

TECHNICAL NOTE: DEFINITION AND MEASUREMENT OF FUEL POVERTY IN SHCS REPORTS

DEFINING FUEL POVERTY

The term *fuel poverty* refers to a situation where a household is unable to heat its home at a reasonable cost. For the 2002 and subsequent Scottish House Condition Surveys fuel poverty in Scotland has been measured and reported on the basis of the definition given in the Scottish Executive Fuel Poverty Statement¹ (FPS), published in August 2002 which states;

“A household is in fuel poverty if it would be required to spend more than 10% of its income (including Housing Benefit or Income Support for Mortgage Interest) on all household fuel use.”

In this context **income** is defined as income before housing costs, as derived from the Households below Average Income (HBAI) definition set out in the FPS. A key feature of the income definition – discussed further in the ‘measurement of income’ section below - is that “income” is calculated net of council tax and income tax.

The definition of “**household fuel use**” is derived from the following heating regime as set out in the FPS:

- nine hours per 24 hour period during the week, with two hours being in the morning and seven hours in the evening.
- 16 hours per 24 at the weekend.
- living-room heated to 21 degrees Celsius.
- rest of the house heated to 18 degrees Celsius.
- for elderly and infirm households, the home is continuously heated for sixteen hours per day to a temperature of 23 degrees Celsius in the living-room and 18 degrees Celsius in other rooms.

Due to software constraints, the SHCS team cannot model a temperature difference of more than 3 degrees between the two heating zones. Contrary to the fuel poverty statement, the temperature regime for elderly and infirm households is fixed at 23 degrees Celsius in the living room and 20 degrees Celsius in other rooms. This leads to an increase in modelled fuel poverty, estimated in the SHCS Key Findings Report 2012 section 4.5.3.

The FPS does not give a precise definition of “**elderly**” or “**infirm**”. The following definitions of these terms have been applied in the SHCS analyses:

¹ The 2002 Scottish House Condition Survey also reports fuel poverty on the basis of the definition used in the 1996 Scottish House Condition Survey. Details of the definition and comparison between 1996 and 2002 are given in the 20032 Fuel Poverty Report.

- “elderly” refers to a household where at least one member is aged sixty or over (male or female).
- “infirm” refers to a household where at least one member has self-reported as long-term sick or disabled.

DEFINING AND MEASURING HOUSEHOLD INCOME

In the Fuel Poverty Statement, the income against which fuel poverty is assessed is defined as the total income from all members of the household, including dependants². This includes the following components:

- usual net earnings from employment.
- profit or loss from self-employment.
- all Social Security benefits (including Housing Benefit, Social Fund, maternity, funeral and community care grants, but excluding Social Fund loans) and Tax Credits.
- income from occupational and private pensions.
- investment income.
- maintenance payments, if a person received them directly.
- income from education grants and scholarships (including for students, top-up loans and parental contributions).
- the cash value of certain forms of income in kind (free school meals, free welfare milk, and free school milk).

Under this definition, **income is net of the following items:**

- income tax payments.
- National Insurance contributions.
- Council Tax.
- Contributions to occupational pension schemes (including additional voluntary contributions) and any contribution to personal pensions.

² The Fuel Poverty Statement defines the income of a household with reference to the measurement of income in the Households Below Average Income Analyses used to measure and report on poverty more generally.

- All maintenance and child support payments, which are deducted from the income of the person making the payment.
- Parental contributions to students living away from home.

Measurement of income in SHCS

The household income used in the SHCS implementation of the FPS definition is the income (net of income tax and national insurance) of the Highest Income Householder (HIH) and his or her spouse/partner. Household income comprises all income from the following sources:

- employment, self-employment, part-time and casual work.
- state benefits including Council Tax Benefit and Housing Benefit (see below).
- student grants and loans.
- any other regular non-work income including non-state pensions, investment income, etc.

Information was also collected on the receipt of the Winter Fuel Payment. This was added to the income of all households containing a person of state pension age and to those households with a person aged 60 or over who had stated that they had received this payment. This income figure was then adjusted by deducting council tax.

Differences between SHCS income measurement and FPS definition

The main difference between the income and benefits data collected in the SHCS and the FPS definition is that SHCS measures only the income of the Highest Income Householder (HIH) and his or her spouse/partner. No income information is obtained about any other economically active adult household members. Therefore, the SHCS will underestimate the income of households which include several working adults and therefore may overstate fuel poverty for this group. Since the incidence of fuel poverty among multi adult households is relatively small this omission does not have a major impact on the overall estimate.

How the information is collected in the survey

Household income is the net income of the Highest Income Householder and their spouse/partner. The income of any other member of the household is not included. Household income comprises all earned income (from employment, self-employment, part-time and casual work), all income from state benefits (including Council Tax and Housing Benefit), student income, non-state pensions, investment income and any other regular non-work income.

The data for individual components of the income are collected in the social survey under the following main headings:

- Earnings from main job (employed or self-employed) and other jobs.
- State benefits including state pensions.
- Other regular income (non-state pensions, investment income, rent from property, maintenance payments, student income etc).

All income data are thoroughly checked for inconsistencies and corrected where the source of error can be readily identified. Mostly, errors are due to incorrect recording of the period for the income amount (eg per annum amounts were incorrectly recorded as per month).

Where amounts given covered a period of less than a year, it is assumed that they are typical incomes for the purpose of calculating the annual income. Earnings data are requested net (after tax and national insurance), but gross amounts are collected if the respondent was unable to provide a net amount. Tax and national insurance are calculated for the amounts given gross and deducted to give the net annual income. Many benefits are not taxable. The amount received is requested for benefits and other regular income sources. The amounts for these income sources are therefore assumed to have had tax already deducted, where applicable.

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Imputation

Although some level of item non-response is inevitable across all aspects of the social and physical surveys (eg where a householder refused to answer a particular question, or a surveyor could not get into a loft), in most situations this does not affect the power of the survey to produce valid and useful estimates. The exception to this is the assessment of income and housing costs, where there is generally a higher proportion of item refusals.

In order for the survey to be able to produce income and housing costs, a statistical process known as imputation is carried out. Imputation involves replacing missing values with the values associated with other households which have the same characteristics, defined according to the nature of the missing item. In each of the surveys, the imputation of missing income and housing costs data has been carried out by the survey contractor according to a set of requirements specified by the Scottish House Condition Survey team. Hot Deck imputation was used for all missing income and housing costs items. In Hot Deck imputation, the sample is divided into imputation classes based on the relevant characteristics of cases and these classes contain potential donor cases. A donor case is selected at random from the imputation class and the item value for that case is assigned to

the case with the missing item value. The relevant characteristics were chosen using regression analysis.

MODELLING FUEL COSTS

The fuel costs used in the estimation of fuel poverty are based on a model which estimates how much it would cost to heat the dwelling to the specified regime. These modelled fuel costs include an allowance for other fuel costs including lighting, cooking and use of appliances.

The BREDEM-12 model

The model used to calculate required fuel costs is based on a methodology developed by the Building Research Establishment (BRE) to calculate energy consumption in dwellings. The methodology is known as BREDEM (the Building Research Establishment Domestic Energy Model). The version used for estimating energy use and hence fuel costs in this report was BREDEM-12.

BREDEM-12 uses a mixture of analytical and empirical techniques to assess the energy requirements needed in a dwelling to achieve a specified heating regime. A full technical description of the model is covered in the BRE Laboratory Report. A very broad description of the model is provided here.

BREDEM-12 models a dwelling as a number of 'zones'. Zone one is the main living area of a dwelling; Zone two the remainder, or that proportion of the remainder explicitly designated if the property is underoccupied. The model takes as raw data the heating regime required for each zone, occupancy levels, and the dwellings' heating system together with the characteristics of the dwelling and its fabric. In calculating the energy requirements of a dwelling, BREDEM-12 uses what has been discovered about the thermal qualities of housing over successive English House Condition Surveys, and allows for:

- Dwelling 'U' values – the capacity of the fabric of a dwelling to allow heat loss from within, to the external environment.
- 'Infiltration rates' – the patterns of air movement within a dwelling.
- 'Thermal capacity' – or the intrinsic ability of different materials (e.g. stone, or wood) to hold heat.
- 'Internal Heat Transfers – from zone one to zone two, and from zone two to the unheated part of a house (if relevant).
- 'Metabolic gains' – essentially heat from bodies.
- Characteristics of the heating system within a house, like efficiency, responsiveness to change, and control systems.

- External weather conditions, including temperature, wind, and solar effects.

AutoEvaluator

To calculate annual dwelling fuel costs a complementary program that works with BREDEM-12 was used. This program, known as AutoEvaluator was developed by the National Energy Services Ltd (NES) in conjunction with BRE and National Energy Foundation (NEF). A full technical description is available in the documentation developed by NES. AutoEvaluator uses information determined from the energy analysis and, together with data on the cost of different types of fuel calculates annual dwelling running costs, both in total and broken down by costs associated with:

- Space heating.
- Water heating.
- Lighting and electrical appliance use.
- Cooking.

The program can also produce an estimate of the energy requirements of the dwelling for each of the above, together with the CO₂, SO₂ and NO₂ emissions for the dwelling.

AutoEvaluator generates three separate energy ratings for a dwelling:

- NHER (National Home Energy Rating), a rating system developed by NEF.
- SAP (Standard Assessment Procedure), a rating system developed by BRE.
- BEPI (Building Energy Performance Index), an alternative rating system developed by BRE.

During the development of the NHER index, two main objectives had to be met

(a) The index had to be directly related to the estimated running costs. Any feature of the dwelling that would have a significant effect on the running costs would be included and accredited.

(b) The index should relate to the engineering concept of energy efficiency.

Dwellings with the same level of insulation and heated by appliances with the same overall conversion efficiency should have the same rating. This led to the index being based on the total running costs per square metre of floor area. The details of the methods used to resolve this are beyond the scope of this report. However, it should be noted that item (a) above would be influenced by changes in fuel costs.

During development there was also a need to stabilise the NHER rating against fuel price changes. This was accomplished in two ways. Firstly the fuel prices are indexed to remove

inflation; secondly, the NHER uses a set of UK fuel prices that are the average of the fuel prices over the previous three years. This averaging process smoothes out fluctuations in relative fuel prices. The NHER uses the Fuel Price Index published as part of the retail price index series.

This stabilising process means that the standard fuel prices used in the NHER calculation are around 18/24 months behind actual fuel prices. This normally has no deleterious effect when used in a survey such as the SHCS since the energy analysis is carried out around 12/18 months after the data have been collected, meaning that there is a degree of synchronisation between the fieldwork period and the fuel cost data.

The AutoEvaluator program can operate at several levels, depending upon the amount of data available. In 1996 the SHCS collected data at an enhanced Level 0 with some householder data. For 2002 the scope of data collection was increased to include items like floor areas, ceiling heights, and appliance controls for the primary heating system. This improves the accuracy of the energy rating, as the calculation is less dependent on the default values provided by the program.

TREATMENT OF CASES WHERE FUEL POVERTY COULD NOT BE ESTIMATED

For the surveys in 2003-04 and 2004-05, in around 6% of cases in the sample it was not possible to assess whether the household was or was not fuel poor. This was mainly because the income imputation process had insufficient information about the household to successfully impute a household income. In previous house condition survey reports up to the report for 2003-04, these missing values were excluded from the estimated number fuel poor. In preparing the 2004-05 estimates the SHCS team review this approach, as it seemed likely to lead to an under-estimate of the number fuel poor. An examination of the household and housing characteristics of those households in the samples for whom a fuel poverty estimate could not be made showed that they were broadly a cross section of all respondents to the survey. On this basis, estimates of numbers fuel poor from 1996 onwards have been updated to include an estimate of fuel poverty for those whose fuel poverty status could not be directly assessed from the survey data.

The details of the changes are as follows:-

1996 estimate - 323 cases with missing fuel poverty information, equivalent to 48,000 households, of which 17,000 are estimated to have been fuel poor.

2002 estimate -379 cases with missing fuel poverty information, equivalent to 56,000 households, of which 7,000 are estimated to have been fuel poor.

2003/04 estimate -184 cases with missing fuel poverty information, equivalent to 141,000 households, of which 22,000 are estimated to have been fuel poor.

2004/05 estimate -182 cases with missing fuel poverty information, equivalent to 131,000 households, of which 24,000 are estimated to have been fuel poor.

Improving income imputation

The higher proportion of missing cases in the most recent period is partly a reflection of the difficulty in imputing missing values in a survey with a relatively small sample. With the survey contractors we are planning to examine ways in which we might improve the income imputation for the survey by drawing on income information collected in the Scottish Household Survey, which gathers income in a very similar way to SHCS and has a much larger sample.