wider evidence of the diverse geographical distribution of fuel poverty across the devolved nations, that spans urban–rural divides.[43]

42. UK Government (2012) Hard-to-treat properties.

43. Morrison, C. and Shortt, N. (2008) Fuel poverty in Scotland: Refining spatial resolution in the Scottish Fuel Poverty Indicator using a GIS-based multiple risk index, Health & Place, 14(4), 702–717; Gordon, D. and Fahmy, E. (2008) A Small Area Fuel Poverty Indicator for Wales. Bristol: University of Bristol; Robinson, C., Bouzarovski, S. and Lindley, S. (2018) 'Getting the measure of fuel poverty': the geography of fuel poverty indicators in England, Energy Research & Social Science, 36, 79–93.

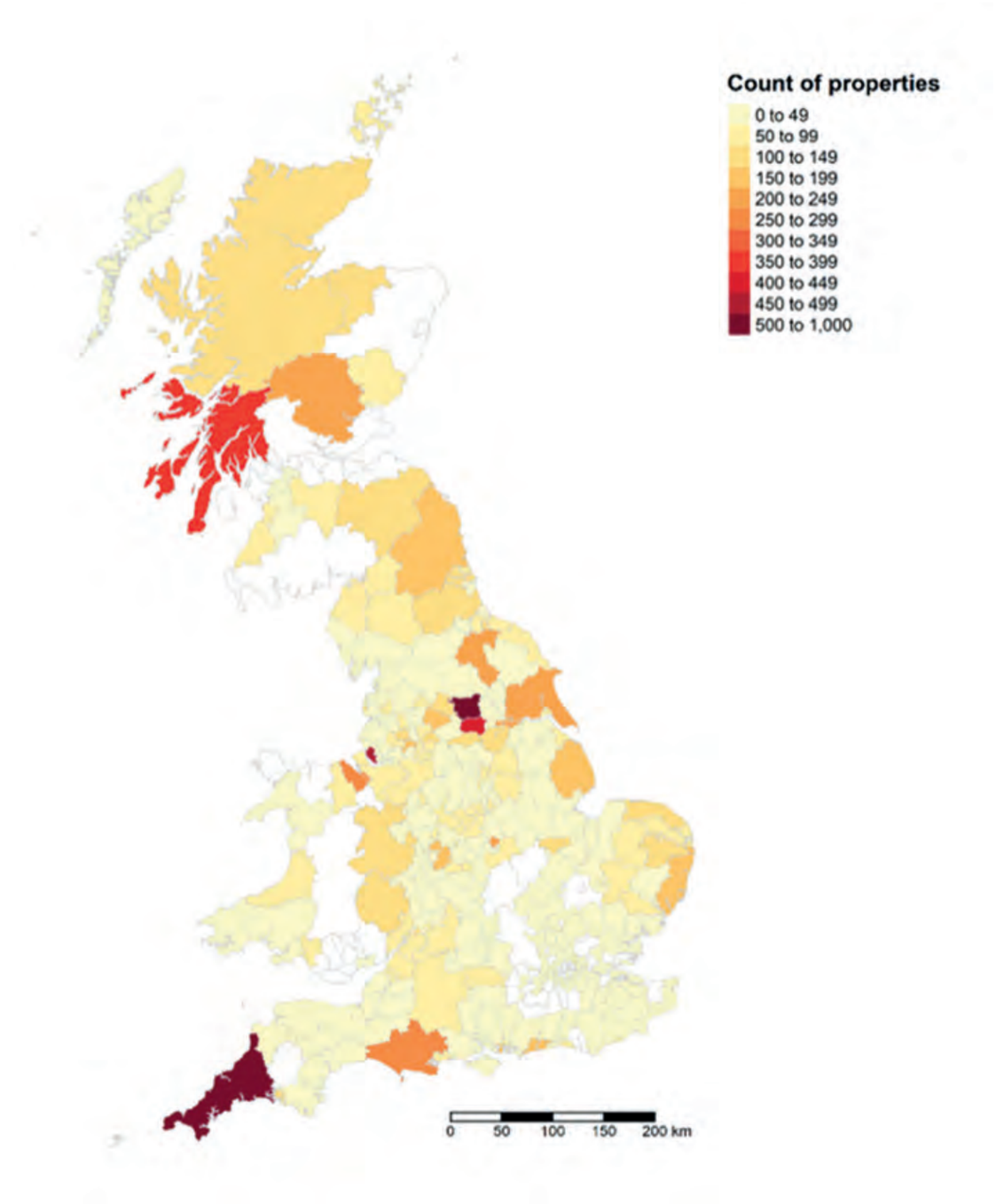

Figure 4.9: Count of properties that received an improvement in each LAD. Note the irregular breaks in the legend.

4.1.6.2. Running cost savings

In terms of running cost savings, it is most useful to disaggregate the median net savings by Degree Day Region. Figure 4.10 below shows that Wales has the largest range of cost savings, and the highest median net cost savings per year. Median values are also comparatively high for Orkney and North East Scotland.

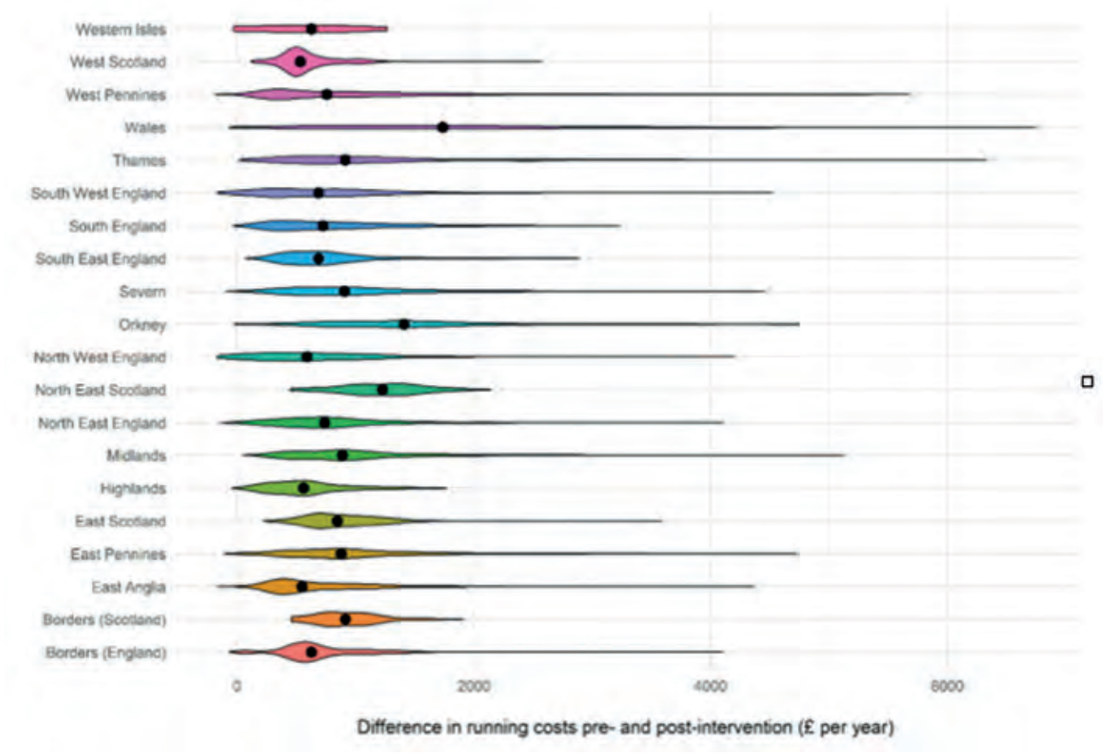

Figure 4.10: Distribution of properties for each Degree Day Region according to the difference in running costs (£ per year) pre-improvement and post-improvement. The violin plots show the distribution of the data and should be read in a similar way to a box plot. The median value is indicated using a black point.

Aggregating the cost savings to provide LAD totals, the highest total change in cost savings is in Leeds, with a saving of £1,135,556.11 per year after improvements are made. Leeds is an outlier in the dataset, with a comparatively large number of properties receiving improvements, primarily due to Leeds City Council's multiple WHF projects. In addition, various types of LAD have a high total net cost saving above £200,000. This includes LADs in major urban conurbations, specifically Liverpool (£519,965.74), Wakefield (£359,519.14), and Birmingham (£209,579.47), and in relatively remote rural areas including Cornwall (£439,812.52), Flintshire (£242,365.98), Dorset (£237,140.63), Argyll and Bute (£219,548.55), and Perth and Kinross (£210,077.63). Comparatively, the median difference in cost saving in Leeds is more typical of values for other LADs in the evaluation, at £1,166.87 (see Figure 4.11 below). The most common median cost saving for LADs is around £1,000; however, the median cost saving reaches as high as £4,408.94 (for Merton LAD) and as low as £54.36 (for South Lakeland LAD). It is worth noting that there is likely to be a smoothing effect of results in those LADs where a high number of properties have received improvements.

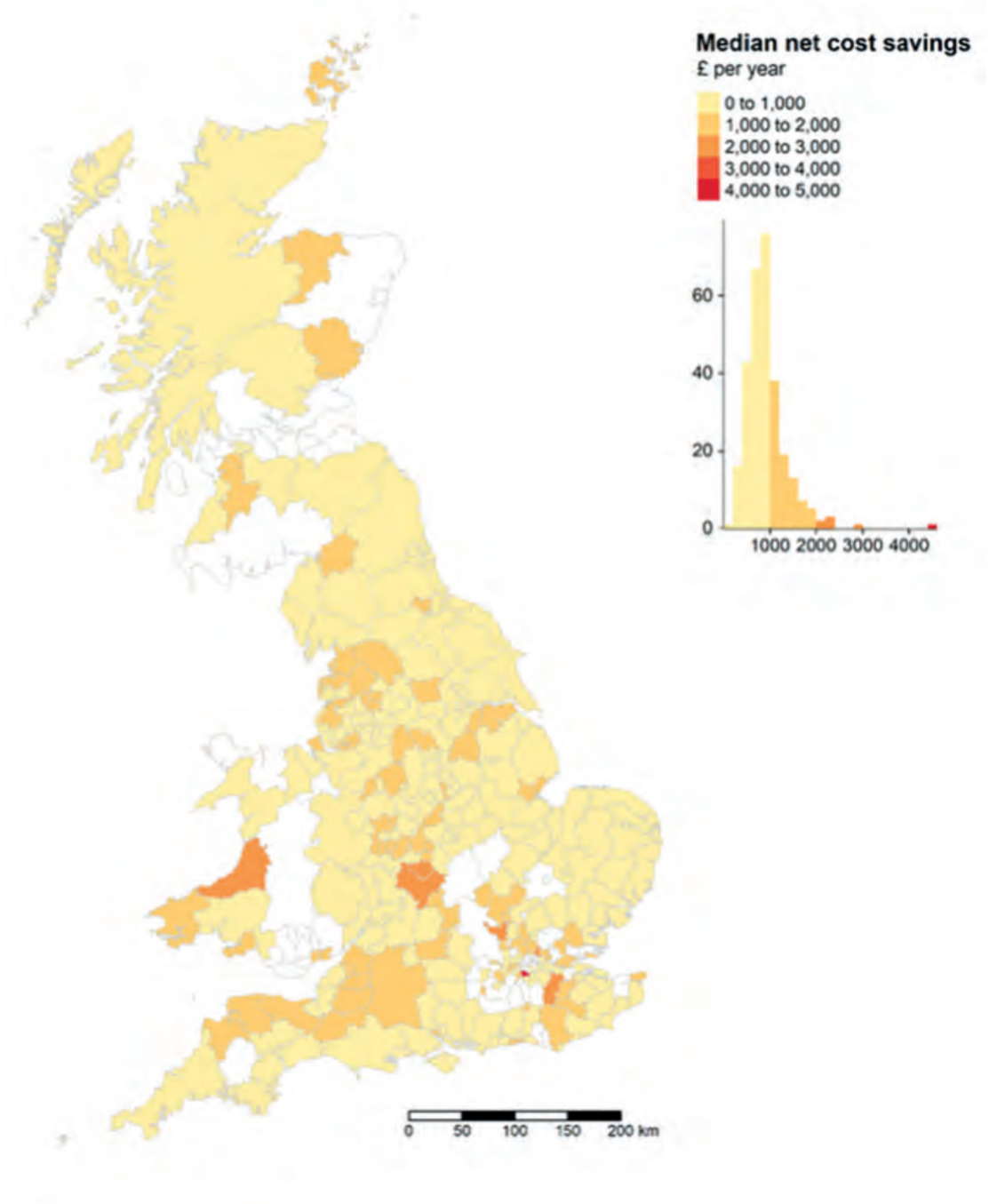

Figure 4.11: Cost saving: median difference between pre- and post-improvement (£ per year).

4.1.6.3. CO2 emissions

As shown in the previous section, the difference in carbon dioxide (CO2) released post-improvement compared to pre-improvement is estimated in kilograms (kg) per year. However, the findings of the spatial analysis reveal considerable variations in how increases and decreases in CO2 emissions are distributed geographically.

For some LADs, total CO2 emissions have reduced considerably (see Figure 4.12 below); presumably these are instances in which the improvements have encouraged households to transition towards generating energy using a less carbon-intensive fuel, or where significant energy efficiency improvements have been made (e.g. Category 2 improvements through 'non-gas' solutions such as heat pumps). LADs with the largest total reduction in CO2 emissions are typically relatively rural. For example, nine LADs have an estimated total reduction in CO2 emissions per year of more than -250,000 kg/yr: East Riding of Yorkshire (-522,451.49), Northumberland (-467,101.77), Argyll and Bute (-453,130.71), County Durham (-388,633.06), Barnsley (-376,200.63), Flintshire (-281,095.72), Cornwall (-266,830.39), Highland (-262,508.47), and Allerdale (-257,307.77).

However, for the majority of LADs (223 of the 301 LADs containing properties that received an improvement), CO2 emissions increased post-improvement. As the LAD with the most properties receiving improvements, Leeds also tops the list of the largest total increase in CO2 emissions per year (+714,538.52 kg/yr). In total, 10 LADs recorded a total CO2 emissions increase of over +100,000 kg/yr post-improvement (Leeds, Liverpool, Leicester, Perth and Kinross, Birmingham, Walsall, Arun, Moray, Newcastle-upon-Tyne, Dorset). In major urban conurbations (which form the majority of LADs with comparatively large increases in yearly CO2 emissions), this is likely to be explained by Category 1 improvements in urban homes and communities where gas central heating systems are installed for the first time; especially when they replace electrical heating such as storage heaters, as also noted in the previous section.

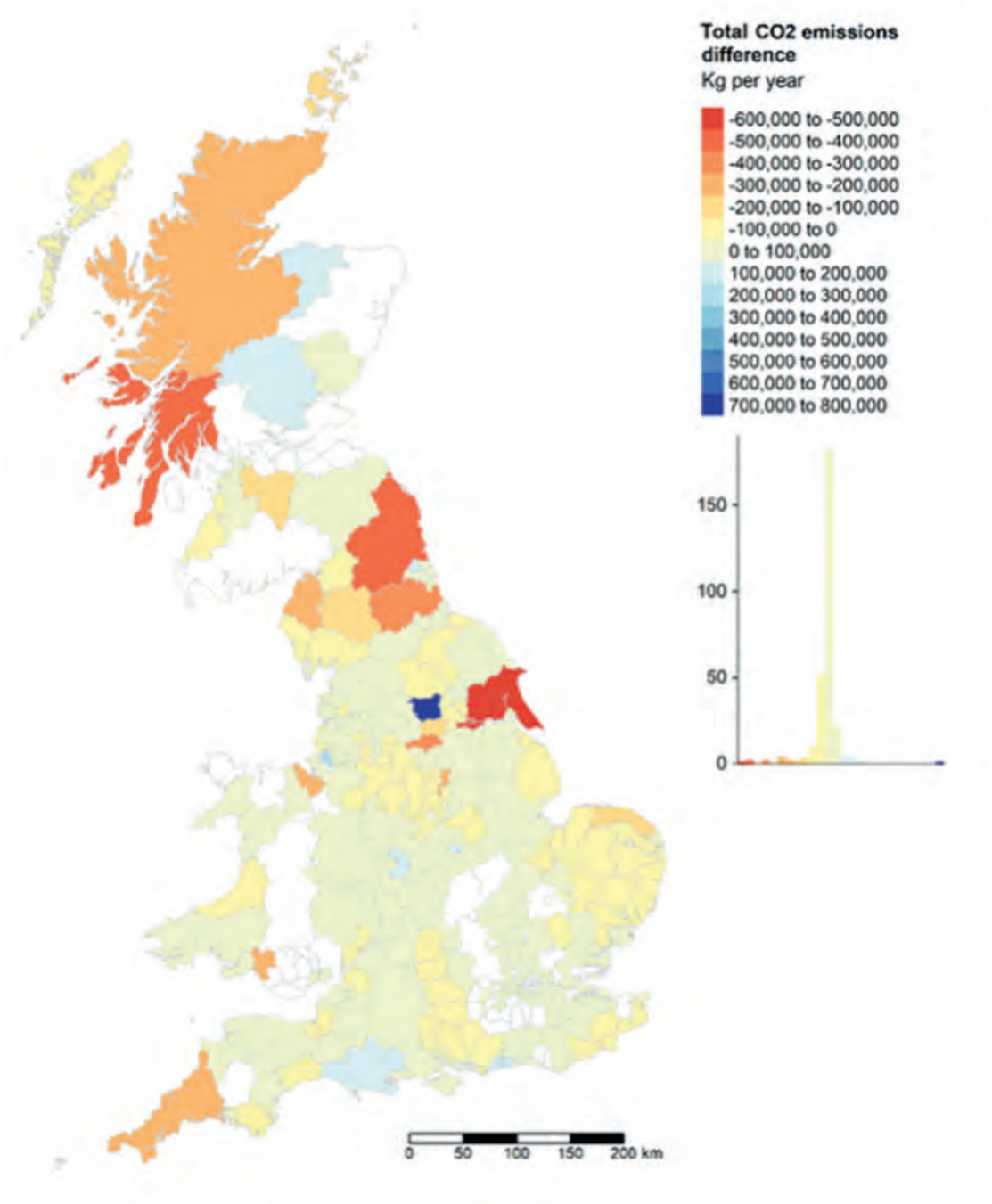

Figure 4.12: Total difference between pre- and post-improvement CO2 emissions (kg per year).

Median differences in CO2 emissions per year are more geographically varied (see Figure 4.13 below). Median yearly CO2 emissions reduce post-improvement in only 57 LADs. Neath Port Talbot in South West Wales has the highest median reduction of -5,982.12. For 166 of the 301 LADs that contain properties included in the evaluation, the improvements lead to an increase in CO2 emissions on average. Median values are most commonly between +500 and +1,000, with 153 LADs falling within this bracket. The median is highest in Rushmoor LAD in South East England (+2,886.56).

Changes in CO2 emissions post-improvement illustrate tensions between reducing fuel poverty and decarbonising the building stock.[44] Whilst efforts to decarbonise housing and energy supply can be conducive to reducing fuel poverty, this is not always the case; hence, this is considered in the corresponding programme blueprint for fuel poverty and energy efficiency schemes.

44. Sherriff, G., Butler, D. and Brown, P. (2022) 'The reduction of fuel poverty may be lost in the rush to decarbonise': Six research risks at the intersection of fuel poverty, climate change and decarbonisation. People, Place and Policy Online, 1–20.

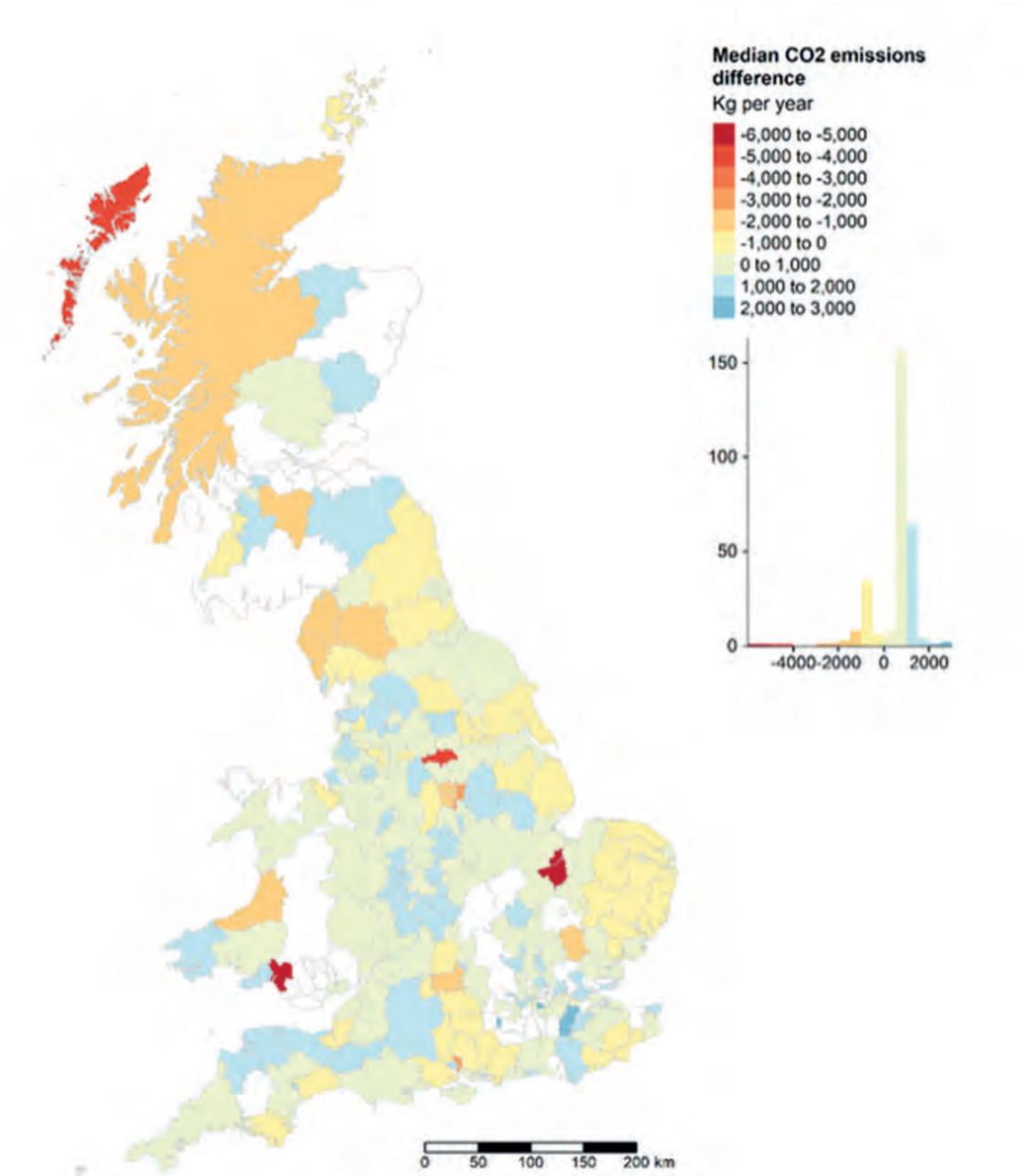

Figure 4.13: Median difference between pre- and post-improvement CO2 emissions (kg per year).

4.1.6.4. Fuel Poverty Gap

Regarding the fuel poverty gap (FPG), the total difference in the FPG for LADs is mapped in Figure 4.14. As noted previously, the value for Leeds is notably higher than other LADs, with a total aggregate FPG difference of -£354,868.59. Eight LADs have an aggregate FPG reduction greater than -£100,000: Liverpool (-£240,405.60), Flintshire (-£174,596.10), Cornwall (-£172,555.38), Argyll and Bute (-£143,132.82), East Lindsey (-£120,229.66), East Riding of Yorkshire (-£118,022.52), and Birmingham (-£111,811.40). As previously noted, reductions in the FPG are highly spatially concentrated in a handful of LADs, whilst a large proportion of LADs have relatively low totals. For example, 24.2% of the LADs with properties that are part of the evaluation (73 of 301 LADs) have a total FPG difference of between £0 and -£10,000.

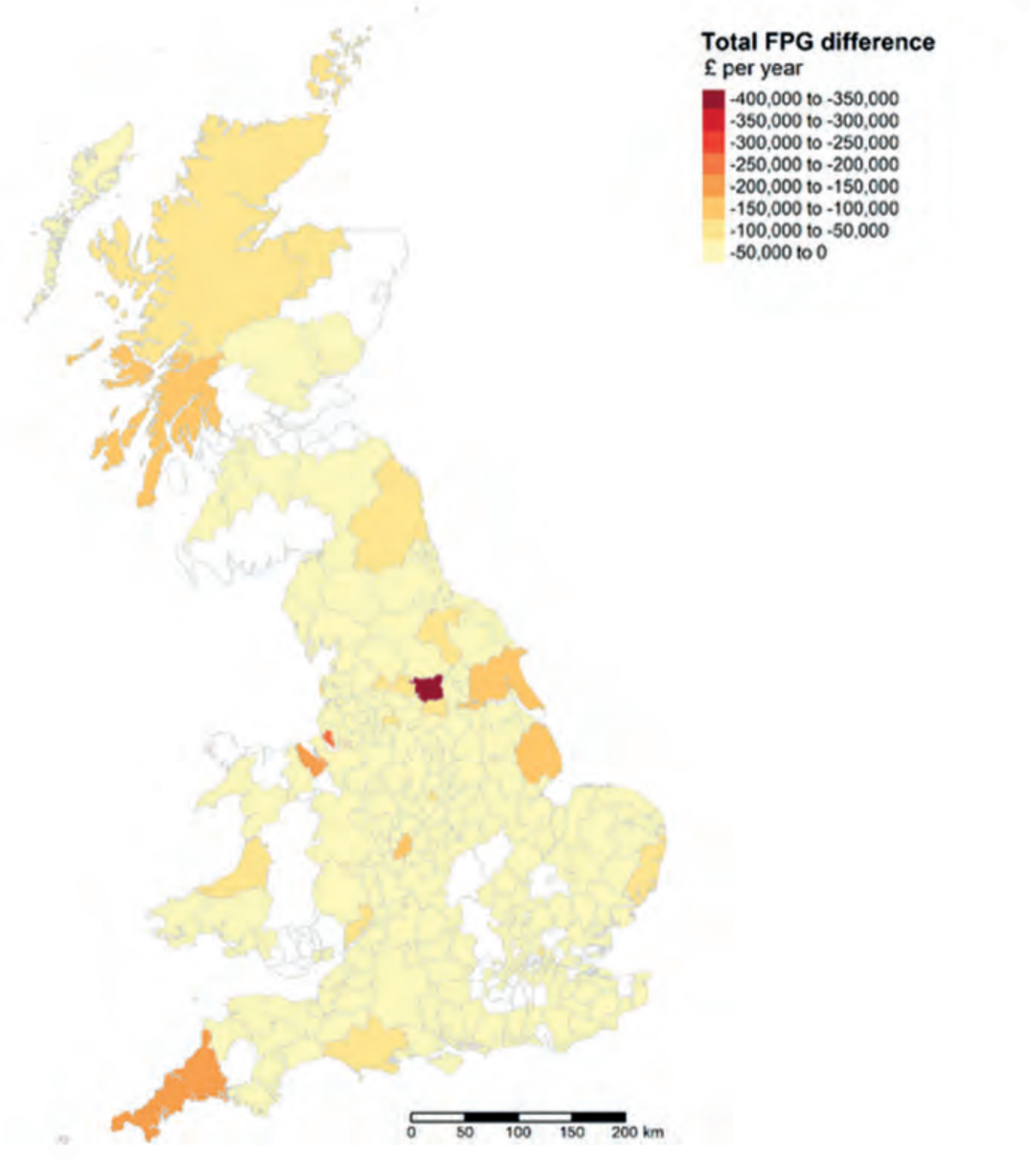

Figure 4.14: Total difference in FPG between pre- and post-improvement (£ per year).

Based on the median change in the FPG from pre- to post-improvement, the average gap decreased in all LADs (see Figure 4.15 below). In the majority of LADs in Great Britain, the median change was -£1,000 or below. However, some LADs had more substantial reductions in the average gap: for example, Merton in South West London, with -£3,975.58.

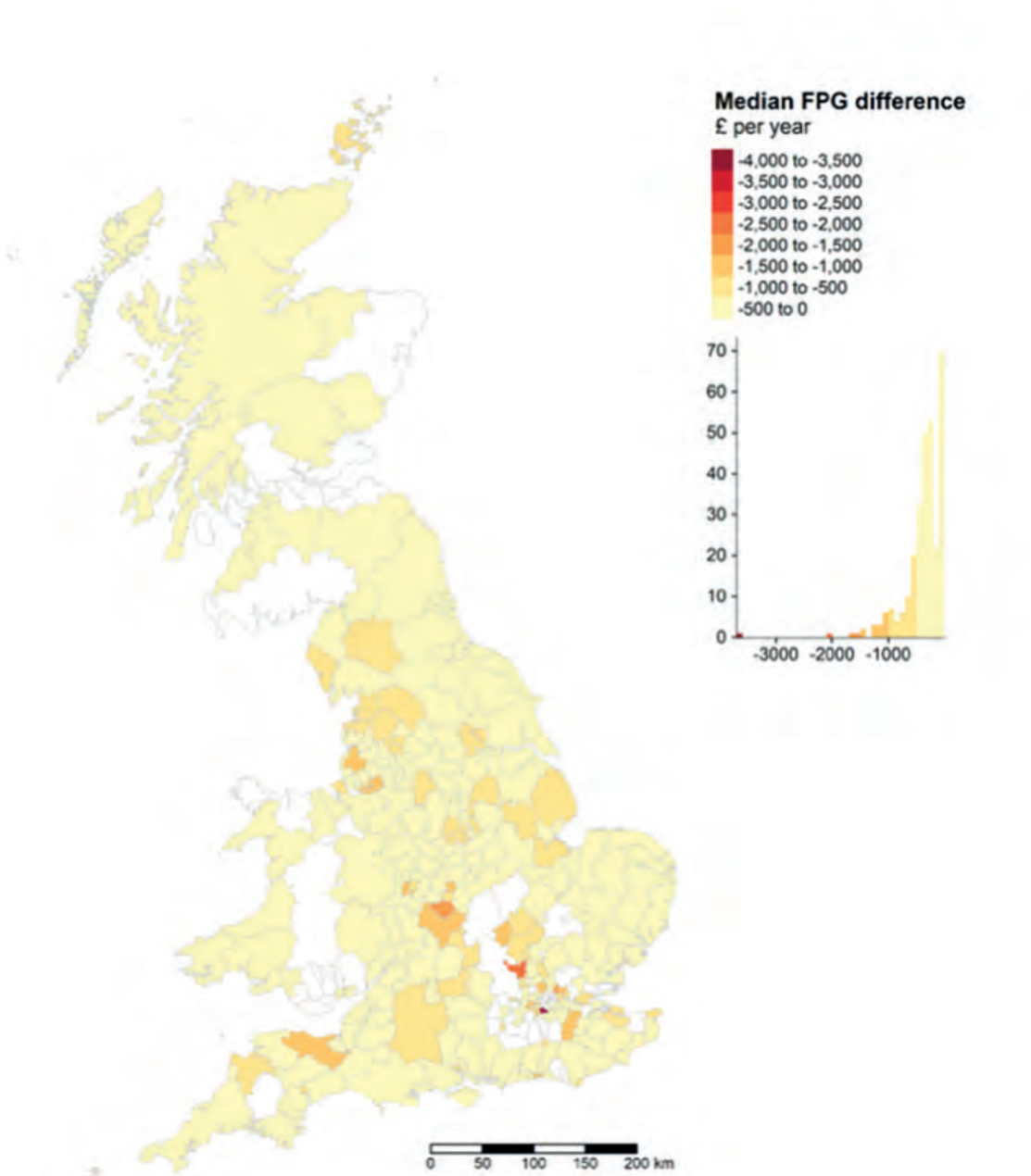

Figure 4.15: Median difference in FPG between pre- and post-improvement (£ per year).

4.1.6.5. Standard Assessment Procedure (SAP) ratings

The Standard Assessment Procedure (SAP) rating assesses the energy performance of a home, providing a figure between 0 and 100+. Specifically, 100 represents zero energy costs, and a score above 100 means that the property is a net exporter of energy, whereas 0 is the least efficient. Across all properties in the evaluation, the median difference in SAP rating is +13.6 points. When properties are aggregated by LADs, the median difference in the SAP rating comparing properties pre- and post-improvement ranges from +3.96 (Gateshead) to the largest difference of +53.93 in Merton (see Figure 4.16 below). High median SAP increases are concentrated spatially in particular regions, especially the North West of England, parts of Greater London, the West Midlands conurbation, and South West Wales. The total aggregate difference in SAP rating between pre- and post-improvement is greatest in the LAD of Leeds (+18,159.24). Only 84 LADs have a total aggregate SAP rating improvement of over +1,000.

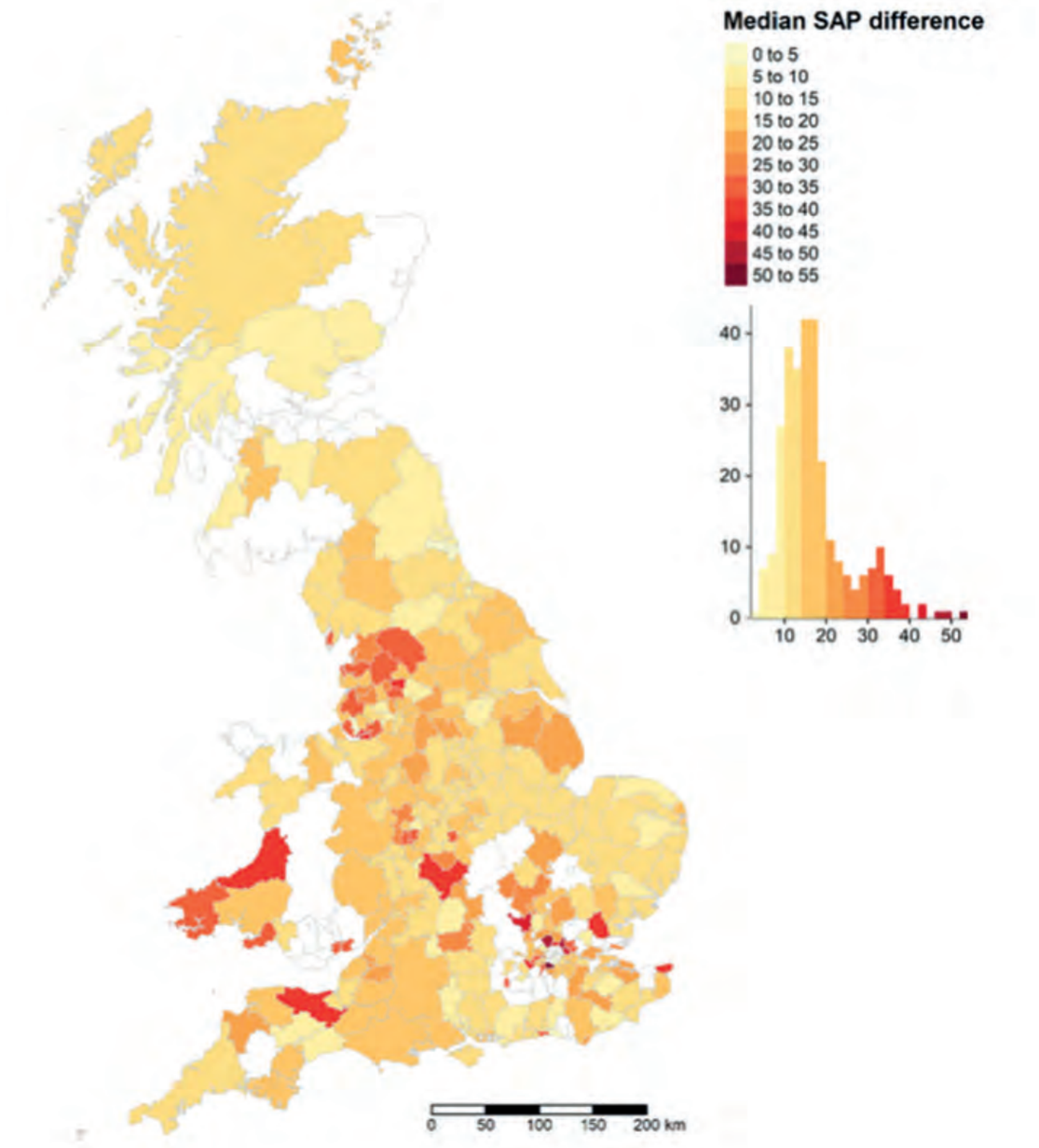

Figure 4.16: Median difference in SAP rating for LADs pre- and post-improvement.

4.1.7. Additional improvements to lift households out of fuel poverty

Given that not all fuel-poor homes (defined under LILEE) were lifted out of fuel poverty with the installation of a new heating system, an interesting question arises that is considered in this section: What extra work was required to lift a household out of fuel poverty, in addition to the improvements they received?

To answer this question, the UNO database's improvements module was utilised. The module assesses which applicable improvements could be made to a dwelling, and then calculates the results of making those improvements. The costs of the improvements can also be tailored to the dwelling in question, allowing a more accurate estimate of the final cost to be calculated. For example, the cost of installing wall insulation is initially input into the module as £/m2 of wall area to be improved, in order to account for the cost difference of putting wall insulation on a mid-terrace dwelling (two exposed walls) and end-terrace dwelling (three exposed walls).

This analysis was undertaken with the 5,500 dwellings that still fell into the LILEE bracket post-intervention. The initial costs used were averages of costs used by various social housing providers, and the improvements module was set to only improve the dwellings to SAP band C. From this analysis, the improvements shown in Table 4.2 below were found to be necessary in order for the remaining LILEE homes to move into the LIHEE bracket (not fuel poor).

Improvement	Number	Installation Cost (£)
Cavity Wall Insulation	842	23,4099
Double Glazing	2,062	6,313,491
Flat Roof Insulation	65	22,471
Floor Insulation	3,967	7,945,181
Insulated Door(s)	4,582	4,524,500
Loft Insulation	1,099	415,270.40
Low-Energy Lights	4,443	58,927.50
Photovoltaics	418	5,321,803
Solid Wall Insulation	1,162	8,472,315

Table 4.2: Breakdown of the additional types of improvements necessary to transform the LILEE homes into LIHEE ones.

The total amount required to remove households from fuel poverty is £33,308,058. As this comes from a sample of 15,690 homes, and in total the WHF has improved 27,239 homes, **the extra spend required to eliminate fuel poverty across the entire project is estimated to be £57,825,251**.

An alternative way of considering this question is to examine the amount that the annual household income of beneficiary homes left in the LILEE bracket would have to change, in order to move them into the HILEE bracket. This can be investigated by looking at the post-intervention fuel poverty gap for all homes left in the LILEE bracket after receiving improvements. There are different ways in which the fuel poverty gap could be eliminated for each household, such as increasing the annual household income (e.g. through income maximisation, debt restructuring, employment support), or decreasing the cost of energy bills through a targeted intervention (e.g. a social tariff). However, it should be noted that the co-benefits of energy efficiency improvements would not be achieved through this route – such as the wider economic impacts associated with investment, energy efficiency or NHS savings, as discussed in Sections 4.2 and 4.3 below.

Analysis of the energy modelling dataset shows that the aggregate fuel poverty gap for homes left in fuel poverty under LILEE after receiving improvements is £688,643. In other words, this is the total amount per annum by which household incomes would need to increase, or energy bills would need to decrease, to lift all households in the energy modelling dataset out of fuel poverty. As this is based on sample of 15,690 homes, and in total the WHF has improved 27,239 homes, the extra spend per annum required to eliminate the fuel poverty gap for all households is estimated to be £1,195,535. Following this reasoning, it would take approximately 48 years for the same amount of money required for improvements (£57,825,251) to be spent on eliminating the fuel poverty gap for all beneficiary households (i.e. an outlay of £1,195,535 for 48 years).

This leads to an important conclusion: in order to eliminate fuel poverty among homes that are still defined as fuel poor under LILEE after an intervention, there are a mixture of options available. The precise route used (i.e. increasing the annual household income, making further improvements, or a mixture of both) would depend on the circumstances of each individual home.

To briefly provide an example of this, Table 4.3 below shows two real homes from the energy modelling dataset that were still defined as fuel poor under LILEE after their intervention. To lift Home 1 out of fuel poverty, it is far more cost-effective to make further improvements to the home than to increase the annual household income. For Home 2, the opposite is true. These two examples are extreme, but they show **the need to tailor interventions to the incomes and the dwelling fabric of specific households, if fuel poverty is to be tackled in a cost-effective way**.

	Home 1	Home 2
Post-intervention fuel poverty gap	£628.91	£5.47
Increase in annual household income required to lift household to HILEE	£628.91	£5.47
Further improvements required to lift household to LIHEE	Low-energy lights; flat roof insulation	Low-energy lights; insulated doors; floor insulation
Cost over 48 years of required household income increase	£30,187.68	£262.56
Total cost of further improvements	£467	£2,401.90
Most cost-effective solution	Further improvements	Increase to annual income

Table 4.3: Examples of two beneficiary homes with two different 'cost-effective' pathways out of fuel poverty.

4.1.8. Rising fuel prices

Finally, at the outset of this work the evaluation aimed to examine the impacts of changes in fuel prices on fuel poverty. This was initially motivated by a desire to understand the issue of churn, or how changing fuel prices might cause homes to slip back into fuel poverty after being improved. How this occurs is simple to explain in the context of the previous Low Income High Costs definition of fuel poverty: if a home received improvements that lowered the running costs below the national median running costs, it could no longer be fuel poor.[45] However, if fuel prices rise, the national median running costs will rise; this can put the home at risk of fuel poverty again if they rise above the running costs of the home.

However, when the definition of fuel poverty was changed to LILEE, it effectively eliminated the churn effect. Because LILEE is based on the SAP rating (which uses a standard set of fuel prices), rising fuel prices only have a small indirect effect on fuel poverty status. Specifically, it is only those homes that have an income marginally above the poverty line that are susceptible to being flipped back into fuel poverty as prices change, as long as the home is in SAP band D or worse.

Nevertheless, the effects on running costs and fuel poverty status were also modelled, as the economic impacts of rising fuel prices are still of interest. In order to do so, the post-intervention running costs, fuel poverty status and fuel poverty gap were re-calculated in UNO after applying new unit costs on top of the base ones. The base ones were taken from an estimate of the unit prices of gas, electricity and oil at the start of 2022 (pre-April, before the April 2022 price cap came into force); and then these quantities were multiplied by the requisite amounts to produce modelled running costs and fuel poverty parameters when fuel prices rose by 50% intervals up to 400%.

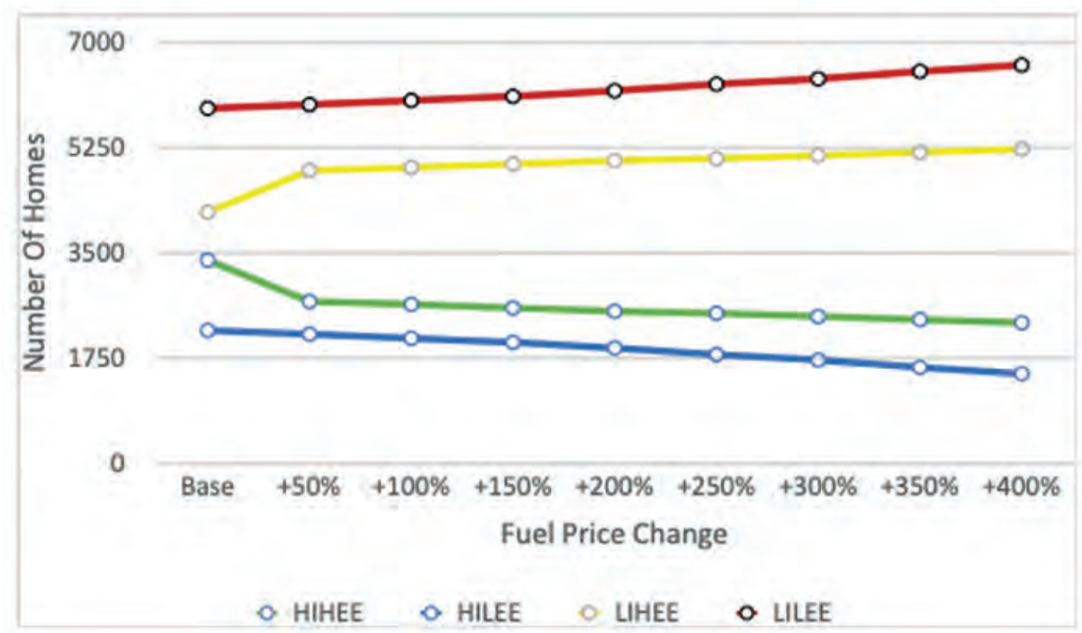

Figure 4.17: Number of homes in each fuel poverty classification in relation to changes in fuel prices.

45. See Hills, J. (2012) Getting the measure of fuel poverty: Executive summary, for the LIHC definition of fuel poverty.

Figure 4.17 above shows the number of homes in each fuel poverty quadrant change as fuel prices increase. The main effect is a transfer of homes from the High Income classifications (HILEE and HIHEE) to the Low Income classifications (LILEE and LIHEE), which occurs because the income calculated in LILEE is the residual income that remains after the householders have paid the required running costs.

The rise in number of fuel-poor homes is overall a small effect. Even after quintupling fuel prices, the proportion of fuel-poor homes only changes from 37.7% of all homes to 42.3%. This is due to the aforementioned reason: that the homes most vulnerable to falling back into fuel poverty are those where the residual income is close (in terms of the size of the running-costs change) to the poverty line. Those households where the residual income is several thousands of pounds higher than that level will not change unless fuel prices rise by dramatic and conceivably impossible levels. For comparison, at the time of writing in Autumn 2022, gas and electricity prices have roughly doubled from what they cost a year ago, which corresponds to the 100% level in Figure 4.17.

There is also an effect that can be seen in Figure 4.17, where after a small increase in fuel prices there is a larger transfer of High Energy Efficiency (HEE) homes from the High Income classification to the Low Income classification, which then slows down as fuel prices increase further. This effect does not happen with the Low Energy Efficiency (LEE) homes. As the HEE homes have on average lower running costs than the LEE homes, which corresponds to a higher residual income, this effect must be due to the presence of a large number of low-income homes in our sample, whose residual income is approximately around the poverty line. This is unsurprising given the choice to use a low-income value of £9,000, where the only data available was that the residents were in receipt of benefits.

4.2. Economic modelling outputs

4.2.1. Introduction

As demonstrated in Section 4.1 above, required running costs have decreased on average for WHF Category 1 and Category 2 households, by reducing energy bills and improving beneficiaries' ability to keep their homes warm. Academic literature shows that in such instances a 'rebound effect' occurs, where financial savings driven by the installation of energy efficiency measures are re-spent by households in different ways. A review of this literature suggests a rebound coefficient of 0.75, whereby 25% of achieved savings are spent on energy to keep the home warmer, meaning the real reduction in spending on energy bills is 75%.[46] In other words, the assumption is made that 75% of the modelled reduction in running costs for any given household is spent elsewhere in the economy, and the wider economic impacts of this re-spending can be modelled (see the detailed methodology in the annex for further information).

This section reports on the outputs of this modelling. Firstly, it investigates evidence from household interviews with WHF beneficiaries, to examine how reductions in running costs, experienced by beneficiaries as reductions in energy bills, have led to different patterns of spending in the economy. In other words, if a household has saved money as a consequence of a Category 1 or Category 2 intervention, it looks at where (if anywhere) that money has been spent. Overall, findings from the household fieldwork support the premise of the economic modelling by demonstrating that beneficiaries of WHF interventions spend running cost savings in multifarious ways across the economy, including on extra heating. After this, the section moves on to outline the results of the economic modelling exercises, firstly demonstrating the modelled impacts of running cost reductions on the economy. Secondly, the focus is widened to consider how National Grid's investment in the WHF has affected broader sectors of the economy.

4.2.2. "I just stick the extra in the meter": the re-spending of running costs savings in the economy by WHF beneficiaries

To begin answering the question of where WHF beneficiaries spend the money they have saved as a result of their interventions, Figure 4.18 below shows the responses to a specific item on the household questionnaire which asks the extent to which beneficiaries cut back on food, heating and other essential items, before and after their intervention. Figure 4.18 shows that, for Category 1 and Category 2 interventions, the proportion of survey respondents cutting back on heating all or most of the time reduced by 23 and 24 percentage points respectively.

46. See Barker, T., Ekins, P. and Foxon, T. (2007) The macro-economic rebound effect and the UK economy, Energy Policy 35 (10): 4935–4946; Sorrell, S., Dimitropoulos, J. and Sommerville, M. (2009) Empirical estimates of the direct rebound effect: A review, Energy Policy 37 (4): 1356–1371; Gillingham, K; Kotchen, M.J., Rapson, D.S. and Wagner, G. (2013) The rebound effect is overplayed, Nature 493 (7433): 475–476.

In other words, taken as an aggregate across the sample, this suggests that these households are using their heating systems more frequently (i.e. rationing their heating less). This provides evidence in favour of applying a rebound effect, although it should be noted that there is no reliable way of calculating an equivalence between percentage point reductions in heat rationing practices and a rebound coefficient. Furthermore, Figure 4.18 shows that for Category 1 and Category 2 interventions, the proportion of respondents cutting back on food and other essentials also reduced, albeit by smaller values of 8%. In other words, this indicates that higher proportions of larger household budgets are being spent by WHF beneficiaries in other parts of the economy, specifically on food and other essential items.

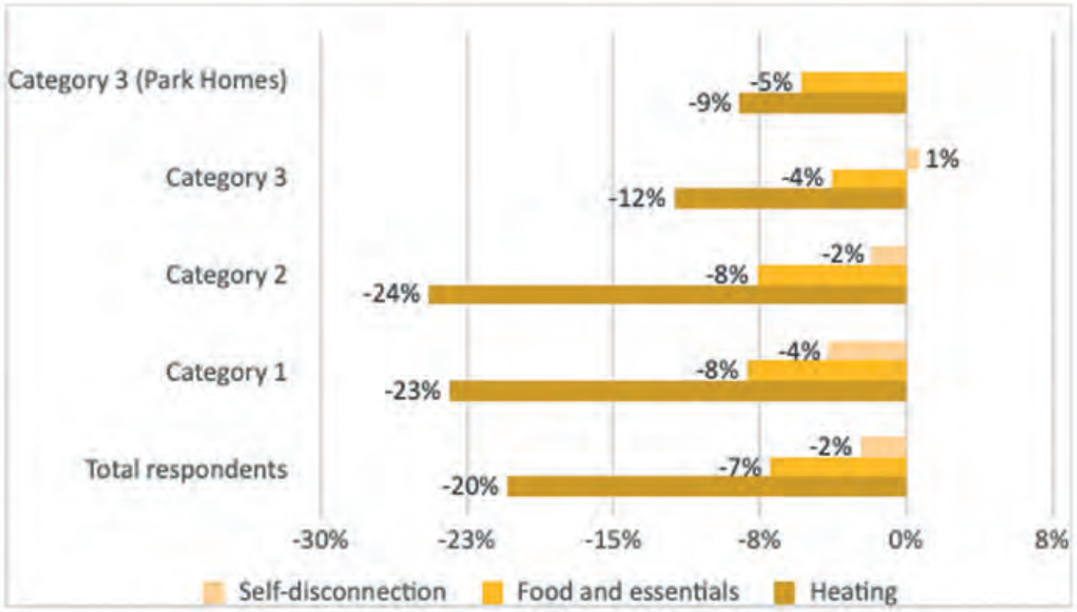

Figure 4.18: Percentage point reductions in the extent to which questionnaire respondents were cutting back on heating, essentials, and prepayment meter usage/topping up.

This insight from the household survey can be nuanced further by findings from household interviews. In cases where Category 1 and Category 2 beneficiaries reported running-cost savings (typically narrated in terms of a reduction in their direct debit or monthly/annual spend on energy, as shown in Section 3.7), they were asked how they were spending the additional money that their intervention had freed up in their household budget. Table 4.4 below summarises the responses received to this question, alongside indicative quotations.

Household spending	Indicative quotations
Children's activities (e.g. days out at the zoo)	*"There's not a lot of things that he really enjoys. But there are things that are a bit more diva that he likes to do as a family. So we can take him on those kinds of trips out now."*
Children's items	*"Buying my son extra toys."*
Energy (i.e. the rebound effect)	*"I just stick the extra [the running cost savings] in the meter"; "we haven't been cutting back on it because, like I say, it is like a honeymoon sort of scenario at the moment. You have got the heat, and take full advantage of it."*
Food (e.g. both weekly food shopping and eating out at restaurants)	*"Well, yes, we can actually go out now and again, which we couldn't do before, we couldn't afford to do. It has given us a broader area of shopping rather than going to bargain places all the time. We are able to pick where we go."*
Household electrical appliances	*"We used some of the extra budget we had to buy a decent dehumidifier, so we're able to dry washing now without putting the tumble dryer on more or less constantly, which is really good."*
Holidays	*"We went away last week, just to a caravan. I wouldn't have been able to do that if I was spending £9 a night on the heating."*
Other bills	*"Probably other bills"; "catching up with other things."*
Paying off debts	*"At the moment we're paying debts off and we've been helping my son out, my adult son. [The savings have] enabled us to do that without building debt but actually reducing debt."*
Savings	*"It actually enabled me to start saving a bit of money [...] I've cut my electricity bill by £20 so I'm putting that away."*

Table 4.4: Evidence from qualitative household interviews on where beneficiaries were spending the additional disposable income obtained as a result of their WHF intervention.

As Table 4.4 begins to show, the flow of running cost savings into different parts of the economy was varied. In addition, evidence from the household interviews shows that WHF interventions have led to other effects that will have direct or indirect impacts on the economy. In one instance, an interviewee described being able to reduce their hours at work as a result of the savings their intervention provided, saying that *"I suppose I have changed my work slightly [...] I've cut back on work as I get older, whereas before I would be working longer hours."*

In another example, one Category 3 interviewee described previously being self-employed, working from home on her own jewellery business. She described her experience of working at home in the cold as difficult, explaining that:

"The jewellery making I was doing before, the bridal stuff, that was working from home, it was hard to do that when I was cold because my hands would be freezing and then to sit there and try and make intricate jewellery is really hard."

In contrast, after receiving a grant via a Category 3 project for a new heating system installation, the interviewee envisioned how she would feel next winter:

"Working from home this winter coming, that isn't daunting because it's actually going to be cosy and actually it's quite nice to work from home. Whereas before it was a bit miserable. Yes, I feel positive in that sense, definitely."

Moreover, this interviewee also described how having a warm, comfortable space to work and think at home had helped her set up a new business. At the time of the interview, the business was in the process of being established. However, although the name of the business cannot be revealed due to a need to protect the interviewee's anonymity, at the time of writing the business had expanded, transitioned from a Private Limited Company to a Community Interest Company, and been featured across UK national media. This is an isolated example but **demonstrates that providing warm and safe homes can enable wider economic growth and development, such as the establishment of new businesses.**

More generally, findings from the household fieldwork support the premise of the economic modelling by demonstrating that beneficiaries of WHF interventions spend running cost savings in multifarious ways across the economy, including on extra heating, justifying the inclusion of a rebound effect in this analysis. The next subsection moves on to discuss the wider economic impacts of these different spending patterns.

4.2.3. The impacts created by reduced energy bills

After the rebound effect was accounted for, the energy bill savings generated by the WHF, which can be stated as an increase in household disposable income, amounted to £10.8mn.

Table 4.5 below shows that this figure is reached by applying the 75% rebound coefficient to the total potential increase in annual disposable income, which was £14.4mn. Of the £10.8mn increase in disposable income, the analysis shows that £8.6mn was re-spent in the economy in the first round of re-spending. This re-spent disposable income then had multiplier effects throughout the economy, in a second round of economic impacts of £9.6mn. These are estimated by using the ONS demand multipliers for each sector of the economy, to create marginal multiplier coefficients, as described in the methodology. Taken together, these two rounds of positive economic impacts total £14.4mn and represent the positive economic impact of the bill reductions on the wider economy. This happens because even though some of the bill savings are not spent in the UK economy (they are used to pay off debt, saved, taxed, or spent abroad), that which is spent in the UK goes on to circulate in the economy. This creates a multiplier effect which produces demand in the economy greater than the amount initially re-spent by households.

Potential increase in annual disposable income	£14,444,019
Actual increase in annual disposable income after rebound effects	£10,833,014
1st round of annual re-spending	£8,579,604
2nd round of annual re-spending	£9,584,580
Total economic impact	£14,420,653

Table 4.5: Economic impact analysis of the effects of the changes to household running costs.

The spending boost detailed in Table 4.5 above does not take place evenly across all sectors of the economy. The distribution and shape of the impact of this spending can be estimated by using a social accounting matrix, as described in the methodology annex.

The modelling analysis shows that the two rounds of re-spending, as described above, and which resulted in positive economic impacts totalling £14.4mn, stimulated and boosted some sectors of the economy more than others. The destinations of this re-spending are shown below in Figure 4.19.

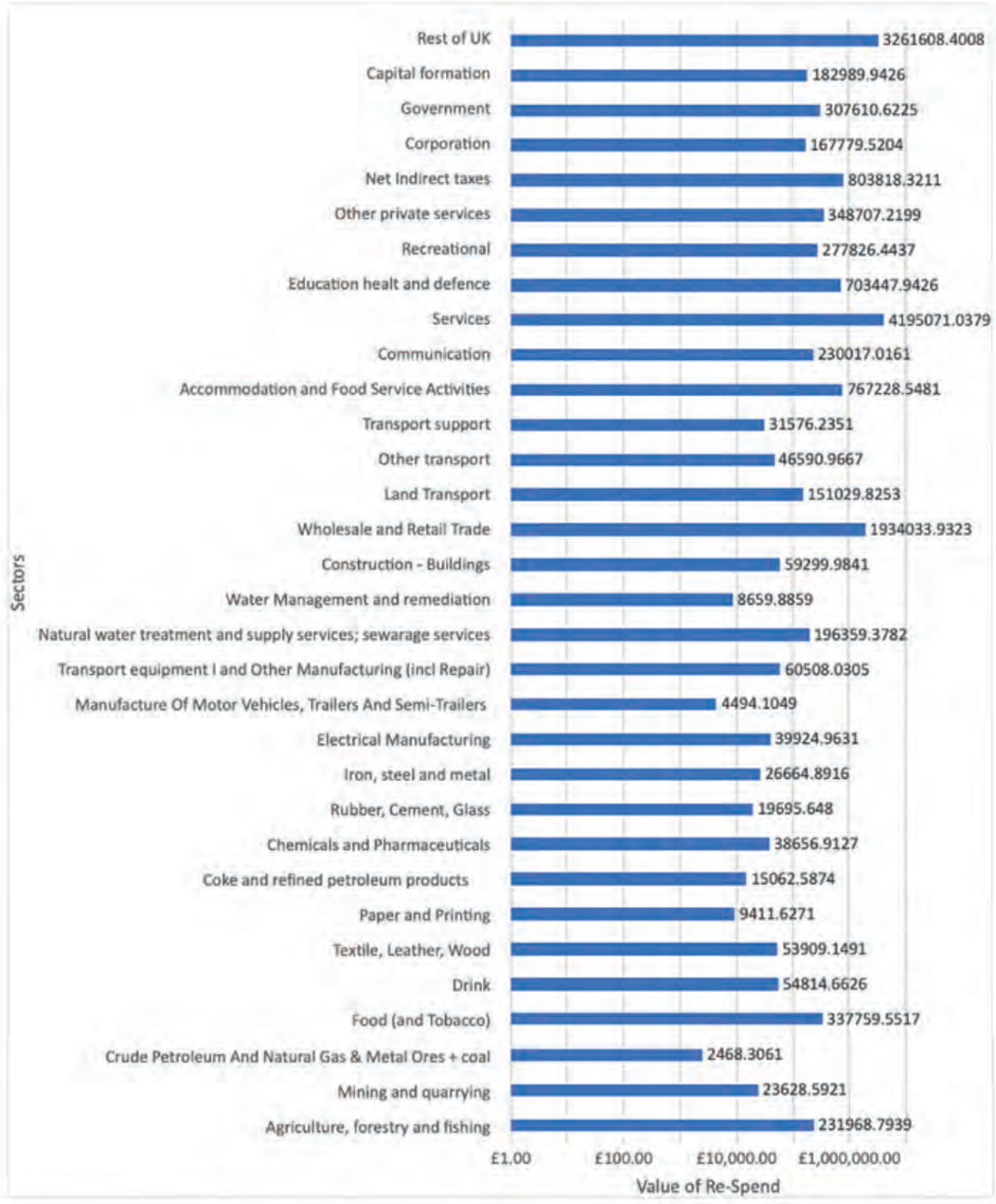

Figure 4.19: Destinations of re-spent energy bill savings (log scale).

4.2.4. Targeting interventions at low-income households

A further comparison can be made between the modelled economic impacts of the WHF measures and the likely impacts they would have had were they not so specifically targeted at low-income households. We can estimate these differences by using the Strathclyde Social Accounting Matrix (SAM), which provides spending patterns of households in five income quintiles.[47] In other words, it divides households into five equally sized groups based on levels of income, so that group one is the 20% of all households with the lowest incomes, while group five is the 20% with the highest incomes. These different household groups have observably different spending patterns and rates of saving and taxation liabilities. As a result, boosting the incomes of households with different incomes leads to different economic impacts, and this can be modelled.

When interventions are targeted at low-income households, this not only helps the beneficiaries; the economic benefits for the wider economy are greater when compared to untargeted interventions.

Table 4.6 below compares three different scenarios, to illustrate the difference between the actual modelled impacts of the WHF throughout the economy in a scenario in which the average household income was used, and one where measures were provided exclusively to higher-income households. This is relevant to this exercise because it indicates the likely impact of the interventions had they been distributed across all households and income bands, which is how one might imagine a non-targeted WHF operating. Including a third scenario, where measures are directed to higher-income households, helps to illustrate what could be termed a 'sliding scale' of economic impacts in relation to recipients' household income, whereby the lower the recipients' income, the greater the economic impacts, and vice versa. In summary, by targeting low-income households, the WHF grants produced a greater boost in demand across the economy, as detailed in Table 4.6.

	Scenario 1: Low-income targeting	Scenario 2: Measures go to middle-income households	Scenario 3: Measures go to high-income households
Round 1 re-spending	£8,579,604.13	£7,345,493.08	£6,384,373.14
Round 2 re-spending	£5,841,048.94	£4,847,808.94	£4,007,291.27
Total re-spending	£14,420,653.07	£12,193,302.03	£10,391,664.41

Table 4.6: Comparison of targeting scenarios.

Figure 4.20 and Table 4.7 show that the main differences in the distribution of re-spending between targeting scenarios (which cause the different multiplier effects) are that the WHF targeting resulted in more spending on services, groceries, food and drink, and general spending in the economy, compared to the higher-income targeting scenarios. In those scenarios, beyond small increases in areas such as spending in restaurants and accommodation services, households would have been more likely to save or pay tax. The significance of this finding is that it illustrates and explains what the multiplier calculations show: that low-income households pay less tax, save less and spend more. Because of this, interventions targeted at this group do not only help the beneficiaries themselves; they also have stronger economic benefits for the wider economy, compared to untargeted interventions.

47. Katris, A., Figus, G. and Greig, A. (2019) The 2013 Social Accounting Matrix for Scotland disaggregated by household income quintiles.

48. Note that Figure 4.20 and Table 4.7 include monies which leave the circulating economy and are not included in the multiplier analysis. They are shown here to build up a picture of all flows. As a result, the totals here do not match the totals reported above.

	Scenario 1: Low-income targeting	Scenario 2: Measures go to middle-income households	Scenario 3: Measures go to high-income households
Agriculture, forestry and fishing	£231,968.79	£176,123.11	£125,016.02
Mining and quarrying	£23,628.59	£21,391.28	£17,876.13
Crude petroleum and natural gas; metal ores and coal	£2,468.31	£2,746.33	£2,545.42
Food (and tobacco)	£337,759.55	£244,213.39	£166,282.60
Drink	£54,814.66	£43,868.01	£28,237.38
Textile, leather, wood	£53,909.15	£51,415.32	£47,589.87
Paper and printing	£9,411.63	£10,280.91	£9,313.40
Coke and refined petroleum	£15,062.59	£19,767.68	£21,232.21
Chemicals and pharmaceuticals	£38,656.91	£34,006.87	£25,737.50
Rubber, cement, glass	£19,695.65	£17,600.39	£15,061.15
Iron, steel and metal	£26,664.89	£22,864.06	£18,995.46
Electrical manufacturing	£39,924.96	£38,027.82	£32,573.00
Manufacture of motor vehicles, trailers and semi-trailers	£4,494.10	£5,933.59	£6,325.10
Transport equipment and other manufacturing (incl. repair)	£60,508.03	£63,525.29	£57,943.40
Natural water treatment and supply services; sewerage services	£196,359.38	£127,551.52	£67,132.02
Water management and	£8,659.89	£5,625.31	£2,960.67
Construction – buildings	£59,299.98	£38,520.20	£20,273.68
Wholesale and retail trade	£1,934,033.93	£1,802,402.33	£1,546,036.87
Land transport	£151,029.83	£204,020.66	£222,281.37
Other transport	£46,590.97	£62,938.03	£68,571.25
Transport support	£31,576.24	£28,463.93	£24,428.19
Accommodation and food service	£767,228.55	£841,384.42	£864,883.64
Communication	£230,017.02	£177,290.59	£131,811.07
Services	£4,195,071.04	£2,929,989.04	£1,766,705.97
Education health and defence	£703,447.94	£666,632.06	£848,470.45
Recreational	£277,826.44	£318,983.29	£291,299.24
Other private services	£348,707.22	£294,539.65	£246,166.30
Net indirect taxes	£803,818.32	£819,757.60	£686,115.78
Corporation	£167,779.52	£624,890.34	£1,114,594.62
Government	£307,610.62	£1,453,488.28	£2,252,868.44
Capital formation	£182,989.94	£452,993.02	£857,637.00
Rest of UK	£3,261,608.40	£2,589,184.01	£2,217,573.68

Table 4.7: Comparison of total re-spending in three targeting scenarios.

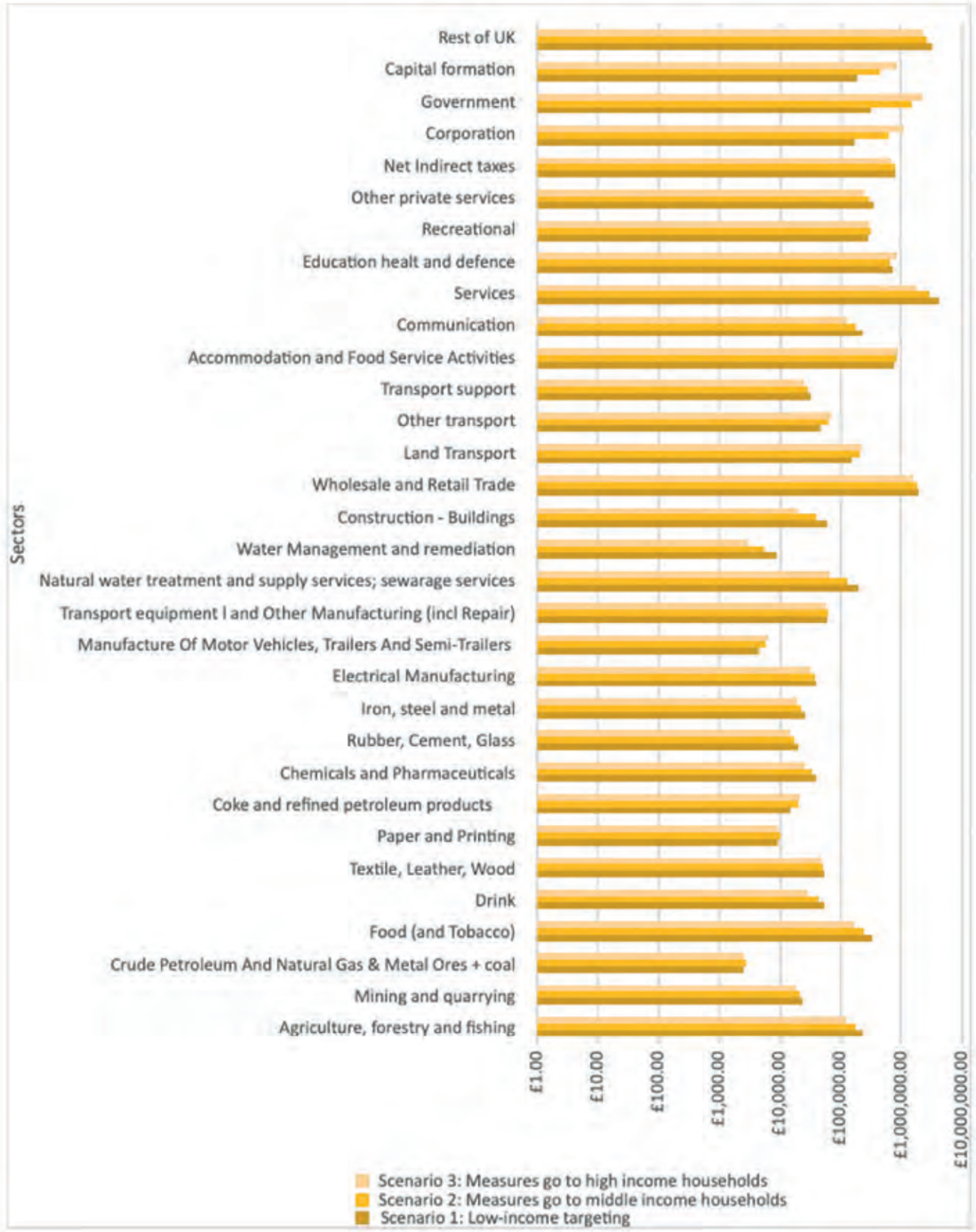

Figure 4.20: Comparison of total re-spending in three targeting scenarios (log scale).

4.2.5. Economic impacts of the WHF in different pricing scenarios

In addition to considering the size and shape of impacts created by different approaches to targeting, it has also been possible to model the impacts in different potential energy price scenarios, drawing on the scenarios modelled and developed in Section 4.1. above.

In these scenarios, it is assumed that measures are effectively targeted at low-income households. Energy prices, however, are modelled to rise from those used across the evaluation, in four distinct price scenarios:

1. 50% energy price rise from base year
2. 100% energy price rise from base year
3. 200% energy price rise from base year
4. 400% energy price rise from base year

The impacts that the changes in energy prices are estimated to have on household running costs in each scenario vary considerably. This is because the reduced running costs in each scenario are determined by a comparison between the energy bills that would be faced in each price scenario by each household **had the measures not taken place**, and their energy bills in each scenario **now that the measures have taken place**. In other words, this approach proposes and answers a counterfactual for each of the four scenarios listed above, before modelling and estimating the impacts on the economy in each scenario.

Tables 4.8 and 4.9 show that in high energy price scenarios, the measures funded by the WHF under Category 1 and Category 2 have even greater direct and indirect impacts than in the base price scenario. In other words, as prices rise, so does the value of these measures to households and to the wider economy. This is for two reasons. Firstly, the difference between household energy running costs with and without the measures is greater in high price scenarios; this is because as unit costs rise, the advantage of not having to buy as many units of energy (thanks to the funded measures) becomes greater. Secondly, these larger differences in running costs have greater economic impacts due to the multiplier effects of re-spending.

	Base price scenario	50% energy price rise from base year	100% energy price rise from base year	200% energy price rise from base year	400% energy price rise from base year
Household running costs in this price scenario **WITHOUT** measures	£31,521,968	£45,063,619	£58,605,269	£85,688,569	£139,855,170
Household running costs in this price scenario **WITH** measures	£17,077,949	£28,773,817	£37,438,401	£54,767,569	£89,425,904
Impact of intervention in this price scenario	£14,444,019	£16,289,801	£21,166,867	£30,921,000	£50,429,266
Energy bill reduction after rebound effect	**£10,833,014**	**£ 12,217,350**	**£ 15,875,150**	**£ 23,190,750**	**£ 37,821,950**

Table 4.8: Modelled impact of the measures on household energy bills in each price scenario.

	Base price Scenario	50% energy price rise from base year	100% energy price rise from base year	200% energy price rise from base year	400% energy price rise from base year
Total household income boost after rebound effect	£10,833,014	£ 12,217,350	£15,875,150	£23,190,750	£37,821,950
Direct re-spend by households per year (Round 1)	£8,579,604	£9,675,980	£12,572,909	£18,366,767	£29,954,484
Wider economy re-spending per year (Round 2)	£5,841,048	£6,587,468	£8,559,716	£12,504,212	£20,393,202
Total re-spending in the wider economy per year, resulting from energy bills being lower with the measures than without	**£14,420,653**	**£16,263,449**	**£21,132,626**	**£30,870,979**	**£50,347,687**

Table 4.9: Modelled impact of the reduced household energy bills in each price scenario on the wider economy after multiplier effects.

4.2.6. Broader economic impacts of the WHF

Finally, further to the economic impacts of the WHF resulting from changing spending patterns in the economy, the ways that WHF investment have supported and grown different sectors of the economy can also be modelled.

The starting point for this analysis is National Grid's £150mn investment in the WHF. This was split between £132mn in the building, housing services and energy installation industry, and £18m in support services. This led to an additional £200mn in additional indirectly stimulated demand in the economy, giving a total demand stimulus of £350mn. This means that for every £1 invested, a further £1.34 was stimulated in the economy, giving a total of £2.34 of total economic impact for every £1 invested, as shown in Table 4.10 below.

Value of the Initial Investment	**£150,000,000**
Construction Sector Portion	**£132,000,000**
Round 1: Re-spending by Construction and Installers	£104,685,455
Round 2: Further re-spending in the economy	£78,359,374
R1+R2	£183,044,830
Total economic boost created by the grant funding	£315,044,830
Support Services Portion	**£18,000,000**
Round 1: Re-spending by Construction and Installers	£10,495,158
Round 2: Further re-spending in the economy	£6,820,245
R1+R2	£17,315,404
Total economic boost crated by the grant funding	£35,315,404
Total indirect economic boost created by funded work	£200,360,234
Total economic boost of funded work	**£350,360,234**

Table 4.10: Economic impact analysis of capital expenditure using ONS multiplier coefficients.

Behind this aggregated figure we can see the distribution of this money in the economy. The distribution of these indirect effects was modelled using sector-specific spending coefficients to capture the breadth of economy-wide effects from the investments: specifically, the £132mn in the construction sector and the £18mn in the support services sector. These are summarised in Figure 4.21.

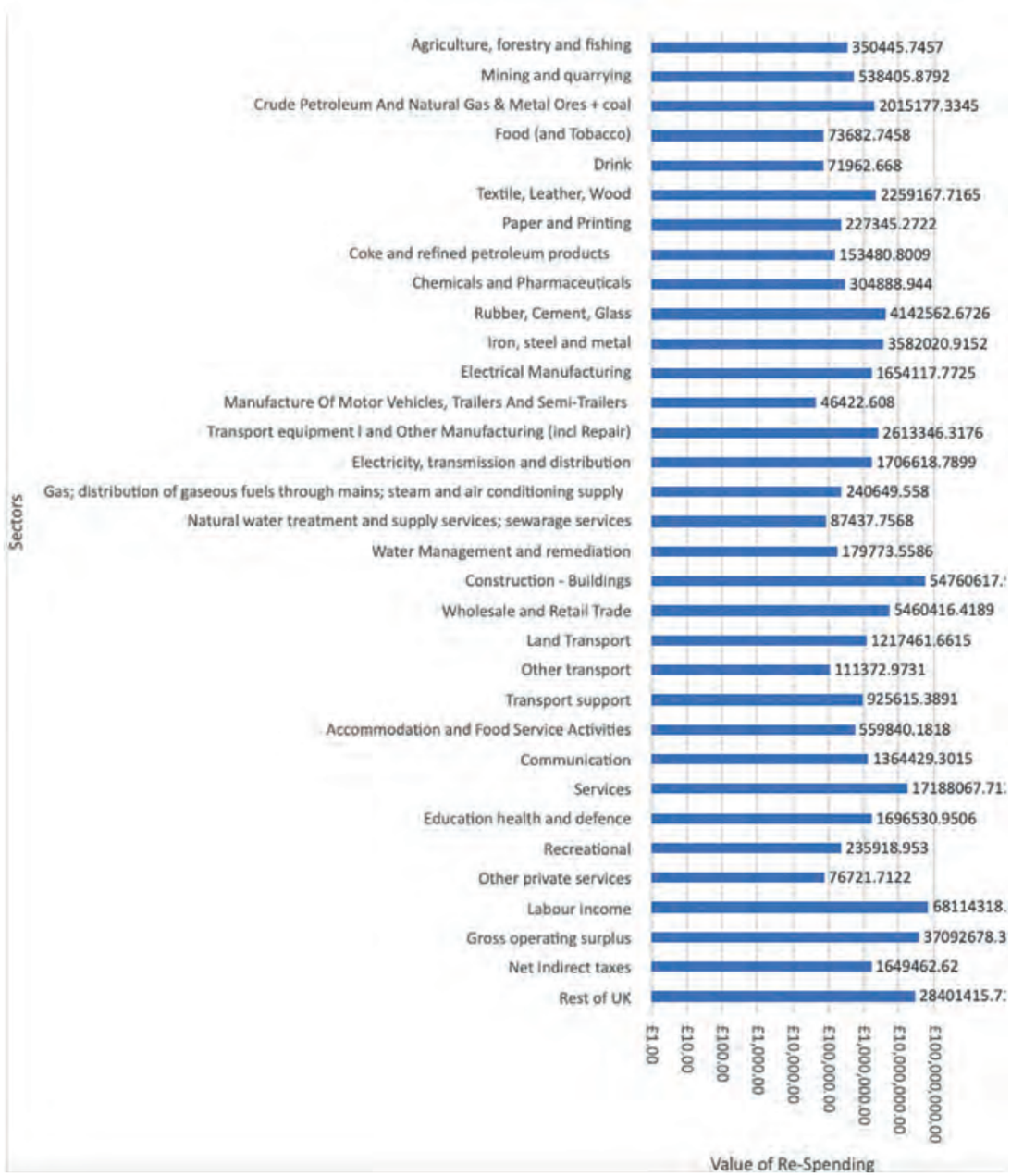

Figure 4.21: Multiplied re-spending of grant funding via both the construction and support services. sectors (log scale)

4.3. Modelled health impacts, avoided NHS costs and wider societal benefits

4.3.1. Introduction

The health impacts of providing adequately warm homes can be profound. Section 3.8 above shows that the effects of WHF interventions on the health and wellbeing of beneficiaries have been substantial, but a large amount of research has also shown that tackling cold homes can have significant societal benefits, including NHS cost savings.[49] A suitable starting point for this analysis is the HHSRS, defined as *"a risk-based evaluation tool to help local authorities identify and protect against potential risks and hazards to health and safety from any deficiencies identified in dwellings."*[50] HHSRS guidance states that:

"A healthy indoor temperature is around 21˚C, although cold is not generally perceived until the temperature drops below 18˚C. A small risk of adverse health effects begins once the temperature falls below 19˚C. Serious health risks occur below 16˚C with a substantially increased risk of respiratory and cardiovascular conditions. Below 10˚C the risk of hypothermia becomes appreciable, especially for the elderly."[51]

Cold homes, therefore, lead to a range of health risks that translate into likelihoods of primary care attendance, hospitalisation, and NHS transport requirements (e.g. ambulance callouts). This section estimates the health impacts, avoided NHS costs, and wider societal benefits of the measures funded by the WHF. Before doing so, it examines supporting evidence from household interviews, showing that some interviewees had been hospitalised in previous winters as a result of the indoor temperature of their homes. It then moves on to summarise the findings of the analysis, based on the Building Research Establishment's (BRE) Housing Health Cost Calculator (HHCC), as discussed in detail in the methodology annex.

4.3.2. "He'd been in hospital so many times": interviewee experiences of cold-related hospitalisation

There is evidence, particularly from household interviews, that WHF beneficiaries had experienced hospitalisation from cold-related illnesses caused by low indoor temperatures inside their homes. One interviewee said of their partner that *"before we had the heating in, I mean in wintertime especially, he'd been in hospital so many times because his chest infection had turned to pneumonia. Whereas this winter, we've gone through it, and he's not had any problems."* A second interviewee concurred when they said that *"the wife would end up in hospital with chest infections and stuff like that."* Beyond this, there is evidence from the evaluation findings that broader issues related to fuel poverty, such as energy and food rationing, can also lead to hospitalisation and NHS costs. One interviewee, unable to afford food or heating, described being unable to afford food or heat for six days:

"I got dehydration and my kidneys collapsed, so I had to go on dialysis, I was in [...] intensive care [...] so yes, it has helped actually, because when I came out from that I did have the heating on, after I came out from hospital. So that helped."

As two of these quotes indicate, the installation of a new heating system under Category 1 and Category 2 of the WHF was perceived by some interviewees as protecting them from future hospitalisation, and in parallel prevented further accumulation of healthcare costs caused by their homes.

4.3.3. NHS cost savings and wider societal benefits

Based on the methodology set out in the annex, **the total NHS cost savings generated by the WHF are estimated to be £2,491,381 per annum, while the wider societal benefits are estimated to be £41,854,679 per annum**.

The NHS and wider societal impacts of the measures funded under Category 1 and Category 2 of the WHF are detailed in Table 4.11 below. Some of the greatest savings have been created in improving many extremely poorly performing homes; and even though some of these households may still technically be in fuel poverty under the LILEE metric, the likely costs arising from excess cold have been significantly reduced.

49. BRE (2021) The cost of poor housing in England.

50. UK Government (2006) Housing health and safety rating system (HHSRS): guidance for landlords and property-related professionals.

51. UK Government (2019) Housing health and safety rating system (HHSRS) guidance.

Pre-intervention SAP Band	Post-intervention SAP Band	Total NHS savings per annum
B	A	£96
C	B	£3,239
D	A	£276
	B	£2,052
	C	£279,809
E	B	£2,490
	C	£254,592
	D	£478,035
F	C	£260,325
	D	£82,002
	E	£552,420
G	C	£39,146
	D	£437,236
	E	£91,949
	F	£7,714
	Total NHS savings	**£2,491,381**

Table 4.11: NHS savings attained through the movement of beneficiary homes from pre-intervention SAP bands to post-intervention SAP bands.

Table 4.12 overleaf provides the full breakdown of these findings, including the wider societal benefits.

SAP Band			Risk Scale Point		NHS Costs of Excess Cold			Wider Societal Costs of Excess Cold			Risk Ratings			
PRE	POST	n	ONE IN ...	ONE IN ...	PRE	POST	IMPACT	PRE	POST	IMPACT	PRE	POST	Total NHS Savings per annum	Total Societal Savings per annum
B	A	4	560	1,000	£54	£30	£24	£967	£541	£426	D	E	**£96**	**£1,704**
C	B	79	320	560	£95	£54	£41	£1,692	£967	£725	C	D	**£3,239**	**£57,275**
D	A	2	180	1,000	£168	£30	£138	£3,008	£541	£2,467	C	E	**£276**	**£4,934**
D	B	18	180	560	£168	£54	£114	£3,008	£967	£2,041	C	D	**£2,052**	**£36,738**
D	C	3,833	180	320	£168	£95	£73	£3,008	£1,692	£1,316	C	C	**£279,809**	**£5,044,228**
E	B	10	100	560	£303	£54	£249	£5,414	£967	£4,447	B	D	**£2,490**	**£44,470**
E	C	1,224	100	320	£303	£95	£208	£5,414	£1,692	£3,722	B	C	**£254,592**	**£4,555,728**
E	D	3,541	100	180	£303	£168	£135	£5,414	£3,008	£2,406	B	C	**£478,035**	**£8,519,646**
F	C	585	56	320	£540	£95	£445	£9,668	£1,692	£7,976	A	C	**£260,325**	**£4,665,960**
F	D	346	56	180	£540	£303	£237	£9,668	£3,005	£6,663	A	B	**£82,002**	**£2,305,398**
F	E	1,485	56	100	£540	£168	£372	£9,668	£5,414	£4,254	A	C	**£552,420**	**£6,317,190**
G	C	46	32	320	£946	£95	£851	£16,919	£1,692	£15,227	A	C	**£39,146**	**£700,442**
G	D	562	32	180	£946	£168	£778	£16,919	£3,008	£13,911	A	C	**£437,236**	**£7,817,982**
G	E	143	32	100	£946	£303	£643	£16,919	£5,414	£11,505	A	B	**£91,949**	**£1,645,215**
G	F	19	32	56	£946	£540	£406	£16,919	£9,668	£7,251	A	A	**£7,714**	**£137,769**
												Total	**£2,491,381**	**£41,854,679**

Table 4.12: Total NHS and wider societal savings per annum.Annex 1. Detailed methodology

Annex 1. Detailed methodology

A1: Methodological approach

Evaluation is a valuable and powerful tool for evidence-based decision making. It aids understanding of how change is brought about and provides insight into the effectiveness of programmes. Furthermore, robust evaluation provides greater transparency and accountability. Where programmes have been running for some time, as was the case with the WHF, evaluation can be focused to demonstrate the continuing value of investment, inform if and how programmes can be refocused or made more effective, and how an initiative may be transferrable – for example, by informing future energy efficiency and fuel poverty programme design.[52]

The evaluation framework was based on Programme Theory and Theory of Change approaches, which aim to determine the causal chain of events that explain why and how certain changes (e.g. achievements, impacts, outcomes) occur. The simplified logic model is illustrated in Figure A1 below.

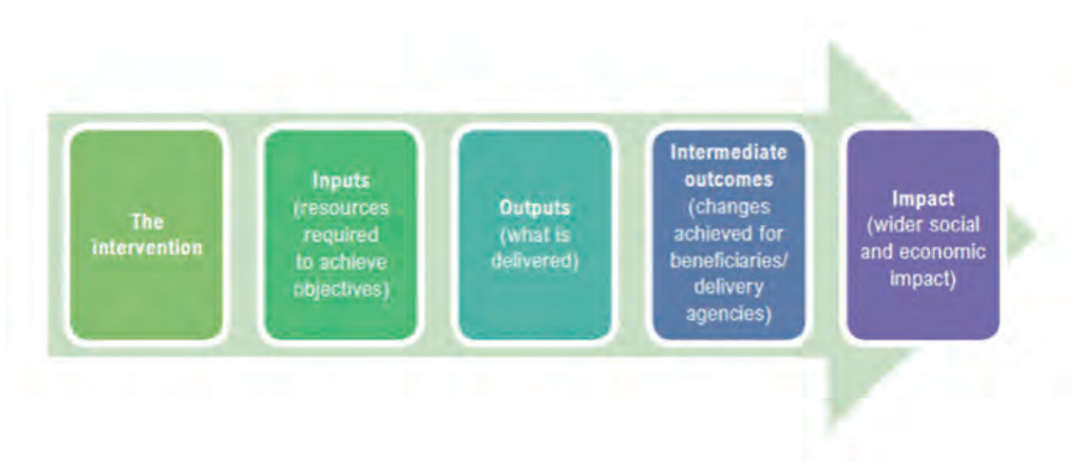

Figure A1: Evaluation logic model process.

Evaluation based on such a model typically takes three forms: 1) process evaluation (how the programme was delivered); 2) impact evaluation (the difference made); and 3) economic evaluation (costs and benefits). Process evaluation cannot determine whether a programme achieved its aims or the extent to which aims were achieved; hence, this is complemented by impact evaluation, which can more effectively test the underlying logic model. Using a multi-method approach to evaluation enables methodological triangulation and the combination of data from multiple sources (including temporal, spatial, and populations of interest). Triangulation can be a useful tool to validate data, assumptions and results, by enhancing credibility and helping to ensure the best available evidence (i.e. that which accounts for diversity as well as nuance),[53] in order to answer the principal research questions. These are:

1. How was the programme delivered?

2. What was the difference made (outcomes and impact)?

3. What were the costs and benefits of the programme, and do the benefits justify the investment?

52. Parsons, D. (2017) Demystifying Evaluation: Practical Approaches for Researchers and Users. Bristol: Policy Press

53. Bryman, A. (2004) Triangulation and measurement.

Based on this overarching methodological approach, the principal objectives of the programme-wide evaluation were to:

- Develop a framework of appropriate input, output and impact measures, which will provide a basis on which delivery performance can be assessed.
- Determine the social and economic benefits from the WHF investment (return on investment).
- Determine the extent to which the support has reached the households most in need, and any regional differences, specifically between England, Scotland, and Wales.
- Produce a blueprint model that could be used to inform policymakers on options for delivering future large-scale energy efficiency programmes.

To meet these objectives, the evaluation adopted an Action Research strategy that integrated formative evaluation (to improve and shape) and summative evaluation (to assess outcomes). The formative strand focused on process evaluation and considered progress against stated goals, effectiveness of delivery, and lessons learned. The summative element focused on the outcomes of the programme for multiple actors, including AWS, WHF project delivery organisations, and for beneficiary households. This included a multi-factor assessment of the programme's return on investment, in order to quantify its social, economic and environmental impacts.

The remainder of this section explains the specific methods used to meet the objectives. Broadly, these were:

- Householder fieldwork
- WHF project fieldwork
- Indoor environmental monitoring fieldwork
- Energy modelling
- Economic modelling
- Health service and wider society impact modelling
- Socio-spatial analysis

Each is discussed in turn, starting with the householder fieldwork.

A2: Household fieldwork

Household survey fieldwork was designed to be deployed in three waves, to ensure that beneficiaries from across the lifespan of the WHF could communicate their experiences of receiving support. Wave 1 took place in March–April 2020, Wave 2 in March–May 2021, and Wave 3 in March–May 2022. Given the difference between the fund categories, two separate questionnaires were designed: one for measures that included heating interventions (Categories 1 and 2), and another for Category 3, whose measures were primarily more advice-based. Park Homes recipients received a version of the Category 1 and 2 questionnaire, with some additional items to reflect the different context of their interventions. Table A1 below shows the projects that have been engaged with across the evaluation lifespan, disaggregated by category of funding.

Category	Recruited projects		
	Wave 1	Wave 2	Wave 3
Category One	East Suffolk Council; Greater Manchester Combined Authority; Newcastle City Council	Bristol City Council; Connected for Warmth; Corby Borough Council; Durham County Council; Hertfordshire County Council; Leeds City Council; Liverpool City Council; Neath Port Talbot County Borough Council; North Yorkshire County Council; Perth and Kinross Council; Reading Borough Council; Shropshire Council; Walsall Metropolitan Borough Council; Warmer Homes	Agility Eco (Connected for Warmth); Bristol City Council; Derbyshire County Council; Liverpool City Council; London Borough of Waltham Forest; Longhurst Group; Neath Port Talbot Council; North Yorkshire County Council; Portsmouth City Council (Warmer Homes); Sedgemoor District Council; Shropshire Council; Stoke City Council; Wakefield and District Housing Association; Wakefield Council; Worcestershire County Council
Category Two	East Suffolk Council	Argyll Community Housing Association; Ceredigion County Council; Eden Housing Association; Flagship Housing Group; Herefordshire Council; Neath Port Talbot County Borough Council; Perth and Kinross Council	Argyll Community Housing Association; Broadacres Housing Association; Ceredigion County Council; Derbyshire County Council; Eden Housing Association; Flagship Group; Highland Council; Southside Housing Association
Category Three	East Suffolk Council; Newcastle City Council	Bristol City Council (Centre for Sustainable Energy); Community Law Service; Connect for Help; Scottish Borders Council; Shropshire Council	Agility Eco (Connect for Help); Cheshire East Council; Essex County Council; London Borough of Waltham Forest; Northamptonshire County Council (Community Law Service); Sedgemoor
Category Three (Park Homes)		Herefordshire Council; Newark and Sherwood District Council; Walsall Metropolitan Borough Council	Walsall Metropolitan Borough Council

Table A1: WHF project leads taking part in household fieldwork.

Across these projects, Table A2 below shows the total number of questionnaires that were distributed.

Category	Recruited projects			
	Wave 1	Wave 2	Wave 3	Total
Category One	541	901	1,033	2,475
Category Two	10	316	856	1,182
Category Three	254	1,175	1,022	2,451
Category Three (Park Homes)	0	181	22	203
Total	805	2,573	2,933	**6,311**

Table A1: WHF project leads taking part in household fieldwork.

Table A2: Total numbers of questionnaires distributed in each wave and across each WHF funding category. Table A3 below shows the sample achieved, disaggregated by wave and funding category. As Table A3 shows, targets have been exceeded for all three initial WHF funding categories, in addition to a smaller number of Category 3 (Park Homes) respondents.

	Category 1	Category 2	Category 3	Category 3 (Park Homes)	Total
Wave 1	82	4	11	0	97
Wave 2	221	94	138	44	497
Wave 3 to date	163	162	75	5	405
Targets	150–200	150–200	80–100	n/a	380–500
Response rate	18.8%	22%	9.1%	24.1%	15.8%
Total	466	260	224	49	999

Table A3: Questionnaire returns, disaggregated by Wave and funding category.

Descriptive and inferential analysis was conducted on the survey response dataset, using statistical analysis software SPSS. Descriptive statistics were produced to examine the distribution of responses, and inferential analysis was employed to understand any relationships between variables. Specifically, chi-squared tests were performed to determine the statistical significance of relationships, and to demonstrate the level of confidence that can be attributed to the results. Throughout the report, 95% confidence intervals are used, and results are found to be statistically significant they are noted as having a significance level of p=<0.05.

Further to the household survey fieldwork, the evaluation conducted semi-structured qualitative interviews with 61 beneficiary households to understand in more depth their experiences of receiving support. Specifically, the interviews focused on the impact of the intervention, and the lived experience of fuel poverty and energy vulnerability prior to receiving support. Initially, it was intended that interviews would be split evenly among funding categories (excluding Category 3 Park Homes beneficiaries) and spread across the period of the evaluation (i.e. 20 per annum). However, it was also intended that the household interview schedule would be flexible, to respond to programme developments (e.g. the introduction of Category 3 Park Homes) and sample availability.

Table A4 below shows the final achieved interview sample, disaggregated by wave and funding category.

	Category 1	Category 2	Category 3	Category 3 (Park Homes)	Total
Wave 1	10	2	4	0	16
Wave 2	7	10	12	4	33
Wave 3	2	7	3	0	12
Targets	20	20	20	n/a	60
Total	19	18	19	4	61

Table A4: Completed household interview sample, disaggregated by wave and WHF funding category.

The interviews aimed to explore householders' subjective fuel poverty status. Subjective fuel poverty is a measure of fuel poverty using the subjective view of the household rather than the official definition, which would require an energy audit of the dwelling to establish required running costs to meet a standard heating regime. Subjective fuel poverty is used together with other indicators of fuel poverty risk, such as energy rationing, and indications of why a household may be in subjective fuel poverty.

Each interview was digitally recorded and professionally transcribed. Analysis of the transcripts was undertaken in qualitative analysis software NVivo following an inductive method, allowing key themes to emerge from the data rather than being led by predetermined lines of analysis developed by the research team. An initial sweep of analysis was undertaken to first establish the broad overarching themes. This was followed-up by one further sweep exploring more granular sub-themes in the data. The analysis presented in this report is structured around these themes (i.e. in Section 3). These themes do overlap and intersect, and this is acknowledged and commented upon where appropriate in the analysis discussion.

A3: WHF project fieldwork

In addition to household fieldwork, the evaluation undertook research with WHF projects. Primarily, this work encompassed a series of online surveys and in-depth qualitative interviews with project delivery teams. In this section, information is provided firstly on project surveys, followed by project interview progress.

Three different kinds of survey were utilised throughout the evaluation, as follows.

Firstly, a 'data gathering' survey.

This was used by the evaluation team to gather basic information about each project, including the details of key contacts and delivery timeframes. This survey was deployed twice: once in November 2019, and again in November 2020. The evaluation used responses to the survey to identify and approach WHF projects to take part in other fieldwork activities (including household fieldwork).

Secondly, a survey focusing on project experiences of delivery.

This included items on current service provision, delivery and referral systems and processes, partnerships and networks, influence of and impact on wider or related policy areas and agendas; it also investigated what are/were perceived to be the key challenges, successes, or issues with delivery, as well as attainment of intended goals and objectives. This survey was also deployed twice: once at the beginning of 2020, and again in November 2021. Aside from small additions, primarily introduced to reflect the changed context due to Covid-19, the survey was identical in both deployments. This enabled the assembly of a single project survey dataset.

The rationale for deploying the survey in this way was to ensure that projects from all rounds of WHF funding had the opportunity to complete it. The 2020 survey was administered to projects in receipt of funding through Rounds 1, 2, and 3 of the WHF,[54] and the 2021 survey was deployed to projects in receipt of funding through Rounds 4 and 5 of the WHF (including Park Homes).

Consequently, 37 responses were received in the first deployment, and 17 in the second deployment, resulting in a single dataset of 54 responses from across the lifespan of the WHF. Figure A2 below shows the geographical distribution of projects that responded to the surveys; responses were garnered from projects active in all regions and nations of Great Britain, with the most responses from projects working in Yorkshire and the Humber.

54. At the time of first deployment of the survey, projects funded under Round 4 had just been informed of their successful applications. The second deployment therefore also included projects funded under Round 4, to obtain their perspectives after delivery had commenced.

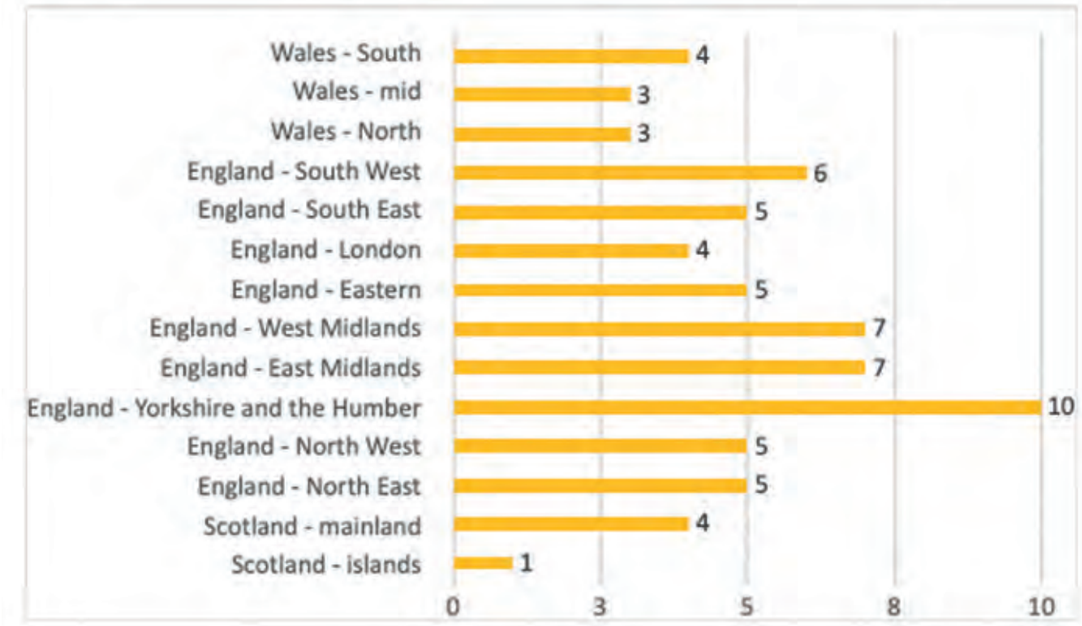

Figure A2: Geographical distribution of projects responding to the surveys (n=52).[55]

In addition, Figure A3 below shows that responses were received from projects covering all four categories of WHF funding.

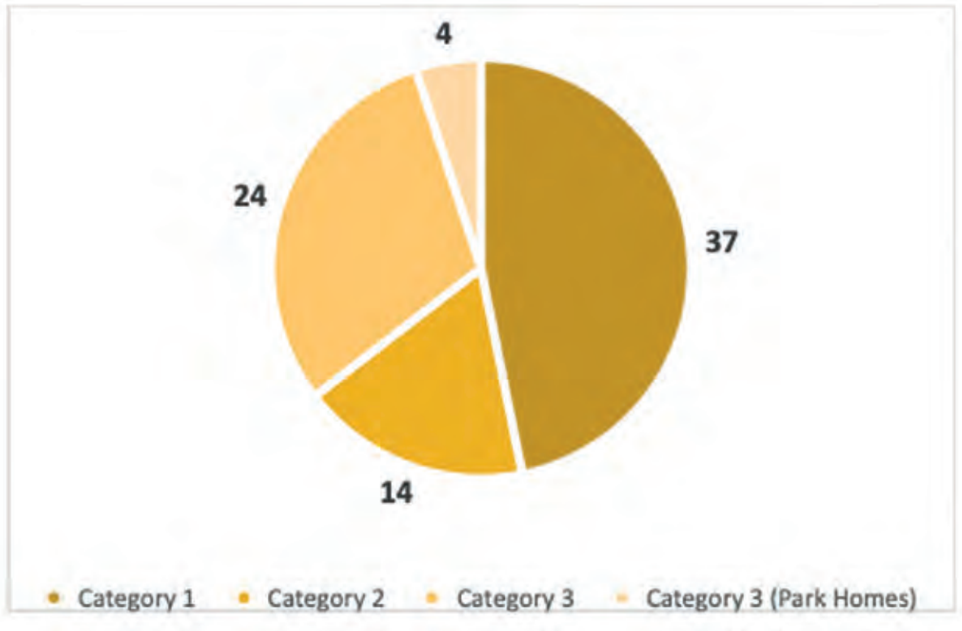

Figure A3: Categories of funding received by survey respondents (n=54)..[56]

55. Note that although 54 responses to the survey were obtained, two respondents submitted a separate response to the first survey for each of two categories of funding they were in receipt of. Consequently, their responses to questions on geographical area are not double-counted in this figure. Also note that because several projects were/are active in more than one geographical area, responses amount to more than 52.

56. Note that because several projects were/are in receipt of multiple categories of funding, responses amount to more than 54.

Thirdly, a survey focusing on project perspectives on the future of fuel poverty and energy efficiency schemes.

This was deployed in November 2022. This survey aimed to test some of the themes and ideas that, through other research activities, the evaluation had identified as important to the design and delivery of such schemes in the future. Projects were asked for their views on topics related to funding and finance; interventions and technologies; eligibility criteria and targeting methods; the measurement of impacts, outputs and outcomes; and finally, relationship-building and partnership-working. This survey was responded to by representatives of 48 projects, and was used primarily to inform the content of the blueprint (published separately to this document). To enable projects to freely give their views on topics that are contested (e.g. the continuing inclusion of first-time gas central heating systems in fuel poverty schemes), no detailed information was gathered about the identities and locations of project respondents.

In addition to the surveys, in order to explore the experiences of WHF projects in more detail, the evaluation conducted a series of semi-structured interviews with project delivery teams. Table A4 shows the interviews that were undertaken across the evaluation.

Total number of interviews completed	**48**
Category 1 projects	**35**
Category 2 projects	**17**
Category 3 projects	**19**
Category 3 (Park Homes) projects	**3**
Total number of projects covered in the interviews	**74**
Total number of project personnel interviewed	**82**

Table A5: WHF project interviews sample.

Table A4 shows that although 48 interviews with projects took place, 74 projects have been discussed in the interviews. This is because several projects interviewed were in receipt of multiple categories of funding and were delivering their projects in an integrated way (e.g. as part of one service offered to households).

To conduct the analysis, project survey responses were cleaned and analysed in SPSS. Interviews with project personnel were audio recorded and professionally transcribed, and analysed in qualitative analysis software NVivo. All quotations and evidence presented in the main body of this report, from survey and interview research, are anonymised to protect the confidentiality of respondents and interviewees.

Lastly, the evaluation worked with 10 WHF projects to produce **detailed holistic case studies**. The case studies bring together and synthesise the research findings from all elements of the evaluation, and allow the reader to gain a detailed understanding of the projects' delivery, operations and impact. They were developed over the lifetime of the evaluation, drawing on an annual synthesis of findings and insights. The case studies particularly focus on good or innovative practice across the entire WHF programme.

A4: Indoor environmental monitoring fieldwork

NEA's Innovation and Technical Evaluation team worked with project partners to collect indoor environmental monitoring data from homes that had received interventions. With the assistance of project partners, data loggers were deployed to collect temperature, relative humidity and carbon monoxide data from properties benefitting from interventions supported through the WHF. The purpose of this monitoring was to complement the wider WHF programme evaluation and assess the impact of interventions on internal living conditions and other risk factors. These factors are associated with fuel poverty risk or poor energy efficiency – for example, high humidity can lead to mould growth and increased indoor pollutants, which can affect or trigger respiratory conditions or damage building fabric or interior fittings, and cause additional maintenance and household expenditure for treatment and/or repair work.[57]

Monitoring was undertaken using temperature and humidity, and CO Lascar[58] data loggers. To gather temperature and humidity data, two loggers were deployed to the monitored households via project partners: one in the primary living area (typically the living room), and another in a secondary living area (typically a bedroom). For carbon monoxide monitoring (Category 1 households only), a single carbon monoxide sensitive data logger was supplied, to be situated appropriately. In total, 192 loggers were supplied to be installed into people's homes through 2020 and 2021.

The loggers were collected by project partners and returned to NEA in spring and summer 2022. The data gathered, along with the installation date of the intervention, gives an opportunity to monitor the temperature, relative humidity and carbon monoxide levels before and after the heating change. House-hold heating requirement varies throughout the year, so in order to compare pre- and post-intervention, a period of time with similar heating need is required to conduct a fair comparison of how to the two heating systems performed.

Heating Degree Days are an accepted measure of how much (in degrees), and for how long (in days), the outside air temperature was below a certain level, where it is accepted that in-house heating is necessary. They are commonly used in calculations relating to the energy consumption required to heat buildings. An external temperature of 15.5˚C is the commonly used base temperature below which heating is normally required inside a building, and above which no heating is normally needed. Degree days are a measure of a building's heating demand relative to the external weather i.e. the number of degrees below 15.5˚C that the average temperature falls, for each day. For example, if the average outside temperature is 14.5˚C, this is recorded as 1 degree-day. Using the locally appropriate weather data,[59] a similar heating period pre- and post-intervention was selected for comparison. Temperatures of homes in the evening between 6pm and 9pm were selected for comparison, as well as 24-hour average temperatures. The results are integrated where appropriate throughout this report.

In addition to the environmental monitoring analysis integrated in this report, a separate briefing report has been prepared by the evaluation team, featuring the results of the environmental monitoring analysis in one narrative.

A5: Energy modelling methods

The energy modelling methodology is broadly similar to that reported in the second interim report. However, as the definition of fuel poverty used in England has changed from LIHC to LILEE, the modelling process has been updated to use the new criteria.

The LILEE definition of fuel poverty states that the occupants of a home shall be deemed to be fuel poor if the following criteria are satisfied:

a. The SAP rating of the home is in band D or worse;[60]

b. If by paying the required running costs, the income of the occupants would be below the poverty line.[61]

LILEE is similar to LIHC, which assessed the fuel poverty status of a home by assigning it to one of four classifications: Low Income High Cost (LIHC), Low Income Low Cost (LILC), High Income High Cost (HIHC), and High Income Low Cost (HILC). LILEE classifies the households in an analogous way: Low Income Low Energy Efficiency (LILEE), Low Income High Energy Efficiency (LIHEE), High Income Low Energy Efficiency (HILEE), and High Income High Energy Efficiency (HIHEE).

The main difference is that the running cost standard has been replaced with a SAP-based one. This is advantageous in one important respect: assessment of the fuel poverty status against the (mostly) fixed SAP scale means that outcomes can be measured absolutely, and do not affect the outcomes of other households. This was not the case with LIHC, where the running cost was compared against the national median, leading to a slightly strange situation: if the most fuel-poor 10% of all homes were improved, the national median would improve; this could push homes that were not previously regarded as fuel poor into fuel poverty. By contrast, if a home's SAP band is improved from D to C, it can never be fuel poor under LILEE, and this has no effect on the assessment of another home's fuel poverty status.

Consequently, in order to model the fuel poverty status, the two most important parameters to identify are the SAP band and the household income. To obtain them, the household incomes were estimated from the eligibility criteria of the WHF, whilst the SAP bands were modelled by analysis and conversion of the Energy Performance Certificate (EPC) data, collected as part of the project recipient's reporting requirements. The two datasets were then combined in EAC's UNO database system, which contains a dedicated module for performing the calculations required to assess fuel poverty status.

Regarding the data utilised to assemble the final dataset, the two most important datasets were the project returns data supplied by the WHF, and bulk EPC data, which is available from Open Data Communities – this is a repository of publicly accessible data, and is administered by the Department for Levelling Up, Housing and Communities (DLUHC).[62] The returns data consists of information that the project recipients are contractually obligated to return to AWS; most importantly for the purposes of modelling, this includes the approximate address of the beneficiary households, the eligibility route, what measures were installed in the home, and the approximate ages of the residents.

Every property that undergoes an EPC survey has this data lodged with one of the UK's accreditation schemes, which then passes on a summary of that data to MHCLG/DLUHC. This information is then published on Open Data Communities and is available to be downloaded for the purposes of research. Although it does not comprise a complete collection of the survey data, there is enough to model a running cost. For example, an EPC surveyor will record the exact model of a boiler, while the bulk data only records that a boiler is present and 'stars' it according to its efficiency.[63] In order to obtain the EPC data of the beneficiary households, their postcodes were taken from the returns data, and then the EPC data for these postcodes was downloaded from Open Data Communities. The partial address data from the returns was then address-matched by software to the downloaded set, in order to produce the final EPC dataset. Overall, 15,690 properties were included in this final dataset. As the total amount of properties improved by the WHF is 27,239, this constitutes a sample of 58% of properties.

Each of the 15,690 properties entered the WHF through a specific eligibility route which enables the data conversion process. At the beginning of the WHF there were four such routes, as shown in Table A5 below.

57. Children's Society and NEA (2015) Making a House a Home. Research for National Grid Affordable Warmth Solutions.

58. Logger specifications and information can be found here.

59. See www.degreedays.net/#generate.

60. LILEE uses FPEER (Fuel Poverty Energy Efficiency Rating), which is the same as the SAP rating except that the Warm Home Discount is considered when calculating the energy costs of the home. As there is no information on whether householders are in receipt of the WHD, the FPEER has been treated as being the same as SAP – an approach used by housing stock managers across the country when assessing their fuel poverty targets.

61. Defined as 60% of the national median income.

62. See https://opendatacommunities.org/home. The repository is still noted on the website as being administered by the Ministry for Housing, Communities and Local Government (MHCLG), which has now been renamed as the DLUHC.

63. In an EPC, each aspect of the energy efficiency of a home, such as the heating system, is rated on a scale running from 1 to 5 stars.

Eligibility Route	Description
Affordable warmth benefits	One or more of the occupants is in receipt of a means-tested benefit
ECO flex	Qualifies for assistance through meeting the local authority's flexible eligibility criteria
Fuel poverty	Has had a fuel poverty assessment carried out
IMD	The household is located in a Lower Super Output Area which is in the top 25% of most deprived areas in the country

Table A6: Possible eligibility routes for beneficiary homes.

For each route, an income figure was assigned. The 'Affordable warmth benefits' and 'Fuel poverty' routes were the most straightforward. Occupants in receipt of benefits are already highly likely to meet the low income requirement of fuel poverty, as are households that have already been assessed as fuel poor; and so a suitably low income figure was chosen (£9,000) for these two routes. For ECO Flex, each local authority is required to publish its criteria for households to be eligible for assistance, one of which is based on household income. Where a household qualified through this route, the income was taken from the definition of low income used in the corresponding authority's criteria. This led to a large range of income figures amongst this group.

The final eligibility route was the IMD one. As the IMD is not based on income, there was no way to directly estimate the income based on this information alone. For these examples it was decided to use the 'Whether on Benefits?' field in the project returns data. It is unknown whether the benefits the occupants receive refer to means-tested ones or are largely unrelated to income, such as child benefit. However, in the absence of any other data, it was assumed that benefits were means-tested. Households that qualified through the IMD route and were in receipt of benefits were therefore assumed to have a low income, for which an amount of £9,000 was again used. Where they qualified through IMD but were not in receipt of benefits, the national median income was used (£21,333).

To complete the conversion process, the physical data for the recipient homes (age, size, wall type, roof type, glazing type, insulation levels, and heating system) was taken from EPC information and converted into a format suitable for use in UNO. UNO uses a modified RdSAP (Reduced data SAP) dataset to calculate four important quantities: SAP rating, annual carbon emissions, annual running costs, and fuel poverty status. The SAP calculation follows the current SAP v9.4 methodology, while the unmodified running costs and carbon emissions are calculated in the same broad way, but take account of regional factors that are relevant to the dwelling, such as external temperatures and solar irradiance. The running costs are calculated from the energy usage by applying a standing charge and unit cost (pence/kWh) to them, for applicable fuels. For this analysis, the fuel prices were taken from the prices quoted in the January 2022 version of the Product Characteristics Definitions File (PCDF), which is normally used to calculate the running costs displayed on EPCs, and represents an average of the previous year's national fuel prices.

The calculation of the fuel poverty status then follows the same methodology used by BRE in its production of the national fuel poverty statistics, by modifying the running costs calculation according to occupancy and combining it with the income figure, to produce an after-running-costs income. The SAP rating and income are then combined to produce an assessment of the fuel poverty status. The fuel poverty gap is also calculated where the household is fuel poor.

The figures below show the results of undertaking this process for a single home.

Figure A4: Physical data for a beneficiary home.

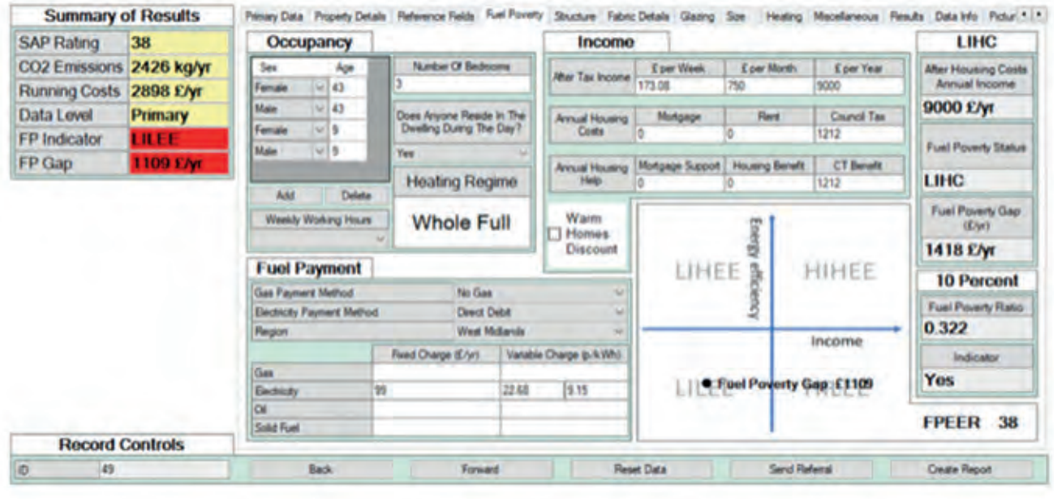

Figure A5: Fuel poverty analysis module for the same beneficiary home.

Having constructed a database containing the fuel poverty status, running costs, SAP rating and carbon emissions of 15,690 beneficiary homes, the next step was to calculate the effects of installing the new heating systems, and also (where applicable) any other improvement measures. Both items of information were taken from the project returns data and then incorporated into a new database file. The results were then re-calculated, allowing a before and after set of results to be calculated, as again illustrated in the following figures.

Figure A6: Physical data for the same beneficiary home as before, after the installation of a gas boiler.

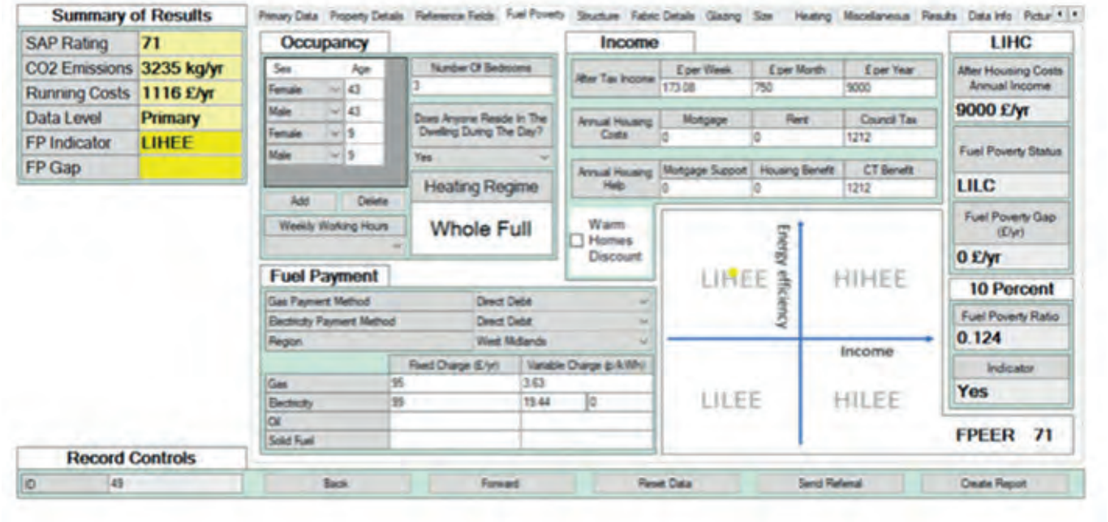

Figure A7: Fuel poverty module for the same beneficiary home as before.

A6: Economic modelling methods

The approach to the economic impact analysis begins by considering the £150mn investment in energy interventions by National Grid. This created two wider effects in the UK economy.

The first effect was a transfer of £150mn from National Grid into the construction, housing and installer sector, and the support services sector; this was split into £132m and £18m for the respective sectors. This simultaneously created boosted income for these industries (in the form of grants) while creating a reduction in surplus held by National Grid. These direct effects are immediate and equal in both 'accounts'. However, the two sides of this effect both have multiplier effects which are not equal – positive in the case of construction and installer activity, and negative for reduced e-investment and spending of surplus (profit).[64] This transfer is likely to create a net positive effect on the economy, because the ONS multiplier coefficient of the construction sector, and thus its associated effect, is extremely high, given that there is a relatively high level of re-spending in this part of the economy. On the other hand, the reduction of money held by National Grid will have had a negative effect in the wider economy, but this is expected to have been smaller, as the money would have been far less likely to be re-spent in the economy, and a greater proportion of it would leave circulation due to capital formation and taxation.

This approach is based on the common practice, in economic impact assessment, of calculating a multiplier coefficient on the basis of the 'marginal propensity to consume' (MPC), which itself is defined as demand less tax, savings and imports (the three main ways in which money leaves the circulating economy).

The second effect is that an annual reduction in the flow of money from low-income households to energy companies is taking place because of the measures funded by the WHF. This is due to the after-rebound reductions in energy demand resulting from the interventions as modelled by EAC. We apply a modest rebound coefficient of 0.75, based on a review of the literature.[65] As with the first effect, the two sides of this second effect both have multiplier effects – positive in the case of households, and negative for energy providers. These effects have been modelled through two rounds of re-spending, as follows:

- The initial re-spending effects throughout the economy using re-spending coefficients published by Strathclyde University – used here because the data is relatively recent, and entirely based on data, rather than modelling and splitting house holds into income quintiles. This allows us to observe the distinctive effect of targeting these interventions at low-income households.

- The additional economic multiplier effects of the re-spending effects throughout the economy, using published ONS demand multiplier coefficients for each sector.

With the approach set out, the methodology for modelling the economic impacts of the WHF can be explained. As noted above, economic impacts are often modelled using multiplier coefficients. The idea of a 'multiplier' is that because money circulates throughout the economy, and one person's takings or wages are re-spent and become the next person's income, and so on, demand grows considerably beyond an initial boost to income.

This process of re-spending would theoretically continue for ever, but at each stage (each round) the amount of money still in circulation is reduced, to the extent that money leaves the circulating economy through imports (it leaves the geographic boundary of the economy being studied, in this case the UK), savings, and taxation. The remaining money is passed along the chain, and this continues until there is next to nothing of the initial boost left. The rate at which this leakage occurs depends on the balance between consumption and leakage at each stage. This is referred to as the MPC, and of course it varies considerably, for many reasons. Hence, the more specific we can be in applying MPC coefficients to the data, the less likely we are to introduce uncertainty. The approach taken here has utilised the most recently produced sector-specific multiplier

64. For the positive multiplier applied to the £150mn grant funding, we use the ONS construction sector multiplier as it includes the majority of works carried out.

65. See Barker, T., Ekins, P. and Foxon, T. (2007) The macro-economic rebound effect and the UK economy, Energy Policy 35 (10): 4935–4946; Sorrell, S., Dimitropoulos, J. and Sommerville, M. (2009) Empirical estimates of the direct rebound effect: A review, Energy Policy 37 (4): 1356–1371; Gillingham, K., Kotchen, M.J., Rapson, D.S. and Wagner, G. (2013) The rebound effect is overplayed, Nature 493 (7433): 475–476.

coefficients for all sectors of the UK economy,[66] and uses a social accounting matrix which disaggregates households on the basis of income.[67]

Importantly, although multiplier analysis is often used to model the effects of investment in an economy from outside that economy (such as in the case of national government investing in a locality), this is not the case here. The WHF grants have not come from beyond the UK economy, but they represent a transfer within it. As a result, while we can model and summarise the very considerable economic impacts of the funding, when producing aggregate summaries of its wider economic effects, we should consider not only the positive boosts in demand that it creates, but also that there are opposite and (initially) equal effects too. The investment of £150mn by National Grid is a transfer of money from itself to the construction, housing installer sector and the support services sector, not a foreign investment or a central government demand stimulus. Similarly, the reduced running costs created by the measures are reductions in flows of money from households to energy firms, meaning that there are effects on both sides. In this situation the initial direct effects cancel each other out at a macro-economic level. They differ in two important ways, however:

- They produce starkly different distributions of demand across different sectors within the economy;
- The subsequent re-spending seen in these sectors is also different, and leads not only to further amplified differences between winners and losers, but also to different multiplier effects, and hence different effects on aggregate demand.

In summary, what begins as two equal but opposite effects leads to two totally independent and simultaneous processes of boosted and reduced (re-)spending. This is true of what we refer to here as 'effect one' (the impacts of the capital expenditure) and 'effect two' (the impacts of the measures on energy bills).

The next step in the process was to model the likely re-spending of household income, and the reductions in spending by energy firms. We employed a social accounting matrix (SAM); this is a special kind of table (a matrix) which provides summary data on flows of money between actors in a specific economy. A SAM is always geographically bounded, and typically specifies the flows between firms, households and governments within the economy, as well as flows to and from the 'rest of the world'. These flows are shown in a SAM using pathways such as capital formation, labour payments, gross surplus, taxation, spending, and so on. They require considerable time and expertise to develop and are typically produced for national accounts. They will also often disaggregate the main categories of actors listed above into sub-categories based on a combination of local convention, the availability of data, and the interests of the analyst.

The SAM chosen for use in this analysis was produced by researchers at Strathclyde University and is a SAM for Scotland based on data from 2013.[68] It was chosen for two reasons. Firstly, although 2013 may seem a long time ago now, producing accurate social accounting matrices is extremely time-consuming, and this one, published in 2019, remains recent in comparison to other available data. The fact that it is a Scottish SAM should not be a significant concern as, with the exception of London and Aberdeen, the Scottish economy is comparable to the wider UK economy. These points aside, the most compelling reason for using this SAM for this exercise was that it remains the only British SAM that disaggregates households into income groups, which enables analysis to be attuned to the low-income households targeted by the WHF.

The SAM provides real spending data in £s, which was used to create a matrix of spending coefficients; this formed the basis for determining the distribution of the re-spending in the first round of economic effects. Beyond the initial first round of re-spending, it was important to model the subsequent rounds. As outlined above, this re-spending will continue indefinitely; thus, it is common practice to use multiplier coefficients to summarise the rate at which the re-spending diminishes through each round, and hence the ultimate size of the effect. For this part of the analysis we matched the demand multipliers published by the ONS for each sector of the economy to the disaggregated sectors in the SAM, in order to estimate the final value of re-spending.[69] This disaggregated approach was important for capturing both the size and the shape of the effects, and enabled a summary of which sectors would see the greatest increases in demand; this insight was used to explain and build intuitive confidence in the findings.

66. ONS (2021) UK input-output analytical tables.

67. Katris, A., Figus, G. and Greig, A. (2019) The 2013 Social Accounting Matrix for Scotland disaggregated by household income quintiles.

68. Katris, A., Figus, G. and Greig, A. (2019) The 2013 Social Accounting Matrix for Scotland disaggregated by household income quintiles.

69. ONS (2021) UK input-output analytical tables.

A7: Health modelling methods

To estimate the health impacts, avoided NHS costs, and wider societal benefits of the measures funded by the WHF, the evaluation team have used BRE's HHCC, which is based on a risk-based approach to health and a series of costs that are associated with given risks. The risk considered in our evaluation work is excess cold, which is known to be present in homes that lack an adequate heating system, or which have a very low SAP rating. The risk-based approach used by the BRE's tool, and which we have employed, is based on the likelihood of excess cold leading to ill-health, and how this likelihood changes when measures such as those funded by the WHF are undertaken.

The range of harms caused by excess cold are described as follows:

"Cardiovascular conditions (e.g. heart attacks and stroke) account for half the excess winter deaths, and respiratory diseases (e.g. influenza, pneumonia and bronchitis) account for another third. The increase in deaths from heart attacks occurs about 2 days following the onset of a cold spell, the delay is about 5 days for deaths from stroke, and about 12 days for respiratory deaths." [70]

Guidance on estimating the likelihood of excess cold resulting in harm is provided by the government's Operating Guidance document.[71] In it, the likelihood of excess cold leading to harm is shown to be 1 in 380 for the typical UK household, and the typical spread of harms in four classes of severity are given. The guidance is explicit in stating that risk likelihood requires judgement and estimation, and where guidance is offered for assessing excess cold, the SAP rating of a property is identified as an appropriate point of reference, because simple measures of indoor temperature are inadequate.[72]

With this in mind, the evaluation team's approach was SAP-based (i.e. based on EPC bands) and considered an EPC band of C to be a carry a normal level of risk, with higher EPC bands being associated with lower risk of excess cold, and lower EPC bands carrying higher risks. The HHSRS[73] does not require specific likelihood estimations; instead it uses risk 'scale points', each referring to a range of likelihoods, as shown in Figure A8:

70. UK Government (2006) Housing Health and Safety Rating System Operating Guidance, p.57.

71. UK Government (2006) Housing Health and Safety Rating System Operating Guidance.

72. UK Government (2006) Housing Health and Safety Rating System Operating Guidance, p.62.

73. UK Government (2006) Housing Health and Safety Rating System Operating Guidance, p.19.

BOX 3

HHSRS Standard Range of Likelihoods –

			Representative Scale Point
Less likely than		1 in 4,200	1 in 5,600
1 in 4,200	to	1 in 2,400	3,200
2,400	to	1,300	1,800
1,300	to	750	1,000
750	to	420	560
420	to	240	320
240	to	130	180
130	to	75	100
75	to	42	56
42	to	24	32
24	to	13	18
13	to	7.5	10
7.5	to	4	6
4	to	2.5	3
2.5	to	1.5	2
More likely than		1 in 1.5	1

The inspector judges the range for the likelihood. The HHSRS Hazard Formula uses scale points to represent that range.

Figure A8: Reproduction of the standard HHSRS range of likelihoods for hazards, and representative scale points of those ranges that are used in the hazard rating formula.

Because, as explained above, the typical UK home has a likelihood of excess cold of 1 in 380, it would fall into scale point 320. From this point of reference we can make the following estimations of risk, which lead to risk ratings in column three of Table A6 below.

It should be noted that unlike EPC band ratings, a category A risk is the worst rating possible, and a risk rating of E is a 'better' rating, because it is rating a risk not a benefit. These risk levels are produced by the BRE's Housing Health Cost Calculator.

SAP/EPC Band	HHRRS Scale Point	Equivalent Health Risk Rating
A	1000	E
B	560	D
C	320	C
D	180	C
E	100	B
F	56	A
G	32	A

Table A6: Estimates of HSSRS risk ratings and their relation to SAP/EPC bands.

Using the BRE's HHCC, it is possible to produce property-specific risk ratings based on this conversion of EPC bands into risk scale points. The evaluation team have done this for each property, converting its **EPC band transition** before and after the interventions into an **excess cold risk transition**. This produces the likely NHS costs before and after the measures, and thus enables a comparison of these, and reveals the resulting NHS savings per annum.

The HHCC also quantifies the wider societal costs per annum of the health improvements over and above the NHS cost savings. These wider societal cost savings refer to costs that fall outside the NHS, some of which are quantifiable, and others are not. The wider societal costs are estimated to be up to ten times greater than the NHS costs, and are calculated using the BRE HHCC, which adopts a methodology based on the way transport costs in society are quantified by the Transport Research Laboratory and the Royal Society for the Prevention of Accidents (RoSPA).[74] Examples of wider societal costs are:[75]

- Reduction in cost to the emergency services, following a home health incident
- Wellbeing and mental health benefits
- A reduction in direct care, aftercare and assistance
- Improved education and productivity
- Increased asset value of property
- Improved rental income of property
- Saved costs of future retrofitting
- Reduction in cost of future interventions, including those of charities
- Increased social capital
- Local job opportunities and tax revenues

The evaluation team's approach has been to apply the tools and guidance for estimating risk likelihood provided by the government and BRE to all households pre- and post-intervention. This has enabled the establishment of a risk transition for all households who have had a EPC band transition. This includes those who were already at EPC band C, and have moved to A or B, because even though these households were not officially in fuel poverty (using the LILEE definition), the property is now less likely to pose a risk of excess cold, and thus the expected NHS and wider societal costs are quantifiably lower. Similarly, properties that have made EPC band transitions from E, F or G up to EPC band D may remain in fuel poverty, but they are also less likely to pose a risk of excess cold, and thus the expected costs to the NHS and wider society are lower.

74. Walter, L.K. (2010) Re-valuation of home accidents. TRL Published Project Report PPR483.

75. BRE (2021) BRE report finds poor housing is costing NHS £1.4bn a year.

A8: Socio-spatial analysis methods

The following methods were used to conduct socio-spatial analysis on outputs of the energy modelling data. Typically, data is aggregated to the Local Authority District (LAD) scale in the analysis. Aggregation ensures that individual households that received an improvement cannot be identified in parts of Great Britain (GB) where a low number of households were part of the programme. This is especially important given that potentially sensitive characteristics such as income are modelled as part of the evaluation. When calculating averages, median values are used to mitigate the impact of outlier (very high) values on the results. For each variable, the median and total value for properties in a LAD were mapped.

The LAD boundaries for GB are downloaded from the Open Geography Portal and were correct as of May 2021.[76] The boundaries were downloaded at full resolution and clipped to the coastline. Out of the 363 LADs in GB, 62 do not contain any properties that received an improvement, considered as part of the evaluation of the Warm Homes Fund programme. These LADs are represented in white shading on the maps throughout this report. As a result of some LADs not having data, absolute rather than relative classifications are used when mapping.

At times, Degree Day Regions were also used to disaggregate properties. There are 18 Degree Day Regions in the UK, which reflect the role of the external temperature in shaping energy use, particularly in buildings, or for heating energy use.

The analysis was carried out in RStudio, using a range of packages including tmap, sf, ggsankey, ggpubr, tidyverse, dplyr, and ggplot2. The code to replicate the analysis and outputs presented here can be openly accessed via the GitHub repo: https://github.com/CaitHRobinson/warm-homes-fund/ (currently private until the report is published). This repository does not contain any of the raw data underpinning the analysis, which is not publicly available.

In addition to the spatial analysis integrated in this report, a separate briefing report has been prepared by the evaluation team, featuring the results of the spatial analysis in one narrative.

A9: Fieldwork with Affordable Warmth Solutions

Lastly, two focus groups were undertaken with senior representatives and programme managers from AWS. The first focus group was conducted in summer 2021, and focused on the design and delivery of the WHF. The second focus group took place in summer 2022, and focused on key themes and topics included in the programme blueprint. Both focus groups were audio recorded and professionally transcribed. Although they are not quoted from directly in this report or in any evaluation outputs, the contents of these focus groups have informed the report and the accompanying programme blueprint.

76. ONS (2021) Local Authority Districts (May 2021) UK BFC.

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