

Scottish House Condition Survey: 2017 Methodology Notes

PEOPLE, COMMUNITIES AND PLACES

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1. Introduction

1. The purpose of this document is to provide information on the definition and methods of derivation of key indicators measured through the Scottish House Condition Survey (SHCS) which apply to the reporting of 2017 data.
2. This document is periodically updated to reflect changes in definitions and methods used in SHCS reports. The last time substantial methodological changes were made was with the reporting of 2014 SHCS data, when the methodology for estimating the cost of modelled fuel poverty energy requirements was updated. There have been no further substantial changes since then.
3. The description of the energy modelling methodology and outputs in this document includes contribution from the Building Research Establishment (BRE).

2. Modelling Domestic Energy Use

4. Estimating energy use in dwellings is at the core of assessing the energy efficiency of the housing stock, the greenhouse gas emissions for which it is responsible and the risk of fuel poverty faced by residents. A number of measures produced through the SHCS are based on modelling energy use in the home:
 - Energy Efficiency Ratings: SAP, EPC band, and NHER ratings;
 - Carbon emissions and Environmental Impact Ratings; and
 - Fuel Poverty.
5. The general methodology that underpins all of these estimates is known as BRE Domestic Energy Model (BREDEM). 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 UK housing stocks.
6. Prior to the 2013 SHCS Key Findings report¹, domestic energy consumption in SHCS statistics was estimated through the use of 'Auto-Evaluator', a software programme developed by National Energy Services Ltd (NES) and National Energy Foundation (NEF) which is based on an earlier version of BREDEM, BREDEM-12, published in 2001². Details on this methodology and the outputs

¹ [Scottish House Conditions Survey Key Findings 2013](http://www.scotland.gov.uk/Publications/2014/12/6903)
<http://www.scotland.gov.uk/Publications/2014/12/6903>

² Anderson, B.R. 2002: BREDEM-12 Model Description: 2001 update

it provided are available in the Scottish Government's Technical Note on Fuel Poverty³.

7. With the publication of the 2013 Key Findings report, the SHCS moved to an updated methodology which reflects the current industry standard of assessing home energy performance. The new approach is based on BREDEM 2012⁴, and is implemented by the Building Research Establishment (BRE) with the use of proprietary energy models. This improvement incorporated several years of cumulative change and resulted in a substantial impact on all energy consumption-based indicators.
8. The 2013 SHCS Methodology Notes⁵ provided detailed information on the key measures which were affected by the methodological update. Revised estimates for the key measures of energy efficiency and fuel poverty for the period 2010 – 2012 were published alongside the new figures for 2013 in order to provide some degree of continuity.
9. Further changes were introduced for the 2014 Key Findings report to reflect the updated version of BREDEM 2012, version 1.16, which was published in January 2015. Details of what these changes involved were provided in the 2014 Methodology Notes publication⁷. The 2015, 2016 and 2017 Key Findings reports continue to use the same version of BREDEM 2012.

2.1 Standard Assessment Procedure (SAP)

2.1.1. Energy Efficiency Rating

10. The Standard Assessment Procedure (SAP) is a BREDEM-based methodology which provides the UK Government's recommended system for assessing the energy and environmental performance of dwellings, taking into account the energy needed for space and water heating, ventilation and lighting, and where relevant, energy generated by renewables. SAP ratings allow comparisons of energy efficiency between different dwellings to be made.
11. The Energy Efficiency Rating (EER) is expressed on a scale of 1 – 100 where a dwelling with a rating of 1 will have a very poor energy efficiency and high fuel bills, while 100 represents very high energy efficiency and low fuel bills. Ratings can be greater than 100 for dwellings that generate more energy than they use; however these are rare in the existing stock. Extremely inefficient cases can result in a negative rating. These are reset to a value of 1.

³ <http://www.scotland.gov.uk/Topics/Statistics/SHCS/TechnicalNote>

⁴ BRE, BREDEM 2012: A technical description of the BRE Domestic Energy model
<http://www.bre.co.uk/filelibrary/bredem/BREDEM-2012-specification.pdf>

⁵ <http://www.gov.scot/Resource/0046/00465693.pdf>

⁶ <http://www.bre.co.uk/filelibrary/bredem/BREDEM-2012-specification.pdf>

⁷ <http://www.gov.scot/Resource/0049/00491038.pdf>

12. Ratings are adjusted for floor area so that they are essentially independent of dwelling size for a given built form. They give a measure of the floor area-weighted fuel costs for the dwelling under standard occupancy and heating regimes. The fuel prices used are averaged over the previous three years across the different areas of the UK. The SAP rating takes into account a range of factors that contribute to energy efficiency, the main of which include:
- the dimensions of the heat loss surfaces of the dwelling;
 - materials used for construction of the dwelling;
 - thermal insulation of the building fabric;
 - efficiency and control of the heating and hot water systems;
 - fuel used for space and water heating;
 - ventilation and solar gain characteristics of the dwelling;
 - renewable energy technologies.
13. SAP is used to compare the energy performance of dwellings and so is not affected by the individual characteristics of the occupying household, nor by the dwelling's geographical location. The calculation is based on a fixed heating pattern of 21°C in the main living area and 18°C elsewhere and 9 hours of heating on a weekday and 16 hours at the weekend.
14. The heating season occurs during the months of October to May. It is based on standard occupancy assumptions with the household size correlating with the total floor area of the dwelling. The dwelling is assumed to be located in the East Pennines region.
15. SAP is updated periodically by BRE on behalf of BEIS in order to reflect developments in our understanding of energy consumption, to update data for factors such as prices and temperatures, to incorporate new systems and technologies and to address applications across an increasing range of carbon and energy reduction policy areas. Alongside this, there is a 'reduced data' version of the methodology, RdSAP, which is applied to the assessment of existing buildings. The 2017 Key Findings publication is based on RdSAP (version 9.92) which was implemented across the UK on 7 December 2014 and uses the SAP 2012 methodology. A further edition, 9.93, was published on 19th November 2017. However, the 2017 SHCS continues to use RdSAP 2012 v9.92 since this was applicable to the majority of the 2017 SHCS sample.
16. This report uses two editions of SAP to describe the energy efficiency of the Scottish housing stock, SAP 2009 and SAP 2012. SAP 2009⁸ was adopted in the 2013 SHCS Key findings report and applied to data back to 2010. The 2017 Key Findings report continues to publish energy performance statistics on this basis to allow an analysis of change over time.

⁸ http://www.bre.co.uk/filelibrary/SAP/2009/SAP-2009_9-90.pdf, Table 15 p. 205

17. SAP 2012, which is the current edition of the SAP methodology, is used in the 2014, 2015, 2016 and 2017 Key Findings publications to report on the energy efficiency and the environmental impact of Scotland's homes.

18. The key differences between SAP 2009 and SAP 2012 are summarised below, for the reduced data and for the full SAP calculation. The full documentation can be found on the BRE website.

19. The main changes in the SAP 2012 edition include:

- Climatic data has been extended to allow calculations using regional weather for some elements.
- An allowance for height above sea level is incorporated into external temperature data.
- CO2 emission factors have been extensively revised.
- Fuel price and primary energy factors have been revised.
- The options for heat losses from primary pipework have been extended.
- Default efficiencies for heat pumps have been revised.
- Adjustments have been made to the solar water heating methodology (lower savings if electric shower present).
- A new heating type has been added: high heat retention electric storage heaters.
- Low temperature heat emitter options have been extended (previously only underfloor).
- Thermal bridging details have been updated.
- Appendix R (reference values for calculating TER) has been updated.
- Solar radiation calculation has been updated (effects solar gains, solar water heating).

20. The main changes in RdSAP v.9.92 include:

- Provision for dealing with park homes added
- Party wall heat losses included
- Post 2012 age band added
- More wall types included in tables
- Flue gas heat recovery and waste water heat recovery now recognised
- Ability to enter specific data in place of defaults where documentary evidence is available for the U-values of most items and some other features, e.g. solar water heating
- Additional improvement measures included such as glazing only upgrade (keeping existing frames)'.

21. Each year, small improvements are made to the modelling accuracy of RdSAP and details can be found in the relevant year's methodology notes. For the 2016 SHCS report, modelling accuracy was improved by:

- No longer treating clay / earth, blockwork or metal walls as Clay/earth, blockwork or metal walls as solid walls, and assigning these the associated system build U-values. This change only affected walls built before 1965.
- Improving the derivation underpinning the number of sheltered sides in a flat by using more raw data collected in the survey, bringing it more in line with RdSAP.
- Updating assumptions around automatic ignition of pilot lights in post-1998 condensing boiler efficiencies in line with RdSAP.

The total estimated impact of these changes on the average SAP 2012 rating is estimated at +0.13 points, compared to if no changes were applied.

2.1.2. Environmental Impact Rating

22. The Environmental Impact Rating (EIR) represents the environmental impact of a dwelling in terms of the carbon emissions associated with fuels used for heating, hot water, lighting and ventilation. This calculation is based on SAP and uses the same heating regime and occupancy assumptions as for the calculation of Energy Efficiency Ratings. Environmental Impact Ratings are adjusted for floor area so they are independent of dwelling size for a given built form. They vary between 1 and 100, where 1 represents very high carbon emissions and 100 very low carbon emissions.

23. The Environmental Impact Ratings for 2015, 2016 and 2017 are based on SAP 2012. EIR relating to 2010-2013 are based on SAP 2009 and were first published as part of the 2013 Key Findings report.

2.1.3. Energy Performance Certificates

24. Energy Performance Certificates (EPCs) were introduced in January 2009 under the requirements of the EU Energy Performance Building Directive (EPBD). They are required when a property is either sold or rented to a new tenant.

25. EPCs are generated through the use of the SAP methodology. For Energy Performance Certificates Energy Efficiency (EE) and Environmental Impact (EI) ratings are presented over 7 bands, labelled A to G. Band A represents low energy cost and high energy efficiency (or low environmental impact), while band G denotes high energy cost and low energy efficiency (or high environmental impact).

2.2 National Home Energy Rating (NHER)

26. The NHER system was extensively used in SHCS reports prior to the 2013 Key Findings publication to describe the energy efficiency of housing. Detailed discussion of this methodology can be found in the Technical Note on Fuel Poverty available from the Scottish Government website⁹.
27. The NHER methodology used in the SHCS was based on an earlier version of the BRE Domestic Energy Model, BREDEM-12. This has now been superseded and under the updated method, BREDEM 2012, it is no longer feasible to reproduce accurately the original NHER measure. To provide some degree of continuity, an emulated NHER measure was developed for the 2013 Key Findings report and has been reported in the Key Findings reports since then. Details on how this measure compares to the original NHER measure are provided in the 2013 SHCS Methodology Notes¹⁰.

3. Boilers

28. Since 2012, the SHCS has collected enough information to derive a surveyed dwelling's heating system efficiency. For properties with boilers, comparing the efficiency against the minimum standards set by Scottish Building Standards provides an estimate of the domestic dwelling boiler stock compliant with current regulations, and offers another measure of Scotland's energy efficiency levels.
29. Heating system efficiencies are calculated by BRE, and were first provided in 2012. For 2014 and 2015, a change to the modelling methodology meant the derived efficiency included adjustments for a poorly controlled system, which are notionally less efficient. For the 2016 report however, these data were revised to a pre-control adjustment state for all available years, and are now presented on a consistent basis. In practice, where it has been possible to read an efficiency straight from the Product Characteristics Database, this has been used. Alternatively, the SAP default has been used.
30. Additionally, the efficiency cut-offs used to assess compliance of oil boilers with Scottish Building Standards were amended in the 2016 survey to reflect the different standards required of oil combination and oil non-combination boilers. Furthermore, while non-condensing boilers are present in the SHCS sample, the fuel dependent condensing boiler efficiency cut offs are applied for all boilers in the report when assessing building standard compliance. The methodology applied in the 2017 report is in line with the approach taken in 2016.

⁹ 'Technical Note on Fuel Poverty – Revised', available at <http://www.scotland.gov.uk/Topics/Statistics/SHCS/TechnicalNote>

¹⁰ <http://www.gov.scot/Topics/Statistics/SHCS/Downloads/MethodologyNotes2013>

4. Measuring Fuel Poverty

31. Fuel Poverty is currently defined in terms of the ratio between the cost of the energy required to maintain an adequate standard of warmth and other uses of energy in the home, and the income of the household occupying the dwelling¹¹. When this ratio exceeds 0.1, the household is considered to be fuel poor. In other words, a fuel poor household would be required to spend more than 10% of its income on all household fuel use.

$$\text{Fuel Poverty Ratio} = \frac{\text{Modelled Fuel Cost} \quad (\text{i.e. Modelled Energy Requirement} \times \text{Price})}{\text{Household Income}}$$

4.1 Fuel Poverty Energy Requirement

32. The energy requirement is calculated on the basis of a standard heating regime and other uses of energy in the home. This information is combined with relevant fuel prices to obtain a modelled fuel bill. No information on the actual spend on energy is used in the definition of fuel poverty.
33. To estimate the annual household energy consumption, and hence the fuel bill, the SHCS employs the full BREDEM 2012 model. This is considered a more realistic estimate of energy demand than SAP because it uses more information about the occupants and the physical characteristics of the dwelling.
34. The BREDEM calculation for space heating requires that the heating regime for each dwelling is specified in terms of the temperature of the dwelling, or parts of it, and the number of hours heating is required. Under the fuel poverty definition two types of heating regime are applied:
- standard, where living rooms (zone 1) are heated to 21°C and the rest of the dwelling (zone 2) is heated to 18°C for 9 hours during weekdays and 16 hours on weekends; and
 - enhanced, where living rooms (zone 1) are heated to 23°C and the rest of the dwelling (zone 2) is heated to 18°C for 16 hours each day of the week.

¹¹ For more details see Scottish House Condition Survey 2013 Key Findings Report (<http://www.scotland.gov.uk/Publications/2014/12/6903>); SHCS Methodology Notes 2013 (<http://www.scotland.gov.uk/Topics/Statistics/SHCS/Downloads/MethodologyNotes2013>)

35. The fuel poverty definition requires that the energy needs of elderly and infirm households are assessed on the basis of the enhanced heating regime. The SHCS defines the terms 'elderly and infirm' as households where at least one person is aged 60 or over and/or reports suffering from limiting long-term illness or disability.
36. As mentioned earlier, an update to the underlying BREDEM 2012 model was introduced for the analysis of 2014 data. This increased the estimated fuel poverty energy requirement in comparison to the method used for 2013 data by around 2% and had a corresponding small effect on the estimated level of fuel poverty in 2014. For this reason statistics for 2014 to 2017 inclusive are not fully comparable with previous years.

4.2 Fuel Poverty Modelled Running Costs

37. The SHCS does not collect information on the price of fuel which surveyed households use. In order to calculate the modelled fuel bill for the fuel poverty calculation, information on fuel prices is obtained from other sources. Table 1 sets out the sources of information on fuel price for different types of fuels used in the derivation of the fuel poverty indicator.
38. The method for determining the cost of the energy requirement in the production of fuel poverty statistics follows the approach introduced in the 2014 Key Findings report¹². However, the current report continues a further small improvement first introduced in the 2016 physical survey through the collection of information on the use of pre-payment meters for all households. This means that we are able to identify pre-payment users and assign the appropriate fuel price for them. All other households are applied a weighted average of standard credit and direct debit tariffs.
39. Fuel prices are averaged over a year and relate to Scotland or regions of Scotland where suitable information is available. For metered fuels, some of this information is available from Quarterly Energy Prices (QEP), a BEIS National Statistics publication. Rates for E10, E18 and E24 tariffs are not available from this source and the SHCS uses a bespoke survey of suppliers carried out by Alembic Research. For non-metered fuels the analysis uses prices published as part of the Sutherland Tables publication and SAP 2012.
40. While this method accounts for some of the variation in the price of metered fuels for individual households across Scotland, there are further differences which are not captured: both across energy suppliers and types of tariffs. The information required for this is not available at present.

¹² Full details of the changes this involved and of their impact on comparability over time are provided in the 2014 Methodology Notes publication (<http://www.scotland.gov.uk/Topics/Statistics/SHCS/Downloads/MethodologyNotes2014>).

Table 1: Sources of information on the price of domestic fuel used in costing the energy requirement

Fuel type		
Mains gas, Electricity 7, and Electricity Standard	Source	Department for Business, Energy and Industrial Strategy (BEIS), Quarterly Energy Prices publication, Tables 2.3.4 and 2.2.4 ¹³
	Geographical area	North Scotland, South Scotland
	Time reference	Annual average
	Payment method	Pre-payment metered fuel price for the relevant households; weighted average of St. Credit and Direct Debit for all other households
Electricity 10, Electricity 18, and Electricity 24	Source	Bespoke survey of energy suppliers
	Geographical area	North Scotland, South Scotland
	Time reference	Annual average
	Payment method	Pre-payment metered fuel price for the relevant households; weighted average of St. Credit and Direct Debit for all other households
LPG and solid fuels	Source	Sutherland Tables
	Geographical area	Scotland
	Time reference	Annual average
Wood	Source	Sutherland Tables (wood chips and wood logs based on pellets price adjusted by SAP ratios)
	Geographical area	Scotland
	Time reference	Annual average
Oil	Source	Department for Business, Energy and Industrial Strategy (BEIS), Quarterly Energy Prices publication, Table 4.1.2
	Geographical area	UK
	Time reference	Annual average
District heating prices		SAP 2012 fuel price tables, adjusted by CPI for Gas ¹⁴

¹³ DECC, Annual domestic energy bills
<https://www.gov.uk/government/statistical-data-sets/annual-domestic-energy-price-statistics>

¹⁴ BRE, SAP 2012, Table 12
http://www.bre.co.uk/filelibrary/SAP/2012/SAP-2012_9-92.pdf

4.2.1. Warm Home Discount

41. The Warm Homes Discount (WHD) scheme was launched in April 2011¹⁵. Energy suppliers are mandated to provide support in the form of discounts and rebates, as well as advice and assistance, to fuel poor customers.
42. The SHCS does not collect information on whether respondents receive direct financial support under this scheme. In fact it would be difficult to collect such information as many people are not aware that they are benefiting from a rebate. However, unless this is accounted for in the survey, the modelled fuel bill and therefore fuel poverty would be overestimated.
43. The publication of the 2014 SHCS Key Findings report introduced an allowance for the WHD rebate in the estimation of the number of fuel poor households in Scotland. This was based on modelling households' eligibility for the scheme. This method has been used in all subsequent Key Findings reports.
44. The approach consists of the following stages:
 - Details of the number of households in receipt of each component of the WHD are provided by Ofgem for GB as a whole. It is assumed that the number of recipients in Scotland is proportional to Scotland's share of households in GB (9.2%).
 - Details of eligibility for each element of the WHD provided by Ofgem, are used to flag all households in the SHCS dataset who meet these criteria. Because of limitations in the available survey information, some approximations are necessary.
 - A series of runs are made, where a sample of likely recipients is drawn at random from the pool of all eligible households. For each sample the WHD rebate amount (e.g. £140 for 2017 data, the same as the previous three years of the scheme) is subtracted from the modelled household fuel bill. The estimated number of households in receipt of the Core and Broader Group element of the WHD in Scotland is used to constrain the size of the sample which is selected.
 - A representative iteration based on the number of fuel poor households among modelled recipients is selected from all runs as the best estimate of the set of household in the survey who benefit from the Core or Broader Group element of the WHD scheme.
45. A detailed description of the methodology was provided in the Methodology Notes for the 2014 SHCS report.

¹⁵ <https://www.ofgem.gov.uk/environmental-programmes/social-programmes/warm-home-discount-whd>

46. The value of the WHD rebate (£140) is subtracted from the total cost of the modelled energy requirement for all households who are selected through the simulation method as beneficiaries from the scheme.

4.2.2. Government Electricity Rebate

47. In 2014 and 2015 the UK government provided a £12 rebate to domestic electricity customers to help lower the impacts of Government environmental and social policy costs on consumer energy bills. This was part of a wider package of measures to reduce household energy bills by an average of around £50 per year¹⁶.

48. The scheme only ran for these two years, therefore the £12 contribution of the Government Electricity Rebate is no longer incorporated in the current report.

4.3 Household Income

4.3.1. Definition of household income for the measurement of fuel poverty

49. In the Fuel Poverty Statement (FPS), the income against which fuel poverty is assessed is defined as the total income of all members of the household, including dependants. This includes income from the following sources:

- usual 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).

50. Under this definition, income is calculated net of the following items:

- income tax payments;
- National Insurance contributions;
- Council Tax;

¹⁶ <https://www.gov.uk/guidance/government-electricity-rebate>

- contributions to occupational pension schemes (including additional voluntary contributions) and any contribution to personal pensions;
- all maintenance and child support payments, which are deducted from the income of the person making the payment; and
- parental contributions to students living away from home.

51. In the measurement of fuel poverty, income is currently taken before housing costs.

4.3.2. Measurement of income in the SHCS

52. The household income figure used in the SHCS to implement the Fuel Poverty Statement definition comprises the net income of the Highest Income Householder (HIH) 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 Reduction¹⁷ and Housing Benefit), student income, non-state pensions, investment income and any other regular non-work income.

53. The survey collects information on the receipt of the Winter Fuel Payment and this is included in the household income of all households with a person aged 60 or over who had stated that they have received this payment.

54. All income data are thoroughly checked for inconsistencies by the survey contractor, IPSOS MORI, 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 (e.g. 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

55. The total household income figure is then adjusted by deducting council tax and water and sewerage charges. Where respondents have not provided information about the amount of council tax they pay, this has been modelled based on the council tax band of their dwelling and some household characteristics which make them eligible for certain discounts. In 2012 and 2013, when the SHCS was first integrated into the SHS, no questions about the council tax liability of households was asked as part of the survey. For these years all council tax payments have been modelled and the methodology

¹⁷ Council Tax Reduction replaced Council Tax Benefit in 2013. In practice, the amount awarded is subtracted from the council tax bill, but in the survey it is recorded as an additive component to household income.

used was described in section 3.2.4 of the 2013 SHCS Methodology Notes publication¹⁸. Council tax questions were re-introduced in 2014 and since then, where respondents provide an answer, it has been used in the calculation of net household income. Where this information is not provided, council tax is imputed using the same method as in the two preceding years. In 2015 some additional quality assurance rules were introduced in the modelling of council tax.

56. For the 2017 survey, questions collecting household council tax information were amended to distinguish between cases where the reported amount included discounts/reductions or not.
57. These question changes are reflected in calculations of net household income after council tax necessary for the fuel poverty estimate, in particular where Council Tax Reduction (CTR) is accounted for. While in practice the application of CTR results in a lower Council Tax bill, the survey records the saving as an additive contribution to overall household income.
58. Where a respondent provides a council tax value net of any discounts or reductions, any contribution to income from (CTR) is removed from their household income total, as this will be reflected in the partial council tax value reported. If the respondent provides a full council tax value, any declared CTR is left incorporated in the overall household income total.

4.3.3. Differences between SHS income measurement and FPS definition

59. The main difference between the income and benefits data collected in the SHCS and the FPS definition is that the survey currently only measures the income of the Highest Income Householder (HIH) and their spouse/partner. No income information is obtained for any other household members. Therefore, the survey will underestimate income for households with more than two earners or benefit recipients and may therefore overstate fuel poverty for this group.

4.3.4. Missing income information imputation

60. Although some level of item non-response is inevitable across all aspects of the social and physical surveys (e.g. 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, where there is generally a higher proportion of item refusals.
61. In order for the survey to be able to produce income, a statistical process known as imputation is carried out. Imputation involves replacing missing

¹⁸ SHCS Methodology Notes 2013
(<http://www.scotland.gov.uk/Topics/Statistics/SHCS/Downloads/MethodologyNotes2013>)

values with the values associated with other households which have the same characteristics, defined according to the nature of the missing item.

62. Hot Deck imputation was used for all missing income 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.
63. The imputation of missing income data has been carried out by the survey contractor, Ipsos MORI.

5. Scottish Housing Quality Standard

64. The Scottish Housing Quality Standard (SHQS) is a minimum standard for all social housing in Scotland. In order to meet this standard a dwelling must meet 5 sets of broad criteria: compliant with the tolerable standard, free from disrepair, energy efficient, provided with modern facilities and services and healthy, safe and secure. A target was set for local authority landlords and registered social landlords to bring their housing stock up to the SHQS standard by April 2015¹⁹.
65. The Scottish House Condition Survey (SHCS) provides the official measure of SHQS progress at national level, as laid out at the time of the introduction of SHQS in 2004. Information on the number of dwellings in the social housing sector that have reached the standard is published annually as part of the SHCS Key Findings report and relate to the previous year.
66. The SHCS collects information on 54 out of all 55 elements comprising the SHQS requirements²⁰. This is done as part of the broader survey of the condition of the dwellings in the sample. When conducting the fieldwork, surveyors are not consciously making an assessment of SHQS compliance. Information on each of the 54 elements of SHQS is only a small part of the wide range of other information they collect. This information is subsequently collated independently into the 5 broad criteria and indicators of overall compliance by Scottish Government analysts. In this way the conclusions drawn from the fieldwork are kept independent of the data collections with a view to objectivity.
67. The SHQS guidance acknowledges that there may be situations where certain social rented properties could be exempted from meeting certain elements of

¹⁹ <http://www.gov.scot/Topics/Built-Environment/Housing/16342/shqs>

²⁰ Only one element of the SHQS is not assessed using SHCS data: no information is collected on external noise insulation.

the SHQS for technical or other reasons²¹. An abeyance can be granted where it is technically feasible to make an upgrade but a social issue prevents the landlord from doing so. For example a dwelling may be suitable to have CWI but the tenant refuses to allow the work to be done. The upgrade is expected to be carried out after the problem has been resolved or at change of tenancy.

68. An exemption can arise when a property is capable of meeting SHQS on a particular element but the landlord believes that it is not possible to meet it for technical, disproportionate cost or legal reasons. For example, a wall cavity is present but it is not possible/desirable to fill it for 'technical' reasons, such as too narrow to fill, poor access for work to take place, persistent exposure of walls to moisture.
69. The SHCS does not collect information on whether the landlord has asked for an abeyance or exemption for an element of the SHQS, and because of this the statistics from the SHCS do not take account of these. This means that SHCS statistics would overstate SHQS failure rates.
70. In the 2012 and 2013 data collections a small routing error in the questionnaire relating to tenure meant that a small number of dwellings could not be classified as part of the private or the social rented sector²². This was amended in 2014 and all dwellings in the survey can now be classified by tenure. This introduces a small inconsistency in the basis for the figures relating to the social sector in this report with years prior to 2014.
71. In addition, the 2014 Key Findings report introduced small corrections to the data processing relating to failure thresholds for the energy efficient criterion (energy efficiency rating and thickness of the hot water tank insulation); although the overall effect of these corrections on failure rates in the social sector were broadly neutral, some discontinuities with years prior to 2014 cannot be ruled out, when considering detailed breakdowns. The 2016 Key Findings report also incorporated slight revisions to some of the estimates relating to 2015 in order to correct for an error identified in compiling the failure rate for the energy efficient criterion for 2015, which also affected the 2015 headline SHQS failure rate; while the extent of the revisions may vary for some sub-groups of households, overall it is within the margin of error.

²¹ <http://www.gov.scot/Topics/Built-Environment/Housing/16342/shqs/annexi>

²² Details available in section 6.2 of the 2013 SHCS Key Findings report.

6. Gas Grid

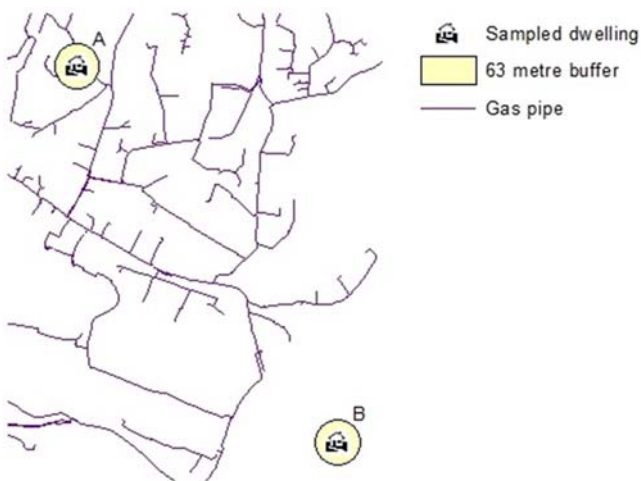
72. Gas network coverage reported in the 2017 SHCS Key Findings report is determined on the basis of the distance between the dwelling and low/medium pressure gas distribution pipes. The information on the location of low and medium pressure gas distribution pipes is provided by Scotia Gas Networks who operate the gas distribution network in Scotland. This data includes both the national gas network and the Scottish Independent Undertakings (SIU). An SIU network is a town gas supply, owned and managed by Scotia Gas Networks, but which is not connected by pipeline to the rest of the gas grid.
73. The geographical location of sampled dwellings is recorded as part of the Scottish House Condition Survey collection. It is therefore possible to compare directly the location of dwellings in the SHCS with the location of gas distribution pipes in the Scottish network. A dwelling which is within the usual maximum distance for a standard domestic gas connection is considered to be covered by the gas grid.
74. In order for a property to be eligible for a standard domestic gas connection, the property boundary must be within 23 metres from the gas pipe, and the gas meter must be within 40 metres from the property boundary.²³
75. The SHCS does not contain information regarding any land surrounding a dwelling. It is only therefore possible to measure the distance from the building centroid to the gas pipe, and not the property boundary.
76. This gives two options for selecting a threshold value for distance from the gas grid beyond which the dwelling is considered 'off-grid':
77. **Option A.** Set a threshold value equal to the sum of the maximum distances (23 m + 40 m) and define off-grid as further than 63 m from the gas pipe. This method potentially under-counts off-grid dwellings: where a dwelling is within 63m of a pipe but its surrounding land accounts for less than 40m of this distance, it will be counted as 'on grid' even though it does not meet the usual standard connection specification. This is more suitable for measurements in rural areas where we can assume the land surrounding dwellings is larger.
78. **Option B.** Ignore the 40 m distance within the property boundary and set the definition of off-grid as 'more than 23 m between building centroid and gas pipe'. This may result in over-counting off-grid dwellings, because it doesn't take into consideration the land surrounding the building.
79. Since grid coverage is lower in rural areas, and rural dwellings are more likely to have surrounding land, we have opted to use 63 m as the threshold distance to determine gas network coverage (Option A). This will therefore result in a

²³ See <https://www.sgn.co.uk/Connect/Before-you-start/Domestic-Connection/>

conservative measure of dwellings off the gas grid in urban areas if the density of gas distribution pipes is low.

80. When determining the distance between dwellings and distribution gas pipes, the SHCS does not include pipes owned and operated by Independent Gas Transporters (IGT). Consequently, there is a chance a dwelling connected to the gas network via an IGT will be classed as outwith the coverage of the gas grid. This could potentially increase the off-grid count, particularly among dwellings in new housing developments, which form the largest residential share of the IGT market²⁴.

81. Using GIS mapping software, dwelling locations and gas distribution pipes are plotted together. Where a gas distribution pipe does not intersect with a 63m ring around a dwelling location, that dwelling is said to be off the gas grid. In the example below, dwelling A is on the network, while dwelling B is not.



82. The gas grid coverage measure does not reflect the presence of gas supply to the building. A dwelling may be located within 63m of a gas distribution pipe and not be connected to the gas grid, and conversely, it may be further way but have a gas connection.

²⁴ <https://www.ofgem.gov.uk/gas/distribution-networks/connections-and-competition/independent-gas-transporters>

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REVISIONS TABLE

	Date	Changes
First Published 1.0	01/02/2019	

UPDATES PAGE
