Technical Annex: Summary of Analysis in the Fuel Poverty Strategy Call for Evidence

Contents

1. Introduction

This annex outlines the assumptions behind the analysis in the Fuel Poverty Strategy Call for Evidence. This includes the projection the impacts from polices and natural replacements on fuel poverty. It also outlines the assumptions behind charts in the 'Defining Reasonably Practicable' section. This shows the distributions of households brought out of fuel poverty with energy efficiency measures under different cost caps or cost effectiveness levels.

Section 2 of this annex sets out the methodology and key assumptions used to estimate these charts. Section 3 details the monetised and non-monetised costs and benefits considered. Section 4 includes analysis investigating the reasonably practicable considerations and Benefit Cost Ratio (BCR) distributions across EER bands and tenure types. Section 5 outlines the risks of the analysis and Section 6 discusses the impact of bringing households with protected characteristics out of fuel poverty.

2. Analytical Approach

This section of the document outlines how the scenarios were appraised. All appraisal has been estimated in line with HMT Green Book and supplementary guidance[1].

2.1 Counterfactual

There were 3,174,000 households estimated to be in fuel poverty in 2023[2]. It is estimated that 264,000 homes will be brought to EER Band C from energy efficiency policies in progress under the previous government and by natural replacements. This would leave 2.9 million households in fuel poverty as outlined in Table 1 below:

Table 1: Estimated Impact of Existing Policies on Fuel Poverty (2024-2030)*

Policy	Households
Social Housing Decarbonisation Fund (SHDF) Wave 2	31,000
Homes Upgrade Grant (HUG) 2	1,000
Energy Company Obligation (ECO) 4	50,000
Great British Insulation Scheme (GBIS)	12,000
Natural Replacements	170,000
Total	**264,000**
Remaining in 2030	**2,910,000**

**These policy impacts are additional to the impact of Warm Home Discount (WHD) which brought 248,000 households out of fuel poverty in 2023.*

Of the 264,000 fuel poor homes expected to reach EER Band C by 2030, 90,000 come from policies in place under the previous government between 2024 and 2030. Government is taking decisive action to bring more households out of fuel poverty with policies such as the Social Rented Sector and Private Rented Sector Minimum Energy Efficiency Standards (PRS and SRS MEES)[3] that aims to take over 1 million

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[1] https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government

[2] *Annual fuel poverty statistics report: 2024 (2022 and 2023 data).* Available at: https://www.gov.uk/government/statistics/annual-fuel-poverty-statistics-report-2024.

[3] *Home upgrade revolution as renters set for warmer homes and cheaper bills.* Available at: https://www.gov.uk/government/news/home-upgrade-revolution-as-renters-set-for-warmer-homes-and-cheaper-bills

households out of fuel poverty[4], and the Warm Homes: Social Housing Fund (WH:SHF) and Warm Homes: Local Grant (WH:LG) that are projected to upgrade up to 69,000 households in 2025 to 2026[5]. These policies have not been included in projections as their impacts on fuel poverty are being further analysed and consultations for are upcoming for the regulations to seek stakeholder views.

The number of homes in scope is also reduced by 170,000 households reaching EER Band C following the natural replacement of certain measures. For households in all tenure types, this includes:

- That any existing lights that are not energy efficient Light Emitting Diodes (LEDs) will be replaced with LED equivalents at the end of their lifetime. Replacement of existing lighting with low energy lighting is taken from the modelling underpinning Ecodesign requirements for lighting products[6].

For homes in the Private Rented Sector (PRS) and in Social Housing (SH), only:

- Existing boilers are replaced with Ecodesign compliant condensing boilers as they reach the end of their lifetimes.
- When boilers are replaced, landlords or homeowners install appropriate heating controls as required by Building Regulations.

The differences between tenure types are based on the assumption that fuel poor Owner Occupiers (OO) are less likely than PRS or SH landlords to be able to replace their boilers. It is also assumed there are no other measures that would be privately installed without government support schemes or regulations. This is assumed because households in fuel poverty are less likely to be able to afford, or be able to borrow to afford, major energy efficiency measures.

This leaves an estimated 2,910,000 households remaining in fuel poverty that are in scope for further support after the counterfactual has been considered. This figure is assumed to remain constant without further government support. However, in reality it could be altered by a range of other factors, some of which the government is not in direct control of. These include changes to people's income, whether the move home, and their housing costs. These are assumed to stay constant throughout the appraisal period for simplicity throughout the modelling. Further details on this are outlined in Section 5.3.

[4] This preliminary estimate used assumptions from the government's preferred position in the 2020 consultation and will be refined further in the forthcoming consultations.
Improving the energy performance of privately rented homes (2020). Available at: https://www.gov.uk/government/consultations/improving-the-energy-performance-of-privately-rented-homes

[5] *Help to save households money and deliver cleaner heat to homes*. Available at: https://www.gov.uk/government/news/help-to-save-households-money-and-deliver-cleaner-heat-to-homes

[6] Regulation guidance on Ecodesign of energy-consuming products, available here: https://www.gov.uk/guidance/placing-energy-related-products-on-the-uk-market

2.2 Deployment of Measures

All the outputs from this analysis are derived from modelling all remaining low-income[7] households to EER C after the impacts of policies and have been accounted for. This is done with energy efficiency measures where households have the technical potential to do so. An even distribution of installations per year is assumed between 2024-30. Once installed measures have reached the end of their lifetime, they are assumed to no longer accrue any benefits. Table 2 below shows the assumed lifetime of measures.

Table 2: Assumed Measure Lifetimes[8]

Energy performance improvement measure	Lifetime (years)
Loft insulation	42
Cavity Wall Insulation	42
Solid Wall Insulation (external)	36
Floor insulation	42
Draught-proofing	10
First Time Central Heating	42
Boilers	12
Air source heat pump	20
Heating Controls	12
Hot Water Cylinder Insulation	10
Hot Water Thermostat	12
Low energy lighting	10
Double glazing	20
Solar PV	30

2.3 National Buildings Model

The National Buildings Model (NBM)[9] has been used to model the costs and benefits of bringing households out of fuel poverty with energy efficiency measures. These costs and benefits form the Benefit Cost Ratios (BCRs) in Section 4. The NBM is a discrete event simulation model. It allows the user to model the impacts of installing various combinations of measures to the housing stock and placing different

[7] A household is considered low-income under the Low Income Low Energy Efficiency (LILEE) measure of fuel poverty if its After Housing Costs (AHC) are below 60% of the median.
[8] The assumptions on measures lifetimes are drawn from the latest Ofgem publication on ECO3 Measures table: https://www.ofgem.gov.uk/publications/eco3-measures-table.
The measure lifetime assumption is consistent with assumptions in other schemes, including ECO4.
[9] The NBM was listed as one of BEIS's business critical models in 2022.

restrictions to the homes and measures selected. For example, it could model the costs and energy benefits from installing double glazing to all homes in the social housing sector where technically possible.

The model uses the 2016/17 and 2017/18 English Housing Survey (EHS)[10], a survey of 13,000 face-to-face interviews and 12,320 physical surveys of households in England. It is weighted to represent the different types of homes in England and has had modelled changes to align it to the 2023 housing stock as it was not possible to use the latest EHS data within the NBM. The estimated impacts exclusively cover England.

The NBM uses a SAP (Standard Assessment Procedure) calculator to estimate the energy demand of a dwelling before and after a measure is installed. SAP can overestimate real world energy savings from energy efficiency measures since, as a benchmarking tool, SAP assumes the same internal temperature and heating pattern in all dwellings. Less efficient homes are often heated less, resulting in a lower real world energy demand and therefore lower energy savings. Households living in poorly insulated homes are also likely to underheat their home to save on fuel bills and subsequently increase their heating when measures are installed to improve their thermal comfort. This is known as comfort taking. The inputs commonly assumed in SAP also reflect theoretical/standardised measure performance whereas measures may not perform as well.

To account for these drawbacks from SAP, the energy calculations have been adjusted in two ways: adjusting the starting energy demand and adjusting for comfort taking (discussed in Section 3.2). A statistical model of real-world heat demand is used to calculate the starting state of the dwelling, based on the National Energy Efficiency Data-Framework (NEED)[11]. The SAP calculator is then used to calculate theoretical heat demand saving achieved by measure installation. SAP 2012 is the version of SAP used. This is then applied to a statistical model of real-world heat demand, before a 15% saving reduction is applied to account for comfort taking[12]. The comfort taking reduction is only applied to measure installations that reduce heat demand.

It has not been possible to account for impacts from the Warm Homes Discount (WHD) in the NBM in this analysis, but the remaining homes in fuel poverty have been scaled down to reflect the 248,000 households brought out of fuel poverty from the scheme in 2023[13]. Modelling outputs therefore reflect the costs and benefits of homes reaching EER C rather than the Fuel Poverty Energy Efficiency Rating (FPEER) C. If the WHD was accounted for, the average costs and benefits are expected to be lower than those reported in this analysis.

[10] Details on the English Housing Survey (EHS) can be found here.

[11] The NEED matches gas and electricity consumption data, collected for DESNZ subnational energy consumption statistics, with information on energy efficiency measures installed in homes, from government schemes, such as the ECO and the Green Homes Grant. It also includes property attribute data and household characteristics, obtained from a range of sources.

[12] The impacts of household retrofit and domestic energy efficiency schemes: A large scale, ex post evaluation, (2015) *Energy Policy*. Phil Webber, Andy Gouldson, Niall Kerr

[13] *Annual fuel poverty statistics report: 2024 (2022 and 2023 data).* Available at: https://www.gov.uk/government/statistics/annual-fuel-poverty-statistics-report-2024.

This way of selecting measures does not always represent reality. Measures might be installed to accord with a range of preferences not modelled, such as measure aesthetics or certain household requirements. The energy efficiency of homes modelled in the NBM may also be different to real life. This means the actual costs and benefits accrued could be higher or lower and that for certain homes reaching EER Band C might not be possible where it has been modelled to be.

2.4 Equity Weighted Benefits

An equity weighting has been applied to several of the benefits. This is to reflect the difference in utility or wellbeing that households with different incomes derive from the same change to their income. For example, a household with an annual income of £10,000 would likely benefit more from an additional £100 than a household with an annual income of £100,000. Equity weighting monetises this difference in utility for different groups. This captures the positive distributional benefits of meeting the fuel poverty target.

The equity weights used are shown in Table 3 below. These were calculated in line with the distributional appraisal guidance with the HMT Green Book (2022)[14] and feature in other energy efficiency policy assessments[15]. They are used in conjunction with estimates of fuel poor households' After Housing Cost Equivalised Income decile distribution, estimated using data from the 2024 Fuel Poverty Statistics[16].

Table 3: Equity Weights using After Housing Cost Equivalised Income

Income Decile	Equity Weight
1	5.3
2	2.4
3	1.7
4	1.4
5	1.1
6	0.9
7	0.8
8	0.6
9	0.5
10	0.3
Where an income decile of 1 is the lowest and 10 is the highest. Based on the English Housing Survey 2017/18.	

[14] pp. 96-98, HM Treasury, *The Green Book* (2022), Annex A3, 'Distributional Appraisal'. Available here.

[15] The approach to equity weighting is consistent with analysis published for other DESNZ policies, such as the final impact assessments for ECO4 and the WHD.

[16] *Fuel poverty detailed tables 2024 (2023 data)*, Table 31. Available here.

Accounting for equity weighting substantially increases the scale of monetised benefits. The figures presented in Section 4 and in the main document have had equity weights applied to certain benefits (indicated in Table 4 in Section 3.1). Non-equity weighted figures are also available in Section 4 of this annex.

2.5 Optimism Bias

Optimism bias adjustments have also been applied. This is to account for the demonstrated systematic tendency for appraisers to be over-optimistic about key project parameters, including capital costs, operating costs and project durations. Therefore, installation costs estimates have been increased by 10% in all the scenarios' central estimates. Note, this is in addition to regular updates to The Department for Energy Security and Net Zero (DESNZ)'s measure cost assumptions. These are scrutinised and updated regularly, which is especially important given the recent levels of high inflation[17] which has been impacting the growth in energy efficiency measure prices.

HMT Green Book guidance on optimism bias[18] suggests that real costs for construction projects in standard buildings may be as much as 24% higher than initially estimated. The impact of adjusting for optimism bias around this level has been estimated in the 'low' sensitivity, where the cost estimates outlined above have been increased by +24%. A 'high' sensitivity has also been estimated, where no adjustments have been made to account for optimism bias. This represents a situation where the installation costs are equal to those estimated by the NBM. Details on the low, central, and high sensitivity scenarios can be found in Section 5.1.

3. Categories of Costs and Benefits

3.1 Summary of Costs and Benefits

This section estimates the costs and benefits that occur where a household is brought out of fuel poverty with energy efficiency measures. Table 4 below summarises the key costs and benefits included in the analysis.

Table 4: Summary of Costs and Benefits.

Group	Costs	Benefits

[17] Office of National Statistics (ONS) *Inflation and price indices*. Details available at: https://www.ons.gov.uk/economy/inflationandpriceindices

18 The Green Book guidance on optimism bias suggests that real costs for construction projects in standard buildings may be as much as 24% higher than initially estimated, as a result of appraisers being overly optimistic. The high sensitivity (+20%) presented here also provides an indication of the policy impact if adjusting for optimism bias around this level. Available at: https://www.gov.uk/government/publications/green-book-supplementary-guidance-optimism-bias

Monetised Impacts	• Measure installation costs (including hidden costs)	• Value of energy saved • Additional utility from lower bills in low-income households* • Carbon emission benefits • Air quality benefits • Comfort taking from installations* • Health benefits
Non-monetised Impacts	• Administrative costs • Search and targeting costs • Operational costs • Publicly Available Specifications (PAS) costs • Compliance, familiarisation, and enforcement costs	• Wider health benefits • Community benefits • Wider economic benefits • Lower energy imports • Lower costs of meeting peak energy demand

*Includes equity weighting

3.2 Description of Costs

Installation Costs (monetised)

Installation costs represent the costs to install the energy efficiency measures needed to bring households in fuel poverty to EER C. Within the NBM, measures are chosen that achieve the highest EER/SAP score per £. This means households will have measures installed that result in their home being brought to a SAP score of 69 or higher, but not below.

Considering the recent high inflationary environment, the DESNZ ensures that the measure cost assumptions used in the NBM are regularly updated and adjusted for different household archetypes. Cost estimate data was compiled in 2022 but has been adjusted to 2024 prices using the HMT Greenbook supplemental guidance GDP Deflator[19].

Data on the average costs of insulating different dwelling archetypes (e.g. Bungalow, Flat, Terrace etc) with Cavity Wall Insulation and Loft Insulation was collected from a survey of installers[20] carried out over November and December 2022. Data on installations from the 2020/21 Green Homes Grant Vouchers Scheme was also used to validate the observed proportional differences of different archetypes and were adjusted where appropriate. The Vouchers Scheme data estimated how the costs of installing cavity wall insulation or loft insulation are scaled in proportion to property size, as measured by floor area.

[19] Table 19 of the Treasury Green Book supplementary appraisal guidance. Available at: https://assets.publishing.service.gov.uk/media/6567994fcc1ec5000d8eef17/data-tables-1-19.xlsx

[20] The survey of installers was carried out by Cambridge Architectural Research on behalf of BEIS (now DESNZ). Telephone interviews were carried out with 18 Cavity Wall Insulation (installers and 17 loft insulation installers from all parts of England, Scotland and Wales. The installer companies that took part in the survey ranged in scale, from 3 to 75 members of staff.

It is assumed that real costs will be constant over time for certain measures and fall for other measures. This is because there are likely to be costs reductions from projected technological improvements or increased competition in product markets. nascent measures, such as air source heat pumps. For example, measures with small but developing markets in the UK, such as air source heat pumps (ASHPs) could see costs fall in future. However, measures cost profiles generally are uncertain, and there is a risk real installation costs for certain measures could also increase over time. Monetised installation costs also do not include search costs, targeting costs, administration costs or delivery costs associated with providing the support to households. These are likely to increase the costs of providing installations.

Hidden costs (monetised and included in installation costs)

There are likely to be hassle costs incurred by the household occupants or landlords affected by policies designed to meet the fuel poverty target. These include the preparation of their homes for installations, liaising with installers, and any oversight. These are presented as part of installation costs for simplicity.

Policy Costs (non-monetised)

The costs estimated in this analysis do not include any policy, delivery, operating, administration, search or targeting costs. These costs would vary considerably depending on the type of policy utilised to bring a household out of fuel poverty. Defining policies to meet the fuel poverty target is beyond the scope of the analysis. However, policy costs could represent a large proportion of overall costs and would decrease the Benefit Cost Ratio (BCR) of bringing a household out of fuel poverty. Estimates of the ratio between installation and policy costs are found in Table 6 in Section 5.2. Potential policy costs are considered in more detail below:

Administrative Costs: There will likely be administrative costs to deliver the fuel poverty target incurred by government, delivery agents and suppliers. The policy mechanisms to deliver the target are not defined in this document and so the size of any administrative costs and their distribution between different bodies is uncertain. However, these are likely to include items such as the costs of running IT databases, staff time and reporting the measures installed. There will also be indirect administrative costs such as funding human resources and legal costs.

Operational Costs: This covers the additional costs of running heating measures, and includes servicing and maintenance costs, but not the fuel or reinstallation costs. These will vary depending on the policy and extent of support offered and are expected to be very low relative to overall costs, so have not been monetised in this analysis.

Search and Targeting Costs: There are likely to be substantial costs accrued in policies meeting the fuel poverty target from searching for eligible households, identifying suitable properties, and verifying they are indeed eligible. This is because fuel poor homes are a diverse pool type of households across the country. The proportion of targeting costs as a proportion of overall policy costs will also vary depending on a policy’s targeting of fuel poor households. For instance, a policy targeting households with an easily identifiable characteristic will have lower proportion of search costs than a policy designed to only treat fuel poor households.

These costs have not been estimated as the design of the policies that aim to meet the fuel poverty target are not decided.

PAS Costs: As installations are made, there are likely going to be costs associated with complying with the Publicly Available Specification (PAS) 2035 framework. PAS 2035 is an industry standard that lays out the specifications retrofitting must meet to be compliant with funding regulations. Associated costs include lodgement fees and using a retrofit co-ordinator (including a design assessment, overheating assessment, air tightness test and monitoring and evaluation costs). The costs of implementing the standard will change over time and will vary by policy mechanism. Given the latter is not defined in this analysis, these costs have not been monetised.

Compliance, familiarisation, and enforcement costs: If there are new regulations introduced to meet the fuel poverty target, there could be costs incurred by homeowners to familiarise and comply with the new rules. There could also be costs incurred by government or local authorities to enforce any new regulations. These are highly dependent on the breadth of any new regulations, if any are installed, that contribute to meeting the target. They have therefore not been monetised in this consultation.

3.2 Description of Benefits

Value of energy saved (monetised)

These are achieved through the installation of energy efficiency measures, causing energy benefits. Energy benefits mean fewer resources are required to meet energy demand and reducing the resources needed to meet the demand for energy services, such as heating. This is a benefit to society in the short run as it frees up energy to be used elsewhere immediately. It can also benefit society in the long run by reducing energy demand that could bring down the long run variable costs of energy supply. These benefits have been monetised in accordance with HMT Green Book supplementary guidance on valuing energy use and GHG emissions[21]. These societal benefits are calculated by multiplying the reduction in energy use by the Long Run Variable Cost (LRVC) of energy, for each energy source.

Additional utility from lower bills in low-income households (monetised and equity weighted)

Energy saving benefits discussed above do not take into account the positive distributional impacts from lowering the bills of low-income households. However, low-income households benefit more from reduced energy bills than a median income household. Therefore, this difference has been monetised by estimating the additional value an equity weighted households receives from lower bills compared to a non-equity weighted household. This is an entirely distributional benefit and is calculated by: [Energy Benefits x Retail price x Equity-weight of recipient households] – [Energy Benefits x Retail price].

[21] *Green Book supplementary guidance: valuation of energy use and greenhouse gas emissions for appraisal* (2023) Available at: https://www.gov.uk/government/publications/valuation-of-energy-use-and-greenhouse-gas-emissions-for-appraisal

Carbon emission and air quality benefits (monetised)

Installation of measures result in a reduction in energy use. For the majority of households, this causes a reduction in traded and non-traded greenhouse gas emissions and positively contributes to the UK's legally binding emission reduction targets. It also improves air quality that reduces adverse health impacts, and other long-term environmental impacts. These benefits have been calculated in accordance with HMT Green Book supplementary guidance.

Comfort taking (monetised and equity weighted)

Energy performance improvement measures reduce the costs to deliver the same level of thermal comfort. This will mean some households will heat their homes to a higher temperature, for a longer period, or heat more rooms in their homes than before energy efficiency measures were installed. The household's overall energy usage is estimated to fall overall, but there is a rebound effect reducing this as the household heats its homes more than before. This additional thermal comfort is estimated to be valued at retail energy prices (in accordance with HMT Green Book supplementary guidance), which acts as a proxy for the willingness of consumers to pay for higher temperatures.

Note, the carbon, energy saving, and extra utility benefits discussed above consider households' estimated energy usage after comfort taking has been accounted for, so there is no double counting of these benefits.

Health benefits (monetised)

In addition to this extra comfort, households also receive additional health benefits from living in higher temperatures. As discussed above, bringing a fuel poor household to EER Band C with energy efficiency measures reduces the costs of heating their home to the same level of thermal comfort. This means that households are likely to increase their energy demand and heat their homes to a warmer level to increase their thermal comfort.

Many people in fuel poverty live at consistently low temperatures during the colder months of the year. Living at low temperatures poses a risk to health, with a range of negative morbidity and mortality impacts associated with exposure to the cold. The Marmot Review Team report[22] on cold homes sets out a body of evidence linking low temperatures to negative health outcomes, in particular cardiovascular and respiratory illnesses.

These health benefits are monetised using the Health Impact Domestic Energy Efficiency Measures (HIDEEM) module of the NBM. HIDEEM simulates the change in relative risk of a range of cold-related morbidity and mortality risks for people living in homes receiving energy efficiency improvements. The changes in relative risk are then converted into Quality Adjusted Life Years (QALYs) and monetised in

[22] Marmot Review Team (2011). *The Health Impacts of Cold Homes and Fuel Poverty*. Available at: http://www.instituteofhealthequity.org/projects/the-health-impacts-of-cold-homes-and-fuel-poverty

accordance with Department of Health guidance on health valuation[23]. Note, that HIDEEM does not account for wider societal benefits, such as the reduced costs to the National Health Service (NHS).

Non-monetised benefits

Wider Economic Benefits: Meeting the fuel poverty target will necessitate a substantial stimulus to the supply chain. This will support green jobs in the sector and encourage research and development in energy efficiency technologies.

Wider Health Benefits: As discussed above, there are monetised health benefits associated with many installed measures. There are also wider impacts from better health that are not included. For example, health benefits are expected to reduce demand on the National Health Service, as fewer households suffer from illnesses associated with living in cold temperatures.

Reduced Damp and Mould Aesthetic Benefits: Meeting the fuel poverty target can also limit the necessary conditions required for the spread of damp and mould. Poor energy efficiency is highly correlated with incidences of damp and mould, as condensation damp is most prevalent in cold, damp homes. Therefore, by improving the fabric and energy efficiency of fuel poor homes, they will be warmer and dryer. In addition to the health benefits from reduced damp and mould captured by HIDEEM modelling, there are also aesthetic benefits from less mould as the appearance of the household is improved.

Community Benefits: Improving the well-being of vulnerable households by bringing them out of fuel poverty can have positive impacts to the communities in which they live. Certain measures can also improve the appearance of communities in addition to the appearance of the dwelling. These physical improvements can improve the aesthetics of their community, improving its residents' perceptions of where they live. For example, External Wall Insulation (EWI) can improve the appearance of both the home internally and externally, improving the appearance of the wider area.

Lower Energy Imports: Installing energy efficiency measures reduces the amount of overseas energy inputs required, in turn reducing the country's reliance on imports and improving its security of supply.

Lower Costs of Meeting Peak Energy Demand: Increasing households' energy efficiency reduces the peak energy demanded, particularly from electrically heated homes. This reduces the amount of electricity capacity required by the grid.

[23] See: https://www.gov.uk/government/publications/green-book-supplementary-guidance-health

4. “Reasonably Practicable” Charts

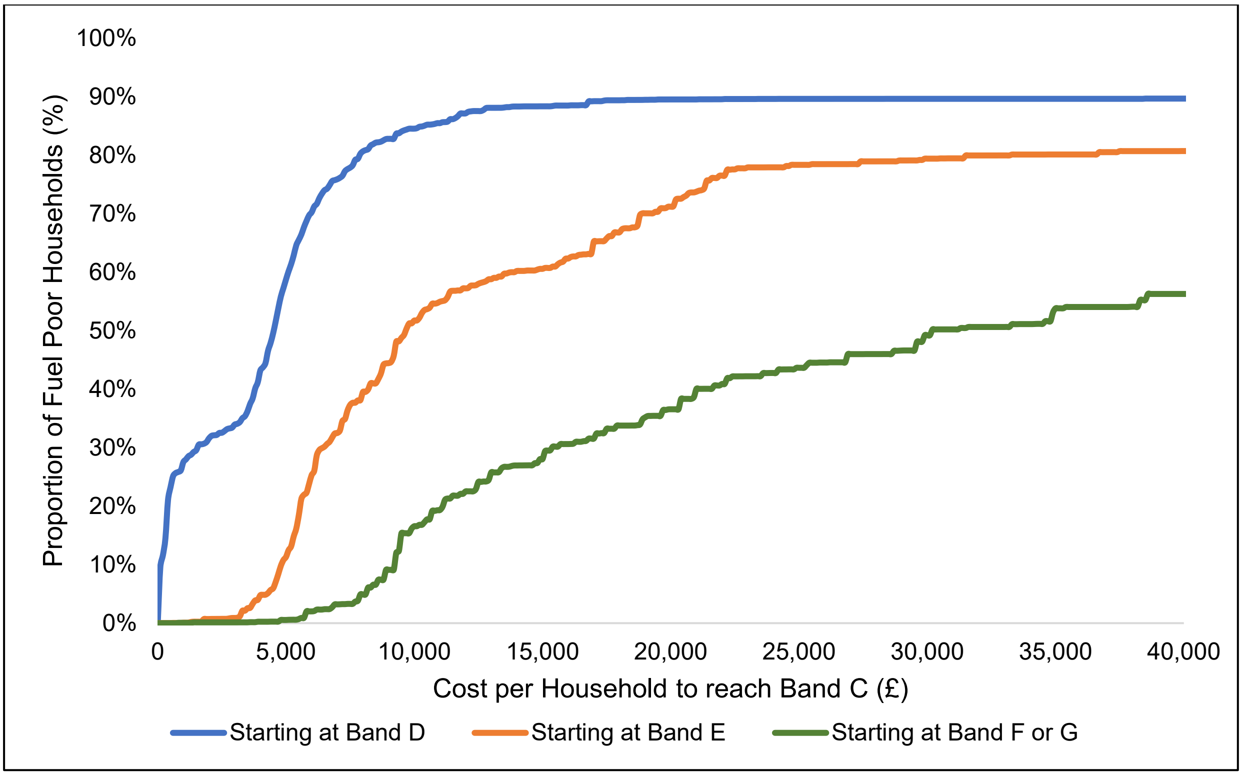
This section evaluates the cost effectiveness and BCRs of bringing the remaining 2.9 million homes remaining in fuel poverty in 2030 to EER C using energy efficiency measures where it is technically feasible to do so. This analysis only considers households that can reach EER C. Around 5% of the remaining fuel poor homes in 2030 after planned policies are technically unable to meet EER Band C. These have been excluded from this analysis but could still have measures installed to raise their home’s energy performance. These homes could also be upgraded to FPEER C with bill support for instance, though bill support interventions have not been considered in this analysis.

4.1 “Reasonably Practicable” Considerations

Cost effectiveness is an important consideration when determining which interventions to bring households out of fuel poverty are ‘reasonably practicable.’ To inform this, we have estimated the cost, and BCR distributions of fuel poor households reaching EER C with energy efficiency measures. As discussed in Section 2.3 above, these charts model bringing homes to EER C by choosing a bundle of measures that have the highest SAP score per £.

In Figure 1 below, the costs to reach EER Band C are considered for households with different starting bands. The proportion of homes that can reach EER C is below 100% as not all homes have the technical capability to do so with just energy efficiency measures. Figure 1 shows where higher costs stop improving a home’s EER. This is lowest for households starting at Band F/G, where around 56% of homes are capable of being brought out of fuel poverty with a cost cap of £39,000. 81% of homes starting at EER E reach EER C with a cost cap of £37,000, while 89% of EER D homes reach EER C with a cost cap of £16,000. 0.3% of homes were outlying and were excluded from the chart to ensure conciseness and simplicity.

Figure 1: Cost distribution to bring remaining fuel poor households to EER Band C with energy efficiency measures, by starting band.



In the NBM, some homes cannot reach EER Band C. This is primarily because they are unsuitable for certain measure upgrades due to a range of characteristics:

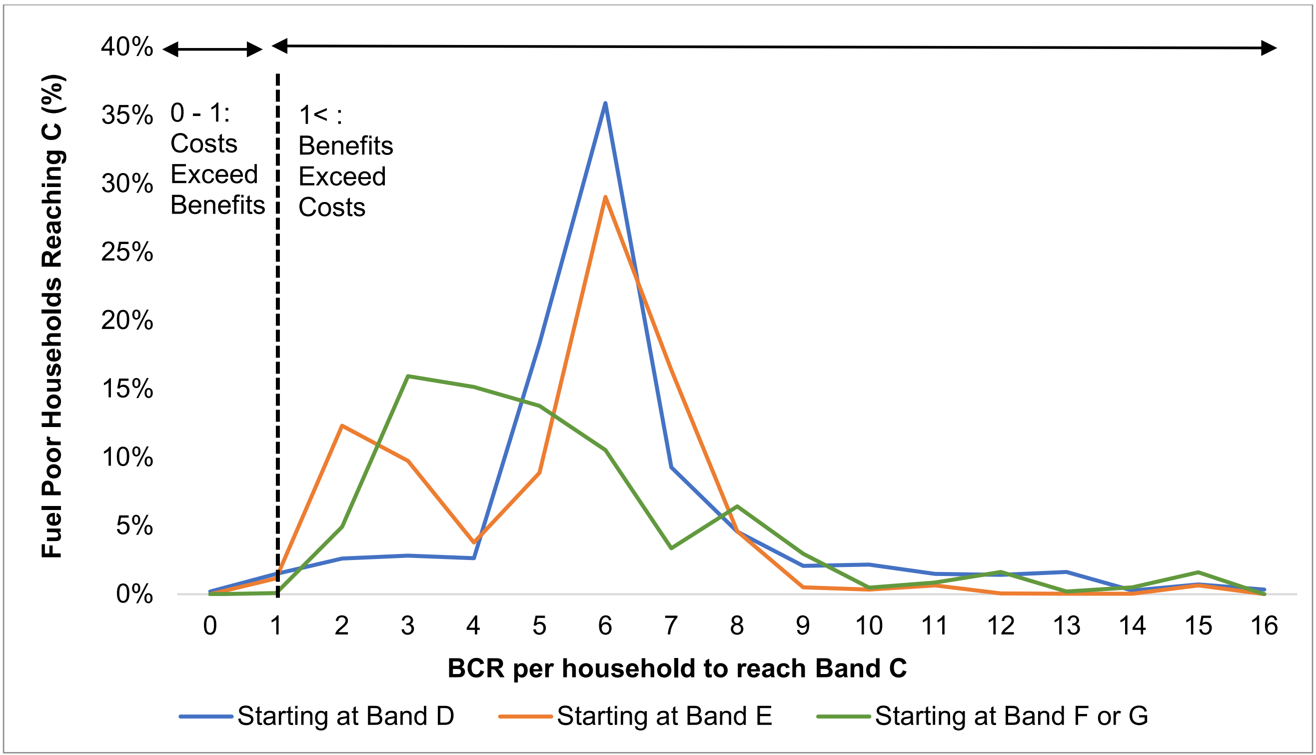
- These homes are typically older, with 77% of the stock that cannot reach EER C built before 1966 compared to 54% of homes that can reach EER C.
- They have larger floor areas, with 78% of homes that cannot reach EER C are larger than 80m^2 compared to 45% of homes that can reach EER C.
- Owner occupied (OO) homes have lower EER C attainment rates than other tenure types and Social Homes (SH) in particular, where 56% of homes that cannot reach EER C are OO while only 8% are SH.

4.2 Equity-Weighted BCR Distribution

In Figure 2 below, the Benefit Cost Ratios (BCRs) of reaching EER Band C are considered for households with different starting bands. As above, not all fuel poor households can reach EER Band C with only energy efficiency measures and this graph only shows BCRs for the households that can reach EER Band C. Figure 2 shows that most households can be brought out of fuel poverty with a societal BCR over 1 (where societal benefits exceed societal costs). However, all bands do contain homes where the social costs outweigh the social benefits, including up to 1.7% of Band D rated homes, 1.3% of Band E homes and 0.2% of Band F/G homes. Bands with a higher starting band, have a higher BCR on average. 8.5% of homes were outlying homes and were excluded from the chart for graphical conciseness.

The costs and benefits included in these BCRs are the monetised costs and benefits included in Table 4 in Section 3.1. A version without equity weighting is also presented in Section 4.3 below.

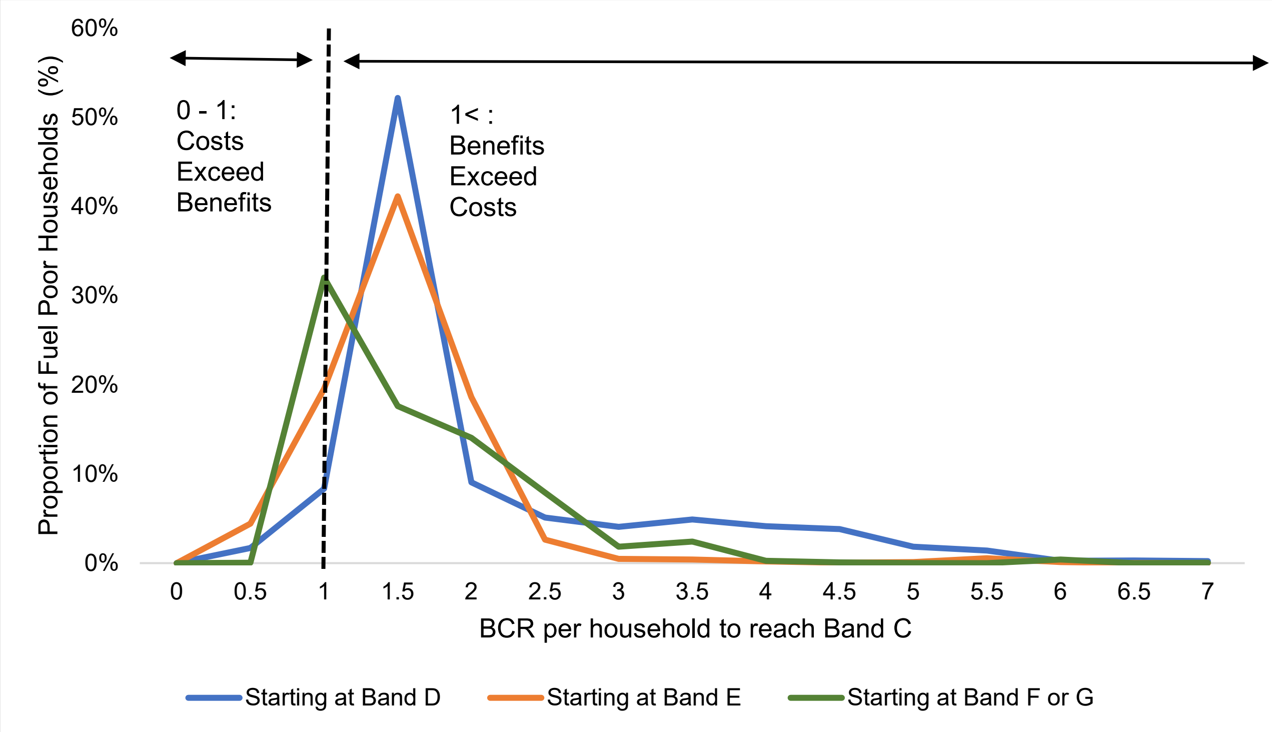
Figure 2: BCR distributions of the combined energy efficiency measures needed to bring remaining households out of fuel poverty, by starting band (equity weighted, rounded to the nearest whole number).



4.3 Non-Equity-Weighted BCR Distribution

In Figure 3, the BCR of reaching EER Band C are considered for households with different starting bands. As above, not all fuel poor households can reach EER C with only energy efficiency measures and this graph only shows BCRs for the proportion of households that can reach EER Band C. The graph shows that even when equity weighting is removed, the majority of homes still have a positive BCR, providing higher societal benefits than costs. Homes starting with F/G have the lowest BCRs, followed by homes with a starting band of E and then D. The majority of homes have a BCR between 0.5 and 2.5. 1.2% of homes were outlying homes and were excluded from the chart for graphical conciseness.

Figure 3: BCR distribution to bring remaining fuel poor households to EER Band C with energy efficiency measures, by starting band, non-weighted weighted.



5. Sensitivity Analysis and Risk Assessment

The key risks and assumptions for the analysis are outlined in this section.

5.1 Sensitivity analysis

To reflect the uncertainty in these estimates, key inputs have been adjusted to understand their impact on the sensitivity of the outputs. Table 5 below outlines the low, central and high scenarios included in this analysis[24]. An optimism bias adjustment of 24% and 10% is applied to the low and central scenarios, respectively, with no adjustments made for this in the high scenario. Energy and carbon prices are altered based on the scenario and represent either the low, central, or high estimates presented in the Green Book supplementary appraisal tables[25]. A reduction or increase of 50% is applied to air quality prices for the low and high scenarios, respectively. This adjustment is in line with the methodology used for calculating the low and high carbon price estimates. There are other sensitivities the government is considering improving this analysis for future publications, such as sensitivity analysis around the inflows and outflows of the fuel poor population discussed in Section 5.3 below.

[24] The low scenario reflects the worst cost effectiveness scenario of installing energy efficiency measures. The high scenario is the best-case scenario.
[25] Green Book supplementary appraisal tables are available here.

Table 5: Sensitivity Analysis Adjustments

Scenario	Capex Optimism Bias	Energy Prices	Carbon Prices	Air Quality Prices
Low	+24%	Low	Low	-50%
Central	+10%	Central	Central	0%
High	0%	High	High	+50%

Figure 4: Percentage change in the average costs and benefits from altering sensitivity criteria.

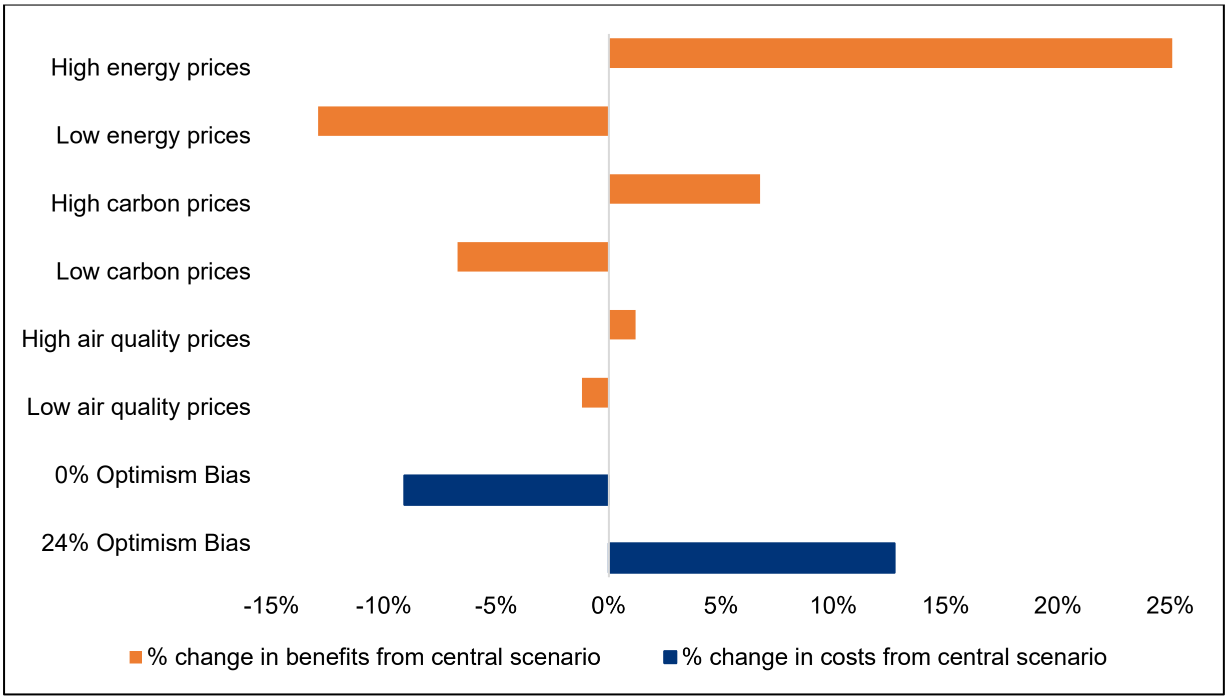


Figure 4 above shows the % change in the average costs and benefits from the central scenario based on changing specific parameters to the low or high scenarios. For example, in the high scenario a 0% optimism bias is applied instead of the 10% used in the central scenario and average costs are reduced by approximately 10%. Each adjustment assumes all other parameters are held constant and continue to match those in the central scenario.

5.2 Potential Policy Costs

This analysis does not include the costs associated with implementing the required policies to meet the target. The mix of capital support schemes, bill support and regulation are yet to be determined. The ratio of the non-monetised policy costs relative to the costs that have been monetised in this analysis are highly uncertain. To illustrate this, Table 6 below presents the ratios of installation and hidden costs (monetised in this analysis) and policy costs (not monetised from this analysis) from recent energy efficiency policies.

Direct support schemes, such as the SHF are likely to have the highest ratio of installation costs (monetised in this analysis) to policy costs (not monetised in this analysis). This ratio is likely to be much lower for regulations like PRS MEES and for bill support schemes such as the Warm Homes Discount. The relative expense of policy costs is also highly dependent on the fuel poverty hit rate of any scheme. A policy with a low hit rate requires fewer eligibility checks and so typically has lower search and targeting costs than a policy with a higher hit rate. The analysis in this annex indirectly assumes a 100% fuel poverty hit rate, while the schemes in Table 6 have much lower hit rates.

Table 6: Ratios of monetised to non-monetised costs, by policy.

Policy	Monetisable costs monetised in this analysis	Monetisable costs not monetised in this analysis	Ratio (%)
ECO4[26]	• Installation costs • Occupant hassle costs (hidden costs)	• Reinstallation costs* • Natural boiler replacement costs • Supplier administration costs • PAS costs • Search costs • Operational costs	73%
GBIS[27]	• Installation costs • Hassle/hidden costs	• PAS costs • Reinstallation costs* • Search costs • Energy suppliers' administration costs • DESNZ and Ofgem admin costs • Economic rent (transfer payment)	104%

*Reinstallation costs are not monetised in this analysis so have been included in the ratios above. However, this analysis only includes measure benefits up to the end of their lifetimes.

5.3 Unmodelled Risks and Sensitivities

This section discussed other risks that could affect the results but have not been tested:

Inflows and Outflows of the Fuel Poor Population

This analysis assumes that the number of households in fuel poverty remains static over time without government support or natural measure replacements. However, there are likely to be fluctuations in the number of households in fuel poverty, because of people's incomes changing and changes to housing costs. Changes in

[26] p20 in ECO4 final impact assessment.
[27] p23 in GBIS final impact assessment.

household compositions can also affect equivalised incomes (with a child being born or leaving home, for example). These factors could increase or decrease the number of households that need to be brought to FPEER Band C by 2030 to meet the target (with either energy efficiency measures and/or bill support). Given the uncertainty of future incomes and housing costs, these effects have not been modelled but could increase or decrease the number of households projected to be in fuel poverty in 2030.

The individuals in fuel poverty are also expected to change. Even if it was assumed there was no government support and the number of fuel poor households did not change, the composition of households in fuel poverty in 2030 would be different to today. For example, there are likely to be inflows from low-income households in above EER C homes moving into homes below EER C pushing them to below FPEER C overall. There are also outflows from fuel poor households moving into homes that are above EER C and being removed from fuel poverty.

The impacts of people moving house have been considered but have not been accounted for in this analysis given the high degree of uncertainty around the proportion of fuel poor people moving house, the tenure type of the homes households would out of and into, and how households' propensity to move changes when their homes are retrofitted.

Measure Costs

Within this analysis, the real costs of measures are assumed to be constant throughout the delivery period between 2024-2030. Measure costs may change over time due to numerous factors such as technological improvements, wider economy inflation and supply chain shocks.

Measure Rollout

It is assumed that measures are deployed uniformly from 2024-2030. However, in meeting the target, the deployment of measures could be clustered around certain years. Certain years could have different macroeconomic conditions that would affect installation costs or measure take up, and therefore the distribution of benefits. For example, if there was relatively more deployment in 2026 than in later years and then benefits would be achieved sooner and could be discounted less.

Measure Mix

This modelling assumes that suppliers will be able to provide measures that achieve the highest EER improvement per £ spent, whereas the extent to which suppliers are able to do so in practice is uncertain. It is also assumed that all measures are accepted by the recipients. However, households may refuse certain measures, and so the measure mix to bring a household to EER Band C might be different to those modelled. Households' preference against installing certain measures could also lead to lower proportions of homes able to reach EER Band C than those discussed in Section 4.1.

Property Characteristic, Household Preference and Supply Chain Exemptions

This analysis assumes all the households that are modelled to be suitable for measures receive them. However, there are many reasons why a household currently included in the average costs and benefits might not be able to receive works. This includes:

- Where a household cannot meet the minimum requirement for reasons not included in the NBM, such as being a listed building.
- Where households refuse certain measures due to personal preferences. Reasons for this might be due to households disliking the way a measure looks or not wanting to have installers enter their home.
- Where supply chains might be stretched in certain areas, reducing suppliers' capability to deliver certain measures.

Supply Chain Impacts

There are a substantial number of measures required to meet the target in many of the scenarios modelled. Delivering these measures could risk supply chains being overstretched in certain areas. The measure estimates also only represent the number delivered to households in fuel poverty and exclude other confirmed policies. These policies, in addition to private installations, could be adversely affected by demands on the supply chain imposed by meeting the target. Conversely, meeting the fuel poverty target could stimulate the energy efficiency supply chain and reduce the costs of energy efficiency.

6. Equalities Impacts

This section provides an analysis of how different groups of people with protected characteristics would be affected by being brought out of fuel poverty, in line with the government's guidance on the Public Sector Equality Duty (PSED)[28]. This guidance suggests the distributional impact of policies should be evaluated with regards to their impact on social groups with certain characteristics, namely:

- Age
- Disability
- Gender
- Gender reassignment
- Pregnancy and maternity
- Race – including ethnic or national origins.
- Religion or belief
- Sexual orientation

[28] Guidance on the Public Sector's Equality Duty. Available at: https://www.gov.uk/government/publications/public-sector-equality-duty-guidance-for-public-authorities/public-sector-equality-duty-guidance-for-public-authorities

For this analysis, the funding implications of any policies are not considered. Therefore, we have considered each characteristic and evaluated whether households with that characteristic are more or less represented in fuel poverty relative to in the wider household population. There is fuel poverty data from 2023 on age (Tables 8-9), ethnic minorities (Tables 10) and long-term illness and disabilities (Table 11). For these characteristics, there is only data on individuals within a household rather than the total number of individuals. This is a limitation to the analysis, as the characteristics of other people living in the household are not known and could be different to the household reference person.

With respect to age, there are a disproportionate number of young people in fuel poverty, given in 4.5% of fuel poor households the oldest household person is aged between 16-24 compared to 2.3% of the wider population. Also, in 13.7% of fuel poor households, the youngest person was 0-4 compared to one in ten for the wider population (9.9%). There are also a disproportionate number of fuel poor households where there is an ethnic minority household reference person, with around one in six fuel poor households containing a household reference person from an ethnic minority (16.4%) compared to 12.8% in the wider population. There are also a disproportionate number of fuel poor households with someone with a disability or long-term illness, with half of all fuel poor households containing someone with a long-term illness or disability (49.9%) compared to under two in five households within the wider population (38.1%).

Table 7 - Fuel poverty, all households in 2023[29]

All households	Number of households (thousands)	Proportion of households that are in this group (%)
In fuel poverty	3,174	13.0
Not in fuel poverty	21,330	87.0

Table 8 – Proportion of households by youngest person in the household in 2023[30]

	0 - 4	5 - 10	11 - 15	16 - 24	25 - 59	60 - 74	75 or more
Fuel poor households	13.7%	12.4%	7.9%	10.6%	26.5%	19.3%	9.5%
All households	9.9%	8.8%	6.3%	10.1%	34.4%	18.8%	11.7%

Table 9 – Proportion of households by oldest person in the household in 2023[31]

	16 - 24	25 - 34	35 - 49	50 - 59	60 - 74	75 or more
Fuel poor households	4.5%	12.4%	26.2%	19.4%	23.3%	14.2%
All households	2.3%	13.1%	24.8%	19.3%	24.4%	16.1%

29 *Annual fuel poverty statistics report: 2024 (2022 and 2023 data).*
30 *Ibid*
31 *Ibid,* Table 23

Table 10 – Proportion of households, by ethnicity of household reference person (HRP) in 2023[32]

	Ethnic minority	White
Fuel poor households	16.4%	83.6%
All households	12.8%	87.2%

Table 11 – Proportion of households, by whether a member of the household has a long-term illness or disability in 2023[33]

	Yes	No
Fuel poor households	49.9%	50.1%
All households	38.1%	61.9%

There is no available data for the prevalence of gender, gender reassignment, pregnancy and maternity, religion, and sexual orientation in fuel poor households. However, if people from any of the above protected characteristics were more likely to be in fuel poverty, the overall impacts would likely be positive given the benefits highlighted above.

[32] *Ibid,* Table 25
[33] Annual fuel poverty statistics report: 2024 (2022 and 2023 data).