Department of Energy & Climate Change

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The Fuel Poverty Statistics Methodology and User Manual

2015 edition

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1. Fuel poverty statistics

1.1 Introduction

The purpose of this document is as a guide for all users of the DECC fuel poverty statistics. Within the manual, the user will find descriptions of the methodology used to calculate the 2013 fuel poverty figures for England, and the consistent fuel poverty time-series produced back to 2003. Information on what data is available and where to find it is also included.

Users should note that the detailed methodological descriptions found in Chapters 5 to 8 are for the English fuel poverty statistics only (details on where to find more detailed information for the other devolved nations are provided in Section 1.4).

This is the 2015 version of this document, relating to the 2013 fuel poverty figures and timeseries, and supersedes all earlier methodology documents and updates.

A more technical handbook regarding the modelling will be published during the summer 2015.

1.2 What is fuel poverty

Fuel poverty in England is currently monitored using the Low Income High Costs (LIHC) Indicator.

Under the LIHC definition, a household is considered to be fuel poor if:

- they have required fuel costs that are above average (the national median level)
- were they to spend that amount, they would be left with a residual income below the official poverty line.

The LIHC definition is a relative measure as it compares households to the national median bill and income – thereby reflecting contemporary trends.

The Low Income High Costs indicator is a twin indicator consisting of:

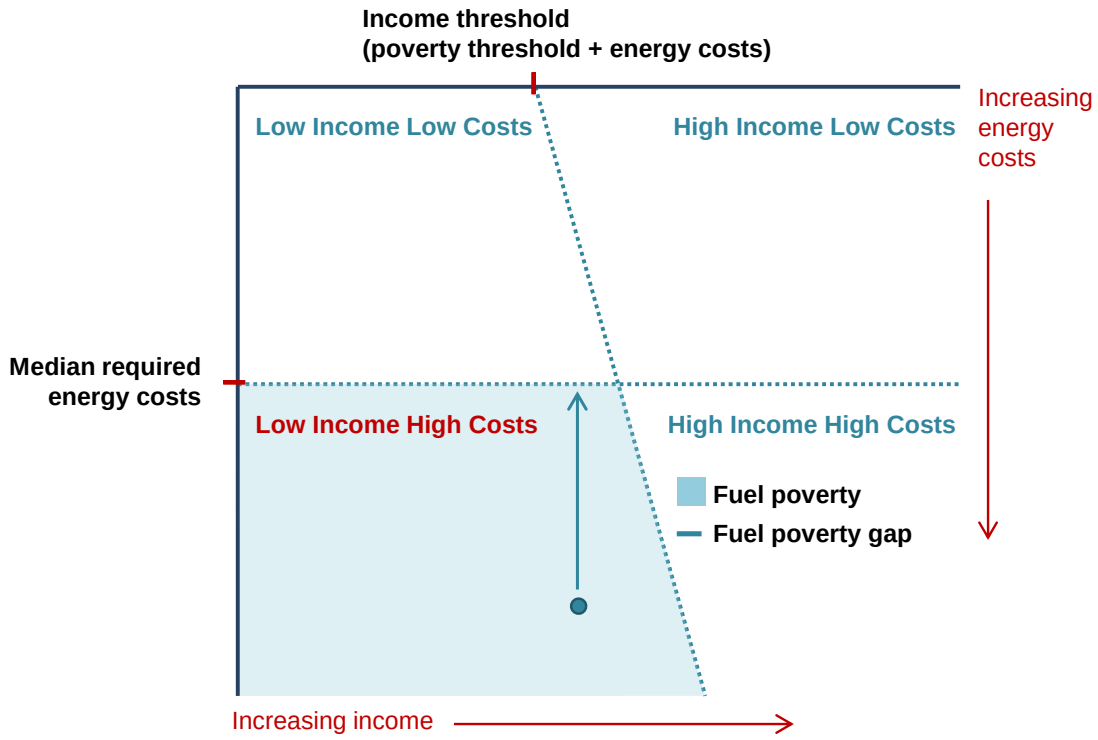
i) the **number** of households that have both low incomes and high fuel costs (shown by the shaded area in the bottom left hand quadrant in Figure 1); and

ii) the **depth** of fuel poverty amongst these fuel poor households. This is measured through a fuel poverty gap (shown by the vertical arrow in Figure 1) which represents the difference between the required fuel costs for each household and the median required fuel costs.

For a detailed explanation of how to calculate the low income high cost headcount and fuel poverty gap, please see Annex B in the Annual Fuel Poverty Report:

https://www.gov.uk/government/collections/fuel-poverty-statistics

Figure 1: Fuel poverty under the Low Income High Costs indicator



Prior to the introduction of the LIHC indicator in England, fuel poverty was measured under the 10% indicator. Under this indicator, a household is considered to be fuel poor if they were required to spend more than 10% of their income on fuel to maintain an adequate standard of warmth[1].

The fuel poverty ratio under this method is defined as:

$$Fuel\ Poverty\ Ratio = \frac{Modelled\ fuel\ costs\ (i.e.\ modelled\ consumption\ \times price)}{Income}$$

Where this ratio has a value greater than 0.1, the household is considered to be fuel poor.

The 2015 Annual Fuel Poverty Report largely covers fuel poverty under the LIHC indicator. Fuel poverty under the 10% indicator is also reported on to provide an overall estimate for Great Britain, as the Devolved Nations continue to measure fuel poverty using the 10% indicator.

[1] An adequate standard of warmth is usually defined as 21°C for the main living area, and 18°C for other occupied rooms, although different temperatures are used in Scotland for some households.

The key elements in determining whether a household is fuel poor are:

- Income;
- Fuel bills; and
- Energy consumption (dependent on dwelling characteristics and the lifestyle of householders).

The cost of energy is modelled rather than based on actual spending. It is calculated by combining the fuel requirements of the household with corresponding fuel prices. These costs capture four areas of fuel consumption:

- Space heating;
- Water heating;
- Lights and appliances; and
- Cooking.

The modelling ensures that the household achieves the adequate level of warmth (as set out in the definition of fuel poverty) subject to a range of characteristics concerning the dwelling and its occupants. Typically, the majority of the fuel bill is accounted for by space heating. In England in 2013, on average, around 51% of the modelled household bill was from space heating costs, 34% from lighting and appliance usage, 12% from water heating and 3% from cooking costs.

The household fuel consumption requirements are modelled based on a number of factors including:

- The size of the property;
- The number of people who live in the dwelling;
- The energy efficiency of the household;
- The mix of different fuels used by each household.

1.3 What are the uses of fuel poverty statistics?

Fuel poverty data has a wide range of uses both within and outside of Government. As well as being used to track objectives against targets, it is used to help develop, focus and target policies. While it is not possible to use the dataset to identify individual and specific households that are in fuel poverty, within Government it is used to provide an understanding of the demography and geography of the fuel poor, and to indicate which groups are particularly susceptible to fuel poverty.

In addition, the wider EHS dataset can provide detail around the heating and energy requirement of different types of households and homes. This information can be used to form an understanding of the role and impact of energy efficiency measures on fuel poverty and also help to target policies to improve the thermal efficiency of the housing stock.

Detailed demographic and dwelling-level splits of fuel poverty in England are available for users, published as part of the annual fuel poverty reporting. In addition

to the current year figures, a spreadsheet showing long term trends in fuel poverty amongst different types of household is updated and published annually.

DECC also publish the full fuel poverty dataset each year at household level. This is made available from the UK Data Archive at around the same time or soon after the EHS data is made available. This is helpful for users who want to extend their analysis of fuel poverty and combine it with the detailed EHS data.

DECC continue to endeavour to meet user requirements for sub-regional estimates of fuel poverty. These data are used particularly by local authorities, who combine this data with information they hold themselves to help target schemes at a local level. In recent years, improvements have been made in terms of both making this data available annually, and bringing the publication date forward to make it more timely and aligned to the national release. Sub-regional fuel poverty data are now available under the LIHC definition for 2011, 2012 and 2013.

1.4 Why are fuel poverty statistics reported separately for England, Wales, Scotland and Northern Ireland?

Fuel Poverty is a partially devolved matter, with each separate administration having individual policy targets, measurement and outputs. The main reason for the devolution is that the separate administrations have the power to affect certain aspects of fuel poverty policies (such as energy efficiency programs) but not others (such as incomes and market conditions, which impact on fuel prices). There are some other differences in the way different countries model fuel poverty, and the frequency and timing of output statistics.

- In England fuel poverty is modelled from the English Housing Survey (EHS), and this document explains the methodology underpinning the English calculation;

- In Scotland, the Scottish Housing Survey (SHS) is used to model fuel poverty, according to the definition of fuel poverty set out in the Scottish Fuel Poverty Statement 2002. The definition is similar to that used in England. The main differences in the Scottish definition are alternative interpretations of a satisfactory heating regime for pensioners, long-term sick and disabled households, meaning the adequate standard of warmth is achieved at a higher temperature for these groups (23°C compared with English 21°C) and a different approach to under-occupancy;

- The Living in Wales Survey is used to estimate fuel poverty in Wales. The methodology is comparable to that for England, although figures for Wales are updated less frequently, as the fuel poverty module of questions are not asked every year. The most recent survey is from 2008;

- The Northern Ireland House Condition Survey and a method very similar to that used in England is used to calculate the Northern Ireland fuel poverty levels. The survey is run approximately two in every five years, with the most recent survey being in 2011.

Scotland, Wales and Northern Ireland each publish reports on their national level of fuel poverty under the 10% indicator. These statistics can be combined with the 10% indicator produced for England to provide an overall UK estimate.

More details of the devolved surveys and fuel poverty can be found at the links below:

Scotland:

http://www.gov.scot /Topics/Statistics/Browse/Housing-Regeneration/TrendFuelPoverty

http://www.gov.scot/Topics/Statistics/SHCS

Wales:

http://gov.wales/topics/environmentcountryside/energy/fuelpoverty/researchreports/?lang=en

Northern Ireland:

http://www.dsdni.gov.uk/index/hsdiv-housing/fuel_poverty.htm

http://www.nihe.gov.uk/index/corporate/housing_research/house_condition_survey.htm

2. What are the key data sources for modelling fuel poverty

2.1 The English Housing Survey

The source of data for housing and the household members, essential in modelling fuel requirement, is the English Housing Survey (EHS). The EHS is currently an annual survey, commissioned by the Department of Communities and Local Government (DCLG)[2]. It covers all tenures and includes a household interview and a physical inspection of properties by a surveyor. The information obtained through the survey provides an accurate picture of the type and condition of housing in England, the people living there, and their views on housing and their neighbourhoods. The survey is a random sample of housing and householders in England. The sample is clustered with half of England being sampled each survey year, but structured in such that any two combined years of the survey provides an unclustered sample.

The two key components of the EHS used in the estimation of fuel poverty are:

- Interview Survey: An interview is conducted with the householder. The interview covers a wide range of topics that include: household characteristics, satisfaction with the home and the area, disability and adaptations to the home and income details;
- Physical Survey: The interview is followed by a visual inspection of the property, both internally and externally, by a surveyor. Data collected includes the number and type of rooms and facilities contained in the property, the condition of a wide range of aspects of the physical structure, details of the heating systems, approximate age of the property, and assessment of neighbourhood quality;

Currently, each year around 13,300 interviews are conducted with householders, and around 6,200 dwellings (approximately 6,000 households) have a follow up physical survey of their dwelling.

Data from both the interview survey such as householder incomes, occupancy characteristics and the method of payment for gas and electricity provide information of relevance relating to the household. These are then combined with data from the physical survey on items such as the floor area, the types of heating systems in use and other energy efficiency characteristics to calculate the LIHC and 10% indicators of fuel poverty. For more information on how the information recorded in the survey is used to model energy consumption, see Chapter 5 of this document.

2.2 Energy price information

Fuel prices used in the modelling of fuel poverty are gathered from a variety of sources, including DECC price surveys, the Office for National Statistics (ONS) and Sutherland tables. Fuel price data for different fuel types have different sources:

[2] In February 2015 a consultation on the future shape of the English Housing Survey was held which may affect the frequency or structure of the survey.

- Gas and electricity are the fuels predominantly used by most households in England. Prices for gas and electricity come from a near-census of tariff charges that DECC carry out from domestic energy suppliers. The census is conducted quarterly, and records specific details of the price of tariffs in each region of the country, splitting this by tariff and payment type. Prices take the form of unit and fixed costs.
- Coal, heating oil and smokeless fuel prices are provided by the ONS to DECC. ONS collects these prices for use in compiling the Consumer Price Indices (CPIs). The prices are collected monthly and split regionally.
- Prices for other (relatively minor) fuels, including LPG and bottled gas, come from the Sutherland Tables[3] or data in the table to SAP (the Government's Standard Assessment Procedure for the Energy Rating of dwellings). Fuel prices from the Sutherland Tables are split regionally, and show comparative heating costs across the UK. Prices are available twice a year.

Prices are combined with modelled levels of consumption for each fuel used by the household to estimate the total bill. For gas and electricity, fuel prices per unit are calculated using data at a regional level and split by payment type. A household's location, fuel mix (gas, standard electricity, economy 7 electricity, heating oils etc.) and fuel payment method (direct debit, standard credit and pre-payment) are matched against the fuel price data to give the cost per unit of fuel required. For more information on this methodology, see Chapter 4.

2.3 Household income

Income is collected from the interview survey part of the EHS, via a set of detailed questions that are specific to the survey. The full model for constructing a household's income is explained in Chapter 3 of this document.

- Basic income is a measure of household income and is calculated by adding the personal incomes of every member of the household together plus any benefit payments that the household receives (from private source, state benefits and savings) but excludes income related directly to housing;

- Full income is used for the 10% definition of fuel poverty. In addition to the basic income measure, it includes income related directly to housing (i.e. Housing benefit, Support for Mortgage Interest (SMI), Mortgage Payment Protection Insurance (MPPI) and Council Tax Benefit (CTB) and deducts the council tax payable.

- Equivalised After Housing Cost (AHC) income is the official income figure used for the LIHC definition of fuel poverty. It is based upon the full income figure but includes the deduction of housing costs (mortgage and rent payments) and the division by the relevant income equivalisation factor to reflect the fact that different households have different spending requirements (see Annex B of the main report for further details).

[3] http://www.sutherlandtables.co.uk/

For all three definitions, the income is calculated as the sum of the income of the Household Reference Person (HRP)[4] and any partner, known as the Primary Benefit Unit (PBU), plus any other adult members of the household, known as Other Benefit Units.

The equivalised AHC income measure is used to define households living in fuel poverty under the LIHC indicator, through both the number of households living in fuel poverty and the fuel poverty gap. The basic and full income measures give rise to two fuel poverty ratios under the 10% definition, though the headline figures use the full income definition.

[4] The Household Reference Person (HRP) is the person in whose name the dwelling is owned or rented or who is otherwise responsible for the accommodation. In the case of joint owners or tenants, the person with the highest income is taken as the HRP. Where incomes are equal, the older is taken as the HRP.

3. How is household income modelled?

This chapter details the income methodology, the calculation of the final fuel poverty income variables, validation of income and changes in the income methodology. A list of the acronyms used in the description of the income methodology can be found in Section 11.

3.1 Overview

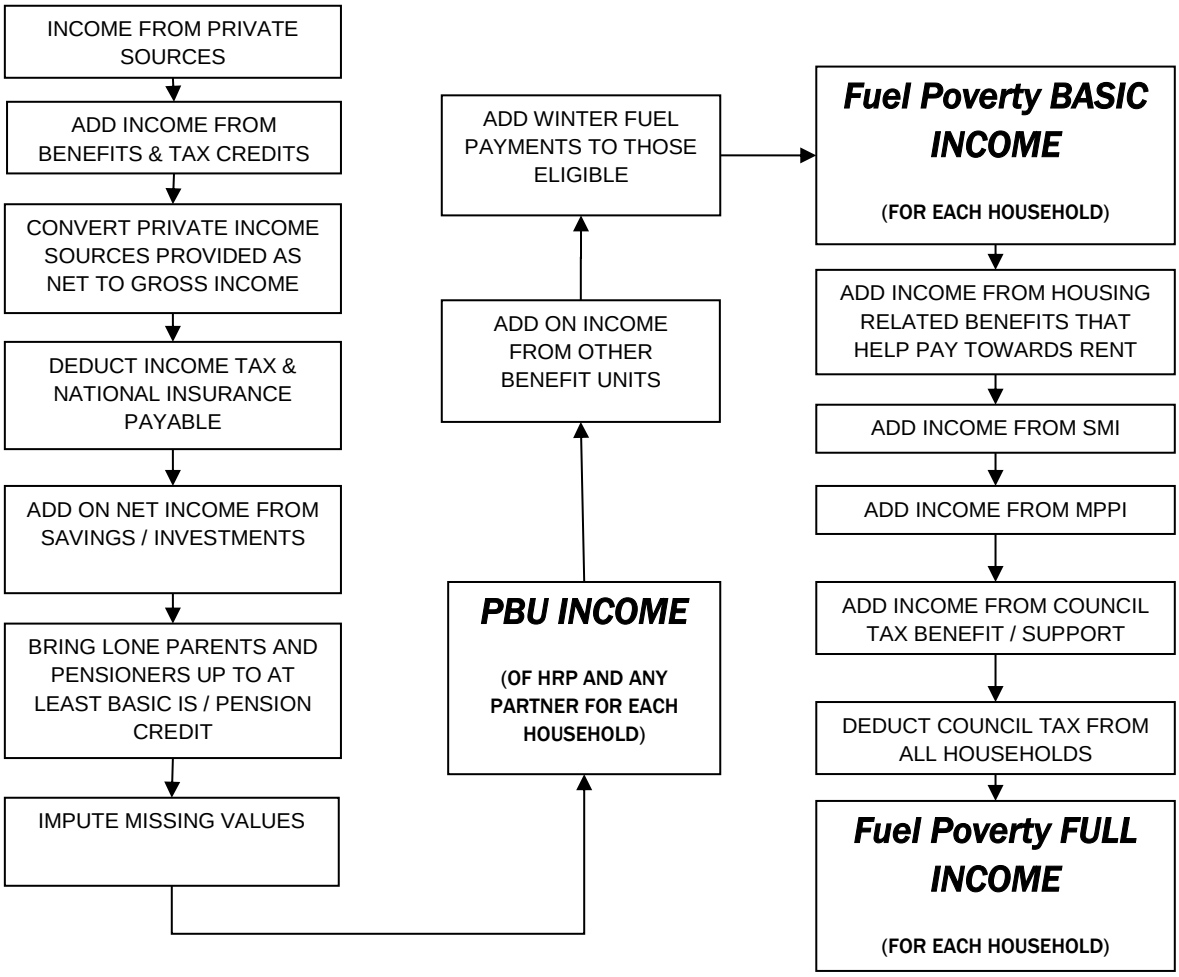
Two different types of income are calculated for fuel poverty purposes. These are *"full household income"* and *"basic household income"* (see section 2.3 above). There are three major steps involved in calculating the full household income. Firstly, the Primary Benefit Unit (PBU) income is calculated for the HRP and partner in each household. The next stage is to produce the fuel poverty basic income for each household, from which the full income is calculated. Figure 2 outlines the main steps involved in this process and the sections to follow detail the procedures involved in each step.

The EHS interview survey collects detailed information about the income of the HRP and any partner from different sources (wages, pensions, benefits, savings and investments and other sources, e.g. rent from property). Respondents are asked separately about each source and which, if any, benefits they receive. This information is collated and modelled to produce total net income for the Primary Benefit Unit (HRP and any partner).

Less detailed income information is collected of other household members aged over 16 (who are not the HRP or partner), referred to in this document as 'Other Benefit Units'. From this information, the income from other benefit units in the household can be derived.

The EHS interview survey also collects information on housing benefit and council tax support, Support for Mortgage Interest (SMI) and Mortgage Payment Protection Insurance (MPPI). These are used in the calculation of the full income measure.

Figure 2: The main steps in calculating full household income



3.2 Missing data

The Computer Assisted Personal Interviewing (CAPI) used to conduct the EHS interview survey contains many 'soft checks' to clarify values with the householder where extreme amounts were initially provided, particularly around state benefits/allowances and tax credits. Thus, the EHS income calculation method assumes that the details given by the respondent are correct unless there is a strong reason to suggest otherwise (assessed on a case by case basis). A method of imputation is required for these cases, and (more commonly) for cases where information on income sources/amounts is either refused or unknown. Table 1 summarises the type and method of imputations carried out.

Table 1: Imputation procedures

Type of income	Type of missing data	Method of imputation
Private incomes	Sources of private income are refused or unknown	Sample median imputed at a later stage
Self-employed	Amounts missing	Uses data from the Annual Survey of Hours and Earnings (ASHE) based on age, gender, part-time/full-time, social economic group and from 2010 data, also geographical location
Regular employment	Amounts missing	
Occupational pension	Amounts missing	Sample median based on gender and social economic group
Private pension	Amounts missing	
Other sources	Amounts missing	Sample median based on working status
State benefits	Benefits received are refused or unknown	Sample median imputed at a later stage
- Universal Credit - Income support - Job Seekers Allowance - Pension credit - State pension - Incapacity benefit - Employment and support allowance - Child benefit - Working tax credit* - Child tax credit - Return to work credit - In work credit - Maternity allowance - Widows pension - War disablement pension - Severe disability allowance - Industrial injuries disablement benefit - Attendance allowance - Carers allowance - DLA (mobility component) - DLA (care component) - PIP (mobility component) - PIP (daily living component) - Statutory sick pay	Benefit amount is refused or unknown	Where the rates vary greatly depending on the situation of the HRP and any partner (notably means tested benefits) individual benefit assessments are carried out. More general methods are used for benefits where fewer rates apply.
Other disability benefit	Benefit amount is refused or unknown	Theoretical amount of DLA (mobility) modelled
Savings	Amount of savings refused or unknown	Imputed using CHAID analysis using various household and dwelling characteristics
Primary Benefit Unit (PBU) income	Overall net household income missing or in households with a partner, HRP only missing/partner only missing	Median sample income imputed based on the HRP and any partner using the variables working status and social economic group or using HRP/partner information only
Other Benefit Units	Income amount missing for additional adults (on an individual basis)	Hot-decking based on gender, age, social economic group, working status and from 2010 data, grouped geographical location for additional adults in work.
WFP	No information collected on whether household receives WFP	Modelled based upon eligibility of all household members. The amount depends upon the age profile of the household members.
Housing related benefits that help pay towards rent	Amounts missing	Full housing benefit – set as the net rent amount Partial housing benefit/don't know if full or partial – individual housing benefit assessment carried out

SMI	Amounts missing	Imputed using mortgage information or from sample median
MPPI	No information given as to amount (applies to all MPPI cases)	Imputed using mortgage information
Council Tax Benefit/Support (CTB)	No information given as to the actual amount (applies to all CTB cases)	Full CTB – set as the council tax due Partial CTB/don't know if full or partial – individual CTB assessment carried out

* The child care element is not modelled for Working Tax Credit.

3.3 EHS Primary Benefit Unit (PBU) income methodology

Initial checks on the interview survey input data are carried out to ensure the data are as clean as possible in preparation for the calculations. This involves checking household characteristic data to identify any implausible values and editing where necessary.

After the initial checks, a series of key indicators about the household are created at the person and household level (for example, age/gender of the HRP and any partner, working status of HRP and any partner and the presence and number of dependent children etc.), which are subsequently checked for completeness/plausibility. These indicators are used to compute theoretical entitlement to benefits and are used in the process of imputing missing values and validation.

Income from private sources

Separate calculations are made for the annual income for the HRP and any partner from regular employment (including income from government training schemes), self-employment, occupational pensions, private pensions and other private sources. For each private income source selected the respondent is asked to provide a banded gross/net amount. If provided, the income is then set at the mid-point of the band.

Where respondents state receipt of private income sources, e.g. employment, self-employment income, but are unable/refuse to specify an amount, then an estimated amount is assigned according to the methods outlined in

Table 1Table 1.

The same amounts are used to impute regular and self-employed income. For these two private income sources, the amount of income assigned depends upon the number of hours worked. The Annual Survey of Hours and Employment (ASHE) data that is used for imputation is presented on the basis of full time employment therefore, if the hours worked are less than or equal to 15 per week, the amount imputed is one-third of the full-time income amount. Part-time work greater than 15 hours per week is set to two-thirds of the full-time income amount.

Respondents predominantly provide gross private income amounts. However, where net amounts are given for income from private sources, the gross amount for that source is approximated. The net amount is increased by 45% if the individual is under pension age and in receipt of earnings/self-employment income (to replicate tax and National Insurance). Otherwise, 25% is applied (to replicate tax only), unless the combined private net and gross income is less than the tax threshold, in which case it is assumed that no tax is paid and the net amount is set to the gross amount. The total gross private income for the HRP and any partner for all sources is calculated. This is required to enable the total tax amount to be deducted. It is not possible to simply calculate the tax on the gross part and then add the gross-taxed to the net as the rate of tax is dependent on income thresholds. Where imputation has taken place this is recorded against the data. On-going validation of the amounts of income from private sources is carried out throughout the calculation.

Income from state benefits

The EHS interview survey asks about benefits received by the HRP and any partner (combined as a benefit unit) and the amounts and time periods of the payments. Where a partner of the HRP is present in the household, with the exception of state pension, child benefit, income support and universal credit, it is unknown whether it is the HRP and/or partner are in receipt of the selected benefit. As this information is required for the purpose of tax deduction, it is estimated based on the eligibility criteria of each person in the couple. Using this information, benefit amounts for the HRP and any partner are calculated.

Missing benefit amounts are imputed for cases where the respondent has answered ‘yes’ to receiving a particular benefit but did not provide the amount received. For means tested benefits, such as income support, the rate varies greatly depending on the circumstances of the HRP and any partner and for these benefits individual benefit assessments are carried out. For other benefits based on rates, such as Disability Living Allowance, the prescribed rates are imputed.

Questions were introduced into the EHS 2010 interview survey to ascertain whether the missing benefit amounts were due to the inclusion of the missing amounts with other specified benefits. From 2010 modelling onwards, use of this data has been incorporated into the assessment of missing benefit incomes to avoid double counting of benefit income where it is deemed that the missing benefit income has already been accounted for.

The total benefit income is derived for the HRP and any partner separately, split between taxable and non-taxable benefit income.

Income deductions

The final income variables are presented in terms of net income, which is the income net of tax and National Insurance. At this stage in the income calculation process, the private income is presented in terms of gross income and the benefit income is presented in terms of gross and/or net income depending on the selected benefit receipt.

The private income and taxable benefit income are added together separately for the HRP and any partner. This information is used in conjunction with the rates and allowances for income tax to derive the income tax payable for the HRP and partner. Based on the rates and allowances for National Insurance, Class 1, 2 and 4 contributions are calculated. The total net income for HRP and partner are computed separately by the following formula:

$$Net\ income = Non\ taxable\ income + Taxable\ income - (National\ Insurance\ payable + Income\ tax\ payable)$$

Income from savings and investment

The EHS interview survey asks the HRP and any partner their combined total amount of savings and any income they have invested, which is provided as banded amounts. The mid-point of the reported band is taken as their savings amount.

Where the amount of savings/investment has not been provided, a method based on Chi-squared Automatic Interaction Detection (CHAID) analysis is used to estimate the combined savings/investment of the HRP and any partner. The banded savings question from the interview survey is used as the dependent variable in the analysis and a variety of household and dwelling characteristics such as tenure and age/gender of HRP are used as the predictor variables for estimating the savings amount. Once all the cases have a savings amount, income received from these savings is then calculated using an interest rate of 3% net of tax[5]. This savings amount is added onto the net private and benefit income.

Low incomes

The next stage in the income calculation is the imputation of low incomes. This is where the PBU net private and benefit income, including income from savings, is assessed for certain groups to ascertain if it is below a theoretical minimum amount.

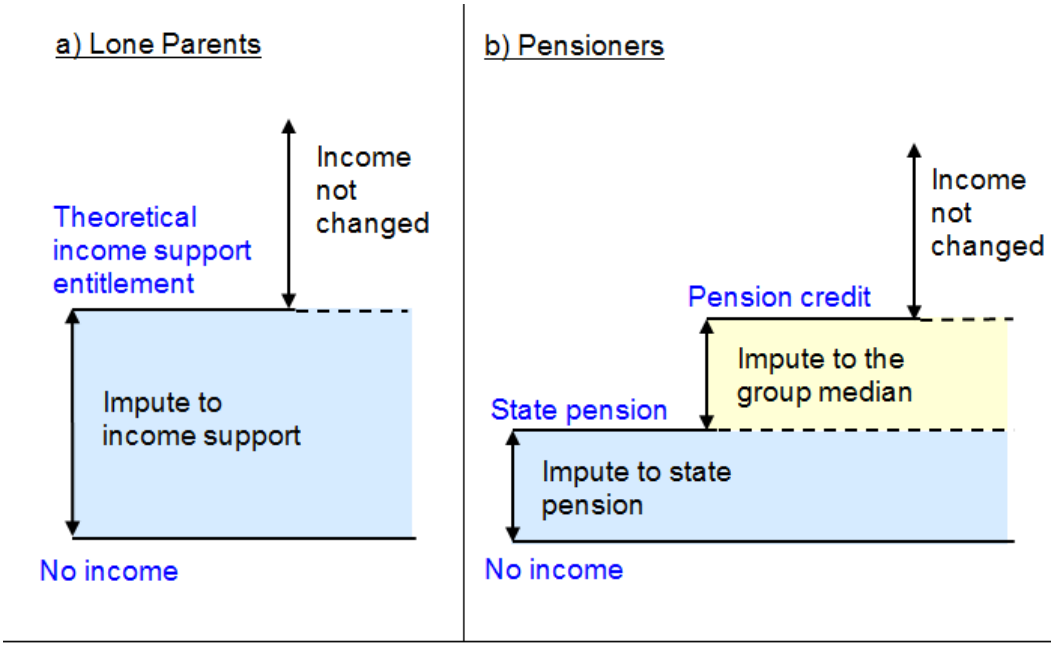
In 2007/2008 this area was the focus for development and the Fuel Poverty Methodology Group (FPMG - see Section 10.1 for more information on the FPMG) recommended some improvements to imputing low incomes in 2008. Analysis produced for the FPMG showed that two household groups are more likely to under-report their income; namely lone parents and pensioners. For these two groups, if their income is less than a minimum amount, their income is imputed, using a different method for each group.

For lone parents, if their net income is below their theoretical income support entitlement then their income is uplifted to their theoretical income support level (Figure 3a). Where the HRP or any partner are over pension age, if their income is lower than state pension, their income is imputed up to state pension (Figure 3b). If their income is greater than state pension but lower than their pension credit entitlement their income is set to missing and later in the calculation procedure it is imputed to the group median based on working status and social economic group. A

[5] No information is collected on the type of savings account, the term of the account or the rate of interest. A rate of 3% is fixed for all householders and has been used for all years of the fuel poverty calculation regardless of whether interest rates are higher or lower than this.

flag is created to identify cases which are changed in the low income imputation routine and the original values are kept for later checking.

Figure 3: Imputation of low incomes



Key: Reported income is in blue, the imputed income is in black

Imputing missing income data

At this stage there are three scenarios in which the total PBU income could still be missing:

i) If the respondent answered 'don't know' 'or 'refused' at the beginning of the income section for the HRP and any partner;

ii) If the benefits received are reported as unknown or refused; or

iii) If, in the case of pensioners, their income is greater than state pension but lower than their pension credit entitlement, their income is set to missing in the low income imputation routine.

Where the HRP has a partner, it is possible that only one of the incomes is unknown or refused. In this situation, or if there is no partner of the HRP, the income of the individual with the missing amount is imputed to the group median based on their working status and socio-economic group. Where the income of both the HRP and partner are missing, their income is imputed to the group median based on a combined employment status and socio-economic group for both HRP and partner.

Output

Each PBU in the dataset has a net private and benefit income, including income from savings/investments.

$$PBU\ income = Net\ private\ income + Net\ benefit\ income + Net\ Savings\ /\ investment$$

$$(all\ based\ on\ the\ HRP\ and\ any\ partner)$$

3.4 Fuel poverty basic income methodology

The fuel poverty basic income measure is the household net income, including winter fuel payment (payable only to those eligible).

Other Benefit Units

The PBU is made up of the HRP, their partner (if applicable) and any dependent children. Other Benefit Units are made up of other household members that are not part of the PBU, e.g. a grown-up child living with their parents or two or more people sharing a house. Each Other Benefit Unit can include up to two adults, but only if they are a couple, otherwise each adult makes up its own Other Benefit Unit. For the fuel poverty calculations, the income of these additional adult household members is considered as part of the household income[6].

Data on the income of other household members aged over 16 (who are not the HRP or partner) are collected at the person level. Household members aged 16 or over that are not in the same benefit unit as the HRP are considered as additional adults and form Other Benefit Units (if the household member is a child of the HRP/partner, aged between 16 and 18 in further education then they will be included in the same benefit unit as the HRP and therefore not considered as an additional adult). If a gross income is provided for the additional adult then this value is used for the income of the household member. If the additional adult has not provided an amount for their income then an income value is imputed based on a 'hot-decking approach'.

The process of hot-decking involves finding cases in the data set that provided an income amount, which are similar in other parts of their responses to the cases with the missing value. For imputing missing additional adult income values, a specification to find similar cases is created for each case based on age (banded), gender, working status, socio-economic group (where applicable) and grouped geographical location for those in work. The case with the missing value has a precise specification and it is matched at random to a case with an income value with the same specification, this income value is then used for the missing case.

[6] Additional adult household members reported during the EHS interview survey to be living in Halls of Residence are excluded from the analysis and their income is not considered to be part of the household.

Not all missing cases are matched and this occurs in two situations:

i) If a case with a missing value has a specification which is not matched by a case with a non-missing value or

ii) When there are more cases with missing values than with non-missing values of the same specification.

Missing cases that are not matched during the hot-decking process are imputed to a sample median based on working status, and for some working status categories with large samples, age (banded) and gender.

Once all of the additional adults have a gross income assigned, it is converted to a net amount by deducting the applicable income tax and National Insurance. The net income of the additional adults is aggregated up to the household level to provide the total net income from Other Benefit Units in the household.

Winter Fuel Payments

Winter Fuel Payments (WFP), introduced in 1998, are a payment given once a year to help older people with their heating bills. They are available to households with at least one resident aged over the female state pension age[7] and paid automatically to an eligible person who receives a state benefit (other than housing benefit, council tax benefit or child benefit). Those who do not receive these benefits have to claim the payment. No question is asked in the EHS survey as to whether anyone in a household receives WFP. The applicable amount of WFP for the household is modelled using the age profile of household members and the specified rates and assigned to the household income. Additional one-off payments for household members aged over female state retirement age are sometimes provided alongside WFP. If applicable for the year of the dataset, these payments will also be included in the WFP amount.

Output

The Fuel Poverty Basic Income variable (fpbasinc) is created by adding the income from the Other Benefit Units (OBU) in the household and the WFP to the PBU income variable.

$$Fuel\ poverty\ basic\ income\ (fpbasinc) = PBU\ income + OBU\ income + WFP$$

There are a small proportion of cases with a Fuel Poverty Basic Income of zero. This occurs where:

i) the HRP and any partner select that they have no sources of income, with no savings/investments;

ii) there is no income from any other additional adult household members; and

iii) where there are no household members over female state pension age and therefore not in receipt of WFP.

[7] A male can claim a Winter Fuel Payment when they reach the state pension age of a woman with the same date of birth.

3.5 Fuel poverty full income methodology

The Fuel Poverty Full Income is created by adding the income related to housing costs, housing benefit, Support for Mortgage Interest (SMI), Mortgage Payment Protection Insurance (MPPI) and council tax benefit to the basic income variable, and by subtracting the annual council tax bill for the household. Income/outgoings relating to housing costs are dealt with in this final step.

Income from Housing Related Benefits that help pay towards rent

Housing benefit, Local Housing Allowance (LHA) and Universal Credit applies only to low income households that rent their home or are in a shared ownership scheme, designed to help people on a low income pay their rent. Housing benefit is derived from the householder's response to the questions in the rent and housing benefit module in the EHS interview survey questionnaire.

Households that receive a housing related benefit that helps pay towards rent but do not provide an amount are imputed in the following ways:

i) If the household states that they are in receipt of full housing benefit/LHA then the weekly housing benefit is set to their theoretical guide rent amount (net of services included in the rent such as heating, meals, water rates etc.) based on their tenure, number of bedrooms and the English Region in which they live.

ii) If the household states that they are in receipt of partial housing benefit/LHA, universal credit or if they do not know if their housing benefit/LHA covers all or some of their rent then an amount of housing benefit/LHA is imputed based on their total net rent payable and their theoretical entitlement to housing benefit. From the 2013 modelling of EHS data, the theoretical entitlement to partial housing related benefits includes the modelling of the under occupation charge for working-age social tenants as introduced by government in April 2013.

Income from Support for Mortgage Interest

Homeowners on certain benefits may be able to get help towards mortgage interest payments called Support for Mortgage Interest (SMI). In the EHS interview survey, applicable households are asked if they receive help towards their mortgage payments through SMI and, if so, whether it covers full/partial payments and the amount/time period of payment. For cases where the amount of SMI is missing, an amount is imputed by applying a Standard Interest Rate (for SMI) to the capital outstanding on the mortgage. However, if their mortgage information is missing, an amount is assigned based on the sample median from those with known amounts.

Income from Mortgage Payment Protection Insurance

Mortgage Payment Protection Insurance (MPPI) promises to make repayments on a householder's mortgage in the event of accident, sickness or unemployment. In the EHS interview survey, applicable households are asked if they are in receipt of contributions towards their mortgage payment under a MPPI policy and, if so, whether it covers full/partial payments. No information is collected on the amount of MPPI. For cases in receipt of MPPI, an amount for MPPI is set to their mortgage payment amount.

Income from Council Tax Benefit/Support

Low income households may be eligible for Council Tax Benefit (CTB), known as Council Tax Support (CTS) from April 2013. The EHS interview survey asks the HRP and any partner liable for paying council tax whether they are in receipt of CTS and, if so, whether it covers full/partial payments. For households in receipt of full CTS payments, their CTS is set to the full amount of council tax payable for their property. For households in receipt of partial CTS or households that do not know if they are in receipt of CTS, a CTS amount is assigned based on the council tax payable for the property and on their theoretical eligibility.

Council Tax Deduction

The council tax band for each dwelling is collected via a data matching exercise undertaken by the Valuation Office Agency[8]. The amount of council tax paid by the household is modelled using the council tax band of the dwelling and information about charges in the relevant local authority area. Single person discount is applied where appropriate based on household size and whether the respondent reported receipt of a discount on their Council Tax.

Output

The Fuel Poverty Full Income variable (fpfullinc) is created by adding the income related to housing costs; i.e. housing benefit/LHA, SMI, MPPI and council tax benefit/support, to the basic income variable (fpbasinc) and subtracting the council tax payable.

$$Fuel\ poverty\ full\ income\ (fpfullinc) = fpbasinc + HB\ /\ LHA + SMI + MPPI + CTB - council\ tax\ payable$$

As mentioned in section 3.4 , there are a small proportion of cases with a Fuel Poverty Basic Income of zero. In these situations, this can lead to a negative Fuel Poverty Full Income if the household does not report that they are in receipt of any housing related payments and where they are liable for council tax for which a deduction is made from their zero income.

3.6 Fuel poverty equivalised after housing costs methodology

The fuel poverty equivalised AHC income, as used in the calculation of the official fuel poverty statistics, is an extension of the fuel poverty full income variable. Housing costs (as published in the EHS derived interview file) are deducted from the full income of the household, and the household income is equivalised to reflect the fact that different households have different spending requirements. The methodology is detailed in Annex B of the Annual Fuel Poverty Report:

https://www.gov.uk/government/collections/fuel-poverty-statistics

[8] This is achieved by matching postcodes to council tax band information in order to feed into modelling undertaken by the survey contractors for the production of statistics only.

3.7 Validation of income data

The validation of the input data into the income calculations, through to validation of the final output Fuel Poverty income variables, is an important process to ensure data quality. This process is outlined below.

Checking of the income data collected begins at the interview stage. The EHS interview survey is collected using a technique called Computer Assisted Personal Interviewing (CAPI) where the interviewer enters the information collected from the respondent directly into a laptop computer. The EHS CAPI has in-built checks to ensure that the respondent's answers are as accurate as possible. For certain benefits, if an amount is entered outside a valid range then a check will appear on the computer screen. The CAPI system has cross checks between variables e.g. if housing benefit receipt is selected but not council tax benefit. The checks in the CAPI system are routinely reviewed bi-annually and updated as appropriate.

Once in receipt of the interview survey files, before beginning the income calculations, initial checks on the interview survey input data are carried out to ensure they are as clean and complete as possible. This involves checking household characteristic data, which is later used for imputing missing values and validation. Implausible and missing values are identified and editing/imputation takes place where necessary.

Checks are made at each stage of the calculation process to ensure as far as possible that the data are reasonable, and that missing data have been imputed correctly. Implausible values are interrogated and only when we can be as certain as possible that the information is incorrect is an imputation or change made. Any changes made are always noted alongside the data to indicate the nature and extent of any imputation. At the end of each stage additional checks are made to ensure that there are no missing values in the final variables.

Certain parameters are evaluated at the end of each stage of the calculation process and compared to previous EHCS/EHS data. For example, once the benefit section of the calculation process is complete, the take-up, proportion of imputed data and average values for each benefit are assessed.

Oddities in the results for the components of the fuel poverty income variables are investigated in detail, concentrating on the difference in the data between the two specific years until the change can be explained. This involves putting the data in context by comparing the components of the fuel poverty income/AHC income to external administrative sources e.g. DWP/HMRC benefit statistics and data from other surveys e.g. the Annual Survey of Hours and Earnings and the Living Cost and Food Survey. From this process it may be deemed that the results are in line with other external sources or the difference attributed to the underlying EHS data or changes to the EHS interview survey.

The internal validation also occurs on the final Fuel Poverty income variables, comparing the total income measures to data from previous years, looking at the distribution of income across the population and the average income of certain household groups. The main external validation techniques applied to the fuel

poverty income measures are trend analysis over time and comparison with specific year income data from other surveys, notably the Living Cost and Food Survey (LCFS) and the Family Resources Survey (FRS).

Income data from the LCFS Family Spending publication for the relevant year in question are published around the time that the fuel poverty income measures are being finalised. This information is used to compare the LCFS disposable household income to the fuel poverty basic income measure (as the two income measures are fairly closely aligned in their definition) by overall households, tenure and income quintiles. Any unexpected divergence in the results between the two income measures is investigated.

The FRS is considered to be the most comprehensive and accurate income survey conducted in this country, and one that is dedicated to measuring incomes. The FRS income data for the comparable year to the fuel poverty full income measure is not published until after the publication of the fuel poverty statistics. However, the FRS provides the best external income data source for comparison and it is therefore important to compare a variant of the fuel poverty full income measure to the equivalent FRS income variable on publication of the FRS data, focusing on the comparability of the distribution of incomes in both surveys and the characteristics of households with the lowest incomes.

The FRS data is also the underlying source behind the AHC equivalised income figures presented in the Households Below Average Income (HBAI) series, published by DWP. Again, the comparable year of the HBAI is not published until after the publication of the fuel poverty results but time series charts are produced on availability of the data to compare the HBAI equivalised AHC income to the fuel poverty AHC equivalised income by overall households and income deciles.

3.8 Changes in income methodology

Each year, minor modifications are made to the Fuel Poverty income calculation methodology as a result of improvements in the treatment of missing data, changes in the benefit and tax system and minor alterations to the EHCS/EHS interview survey. Selected years have also undergone larger methodology changes to the income calculation assumptions which is the focus of this section.

Fuel Poverty incomes were originally calculated for the 1996 statistics and a very similar methodology was followed for the 2001 statistics. Ahead of the production of the 2003 figures, the Department of Trade and Industry (responsible at the time for publishing fuel poverty statistics) commissioned a consultation to discuss proposed changes to the Fuel Poverty income methodology. This resulted in three initial changes to the calculation of household incomes, all of which came about due to additional information being collected in the EHCS interview survey. This updated method was first used to calculate the 2003 Fuel Poverty figures. Headline figures for 1996, 1998 and 2001 were also revised to adopt the new methodology. Further changes have taken place as a result of continual review of improvements towards data quality and substantial changes to the interview survey as discussed in more detail below.

Other Benefit Unit income (2003)

Prior to the work on the 2003 EHCS data, incomes from other benefit units (i.e. other adult household members who were not part of the same benefit unit as the HRP) were modelled using a correction factor based on the Expenditure and Food Survey (EFS – now the Living Costs and Food Survey). For the 2003 dataset a new method of computing the income of other benefit units was introduced that used data collected in the EHCS interview survey. Questions were asked of the respondent about any state benefits or income received by each of the Other Benefit Units and these were used to derive the income of Other Benefit Units.

Council Tax Deduction and Council tax Benefit (2003)

Net council tax liability was not included in the Fuel Poverty Full Income definition prior to the 2003 EHCS data. From 2003, council tax payments (net of council tax benefit) were deducted from the Fuel Poverty Full Income. This was in order to be consistent with the government's official Households Below Average Income (HBAI) measure and to ensure consistency within the income definitions (i.e. for full income, including both the payment of council tax, and the benefit received to help pay it; for basic income excluding both the payment and the benefit).

Low Income Imputation (2006)

In 2004, alongside and in support of the Fuel Poverty consultation, an independent review[9] of the Fuel Poverty methodology took place. In the peer review it was recommended that the treatment of very low household incomes on the EHCS should be investigated with the view to possibly amending the methodology to match more closely that of the Family Resources Survey (FRS), a dedicated income survey. The FRS does not impute very low incomes but leaves them on the dataset, including negative income amounts (e.g. a self-employed person who has made a loss in the year concerned), whereas the EHCS (at the time of the review) uplifted all households that were on a low income up to at least their basic income support entitlement.

Following an extensive income review by BRE and in discussion with the Fuel Poverty Methodology Group (FPMG) a new low income method was decided upon and endorsed by the FPMG. The new method was first adopted for the 2006 Fuel Poverty calculations, whereby only the household composition categories adults over pension age and lone parents are subject to the low income imputation (see details above).

Housing Benefit (2007)

In the 2007 EHCS interview survey, the Rent and Housing benefit module of the interview survey was extensively revised leading to a more comprehensive set of questions on rent and housing benefit. The 2007 Fuel Poverty calculations were adjusted to incorporate these interview survey changes. As a result, the housing benefit amount assigned to applicable households changed from being based on theoretical entitlement to the amount provided by the occupant (where available).

[9] Sefton, T and Chesshire, J. Peer Review of the methodology for calculating the number of households in fuel poverty in England. http://webarchive.nationalarchives.gov.uk/20070603164510/http://www.dti.gov.uk/files/file16566.pdf

Council Tax Benefit (2007)

Also in the 2007 EHCS, the method used for calculating levels of council tax benefit was improved due to increased data quality in this area. Prior to 2007, the level of council tax benefit assigned to a household was based on theoretical entitlement to this benefit. In 2007, the methodology was improved to allow use of the reported receipt of council tax benefit receipt where provided.

Savings/Investment Income (2007)

In the 2007 EHCS interview survey, the questions asked about savings/investment were adjusted to include more detail about savings/investment above £50,000. Questions on the savings of the HRP and partner were asked in banded savings amounts. Prior to 2007, the top savings band was £50,000 or over. For the purposes of Fuel Poverty income calculations it was assumed that this represented a level of savings of £55,000. In the 2007 EHCS interview survey, the following additional bands were added: a) £50,000-£99,999; b) £100,000-£149,999; and c) £150,000 or over. For the purposes of Fuel Poverty, the income methodology assumes levels of savings of a) £75,000, b) £125,000 and c) £175,000 respectively.

Other Benefit Unit income (2008)

In April 2008, the English House Condition Survey (EHCS) merged with the Survey of English Housing (SEH) to create the English Housing Survey (EHS) leading to further changes in the 2008 interview survey. The main change relevant to the Fuel Poverty income due to the move to the EHS was the way income information is collected for additional adult household members.

Prior to the 2008 survey, there was an income module in the interview survey on Other Benefit Units that collected income and benefit information at the Benefit Unit level on other adult members living within the household (who were not part of the same benefit unit as the HRP). This information was used to compute the income of Other Benefit Units and missing values were imputed via two different methods based on working status. If an adult member of the Other Benefit Unit was working, then income data from ASHE was used to impute an income value based on full-time/part-time, age and sex. If no additional adults in the Other Benefit Unit were working then the income of the Other Benefit Unit was imputed to their theoretical income support entitlement.

In 2008, the Other Benefit Unit income section was removed from the EHS interview survey. The required information was collected differently via questions asked of all household members aged 16 or over. Additional adult incomes can be extracted from these data and the 2008 Fuel Poverty income methodology was revised to incorporate the additional adult income survey changes. The method of imputing missing values also changed to hot-decking (for more detail see Section 3.4) to capture the variability found in actual income data on additional adults.

Savings Routine (2008)

Prior to 2008, the addition of income from savings/investment was the last step in calculating the Primary Benefit Unit income (that of the HRP and Partner). This changed in 2008 and the routine is now performed before the low income imputation so that the amount of income from savings/investment can be added onto the net

private and benefit income of the HRP and any partner before the low income assessment. This change was added as an improvement to the income methodology to ensure that the income of lone parents and pensioners are not imputed in the low income imputation routine if they have sufficient savings/investment to put them above the low income threshold.

Earnings from other work (2008)

Prior to 2008, in the EHCS interview survey in addition to the income category 'Earnings from main job' there was also an income category called 'Earnings from other work'. From the 2008 survey year onwards, the EHCS category 'Earnings from other work' was removed from the survey and the employment income category broadened from applying to the main job only (under the EHCS) to a general 'Earnings from employment' category under the EHS. From 2008 onwards earnings from other work is likely to be recorded under the category 'Earnings from employment' or the category 'Other sources'.

Housing Benefit (2013)

For the 2013 modelling of EHS data, the theoretical entitlement to partial housing related benefits includes the modelling of the under occupation charge for working-age social tenants (Removal of Spare Room Subsidy) as introduced by Government in April 2013.

Council Tax Support (2013)

In April 2013 Council Tax Support (CTS) replaced Council Tax Benefit (CTB). Across all Local Authorities, support for pensioners remained the same as under the old CTB scheme. Therefore no changes have been made to the calculation of theoretical partial CTS for pensioners in 2013. Different LA's adopted different approaches to the CTS scheme but it is not feasible to model each scheme on the EHS data. Generally, across the majority of Local Authorities, the support for working age claimants was cut compared to the old CTB scheme. For 2013 modelling, a blanket factor of 0.85 was applied to reduce the theoretical partial CTS entitlement for working age claimants for all Local Authorities. This factor was derived by simulating theoretical CTS entitlement on EHS 2012 data and matching it to research undertaken on CTS reductions by the JRF (http://www.jrf.org.uk/sites/files/jrf/council-tax-support-summary.pdf).

4. How are energy prices calculated?

4.1 Overview

The fuel price element of the fuel poverty calculation produces fuel prices which can readily be combined with energy consumption outputs to produce fuel costs (see Section 4.2).

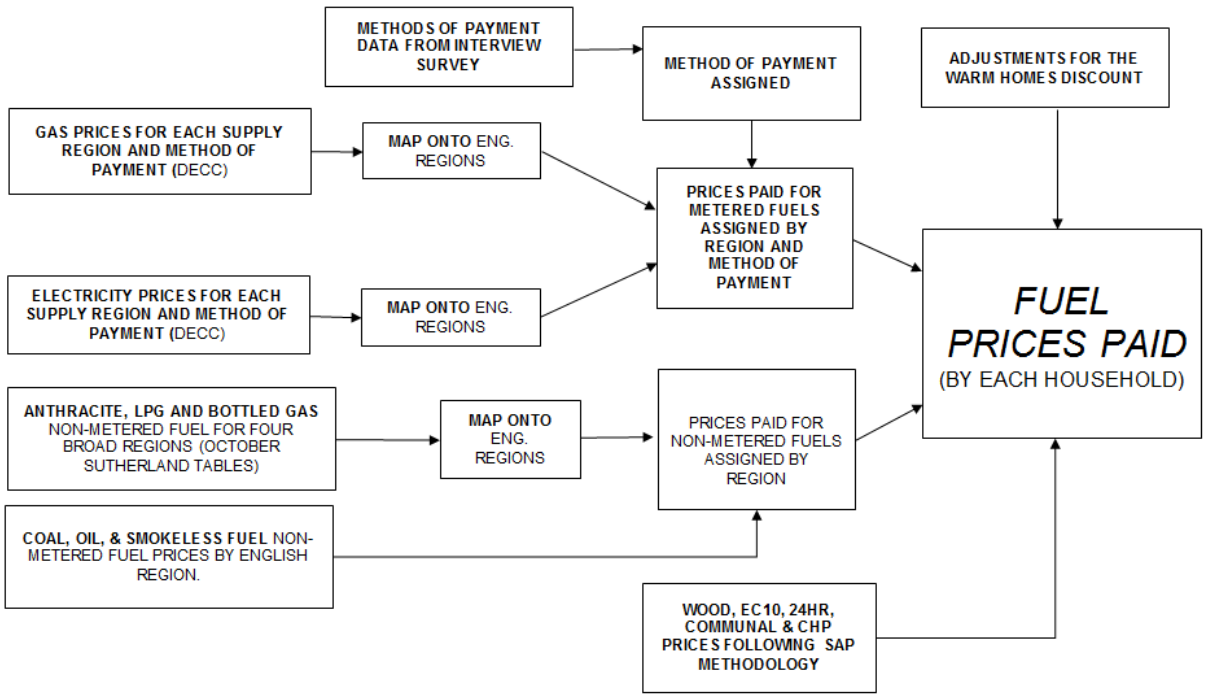
The price each household pays for its fuel depends on four main factors:

- The household's location within the country (as fuel prices vary regionally).
- The choice of supplier.
- The choice of tariff.
- The method of payment where relevant (i.e. payment by direct debit, standard credit or pre-payment meter).

Information on the exact tariff, or the supplier, is not collected in the EHS. The survey does however collect information on the geographical location of each case and on the method of payment for metered fuels (i.e. gas and electricity). Therefore, this allows the application of an average fuel price for each region and method of payment. Fuel prices specific to each household are thus calculated.

The process involved is shown as a flowchart in Figure 4.

Figure 4: Process of calculating energy prices

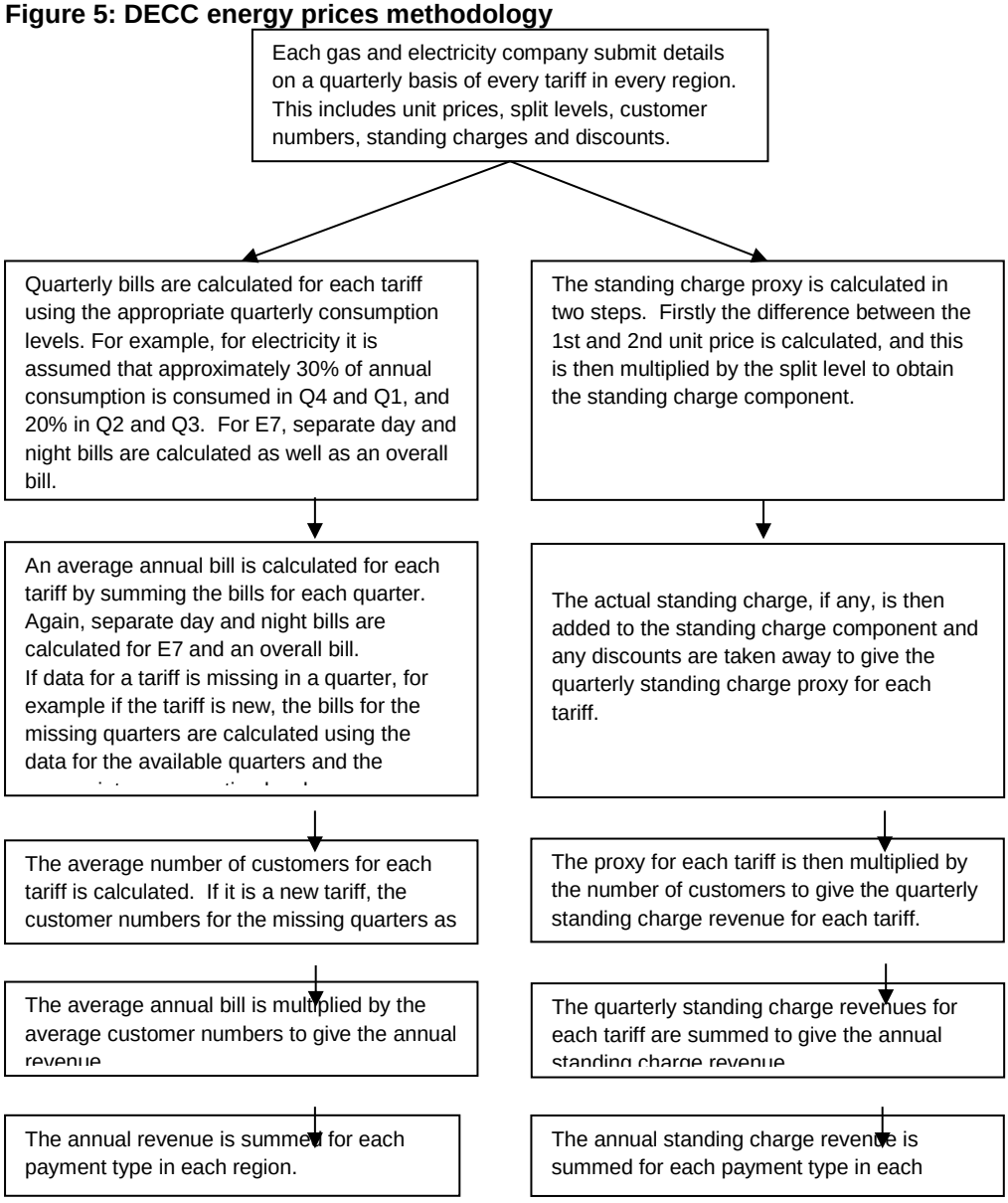


4.2 Data sources

Metered Fuels (Electricity and Gas)

DECC provides average annual prices (on a calendar year basis) for gas, standard electricity and off-peak (Economy 7) electricity[10]. These prices are split by the electricity supply regions (PESs) and gas distribution zones (GDZs) for years prior to 2013, and by PESs only for the 2013 half of the combined 2013 dataset (to better represent how suppliers charge their customers). They are further split by three types of payment (direct debit, standard credit and pre-payment). The prices used to provide initial fuel prices are those excluding any social tariffs (i.e. the Warm Homes Discount legacy tariffs). These tariffs are accounted for later in the modelling (see section 7.5 on Applying the Warm Homes Discount). The method employed by the DECC to produce their energy prices is outlined in the flowchart in Figure 5

Figure 5: DECC energy prices methodology



[10] The metered fuel price data used in the fuel poverty calculations are derived from the DECC quarterly energy prices: https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/quarterly-energy-prices

An example of this data can be found in Table 2 below.

Table 2: Gas Average Unit Price and Average Standing Charge

	Average Unit Price (p/Kwh):			Average Standing Charge (p/year):		
Region	**Credit**	**Direct Debit**	**PPM**	**Credit**	**Direct Debit**	**PPM**
East Midlands	2.87	2.76	2.84	12,204	10,239	15,400
Eastern	2.91	2.80	2.85	11,515	9,458	16,005
North Eastern	2.80	2.68	2.90	13,568	10,748	14,944
North Thames	2.86	2.73	2.83	11,923	9,387	15,252
North Western	2.94	2.82	2.90	11,753	9,810	14,866
Northern	2.80	2.74	2.84	13,552	10,629	14,364
Northern Ireland	4.59	4.60	4.79	4,276	1,960	0
Scotland	2.93	2.76	2.76	9,975	7,016	16,691
South Eastern	2.87	2.77	2.90	11,545	8,775	13,600
South Western	2.87	2.75	2.81	11,708	9,219	14,787
Southern	2.90	2.77	2.50	10,488	8,314	19,878
Wales	2.85	2.73	1.89	9,542	7,987	29,365
West Midlands	2.86	2.76	2.82	12,487	9,947	16,205
England and North Wales	2.87	2.76	2.84	12,006	9,582	15,278
United Kingdom	2.88	2.77	2.83	11,696	9,262	15,843

Source: DECC quarterly domestic fuels inquiry

Notes:

(1) Many companies no longer bill customers for separate standing charges. Instead they charge customers under a two-tier unit price structure with one unit price being charged for the first of a specified number of units each quarter. A second unit price is charged for all further units used.

(2) Regions refer to the Local Distribution Zones used for the gas distribution network and do not necessarily follow the boundaries of any other region.

(3) The sum of the regions listed broadly equates to England, although the regions do not necessarily follow the Welsh and Scottish borders exactly.

(4) The figures shown relate to electricity consumed by customers in the period from Q1 2008 to Q4 2008 (and thus billed to customers between 1 April 2008 and 31 March 2009) and are weighted by the number of customers on each tariff.

(5) All standing charges and unit prices in this table include VAT at 5 per cent

The price of Economy 10 and 24 hour electricity are the SAP 2012 prices, inflated (for the 2013 half of the dataset) using the Consumer Price Index for electricity.

Non-Metered Fuels (e.g. Coal, LPG, Fuel Oil)

The prices paid for anthracite, LPG and bottled gas (non-metered fuels) are taken from the Sutherland Tables (see: http://www.sutherlandtables.co.uk/). These are independently produced reports which provide the average prices paid for fuels, split

into four broad geographical regions. The reports are published twice yearly; once in May and once in October.

For fuel poverty calculations the October Sutherland Tables prices are used for the survey year. The prices produced by Sutherland are taken from a sample of prices collected over the preceding six months.

Prices for heating oil, coal and smokeless fuel (not including anthracite) are currently obtained from the Consumer Price Index (CPI), produced by the Office for National Statistics. These prices have been split by English Region and represent a 12 month average over the calendar year for each fuel.

Other minor non-metered fuels

The price of wood is based on SAP 2012 wood prices, which are inflated from 2012 prices (for the 2013 half of the dataset) using the change in the Consumer Price Index for coal from this date. The price of communal is calculated using SAP 2012 communal prices, inflated (for the 2013 half of the dataset) using the Consumer Price Index for gas.

4.3 Methods of payment data

The methods of payment are collected for gas and electricity only. Each household is asked in the interview survey how they pay for their electricity and gas. For each fuel they have the option of:

(1) Direct debit (including online direct debit).
(2) Payment on receipt of bill by post, telephone, online or at bank/post office.
(3) OPTION 3 IS BLANK
(4) Pre-payment (keycard, slot or token) meters
(5) Included in rent
(6) Frequent cash payment method (i.e. more frequent than once a month)
(7) Fuel direct/direct from benefits
(8) Fixed Annual Bill (however much gas/electricity is used) e.g. StayWarm
(9) Other (Please specify)
(88) Not applicable
(99) Don't know (spontaneous only)

There are more methods of payment collected in the EHS survey than the three methods of payment attached to the prices provided by DECC (see Section 4.1). Therefore assumptions are made in order to assign each household a method of payment. The current assumptions are as follows:

- Those stating ‘direct debit’, ‘included in rent’, ‘fuel direct/direct from benefits’ or ‘fixed annual bill (e.g. StayWarm)’ are coded as Direct Debit.
- Those stating ‘payment on receipt of bill’ and ‘frequent cash payment method (more than once a month)’ are coded as Standard Credit.

- Those stating ‘pre-payment (key card or token) meters’ are coded as Pre-Payment.

For those coded as ‘other’, and where a description is provided, the most suitable method of payment is assigned for each fuel.

After this process there may be a small number of cases without a method of payment (i.e. those who have said they don’t know or “other” and where the description is missing or insufficient). For these cases standard credit is applied.

4.4 Mapping the fuel prices of each household

In addition to matching each household to a fuel based on the method of payment, the household must also be assigned a price based on its location within the country. The EHS collects information on which English Region each household is in, however the English Regions do not correspond with the electricity supply regions, gas distribution zones or Sutherland Table regions.

The fuel prices for each supply/distribution/Sutherland region are matched with the English Region using a geographical matching technique. This is based upon estimates of the proportion of each English Region within each supply region or distribution zone.

For example, if a household’s English Region lies 40% within one supply region and 60% within another supply region the price applied will be a 40/60 weighted average of the two prices. This approach assumes a uniform population density across England.

The prices of wood, Economy 10 electricity, 24hr electricity, communal from boilers and communal from CHP are calculated on a national scale so no regional mapping is necessary.

Prices for heating oil, coal and smokeless fuel are provided by English Region and therefore do not require mapping.

4.5 Applying the Warm Homes Discount (Legacy Tariffs and Core/Broader group)

The metered fuel prices used in the initial assignment of tariffs to households are the average prices for each region without any element of the Warm Homes Discount (WHD) applied. It is important, however, that the Legacy Tariff and Core/Broader group aspects of these policies are accounted for in the fuel poverty statistics. To achieve this, some final adjustments are made to the dataset which act to reduce the prices or total bills for those households considered likely to be in receipt of the WHD. The total number of tariffs applied in this process is set to be equal to the total number of households in receipt of support through these elements of the WHD scheme, as reported by Ofgem.

Information on eligibility for each element of the WHD is also provided by Ofgem to allow the assignment of tariffs. There are, however, more households theoretically eligible for this scheme than actually in receipt of these tariffs. Therefore, a process of repeated sampling from the pool of eligible households, and selection of a representative iteration is undertaken (i.e. through Monte-Carlo type simulation).

The process of assigning the WHD is as follows:

a) Details of the number of households in receipt of each component of the WHD are provided by Ofgem (for the Legacy Tariffs component, this includes the level of associated discount, split by each method of payment).

b) Details of eligibility for each element of the WHD are provided by Ofgem, and flags created in the EHS dataset.

c) A series of runs are made, sampling from the pool of eligible households, which reduces the tariffs for those eligible for Legacy Tariffs, or subtracts the WHD cash amount (e.g. £135 for 2013-14 data) from the final bills for those in the Core or Broader Groups. The number of households in receipt of each element of the WHD is used to constrain this modelling.

d) A representative iteration is selected from all runs.

The representative iteration is selected as the run showing the least variation from the average (median) of all runs. This is done by examining the variation of each run from the median level of fuel poverty split by income decile, tenure, region, age of oldest person in household, method of payment for gas and vulnerability.

The WHD has been applied for all years from 2011 to 2013, although for the 2010 single year data, this process was applied to the precursors to the WHD policies – i.e. Social Tariffs and the £80 electricity rebate.

5. How is household energy consumption calculated?

5.1 Overview

The amount of fuel required to provide the energy needs of each household is one of the components of fuel poverty and, combined with fuel prices, produces the modelled fuel bill.

Under the fuel poverty definition, the energy required to heat and power a home includes energy for

i) Space heating - E_S (GJ).
ii) Water heating - E_W (GJ)
iii) Lights and appliances - E_{LA} (GJ).
iv) Cooking - E_C (GJ).

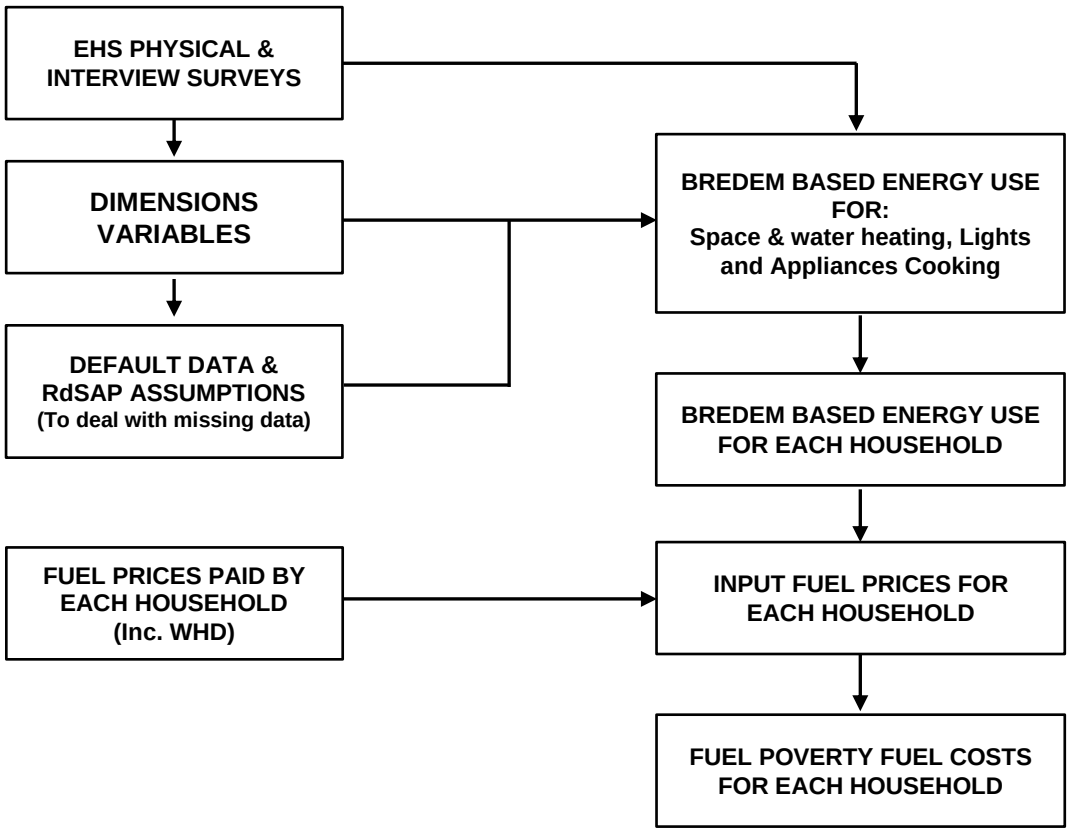
A BREDEM methodology[11] is used to predict the energy use of a household where:

$$Total\ household\ fuel\ consumption = E_S + E_W + E_{LA} + E_C$$

Total household energy use includes space and water heating (to meet defined standards) and energy for lights, appliances and cooking. The amount of energy required to heat a dwelling will depend on the building specification such as insulation levels, heating systems, the geographical location of the dwelling, and construction type. A household's demand for energy will depend on the number of people within the household and the lifestyle and habits of these individuals. Information from the EHS is used to provide details about both dwellings and households. The calculation process is summarised in Figure 6 below.

[11] The BREDEM methodology used for the 2013 data, and accompanying timeseries is described in Henderson J, Hart J, BREDEM 2012 A technical description of the BRE Domestic Energy Model, v1.1, January 2015. http://www.bre.co.uk/filelibrary/bredem/BREDEM-2012-specification.pdf

Figure 6: Calculating household energy consumption and associated fuel costs



The calculation method for each component of energy consumption is aligned with standard energy models such as the SAP[12] for calculating energy use in dwellings and the more general model from which SAP is derived (BREDEM).

5.2 Dimensions calculation for fuel consumption calculations

Data from the EHS physical survey are used to calculate the dimensions of the dwelling and, in particular, the heated volume and heat loss areas. This involves utilising data from many different modules that relate to different parts of the EHS physical survey form. The following information is calculated:

- Internal & external wall areas
- Roof area
- Room specific floor areas
- Habitable floor area and footprint area[13]
- Perimeter of building
- Ceiling height
- Window areas
- Number of floors and rooms in a dwelling

[12] BRE 2012. The Government's Standard Assessment Procedure for energy rating of dwellings: 2012 edition.
[13] Footprint area is the area of the dwelling in contact with the ground at ground floor level.

Key variables are the width and depth of the main and additional parts of the dwelling, which are directly collected in the EHS physical survey. These are used to determine the area (m^2) of each floor. All physical data relating to the dwelling must have a value for the width and depth of the building to be considered part of the main data set. The EHS survey form only has space to include the widths and depths of three levels, so the dimensions of any further levels are imputed. They are assumed to be the same size as the floor below, with the exception of any attics, which are assumed to be half the size of the floor below, and basements, which are assumed to be the same size as the floor above. In general, wherever possible, imputations are based on the case in question, not on stereotypes or on the rest of the data set.

5.3 Dwelling fuel consumption and energy use

The calculation of fuel consumption data for fuel poverty requires information from both the physical and interview surveys and the dimensions data to derive the following:

- Heat loss due to conduction from all the external house structure to the external environment, for example heat lost through the walls or roof.
- Heat gain from solar fluxes and other gains such as from lights and appliances and occupants.
- Heat loss due to ventilation.
- Energy required for space and water heating systems.
- Heating regime of the inhabitants (the details of which will be developed below).
- Energy required for lights, appliances and cooking.
- Electricity generation from renewable technologies (photovoltaics and micro generation wind turbines).

This information is calculated using data collected from the interview and physical surveys, as outlined in Sections 5.4 to 5.7.

5.4 Space heating and definition of heating regime

The amount of energy required for space heating is estimated using the BREDEM algorithm. The 2013 statistics, and accompanying timeseries, use version 1.1 of the BREDEM 2012 methodology for the energy calculations[14].

BREDEM requires the geographical location of a dwelling and the specification of a heating regime (that defines an acceptable level of heating). An acceptable level of heating is defined in terms of the temperature of a dwelling, the extent to which the dwelling space is heated and the number of hours that the occupants spend within the dwelling and require heating.

Geographical Location

BREDEM 2012 defines twelve geographical regions for England. These BREDEM regions define average climatic conditions such as temperature, solar flux (i.e. heat gains from the sun) and wind-speed. Each dwelling in the EHS has a geographical

[14] Henderson J, Hart J, BREDEM 2012 A technical description of the BRE Domestic Energy Model, v1.1, January 2015, http://www.bre.co.uk/filelibrary/bredem/BREDEM-2012-specification.pdf

identifier that can be used to determine in which BREDEM region the property is located.

Demand Temperature

BREDEM 2012 suggests that (generally) a house can be split into three distinct zones: a primary heated zone, secondary heated zone and unheated zone. For the modelling of fuel poverty, the demand temperature of all dwellings within the primary zone is assumed to be 21°C, the secondary zone is assumed to be heated to 18°C and the temperature of the unheated zone relates to the external temperature and therefore varies depending on the local climatic conditions.

Extent of Heating

Some dwellings are considered excessive in size for the number of occupants that live there. In these cases, the house is assumed to be "under-occupied", that is only a proportion of the dwelling will need heating. In order for a dwelling to be considered under-occupied it must fulfil the criteria that depend on both the number of bedrooms in a dwelling and the total floor area of the dwelling. These criteria are described in more detail below.

A dwelling is considered to have surplus bedrooms if there are one or more extra bedrooms than required for homes without dependent children (children under 18 years); or there are two or more extra bedrooms than required for homes with dependent children.

The number of bedrooms required depends on the household constitution. The standard states that a bedroom is required for each couple, children of different sexes below the age of 11 years can share a room, children/adolescents below the age of 21 years of the same sex can share a room.

There is surplus floor area in a property if the floor area of the property is over double that considered to be the "standard" living area required for the number of occupants, as defined by the Parker-Morris Standard[15]. This standard is defined as in Table 3 below.

Table 3: Parker Morris Standard

Occupants	Standard living area required (m^2)
1	33.0
2	48.5
3	61.0
4	79.0
5	89.5
6	97.0
7	114.5
8	128.0
9	140.0

[15] "Homes for today and tomorrow", Department of the Environment, HMSO 1961.

For the purposes of fuel poverty, a dwelling is considered to be under-occupied if there are both surplus bedrooms and surplus floor area.

If a dwelling is under-occupied then it is assumed that approximately half of the dwelling is heated, that is:

$$A_{heated} = 0.5 * A$$

Where *A* is the total floor area of the dwelling.

Heating Regimes

The heating season is defined as the months of October to May, in line with the SAP methodology. The regimes that are applied during the heating season are described below.

A standard heating regime assumes that the occupants are not occupying the dwelling during normal working hours. In this case it is assumed that the occupant heats the dwelling for two hours first thing in the morning and then for seven hours from late afternoon. During the weekend it is assumed that the property is heated throughout the day for 16 hours. The SAP methodology also makes this assumption to calculate the energy consumption in a dwelling.

This heating pattern does not apply for large sectors of the population, in particular the vulnerable such as the elderly and those caring for young children. From 2001, the EHS interview survey included a direct question to ask whether anybody within the household occupied the dwelling during the morning or afternoon. This question is directly utilised to approximate the heating pattern. If anybody is in the house in either the morning or afternoon during weekdays, the house is assumed to require all day heating. In these cases all day heating is assumed throughout the week as well as the weekend.

In dwellings that are under occupied, it is assumed that some of the rooms in the dwelling are not heated and a “half-house” heating regime is applied. For example, where a single person occupies a four bedroom house, it would be assumed that some of the bedrooms are not heated.

The following heating regimes are defined and used to calculate the energy consumption of a household:

Table 4: The standard heating regime for the fuel poverty heating calculations

	Details of STANDARD heating regime
Heating Pattern	Weekday 9 hours of heating Weekend 16 hours of heating
Heating Extent	Whole house
Demand Temperature	Primary living zone 21°C Secondary living zone 18°C

Table 5: The full heating regime for the fuel poverty heating calculations

	Details of FULL heating regime
Heating Pattern	Weekday 16 hours of heating Weekend 16 hours of heating
Heating Extent	Whole house
Demand Temperature	Primary living zone 21°C Secondary living zone 18°C

Table 6: The partial standard heating regime for the fuel poverty heating calculations

	Details of PARTIAL STANDARD heating regime
Heating Pattern	Weekday 9 hours of heating Weekend 16 hours of heating
Heating Extent	Half house
Demand Temperature	Primary living zone 21°C Secondary living zone 18°C

Table 7: The partial full heating regime for the fuel poverty heating calculations

	Details of PARTIAL FULL heating regime
Heating Pattern	Weekday 16 hours of heating Weekend 16 hours of heating
Heating Extent	Half house
Demand Temperature	Primary living zone 21°C Secondary living zone 18°C

Having defined the heating regime used by each household, the energy use for space heating can be approximated using BREDEM, which calculates the energy required to bring each dwelling to the designated temperatures for a set period of time each day and across the year. This calculation incorporates details about the heating systems, applied insulation and dwelling construction and materials.

5.5 Water heating

Energy demand for water heating Q_U is the energy required to heat the volume of water needed for baths, showers and other uses. The detailed equations are presented in the BREDEM 2012 documentation.

Most methods of water heating involve energy losses that relate to storing the water in hot water tanks and distribution losses. Therefore, the total water energy demand must satisfy the hot water requirements and account for the energy losses inherently

involved in satisfying the supply required. Hot water storage losses are mostly influenced by tank insulation and tank volume.

The energy required for water heating E_W (GJ/yr) is given as:

$$E_W = (kQ_U + Q_{Loss} - Q_S)/\mathcal{E}W$$

Where Q_{Loss} are losses through water storage/distribution, Q_S is solar hot water heating, $\mathcal{E}W$ is the efficiency of the water heater and k is a constant.

5.6 Lights and appliance use

Energy demand for electricity E_{LA} (GJ/yr) includes lights, appliances, pumps, fans and electric showers, less the electricity generated by renewable electricity sources such as photovoltaics and wind turbines (where applicable). The algorithm for lighting energy consumption includes provision for low energy lighting. The full equations can be found in the BREDEM 2012 documentation.

5.7 Cooking energy use

Energy demand for cooking is given as E_K (GJ/yr):

$$E_C = f_{gas}(1.7316 + 0.3456N) + f_{electricity}(0.990 + 1.198N)$$

Where f_{gas} and $f_{electricity}$ are the proportions of demand satisfied from gas or electric cooking, respectively.

Where both gas and electricity are present in a dwelling it is assumed that the proportion of gas and electrical energy demanded for cooking is split equally. Consequently, in this case f_{gas} =0.5 and $f_{electricity}$ =0.5.

Where a gas connection is present (i.e. a gas meter is identified by the surveyor), but no gas space or water heating appliances are present, it is assumed that the gas connection is not in use. In these cases 100% of energy demand for cooking is assumed to be met by electricity. No gas standing charge will be applied in the final calculation of fuel cost.

5.8 Energy costs

Total energy consumption is given as:

$$Total\ energy\ use\ (GJ/yr) = E_S + E_W + E_{LA} + E_C$$

Where:

E_S: Energy for space heating;

E_W: Energy for water heating;

E_{LA}: Energy use for lights and appliances;

E_C: Energy use for cooking.

Different fuels may be used for some or all of these energy contributions and therefore different tariffs, and in some cases standing charges, must be applied to approximate the total cost of energy to the household as described earlier in the fuel price section.

$$Total\ energy\ cost\ (£) = £_S + £_W + £_{LA} + £_c + £_{Standing}$$

Where:

$£_S$: Energy cost for space heating;
$£_W$: Energy cost for water heating;
$£_{LA}$: Energy cost for lights and appliances;
$£_C$: Energy cost for cooking;
$£_{Standing}$: Standing charges for all fuels.

In the fuel poverty datasets, standing charges have been assigned to the most appropriate component of energy consumption:

Energy cost for space heating ($£_s$) includes: the gas standing charge if gas is present; standing charges associated with communal systems or other fuels; and standing charges from off-peak electricity tariffs, above the standard rate charge. Energy cost for lights and appliances ($£_{LA}$) includes: the standard electricity charge, not related specifically to heating; and the Warm Homes Discount (WHD) rebate if applicable.

Due to the simplified way of assigning standing charges to the energy costs, this may result in a few cases where a standing charge is assigned to space heating despite the fuel not being used in this way. For example, households with a gas space heating cost but no gas space heating usage can be due to the standing charge allocated to the space heating costs arising from a gas-based water heating system. For households with electric space heating costs yet no electric space heating usage can be due to the allocation of standard electricity charge to lights and appliance and off peak standing charges to space heating.

5.9 Space and water heating systems

Information relating to the heating systems assigned for each dwelling is taken directly from the information collected on the EHS physical survey. The primary heating group, fuel and type are essential for the allocation of the primary heating system and the calculation of energy use for each household. In cases where primary data are missing for the heating systems, information from 'other heating' (secondary heating) is used in its place according to the SAP methodology. System efficiencies are determined from SAP. Heating system boiler efficiencies can also be

assigned from the SAP products characterisation database[16] in cases where boiler manufacturer and model details have been completed by the surveyor. SAP efficiencies are used in all other cases.

Information relating to the presence and specification of the water heating system is also obtained from the EHS physical survey. In the majority of cases, the hot water is heated via the space heating system and, where this is the case, the space heating specification will be applied.

5.10 Handling missing values

Alteration to the dwelling data

When performing detailed checks on the outputs, there are cases that are flagged where values recorded on the physical survey form are deemed implausible and require alteration to the raw data within the energy modelling process. Each case is assessed on a case-by-case basis using other information from the survey form in order to apply the appropriate action for the data to be processed correctly.

Missing dwelling data

Most of the data required to calculate the energy consumption of the household are available from the EHS survey. Where there are missing data items, these are dealt with in accordance with reduced data SAP (RdSAP) assumptions for existing buildings as specified in Appendix S of the SAP 2012 booklet. The exception is missing loft insulation where the occupant has access to the loft space. Loft insulation is assigned using the mean value for dwellings of that age and tenure using what is referred to as ‘default data’. This data is constructed using national averages from the EHS.

Missing household data

The number of occupants living in a dwelling and the composition of the household is provided in the interview survey. Data are required for each individual household. If this information is not available then the property is considered to be vacant – the dwelling will not be included for fuel poverty calculations and can be ignored.

Validation

Validation of the energy use and cost outputs is an important process in the delivery of reliable results. The level of validation applied will depend on the level of accuracy quoted, the significance of the indicator, the type of result quoted and the resource provided for the task. Several layers of data validation are applied to the fuel poverty energy use and cost variables. These include cross checking from an independent member of staff, time series analysis, interrogation of important metrics, and

[16] SAP products characterisations database, http://www.ncm-pcdb.org.uk/sap/pcdbsearch.jsp?pid=26

comparing results against external data sources such as Citizens Advice Bureau[17] for fuel prices and the Digest of UK Energy Statistics (DUKES) [18] for energy use.

Outliers

Outlying cases are identified in the data and validated to ensure that the data modelling processes is being performed correctly. In rare cases where the data is deemed to require modification, the fuel costs are imputed based on the median value from a group with similar characteristics (grouped according to dwelling type and main heating fuel category).

5.11 Changes to the dwelling calculation procedure

The Building Research Establishment Domestic Energy Model (BREDEM) is the calculation procedure used for modelling energy consumption in dwellings for fuel poverty. It was first developed in the early 1980s and has been continuously updated as a result of changes to our understanding of dwelling energy consumption and the use of energy in the national housing stocks.

The latest version of BREDEM 2012, version 1.1[19], is used for both years in the combined 2013 dataset, and all timeseries data. All data is, therefore, on as comparable methodology as possible to allow comparison between years and assist interpretation of the data.

This version of BREDEM supersedes the previous version of BREDEM 2012 (version 1.0), as used in the second half of the 2012 statistics, and the BREDEM-12 (2001 methodology)[20] used all years prior to this.

BREDEM 2012 is a monthly calculation, whereas BREDEM-12 (2001 methodology) is an annual calculation. BREDEM 2012 also included significant revisions to the cooking, lights and appliances algorithms and climate data, alongside numerous other changes. The most significant difference between the version 1.1 of BREDEM 2012 methodology, compared to version 1.0 methodology, is that the interzone heat transfer coefficient is now calculated using the dwelling's smaller zone (typically living room) rather than the larger zone (typically zone 2).

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[17] These data have formerly been produced by EnergyWatch, Consumer Focus and Consumer Futures. Consumer Futures became part of Citizens Advice in 2014.
[18] DUKES, Digest of United Kingdom Energy Statistics: https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/digest-of-uk-energy-statistics-dukes
[19] Henderson J, Hart J, BREDEM 2012 A technical description of the BRE Domestic Energy Model, v1.1, January 2015, http://www.bre.co.uk/filelibrary/bredem/BREDEM-2012-specification.pdf
[20] Anderson B R, P.F Chapman, N.G Cutland, C. M. Dickson, G. Henderson, J.H. Henderson, P.J. Iles, L. Kosmina and L. D. Shorrock, BREDEM-12 Model Description 2001 update, BRE Report, BRE, Watford, 2001.

6. What fuel poverty statistics are available to users?

6.1 Fuel poverty data

DECC publish a large set of detailed tables, showing fuel poverty levels and rates by income decile, tenure, dwelling type, household composition and many other factors concerning both the householders and the dwelling itself (e.g. insulation measures) . DECC also publish an Excel workbook looking at trends in fuel poverty since 2003 for a range of sub-groups. To allow comparison, these tables show the results, under the LIHC definition and under the consistent (BREDEM 2012 v1.1) timeseries.

Both of these can be found on the DECC website at:

https://www.gov.uk/government/collections/fuel-poverty-statistics

The 2013 fuel poverty dataset, along with datasets from previous years, will be made available via the UK Data Archive. These datasets, which contain the underlying data used to calculate fuel poverty, are intended for advanced users of fuel poverty data. Anonymisation techniques are applied to the fuel poverty datasets and the accompanying English Housing Survey datasets deposited on the UK Data Archive to ensure that individuals, households and dwellings cannot be identified. The anonymisation techniques applied include removal of variables e.g. string variables which have the potential to contain disclosive information, bottom/top coding of continuous variables to avoid outliers in the data and aggregating similar categories/responses to reduce risk of disclosure.

In addition to this, DECC also publish fuel poverty data at a sub-regional level. Data for local authorities, counties, Lower Super Output Areas (LSOAs) and Parliamentary Constituencies can be found on the DECC website at:

https://www.gov.uk/government/collections/fuel-poverty-sub-regional-statistics

6.2 Fuel poverty publications

The Annual Report on Fuel Poverty Statistics 2015 reports the headline fuel poverty statistics for 2013 under the low income high cost measures of fuel poverty. Estimates of fuel poverty under the previous 10% indicator are also included to enable a UK wide comparison and to produce the overall UK estimates. The report provides an explanation of these figures, and the reasons for change from previous years, by looking at household income, energy prices and energy efficiency. In addition, the report explores the trends in fuel poverty since 2003 amongst various

sub-groups. This publication is available, alongside the reports from previous years, on the DECC website:

https://www.gov.uk/government/collections/fuel-poverty-statistics

DECC also publish a range of fuel poverty monitoring indicators, which can provide a useful background to consider alongside the report. The indicators include data on disposable incomes, actual expenditure on fuel, and various DECC policies. This publication is also available at the above link.

6.3 Methodology information

Although this document supersedes all previous methodology documents, the methodology documents from previous years are also available from the archive section of the DECC website.

6.4 Consultation

Through the Energy Act 2013, the Government has implemented a new legal framework to monitor fuel poverty in England using the Low Income High Costs Indicator (LIHC). This new measure of fuel poverty was first proposed in Professor Hills' review of Fuel Poverty[21] and following consultation, the Government confirmed its intention to adopt the indicator in July 2013[22]. In the accompanying strategic framework document, 'Fuel Poverty: a framework for future action'[23], Government set out how the new indicator will inform the strategic approach to tackling fuel poverty, including setting a new fuel poverty target which will be underpinned by a new fuel poverty strategy.

A draft strategy and consultation document, 'Cutting the cost of keeping warm' was then published in July 2014. This proposed the creation of an additional indicator known as the Fuel Poverty Energy Efficiency Rating (FPEER) for use in targeting, and a number of targets tied to specific dates. Secondary legislation was put forward in December 2014 for this rating, alongside the LIHC definition, to form the basis of the statutory target for fuel poverty. This requires, as far as reasonably practicable, for all persons living in fuel poverty to have an FPEER of Band C or above by 31st December 2030.

In March 2015 the final Fuel Poverty Strategy was published, confirming the main and interim targets, alongside the responses to the July 2014 consultation.

[21] See https://www.gov.uk/government/publications/final-report-of-the-fuel-poverty-review
[22] See https://www.gov.uk/government/consultations/fuel-poverty-changing-the-framework-for-measurement
[23] See https://www.gov.uk/government/publications/fuel-poverty-a-framework-for-future-action

7. What information is contained in the fuel poverty detailed data?

As referred to in Chapter 6, detailed fuel poverty data for England in 2013 is available from the UK Data Archive. This section summarises the variables that are available in the main dataset. Further details on these variables can be found in the specific documentation which accompanies the dataset. Advanced users of the data should note that additional, more detailed, variables are also available in a supplementary dataset.

- EHS case number (aacode)
  This is the unique identifier of the household within the data set. The first letter of the case number identifies the year to which that household relates. For example, in the 2012/13 data, identifiers beginning with 'K' relate to households surveyed during the 2012 survey, while 'L' relate to households surveyed during the 2013 survey. This unique identifier also enables the detailed fuel poverty data set to be merged with other variables from the EHS (for more information see Chapter 8).
- Annual full household income (£) (fpfullinc)
  The full income definition is calculated by adding the personal incomes of every member of the household together, plus any benefit payments that the household receives (including from private sources, state benefits and savings). Full income also includes income related to housing such as housing benefit, Support for Mortgage Interest (SMI), Mortgage Payment Protection Insurance (MPPI) and Council Tax benefit/support and deducts the amount of council tax payable.
- Full income deciles (FullincDeciles)
  A banded version of the full income.
- Annual basic household income (£) (fpbasinc)
  The basic income definition differs from the full income only in the exclusion of housing related income/deduction of council tax payable.

  Both income variables are modelled using data from the interview part of the English Housing Survey (EHS). More details on the methodology can be found in Chapter 3.
- Total fuel costs (£) (fuelexpn)
  This is the modelled amount spent on fuel for the year, and is the sum of the fuel costs for the four areas of domestic energy consumption (namely space heating, water heating, lights and appliances and cooking). More information can be found in Chapter 5.

- Total space heating cost (£) (spahcost)
  The modelled annual amount spent on fuel for space heating purposes such that the household achieves the adequate standard of warmth as set out in the definition of fuel poverty for England. It is subject to a range of characteristics of both the dwelling and its occupants.

- Cost of energy to heat water (£) (wathcost)
  This is the modelled annual amount spent on fuel for heating water in the household.

- Total cost for lights and appliance use (£) (litecost)
  This is the modelled annual amount spent on fuel for the use of lights and electrical appliances.

- Total energy cost for cooking (£) (cookcost)
  This is the modelled annual amount spent on fuel for the purposes of cooking.

- Method of payment - electricity (elecmop)
  This variable describes how the household pays for its electricity, with the three main categories including Standard Credit, Direct Debit and Pre-payment meters. This information is collected during the EHS and, in some cases, assumptions are made as to which of the categories is the most appropriate – see Section 4.3 for further information.

- Method of payment – gas (gasmop)
  This variable is also devised from information gathered from the EHS. As well as the three main categories (Standard Credit, Direct Debit and Pre-payment meters), there is an additional category 'No gas' for those households that report they do not have a gas connection.

- 10% definition Fuel poverty index - full income definition (fpindf)
  Derived by dividing the total modelled annual fuels costs by the full income in order to calculate the proportion of income that is spent on household energy needs. If a household has an index of over 0.1 then it is said to be in fuel poverty. *N.b. the 10% definition is now no longer used for the official statistics in England.*

- 10% definition Fuel poverty index - basic income definition (fpindb)
  Calculated in an identical way to the above, except here the basic definition of income is used instead of the full definition. *N.b. the 10% definition is now no longer used for the official statistics in England.*

- 10% definition Fuel poverty flag - full income definition (fpflgf)
  Included for comparison with the definition used in other nations. A flag to notify whether a household is in fuel poverty using the 10% indicator, according to the fuel poverty index (full income definition). A value of 1 indicates that the household is in fuel poverty, 0 indicates that they are not in fuel poverty. *N.b. the 10% definition is now no longer used for the official statistics in England.*

- 10% definition Fuel poverty flag - basic income definition (fpflgb)

As above, but using the fuel poverty index – basic income definition. *N.b. the 10% definition is now no longer used for the official statistics in England.*

- Annual housing costs (£) (HousingCosts)

  The annual household costs of the household (rent, mortgage payments)

- Equivalised After Housing Costs annual income (£) (AHCIncomeEQ)

  The equivalised after Housing Costs income as used in the LIHC indicator.

- Equivalised After Housing Costs annual deciles (EqAHCincDeciles)
  A banded version of the equivalised after housing costs income.

- After Housing Cost equivalisation factor (AHCeqFactor)

  The factor used to equivalise after housing costs income in the LIHC indicator.

- Before Housing Cost equivalisation factor (BHCeqFactor)

  The factor used to equivalise *before* housing costs income. Not used directly within the LIHC indicator but included as a supplementary variable for analysis.

- Fuel costs equivalisation factor (FuelCosteqFactor)

  The factor used to equivalise fuel costs in the LIHC indicator.

- Fuel poverty flag- Low Income High Costs definition (fpLIHCflg)
  A flag to notify whether a household is in fuel poverty under the LIHC indicator.

- Fuel poverty quadrant – Low Income High Costs definition (fpLIHCqdt)
  This shows which of the four quadrants under the LIHC metric, a households falls into. The four values are: LIHC (low income, high costs), LILC (low income, low costs), HIHC (high income, high costs) and HILC (high income, low costs).

- Fuel poverty equivalised gap – Low Income High Costs Definition (fpLIHCgapEQ)
  This shows the *equivalised* fuel poverty gap for each household that is classed as being fuel poor under the LIHC indicator. Households that are not fuel poor under this definition will have a gap of zero. The equivalisation factor needs to be applied to return the gap to an unequivalised (actual) value in pounds.

- Fuel poverty unequivalised gap – Low Income High Costs Definition (fpLIHCgapUNEQ)
  This shows the *unequivalised* fuel poverty gap (in pounds) for each household that is classed as being fuel poor under the LIHC indicator. Households that are not fuel poor under this definition will have a gap of zero.

- Vulnerable flag - fuel poverty definition (fpvuln)
  This variable is a flag to notify whether a household is classed as vulnerable (fuel poverty definition). Vulnerable households are those which contain children, the

elderly or someone who is disabled or who has a long term illness. This flag is derived using data from the EHS and a value of 1 indicates that the household is vulnerable, while 0 indicates that it is not vulnerable.

- Under-occupancy (Unoc)
  Under-occupied dwellings are those that are excessive in size for the number of occupants that live there. A value of 1 indicates that the dwelling is under occupied, 0 indicates that it is not under-occupied. More information on the definition of under-occupancy can be found in Section 5.4.

- Household weight (aagph1213)
  As the data set only contains information for 12,008 households (6,058 from the 2012 survey year and 5950 from the 2013 survey year), each entry is assigned a 'weight' which broadly indicates how representative that household is of other English homes. For example, if the weight is given as 2,000, then the characteristics attached to that household sampled in the EHS are similar to 2,000 households in England. The sum of the household weight for all 12,008 entries sums to the total number of households in England. The weighting takes into account he sampling techniques used and issues of non-response within the EHS.

If you require access to these data then please register and download them from the UK Data Archive: http://www.data-archive.ac.uk/

The English Housing Survey is managed by the Department for Communities and Local Government (DCLG). Annual reports on EHS findings and tables of EHS data can be found on the DCLG website at:

https://www.gov.uk/government/collections/english-housing-survey

Users can also obtain a copy of the underlying EHS data at the UK Data Archive. The following describes some of the key variables found in the EHS data set.

- EHS case number
  As in the Fuel Poverty data set, the EHS case number is the unique identifier of the household sampled. This number also allows users to match the EHS data set to the Fuel Poverty data set.

- Tenure
  This variable indicates whether the property is owner occupied, private rented, owned by the local authority or Registered Social Landlords (RSL).

- Dwelling age
  This variable indicates the age of the oldest part of the building, giving the period in which it was built.

- Dwelling type

The type of dwelling includes end terrace, mid terrace, semi-detached, detached, bungalow, converted flat, purpose built flat (low rise) and purpose built flat (high rise).

- Dwelling size
  This variable indicates the total usable internal floor space that the property encompasses.

- Area type
  The EHS contains various categorisations of area which describe the area in which the property is located.

- Household composition
  This variable shows the type of people who live in the household. The categories include 'Couple with dependent child(ren)', 'Couple, no dependent children, aged 60 or over', 'Couple, no dependent child(ren), under 60', 'Lone parent with dependent child(ren)', 'One person under 60', 'One person 60 or over' and 'Other multi-person households'. The EHS also contains other different categorisations of household composition.

- Age of oldest householder
  The age of the oldest person who resides in the household.

- Age of youngest householder
  The age of the youngest person who resides in the household.

- Employment status of the HRP
  This variable indicates whether the Household Reference Person (HRP) was employed, inactive (for example retired) or unemployed at the time of the survey.

- Long term illness/disability
  This variable indicates whether at least one person in the household has a disability or has been diagnosed with a long term illness.

- Ethnicity of HRP
  The Household Reference Person (HRP) ethnicity.

- Length of residence
  This is the length of time that the current occupiers have been in the property.

The EHS also contains a number of variables concerning energy efficiency measures and heating methods, some of these are detailed below.

- Extent of double glazing
  This variable indicates the extent to which the windows in the property are doubled glazed.

- Main heating system
  This variable shows the primary way in which the household is heated, using either central heating, storage heaters, fixed room heating (e.g. a fixed gas fire in the living room) or portable heating (e.g. portable electric heaters).

- Type of boiler
  This variable indicates what type of boiler is present in the property, for example combination boiler, condensing boiler, etc.

- Loft insulation thickness
  This variable shows the depth of thickness of the loft insulation (if any) in the property. It also indicates where a dwelling does not have a loft.

- Cavity wall insulation
  This variable from the EHS data shows if properties with cavity walls are insulated or not. There is an additional category of 'Other', which includes all properties without cavity walls.

- SAP rating
  The SAP rating is based upon the energy costs associated with space heating, water heating, ventilation and lighting in a dwelling. It is adjusted for floor area so that it is essentially independent of floor area for a given built form. SAP ratings are expressed on a scale of 1 to 100+, and the higher the number, the higher the energy performance.

8. How accurate are the fuel poverty statistics?

Fuel poverty in England is published as a point estimate of the number of households affected. A series of models are used to calculate the figure using inputs from a variety of sources, many of which are approximations. Therefore, the modelling process requires numerous assumptions. For example, there is no information on the energy supplier and the tariff that a household uses. Instead, households are assigned an average price depending on the region that they live in and the way in which they pay for their energy (e.g. standard credit, direct debit, etc.).

In 2014, DECC published analysis that estimated the uncertainty around the point estimates of fuel poverty for 2012. This analysis looked specifically at the uncertainty around household incomes fuel prices and fuel consumption, using these to then estimate the levels of uncertainty around the overall national estimates of fuel poverty. This analysis suggests that the addition of uncertainty is likely to increase the levels of fuel poverty observed.

We can interpret this in the context of the distribution of households across the LIHC metric – particularly in terms of how many households can be placed into the LIHC quadrant by the addition of uncertainty, compared to how many can be removed from this quadrant. As just over 10% of households are in fuel poverty, there are more households outside the LIHC quadrant than inside and in particular more households outside the LIHC quadrant close to the income and fuel costs thresholds (in the HIHC and LILC quadrants).Therefore the application of uncertainty is able to

move more households into fuel poverty than out of it (i.e. of 10 households, one would be in fuel poverty and nine not fuel poor – so it is more likely to place a number of the nine households into fuel poverty than remove the one household out of fuel poverty). This has the net effect of increasing the average number of fuel poor households, resulting in a slightly higher distribution of possible values for the number that are fuel poor, and so consequently the aggregate gap, after the addition of uncertainty.

These results need to be interpreted with caution. Any analysis of this kind is ultimately dependent on the input distributions used within the modelling, and the majority of the input distributions used are in themselves best estimates of uncertainty in each factor. Further to this, the analysis has been designed with a cautious approach, with conservative assumptions made throughout. As a result, these figures should be treated as indicative of the effect of uncertainty upon the national estimates of fuel poverty, rather than strictly quantitative.

Further detail on this analysis can be found in Chapter 8 of the 2014 main report:

https://www.gov.uk/government/publications/annual-fuel-poverty-statistics-report-2014

9. Other information

9.1 Fuel Poverty methodology Group

The Fuel Poverty Methodology Group (FPMG) was set up to consider the fuel poverty methodology, and is composed of statistical and methodological experts in fuel poverty and related areas, and users of the data (both government and external). The group's main objective is to ensure that the published data on fuel poverty continues to reflect the needs of the wider user community. Part of this is achieved through:

- Considering future improvement s to the fuel poverty methodology and commenting on year-to-year updates in the calculation process.
- Suggesting supplementary indicators of fuel poverty.
- Considering further analytical work that can be taken forward to widen the understanding of trends and drivers of fuel poverty.

The group, which meets around three times a year, includes members from the following:

- The modelling team working for the contractor, or within DECC.
- The Housing and Household Survey Unit of the Scottish Government, responsible for the Scottish Housing Survey (SHS).

- The Households Below Average Income Division in the Department for Work and Pensions (DWP).
- The Fuel Poverty Advisory Group
- National Energy Action
- Energy Audit Company
- The Centre for Sustainable Energy
- Consumer Focus
- Other fuel poverty and methodology experts

9.2 UKSA Assessment

The UK Statistics Authority (UKSA) is an independent body operating at arms- length from the Government as a non-ministerial department, directly accountable to parliament. The UKSA's objective is to promote and safeguard the quality and comprehensiveness of official statistics and to ensure good practice in relation to official statistics.

Between February and July 2010, the UKSA carried out an assessment of DECC's fuel poverty statistics against the Code of Practice for Official Statistics. The Code is structured in terms of 8 principles and 3 protocols, which encompass meeting user needs, impartiality and objectivity, and sound methods, amongst others. If, after an assessment by the UKSA, official statistics are found to comply with the Code, they are designated as National Statistics. This indicates to users that the statistics have been produced in line with the Code. More details of the Code can be found on the UKSA website at:

http://www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html.

In this assessment, the UKSA judged that the fuel poverty statistics are readily accessible, produced according to sound methods and are managed impartially and objectively in the public interest. As a result, the UKSA confirmed that the statistics published in the Annual Report on Fuel Poverty Statistics can be designated as National Statistics.

These statistics have since been re-assessed by the UK Statistics Authority against the Code of Practice for Official Statistics. The Statistics Authority published its report on 12 June 2014:

http://www.statisticsauthority.gov.uk/assessment/assessment/assessment-reports/index.html.

The Statistics Authority has determined that these statistics can maintain their designation as National Statistics subject to DECC implementing a small number of requirements across the range of DECC statistics assessed, relating to further documentation on the needs of users, improving methodology on assumptions, assessing risks to use of admin data, improving clarity and linkages between the

range of stats produced and review data release formats. These actions will be taken forward by end September.

10. Acronyms

Acronym	Definition
ASHE	Annual Survey of Hours and Earnings
AHC	After Housing Cost
BRE	Building Research Establishment
CAPI	Computer Assisted Personal Interviewing
CHAID	Chi-squared Automatic Interaction Detector
CTB	Council Tax Benefit
CTS	Council Tax Support
DECC	Department of Energy and Climate Change
DLA	Disability Living Allowance
DWP	Department of Work and Pensions
EHCS	English House Condition Survey
EHS	English Housing Survey
FPMG	Fuel Poverty Methodology Group
FRS	Family Resources Survey
HB	Housing Benefit
HBAI	Households Below Average Income
HRP	Household Reference Person

IS	Income Support
LA	Local Authority
LCFS	Living Cost and Food Survey
LHA	Local Housing Allowance
LIHC	Low Income High Cost
MPPI	Mortgage Payment Protection Insurance
MVS	Market Value Survey
ONS	Office for National Statistics
PBU	Primary Benefit Unit
RSL	Registered Social Landlord
SMI	Support for Mortgage Interest
UKSA	UK Statistics Authority
WFP	Winter Fuel Payment
WHD	Warm Homes Discount

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