Chapter 5
Data processing

Overview

5.1 This chapter outlines English Housing Survey (EHS) data processing procedures and gives information about the main derived variables and data outputs. The EHS has a number of quality assurance measures in place which are undertaken throughout the annual survey process, beginning at the point of data collection, both through the computer-aided personal interviewing (CAPI) system and through surveyors validating their forms using the online system developed by the Building Research Establishment (BRE) (details below). As the data are collated, processed and modelled, additional validation procedures are undertaken.

Editing

Interview data

5.2 The CAPI program has numerous built-in checks for identifying obvious discrepancies so that they can be resolved by the interviewer during the interview. The discrepancies are resolved by either correcting a data entry error or by clarifying a response directly with the respondent. The CAPI checks include:

- range checks to identify where the answer falls outside a pre-specified range of responses, for example, an unusually high/low weekly rent is entered
- conflicting answers to different questions, for example, if the number of years living in the current accommodation is greater than the respondent's age

5.3 There are two types of checks:

- hard checks – where the interviewer cannot continue with the interview until they have changed the data entered in some way to remove the inconsistency. Hard checks are used when the inconsistency is impossible as with the example of the number of years living in current accommodation being greater than the respondent's age.

- soft checks (signals) – where the interviewer is told about the error but they can ignore it and move on to the next question. Soft checks are used when an answer is unlikely but not impossible, e.g. if a respondent says they have more than 5 bathrooms. These checks are used to get the interviewer to confirm that the answer is correct and is not a data entry error, checking the answer with the respondent if appropriate.

Physical survey data

5.4 For the physical survey, a system of automatic data validation was introduced in 2008 as part of the move to using digital pens to collect the data. The process is subject to continuous development and operates in three stages.

5.5 First, a large number of checks are built into the EHS surveyors' website as surveys are uploaded. These include:

- range checks – to identify where the entered answer falls outside a pre-specified range of responses
- logic checks – where a combination of responses to certain questions are not logically consistent (e.g. to check that the sum of 'tenths of area' across rows added up to ten)
- consistency checks – to determine whether linked responses in different parts of the form are consistent with each other (e.g. that detailed room data is only entered where a room coded as existing), and
- plausibility checks – to determine whether a response is reasonable given that there is not a well-defined range of possible answers (e.g. ceiling height of a room entered as 24 metres instead of 2.4 metres)

5.6 Surveyors also visually check all pages to ensure that the digital pen entries mirror those on the paper form i.e. that handwritten numbers have not been misinterpreted by the software.

5.7 Second, the CADS Housing Surveys Regional Managers check the data and where necessary discuss with surveyors to agree on a final set of responses.

5.8 Once all EHS physical surveys have been submitted by the surveyors for the survey year, BRE undertakes further consistency and plausibility checks on the raw physical survey data. The purpose of these checks is, firstly, to detect and eliminate certain logical inconsistencies that would cause problems for modelling and, secondly, to identify highly implausible answers, which if deemed necessary after investigation, are corrected. In some cases the raw EHS physical survey data are altered following these consistency and plausibility checks as outlined below.

- Levels checks – data may be inconsistent with regard to the number of storeys in the building, and the floor occupied by the dwelling. The BRE checks test for the following possible errors:
    - a room on a floor that does not exist (e.g. 3rd floor of a three storey block, the 3 floors being recorded as ground, first and second)
    - a room on a level that is not part of the flat (e.g. room on the 3rd floor but flat on the 2nd floor)
    - a measured floor that is not part of the block (e.g. dimensions for 3rd floor when the dwelling only has three storeys)
    - a flat on a level that does not exist (e.g. flat on the 3rd floor when the module only has three storeys)
    - presence of a habitable attic/basement is inconsistent with the number of floors
- Plausible dimensions – checks are carried out on the dimensions, to identify any floor area that seems too large or too small. Where a reliable measurement is missing, BRE will attempt to work out the data from any measurements thought to be correct, or failing this by estimating the dimensions as best as possible from the photographs.
- Non-permissible values – on rare occasions a surveyor response may happen to be equal to a value that is reserved for special purposes. The numbers 77, 88 and 99 are reserved to indicate the section not applicable, question not applicable, or unknown. When these figures occur as real measurements or counts, they are reduced by one.
- Incorrect number of flats – the dimensions of the surveyed flat are checked against the total floor area of the survey module to identify if the number of flats per module seems realistic.
- Incorrect roof type – certain roof types (chalet and mansard) can only occur where the dwelling has an attic. On occasions surveyors may mistake steep pitched roofs for chalet roofs. In this situation, the data for pitched and chalet roofs are swapped over.
- Implausible wall and window areas/fenestration ratio – where a dwelling seems to have a wall or window area/fenestration ratio that is either too high or too low the data are checked. The surveyor's judgement is deemed correct unless there is clear evidence (e.g. from photographs) to amend the data.
- Wall thickness – cases are identified where the wall thickness as measured by the EHS surveyor is not typical of the wall selected i.e. cases where the EHS surveyors' website has triggered a wall thickness range check. Each case is checked by viewing the EHS surveyors' website and looking at the details recorded on the physical survey form in conjunction

with the photos/EHS surveyor comments. Based upon the information gained, the action is decided upon for each case. This could be no action required or it could be that the physical survey data looks incorrect, either the wall thickness value or the way the surveyor has coded something as wall that should not be counted as wall. Where required, the appropriate modifications are applied to the physical survey data.

- Heating system consistency checks – cases which contain inconsistent heating system data on the physical survey form are flagged in the validation process at BRE. Each case is checked by returning to the raw data; in cases where alterations can confidently be made, the data are modified accordingly.

Comparison edits

5.9 A further important quality check involves comparing interview survey data with the corresponding physical survey data for each case. The first step is a series of global edits to resolve particular discrepancies in the data. For example:

- If tenure in the interview survey (IS) was owner occupied AND tenure in the physical survey (PS) was another tenure, the PS tenure would be changed to owner occupied.
- If tenure in the interview survey (IS) was renting from local authority AND tenure in the physical survey (PS) was another tenure, the PS tenure would be changed to renting from local authority.

5.10 The remaining discrepancies between the two parts of the survey are flagged, investigated and recoded where applicable. This process is carried out in order to:

- check that the correct sampled dwelling was visited at both the interview survey and the physical survey, and
- correct any inconsistencies in key variables (e.g. tenure or property type) between the two different parts of the survey. Where possible other information from the survey (e.g. other variables, interviewer's and surveyor's comments, photo of the property) is checked to help decide what information is correct.

Houses in multiple occupation (HMO) edits

5.11 An HMO is a property rented by more than one person who are not from one 'household' (e.g. a family) but share facilities like the bathroom or kitchen. These differ from a shared house in that the residents in an HMO generally have separate tenancy agreements and usually have begun their tenancies independently of each other. The identification of HMOs is critical in order to help ensure the accuracy of the weighting for the sample dwelling. The procedure for monitoring, reconciliation and validation of cases which have

been flagged as HMOs by NatCen Social Research interviewers and/or CADS Housing Surveys surveyors is described below.

5.12 Whether a case is flagged as an HMO or not is dependent upon responses to certain key questions in the household questionnaire. Interviewers are trained in applying the EHS household definition and assessing the type of occupancy in complex situations, particularly in making the distinction between a group of sharers forming one household and separate households sharing facilities. Where necessary, reference is made to a check list of supplementary questions on the HMO Rules Card issued to interviewers (Annex 5.1) to help determine whether an address should be classified as an HMO.

5.13 Where the responses to the interview questions lead to the dwelling being flagged as an HMO or possible HMO, and the dwelling is eligible for a physical survey, the CADS Housing Surveys Regional Manager is notified. The Regional Manager will contact the interviewer to discuss the layout and occupation of the premises. The purpose of this contact is twofold:

- to confirm, as far as possible, that the address is an HMO for EHS purposes, and
- to determine whether the case is one that should be visited by the Regional Manager personally, as a complex HMO, or whether it should be allocated to a surveyor.

5.14 There will be occasions when a physical surveyor considers that a referred address appears to be an HMO despite not being flagged as such by the NatCen Social Research interviewer. In such cases, the surveyor will treat the case as an HMO, and a reconciliation process is applied to the interview and physical data during the final data validation stage.

5.15 CADS Housing Surveys Regional Managers compile and maintain a database of all cases they know to be HMOs. These cases, along with cases flagged as HMOs at the interview survey but which did not have a subsequent physical survey, are reviewed by BRE for data validation as part of the comparison edits process. The HMO checking process also includes cases that were not identified as HMOs at interview survey but which the data suggest could potentially be HMOs. BRE checks relevant interview and physical survey data such as number of households (NumHhld) and number of accommodation units (AcNumber). Where there are inconsistencies further investigation is undertaken and the data altered to the correct values.

5.16 During the HMO comparison process, BRE also derives the ratios of addresses to dwellings and dwellings to households. This information is required to ensure the correct numbers of dwellings and households are used in the production of weights. As part of the QA process, DCLG conducts spot

checks on these ratios as well as the HMO edits resulting from the process above.

5.17 A record of all address changes are kept by interviewers and/or Regional Managers for HMO cases as part of a comprehensive system for recording address changes for all issued cases. This feeds into the address file supplied to DCLG at the end of fieldwork.

Coding

5.18 After the interview, the data are coded and edited by trained coders and editors at NatCen Social Research. An edit program is utilised by these staff to code open answers and back-code responses as appropriate. For example, at the interview, respondents are asked how they pay for their electricity (question HmpyElec2), and the respondent is shown eight possible answers on a card. If their payment method is not on the list the interviewer will code 'other' and is asked to enter the details of the payment method at a follow up question (Hmelothr). After the interview, the coder will look at the details given at Hmelothr and check it against the eight answer codes to see whether it could be classified as one of these payment methods and if it can they will change the answer as appropriate (i.e. backcode the answer). Job details are coded to the Standard Occupation Classification (SOC) and the Standard Industry Classification (SIC).

5.19 Errors detected by the edit program are resolved by referring back to the original questionnaire documents by experienced editors. Individual corrections are made to the data and the corrected data are rerun through the edit programme until it confirms that the data have passed all the checks. Queries arising from the coding and editing process are recorded in a standardised way and these are examined by the supervision team on completion of each batch of work to ensure that they have been carried out correctly.

5.20 After the coding and editing stage further internal consistency checks on the data are carried out by a data manager and the data are corrected where appropriate.

Derived variables

5.21 Derived variables are created either by simply recoding a particular survey question or by combining the information collected from a number of questions, which can involve complex modelling. Examples of basic derived variables include dwelling age and dwelling type and examples of complex derived variables include basic repair costs, usable floor area and energy efficiency rating. The derived variables and geo-demographic variables, such as region, rurality and Index of Multiple Deprivation, included in the key EHS derived datasets interview.sav, physical.sav and general.sav can be found in Annex 5.2.

5.22 In addition to the three key EHS derived datasets, further detailed derived files such as actual costs.sav, energy performance.sav and HHSRS.sav are available on the EHS database, as listed in Table 5.1.

5.23 Further details on the derivation of these derived and detailed variables are available in the EHS Data Dictionary, made publicly available via the UK Data Archive (http://ukdataservice.ac.uk/).

5.24 The EHS derived variables are included in the datasets deposited at the UK Data Archive. To comply with the data disclosure control guidance issued by the Government Statistical Service, some of the variables are released under the more restricted Special Licence rather than through the End User Licence. The further detailed derived files are also available only via the Special Licence. In addition, the very disclosive geo-demographic variables (local authority and postcode) are available only through the Archive's Secure Data Service.

Modelling

5.25 The derivation of some of the derived variables involves complex data modelling. A detailed description of how the more complex derived variables are defined and modelled is covered in Annexes to this chapter:

- Annex 5.3: Accessibility indicators
- Annex 5.4: Household derived indicators
- Annex 5.5: Housing conditions
- Annex 5.6: Energy efficiency
- Annex 5.7: Dimensions
- Annex 5.8: Poor quality environments

Imputation

5.26 As part of the modelling processes, it is sometimes necessary for any missing data to be substituted with imputed values. The imputation of missing data is more prevalent with the interview survey data than the physical survey data. This is because the interview survey data are based on information provided by the householder who can choose to refuse questions or who may not know the answer to particular questions. The physical survey data are based upon a physical inspection of the property and there are only a few sections of the physical survey form where the trained surveyor can select 'information unknown' as an option; the most notable is the loft inspection, where surveyors cannot always obtain access.

5.27 Imputation of data also takes place in the modelling of derived variables where a value provided in the raw data falls outside the pre-specified range of the consistency/plausibility checks. Such values are interrogated and only

changed when it is almost certain that the data are incorrect. See Annexes 5.3, 5.4, 5.5, 5.6, 5.7 and 5.8 for further details.

5.28 Examples of imputation that occurred in the modelling of EHS 2015-16 derived variables are as follows (figures are based upon weighted data):

- In the modelling of the derived variables from the EHS 2015-16 interview survey, 41% of the full sample had some form of income imputation (the highest imputation rate of all of the derived variables due to the sensitive nature of the questions), 14% of renters had weekly rents imputed and 15% of households with a mortgage had their weekly mortgage payments imputed. These imputations were due to a combination of missing raw data and implausible values. The 41% figure for imputation of income includes any change to any component of household income. This may only be to change the amount received from a particular benefit by a very small amount, which would not significantly affect the total household income.
- In the modelling of derived variables from the EHS 2015-16 physical survey on the dimensions of the property e.g. derivation of floor area, external wall area etc., a total of 230 cases in the paired single year dataset had some form of alteration to the raw physical survey data following consistency and plausibility checks on the raw physical survey data.
- In the derivation of loft insulation (which also feeds into SAP12 energy modelling and the modelling of Decent Homes), for the EHS 2015-16 single year paired sample, 9% of dwellings with a loft had a value for loft insulation imputed, due to either the property having a flat roof or because no access to the loft space was possible during the physical inspection of the property. This is the largest imputation rate in the derivation of the energy efficiency rating.

5.29 Where appropriate, the EHS Annual Reports contain details on the approach used to handle the cases that are missing from the raw physical and interview data during analysis.

Data outputs

5.30 A range of EHS datasets are produced annually and released via the UK Data Archive under the End User Licence or the Special Licence, Table 5.1.

Table 5.1 List of annual datasets

Physical datasets	Interview datasets	Detailed derived datasets	Derived datasets (paired sample)	Derived datasets (full household sample)
Available via the Special Licence only			**Available under both End User Licence and Special Licence**	
Amenity.sav		Actual costs.sav	general.sav	generalfs.sav
Around.sav		Dimensions.sav	physical.sav	interviewfs.sav
Chimney.sav		Energy performance.sav	interview.sav	
Commac.sav		Full and paired sample equivalised income.sav		
Common.sav	Attitudes.sav	HHSRS.sav		
Damppc.sav	Contact.sav	Standardised costs.sav		
Doors.sav	Disability.sav			
Dormers.sav	Dwelling.sav			
Elevate.sav	Employment.sav			
Firstimp_PS.sav	Energy.sav			
Flatdets.sav	Fire.sav			
Hhsrs.sav	Firstimp_IS.sav			
HQ.sav	HhldType.sav			
Interior.sav	Identity.sav			
Introoms.sav	Income.sav			
Numflats.sav	Owner.sav			
Plotlvl.sav	People.sav			
Roofcov.sav	Renter.sav			
Rooffeat.sav	Rooms.sav			
Roofstru.sav				
Services.sav	Vacant.sav			
Shape.sav	WaitList.sav			
Shared.sav				
Structure.sav				
Wallfin.sav				
Wallstru.sav				
Windows.sav				

5.31 The data, user guides and supporting documentation are publicly available from the UK Data Archive (http://ukdataservice.ac.uk/). Datasets can be downloaded in SPSS and SAS format.

5.32 Prior to releasing the data in the UK Data Archive, all disclosive variables are removed to maintain the confidentiality of respondents. Some response categories are also condensed, several variables are top coded, and, in a few rare situations, data swapping between cases takes place for disclosure control reasons.

Annex 5.1: **HMO rules card**

Determining Houses in Multiple Occupation ('HMOs')

The following supplementary questions will help determine whether the dwelling is an HMO. Count the number of "yes" responses to the **key questions** and **additional questions** then use the table below to determine whether the pattern of responses indicates that the dwelling is an HMO or instead identifies the dwelling as a single household/shared household (i.e. NOT an HMO).

Key questions (ranked in order):

1. Does the landlord find new tenants to fill any rooms that become vacant (as opposed to the remaining tenants fulfilling this function)?
2. Does the landlord bear the cost of any shortfall in rent if one or more tenants defaults or vacates (as opposed to the remaining tenants having to pay)?
3. Did the occupiers come to rent the house separately (as opposed to a single group of renters)?

Additional questions (not in any ranking order):

4. Do the tenants identify themselves as multiple households?
5. Is there a large group of occupiers (i.e. more than 5 persons)?
6. Is there a separate tenancy agreement for each occupant (as opposed to a joint tenancy)?
7. Do individual tenants keep their rooms locked, excluding other tenants from their accommodation?
8. Has there been a large turnover of occupiers since the commencement of the tenancy? (Say more than 40% over last 18 months.)
9. Is there a mix of different types of occupants at the premises? (e.g. they are not all students)

Pattern of responses	**Meaning**
6+ questions answered 'Yes'	= bed-sits (which collectively would form an HMO)
4-5 questions answered 'Yes' including at least 1 'key question'	= bed-sits (which collectively would form an HMO)
4-5 questions answered 'Yes' but not any 'key questions'	= single household/shared house (i.e. NOT an HMO)
Less than 4 questions answered 'Yes'	= single household/shared house (i.e. NOT an HMO)

Annex 5.2: **List of derived variables**

5.33 This Annex includes a full list of derived and geo-demographic variables found on the End User Licence (EUL) and Special Licence (SL) versions of interview.sav, physical.sav and general.sav files, Annex Tables 5.2.1, 5.2.2 and 5.2.3 respectively. Further details on the derivation of these variables are available in the EHS Data Dictionary, publicly available on the UK Data Archive (http://ukdataservice.ac.uk/).

Annex Table 5.2.1: interview14+15.sav and interviewfs15.sav

accomhh	type of accommodation for household (interviewfs only)	SL only
accomhh1	type of accommodation for household & if not self-contained (interviewfs only)	EUL and SL
agehrp2x	age of household reference person - 2 band	EUL and SL
agehrp4x	age of household reference person - 4 band	EUL and SL
agehrp6x	age of household reference person - 6 band	EUL and SL
agehrpx	age of HRP – continuous	SL only
agen16	number of persons under 16 in household (interviewfs only)	SL only
ageoldbx	age of oldest person in household - banded	EUL and SL
ageoldx	age of oldest person in household	SL only
agepart6x	age of partner - 6 band	EUL and SL
agepartx	age of partner - continuous	SL only
ager	report age categories (interviewfs only)	EUL and SL
AHCinceq	AHC equivalised weekly income (modified OECD scale)	EUL and SL
AHCinceqv5	AHC equivalised income quintiles (weighted by peoplegross)	EUL and SL
AHCinceqv60h	AHC: below 60% of median income (weighted by peoplegross)	EUL and SL
ALLincx	annual gross income of the HRP and partner inc. income from housing benefit and LHA	EUL and SL
amthbenx	weekly housing benefit	EUL and SL
atspaany	is any household member at state pension age?	EUL and SL
atspahrp	is hrp at state pension age?	EUL and SL
atspaprt	is partner at state pension age?	EUL and SL
bedrqx	no. of bedrooms required by the household (2006 definition)	EUL and SL
bedstdx	bedroom standard (2006 definition)	EUL and SL
BHCinceq	BHC equivalised weekly income (modified OECD scale)	EUL and SL
BHCinceqv5	BHC equivalised income quintiles (weighted by peoplegross)	EUL and SL
BHCinceqv60h	BHC: below 60% of median income (weighted by peoplegross)	EUL and SL
Buypresh	year HRP bought present accommodation (interviewfs only)	SL only
Cohabhrp	if HRP is cohabiting (interviewfs only)	SL only
Cohabprt	if HRP partner is cohabiting (interviewfs only)	SL only
emphrp3x	working status of HRP (primary) - 3 categories	EUL and SL
emphrpx	employment status (primary) of HRP	EUL and SL
empprt3x	working status of partner (primary) - 3 categories	EUL and SL
empprtx	employment status (primary) of Partner	EUL and SL

equityr	equity in home (based on respondent valuation only)	EUL and SL
equityr5	equity in home (based on respondent valuation only)	EUL and SL
ethhrp2x	ethnic origin of HRP - 2 categories	EUL and SL
ethhrp4x	ethnic origin of HRP - 4 categories	SL only
ethhrp8x	ethnic origin of HRP - 8 categories	SL only
ethprt2x	ethnic group of hrp's partner - 2 categories	EUL and SL
ethprt	ethnic group of hrp's partner	SL only
ethprt8x	ethnic group of hrp's partner - 8 categories	SL only
famnumx	number of family units in hhold	SL only
FreeLeas	freehold or leasehold	EUL and SL
ftbuyer	if first-time buyer (interviewfs only)	EUL and SL
GrossA	age group & sex of youngest person in household (interviewfs only)	SL only
hatentp3	type of housing association tenancy (interviewfs only)	EUL and SL
hhbensx	household on means tested bens or tax credits with a relevant income below the threshold	EUL and SL
hhcomp1	household composition (interviewfs only)	EUL and SL
hhcompx	household composition	EUL and SL
hhempx	employment status of HRP and partner combined	EUL and SL
hhinc5x	all households - income in 5 bands	EUL and SL
hhincflg	imputations used to create net total hhold income	SL only
hhincx	EHS Basic Income (annual net household income (HRP + Partner) including savings)	EUL and SL
hhltsick	anyone in hhold have long term illness or disability?	EUL and SL
hhsizex	number of persons in the household	EUL and SL
hhtype11	househld type - full 11 categories	EUL and SL
hhtype6	household type - 6 categories	EUL and SL
hhtype7	household type - 7 categories	EUL and SL
hhvulx	household vulnerable - on means tested or certain disability related benefits?	EUL and SL
hhwhch	anyone in hhold uses a wheelchair	EUL and SL
housbenx	household (HRP + partner) receives any housing benefit?	EUL and SL
hpregdis	HRP or partner registered disabled?	EUL and SL
HYEARGRx	household gross annual income (inc. income from all adult household members)	EUL and SL
JOINTINCx	annual gross income of the HRP and partner	EUL and SL
lenown	length of ownership (years)	SL only
lenownb	length of ownership to date of survey	EUL and SL
lenres	length of residence (years)	SL only
lenres2	length of residence (paired interview only)	SL only
lenresb	length of residence	EUL and SL
LHArqx	no. of bedrooms required by the household (2011 definition)	EUL and SL
LHAstdx	bedroom standard (2011 definition)	EUL and SL
loncoupx	single householder or with partner	SL only
market_rent	tenancy types of renters	EUL and SL
mortwkx	weekly mortgage payments	EUL and SL
nbatha	if shares a bathroom, shower room or WC (interviewfs only)	SL only
NBedsX	total no of bedrooms household actually has	EUL and SL
ncouple	number of couples in household (interviewfs only)	SL only

ndepchild	number of dependent children in household	EUL and SL
NEmp	number of employed persons in household (interviewfs only)	SL only
NInac	number of economically inactive persons in household (interviewfs only)	SL only
nkita	if shares a kitchen (interviewfs only)	SL only
nliving	if shares other room (living room) (interviewfs only)	SL only
nlpar	number of lone parent families in household (interviewfs only)	SL only
NoUnits1	banded number of family units in household (interviewfs only)	EUL and SL
nrooms1a	number of rooms available to household grouped (interviewfs only)	EUL and SL
nroomsa	number of rooms available to household (interviewfs only)	SL only
nshare	if shares any part of accommodation (interviewfs only)	SL only
nsing	number of one-person family units in household (interviewfs only)	SL only
nssech9	NS-SEC Socio-economic Classification - HRP	EUL and SL
nssecp9	NS-SEC Socio-economic Classification - HRP's partner	EUL and SL
NStud	number of students in household (interviewfs only)	SL only
NUnemp	number of unemployed persons in household (interviewfs only)	SL only
nxdepch	number of non-dependent children in household (interviewfs only)	SL only
olderx	no. of people aged 60 plus who are HRP or partner	SL only
otherfam	additional families present in household	SL only
othfamlp	type of additional families in household	SL only
Owntype	type of ownership	EUL and SL
Prevten	previous Tenure (interviewfs only)	EUL and SL
pyngbx	age band of youngest person in household	EUL and SL
pyngx	age of youngest person in household	SL only
rentExS	total weekly rent excluding the cost of services	EUL and SL
rentExSflg	rent excluding services changed/imputed	SL only
rentflg	rent/housing benefit changed/imputed	SL only
rentwkx	total weekly rent payable (rent plus housing benefit)	EUL and SL
sexhrp	sex of household reference person	EUL and SL
sexprt	sex of hrp's partner	SL only
SFT	number of FT workers in HHLD (interviewfs only)	EUL and SL
sharer	if shares accommodation with other household (interviewfs only)	EUL and SL
srtentype2	type of social sector tenancy (interviewfs only)	EUL and SL
studhrp	if HRP is a full time student (interviewfs only)	SL only
Studprt	if HRPs Partner is a full time student (interviewfs only)	SL only
tenex	extended tenure of household	EUL and SL
tenure1	tenure Group 1 (interviewfs only)	SL only
tenure2	tenure Group 2 (interviewfs only)	EUL and SL
tenure3	tenure Group 3 (interviewfs only)	SL only
tenure4	tenure Group 4 (interviewfs only)	EUL and SL
totkitsa	number of unshared kitchens (interviewfs only)	SL only
workless	household with no one of working age employed - ILO defn	EUL and SL

Annex Table 5.2.2: physical14+15.sav

alltypex	dwelling age and type	EUL and SL
area3x	type of area	SL only
arnatx	nature of area	SL only
Attic	attic present in dwelling	EUL and SL
basement	basement present in dwelling	SL only
boiler	type of boiler	EUL and SL
constx	construction type	SL only
cstactbx	basic repair costs (actual)	EUL and SL
cstactcx	comprehensive repair costs (actual)	EUL and SL
cstactux	urgent repair costs (actual)	EUL and SL
cststdbx	basic repair costs (per square metre)	EUL and SL
cststdcx	comprehensive repair costs (per square metre)	EUL and SL
cststdux	urgent repair costs (per square metre)	EUL and SL
dampalf	dampness problems in one or more rooms	EUL and SL
dampcdf	serious condensation in one or more rooms	EUL and SL
damppnf	penetrating damp in one or more rooms	EUL and SL
damprsf	rising damp in one or more rooms	EUL and SL
dblglaz2	extent of double glazing	EUL and SL
dblglaz4	extent of double glazing	EUL and SL
dhcosty	cost to make decent (hhsrs 15 model)	EUL and SL
dhdisrx	decent homes repair criterion	EUL and SL
dhhhsrsx	decent homes HHSRS 15 criterion	EUL and SL
dhhhsrsy	decent homes HHSRS 26 criterion	EUL and SL
dhmodx	decent homes modern facilities criterion	EUL and SL
dhnumy	decent homes: number of criteria failed (hhsrs 15 model)	EUL and SL
dhnumz	decent homes: number of criteria failed (hhsrs 26 model)	EUL and SL
dhomesy	decent homes - HHSRS 15 model	EUL and SL
dhomesz	decent homes - HHSRS 26 model	EUL and SL
dhreasny	decent homes criterian not met (hhsrs 15 model)	EUL and SL
dhreasnz	decent homes criterian not met (hhsrs 26 model)	EUL and SL
dhtcacty	requirement to pass decent homes thermal comfort criterion	SL only
dhtcreasy	reason for failing decent homes on thermal comfort?	EUL and SL
dhthermy	decent homes thermal comfort criterion	EUL and SL
dwage4x	dwelling age	EUL and SL
dwage5x	dwelling age	EUL and SL
dwage7x	dwelling age	EUL and SL
dwage10x	dwelling age	SL only
dwtype3x	dwelling type	EUL and SL
dwtype7x	dwelling type	SL only
dwtype8x	dwelling type	EUL and SL
dwtypenx	dwelling type	EUL and SL
EPceeb12e	energy efficiency rating band (ehs SAP 2012)	EUL and SL
EPceib12e	environmental impact rating band (ehs SAP 2012)	EUL and SL
EPceir12e	environmental impact rating (ehs SAP 2012)	EUL and SL

floor5x	useable floor area - original EHS definition	EUL and SL
floor5y	useable floor area - building regulations definition	EUL and SL
floorx	useable floor area (sqm) - original EHS definition	EUL and SL
floory	useable floor area (sqm) - building regulations definition	EUL and SL
fuelx	main fuel type	EUL and SL
heat4x	main heating system	EUL and SL
heat7x	main heating system	EUL and SL
heatsec	secondary heating type	SL only
housex	dwelling type	EUL and SL
loftins4	loft insulation thickness	EUL and SL
loftins6	loft insulation thickness	EUL and SL
loftinsu	loft insulation thickness with unknowns	EUL and SL
loftinsx	loft insulation thickness	EUL and SL
loftu4	loft insulation thickness with unknowns	EUL and SL
lv1upkpx	poor quality environment - upkeep problems	EUL and SL
lv2trafx	poor quality environment - traffic problems	EUL and SL
lv3utilx	poor quality environment - utilisation problems	EUL and SL
lvanyx	poor quality environment	EUL and SL
lvnumx	number of liveability problems present	EUL and SL
mainfuel	main heating fuel	SL only
neivisx	appearance of area	EUL and SL
parking	parking provision of survey dwelling	EUL and SL
pcavwallx	percentage of external wall area that is cavity masonry	EUL and SL
rdsap09	reduced data energy efficiency rating (SAP 2009 based)	EUL and SL
sap12	energy efficiency (SAP12) rating	EUL and SL
sap412	energy efficiency (SAP12) rating	EUL and SL
secure	secure windows and doors	EUL and SL
storeyx	number of floors above ground	EUL and SL
sysage	age of heating system	EUL and SL
typercov	predominant type of roof covering	SL only
typerstr	predominant type of roof stucture	SL only
typewfin	predominant type of wall finish	SL only
typewin	predominant type of window	SL only
typewstr2	predominant type of wall stucture	SL only
wallcavy	type of wall	EUL and SL
wallinsz	type of wall and insulation	EUL and SL
watersys	water heating system	EUL and SL
wins90x	type of wall - post 1990 assumption	EUL and SL
wins95x	Type of wall - post 1995 assumption	EUL and SL

Annex Table 5.2.3: general14+15.sav and generalfs15.sav

aagfh15	household weight (2015-16) (generalfs only)	EUL and SL
aagpd1415	dwell weight, paired cases 2014/15 and 2015/16 (paired general only)	EUL and SL
aapgh1415	hhld weight, paired cases 2014/15 and 2015/16 (paired general only)	EUL and SL
fmonth	fieldwork month (generalfs only)	EUL and SL
Fqtr	fieldwork quarter (generalfs only)	EUL and SL
fyear	fieldwork year (generalfs only)	EUL and SL
GorEHCS	government office region	SL only
GorEHS	government office region - EHS version	EUL and SL
govreg1	government office Region, grouped (generalfs only)	EUL and SL
imd1510	IMD 2015 decile ranking of areas (lower layer SOA)	SL only
paired	whether paired sample case (generalfs only)	EUL and SL
region3x	overall region of England	EUL and SL
rucombin	rurality classification - combined (COA)	SL only
rucontxt	rurality classification - context (COA)	SL only
rumorph	rurality classification - morphology (COA)	SL only
tenure2x	tenure	EUL and SL
tenure4x	tenure	EUL and SL
tenure8x	tenure	EUL and SL
vacantx	type of vacancy (paired general only)	EUL and SL
vaclngth	length of vacancy (paired general only)	SL only

Annex 5.3: **Accessibility indicators**

5.34 The EHS collects a good deal of information on whether dwellings possess certain features or attributes to make them more accessible and useable for people with disabilities. In reporting, it focuses on the four aspects that form the basis of the requirements in part M of the Building Regulations, although the EHS cannot exactly mirror the detailed requirements:

- **Level access to main entrance:** there are no steps between the pavement (or any gate) and the entrance door. The path also has a gradient of less than 1:20. Includes level access to the entrance of the survey module for flats with common areas. Level access is analysed for dwellings with a private or shared plot.
- **Flush threshold to main entrance:** the threshold to the main entrance door has no obstruction greater than 15mm. This prevents the threshold from being a trip hazard and allows a wheelchair user to easily enter through the main door.
- **Width of internal doorways and circulation space conforms to Part M**: complies with requirements of Building Regulations.
- **WC at entrance level:** any WC at entrance level as EHS does not indicate whether it is wheelchair accessible.

5.35 A home is considered to be fully 'visitable' if it has all of the four features listed above. All these features are assessed directly by the surveyors during the physical survey according to a set of detailed guidelines which are detailed in Annex Table 5.3.1.

Annex Table 5.3.1: Four visitability features

<table>
<tr><th>Criterion</th><th>Definition</th></tr>
<tr><td>Level access to main entrance</td><td>Surveyors record the number of steps from the front gate/ pavement to the entrance to the dwelling. A ‘step’ is any planned change in level, excluding the width of the cill at the bottom of the door. Surveyors will only record level access where there are no steps between the gate / pavement and the entrance door to the dwelling for a wheelchair to negotiate. The path must also have a gradient of less than 1 in 20.</td></tr>
<tr><td>Flush threshold</td><td>This is only recorded as present if a wheelchair can be wheeled straight into a dwelling with no step to negotiate or obstruction higher than 15mm. For houses, this will usually be a specified adaptation. For flats, it is the entrance doorway into the flat itself that is assessed. Purpose-built flats are much more likely to have been built with a flush threshold to the entrance door or the flat. Flats on upper or basement floors can be assessed as having a flush threshold if the journey from the entrance to the module to the inside of the dwelling can be negotiated using a suitable lift and there is no step or obstruction higher than 15mm. If the lift is not working, the flat will still have a flush threshold.</td></tr>
<tr><td>The width of internal doorways and hallways conforms to Part M</td><td>This is only recorded as satisfactory if the doors and circulation space serving habitable rooms, kitchen, bathroom or WC comply with Part M regulations, as follows:
<table>
<tr><th>Doorway clear opening width (mm)</th><th>Corridor/passageway width (mm)</th></tr>
<tr><td>750 or wider</td><td>900 (when approach head-on)</td></tr>
<tr><td>750</td><td>1200 (when approach not head-on)</td></tr>
<tr><td>775</td><td>1050 (when approach not head-on)</td></tr>
<tr><td>800</td><td>900 (when approach not head-on)</td></tr>
</table></td></tr>
<tr><td>WC at entrance level</td><td>The WC must be located on the same level as the entrance to the house or flat and must be located inside the dwelling.</td></tr>
</table>

5.36 The survey also collects a range of additional data, which can be modelled to provide additional information on the accessibility of the dwelling, for example:

- living room at ground floor or entrance level or space to provide one
- bedroom at ground floor or entrance level or space to provide one
- space for turning wheelchairs in kitchens, dining areas and living rooms

- bath/shower at entrance level

5.37 A detailed report on the accessibility of the housing stock and its ease of adaptability for independent living can be found in the EHCS 2007 Annual Report and further technical details can be found in Chapter 11 of the EHCS 2007 Technical Report: (http://webarchive.nationalarchives.gov.uk/20120919132719/www.communities.gov.uk/publications/housing/ehcstechnicalreport2007).

Annex 5.4: **Household derived indicators**

1.1 This Annex focuses on the more complex derived household variables created using EHS interview survey data where the home is occupied and covers the following variables:

- income
- equivalised income
- rents and housing benefit
- modelling of mortgage repayments
- equity
- household composition

1.2 These complex derived household variables, along with more straight forward household variables e.g. household composition, age of the household reference person (HRP) etc, are used throughout the EHS Reports. For many of the 2015-16 EHS annual reports, particularly the Housing costs and affordability report, various measures of incomes were examined (for HRP and partner/all household income and income with and without any receipt of Housing Benefit) to help understand housing affordability for mortgagors and renters

1.3 Checks are made on the derived variables to ensure as far as possible that the data values are reasonable and that missing data have been assigned correctly. Implausible values are investigated and only when it is as certain as possible that the data are incorrect is a change made. To assist in analysis, changes made to the data are flagged in the derived EHS interview variable dataset indicating the nature and extent of any imputation.

1.4 All interview based variables are derived from the full annual EHS sample. Most of the 2015-16 EHS annual reports are based mainly on one full annual EHS sample.. Previous EHS annual reports such as the 2013-14 Energy Efficiency of English Housing Report include analysis based on two years of data using the paired household sub-sample (i.e. where an EHS household interview survey and a physical inspection of the property are secured).

1.5 The EHS datasets containing these household variables are available to users via the UK Data Archive www.data-archive.ac.uk/

Income

1.6 The EHS Reports present household/housing related characteristics in relation to various income indicators.

1.7 The income indicators used within the EHS Reports are based on the annual income of the HRP and their partner from wages, pensions, savings, and state benefits. The interview survey collects information on the main components of income for the HRP and their partner. These include:

- earnings from regular employment (including government training scheme income) or as self-employed
- income from occupational and private pensions
- income from other private sources such as rent from lodgers, student loans, maintenance payments etc
- state benefits including state pensions
- income from savings and investments

1.8 The income data are thoroughly checked for inconsistencies and errors to make sure as far as possible that the data are reasonable and that missing data has been imputed correctly. Implausible values are interrogated and only changed when it is almost certain that the data are incorrect. Any changes made are flagged indicating the nature and extent of any imputation (variable hhincflg).

1.9 Where respondents report receipt of private income sources, e.g. employment, self-employment income etc., but are unable/refuse to specify an amount, then an estimated amount is assigned according to the methods outlined in Annex Table 5.4.1. Also, new from 2015 modelling onwards, where the HRP/partner selected working in terms of their employment status, stated as being in receipt of paid work, but did not select any employment or self-employment income under their income sources (nor responded refused to their income sources), then the HRP/partner is assigned an employment income and an employment income amount is imputed based upon the method outlined in Annex Table 5.4.1. In this situation it is assumed that the HRP/partner unintentionally omitted employment income as an income source in the EHS interview survey.

Annex Table 5.4.1: Imputation procedure for private sources

	Type of missing data	Method of imputation
Self-employed	Amount missing	Uses data from the Annual Survey of Hours and Earnings (ASHE) based on age, sex, part-time/full-time , social economic group and geographical location
Regular employment	Amount missing	
Occupational pension	Amount missing	Sample median based on sex and social economic group
Private pension	Amount missing	
Other private sources	Amount missing	Sample median based on working status

1.10 Average values are based on the sample median rather than the sample mean as use of median values better reflects the characteristics of skewed distributions such as are common with income data.

1.11 Where respondents state receipt of particular types of benefits but are unable/refuse to specify an amount, an estimate is inserted based on their theoretical entitlement to the particular benefit. The EHS interview survey incorporates checks on the missing benefit amounts to ascertain whether this were due to the inclusion of the missing amounts with other specified benefits. Use of this data is incorporated into the assessment of missing benefit incomes to avoid double counting of benefit income where this looks probable. Only households that state they are in receipt of benefits are allocated income from benefits. If they are entitled to other benefits but are not claiming them, then estimates for these are not included.

1.12 Information is also collected on savings of the HRP and partner. Where the amount of savings/investment has not been provided, a method based on CHAID analysis is used to estimate the combined savings/investment of the HRP and any partner using predictor variables such as tenure, age/sex of HRP, number of jobs (HRP plus any partner) etc.

1.13 When the annual net income measure needs to be derived, Income Tax and National Insurance payable for the HRP and their partner are calculated where applicable according to Income Tax and National Insurance rates and allowances and deducted to give the total net annual income of the HRP and partner.

1.14 Low incomes in the dataset are uplifted, the justification being that it is likely the respondent under reported their income, either deliberately or by mistake. Where the calculated income of the HRP and any partner is lower than the household's calculated basic theoretical income support/pension credit

entitlement, the income amount is changed as follows. Households in receipt of one or more of the main benefits (excluding child benefit) and with an income below their theoretical income support/pension credit entitlement are allocated their basic income support/pension credit level plus any disability premiums that they might qualify for. Households that are not in receipt of any of the main benefits and with an income below their theoretical income support/pension credit entitlement have their income initially set to missing as it was assumed key components of income had been missed or seriously under-reported. An imputed value is then derived – see below.

1.15 Households where the total HRP and partner income is missing have this estimated using the median income for households as defined by working status, social economic group and whether a partner of the HRP is present in the household.

1.16 There are two versions of the variable for the annual income of the HRP and any partner. One variable is in terms of gross income i.e. income before tax and National Insurance deductions (labelled JOINTINCx) and the other in terms of net income i.e. with the deduction of Tax and National Insurance where applicable (labelled hhincx). It should be noted that these two income variables do not include any housing related benefits/allowances.

1.17 In addition, a variable giving the gross income of the HRP and partner has been created that includes housing benefit/Local Housing Allowance as income (labelled 'ALLincx'). This variable is derived by simply adding together the annual gross income of the HRP and partner (JOINTINCx) and an annualised housing benefit/LHA amount (amthbenx * 52). See the section on 'Rents and housing benefit' for the calculation of housing benefit/LHA using EHS data.

1.18 There is also a further gross income variable available, labelled HYEARGRx which is an extension of the gross income of the HRP and any partner. This variable represents the household gross income of the HRP and any partner but also includes the gross income of other additional adults living within the household that are not part of the primary benefit unit[1] e.g. a grown-up child living with their parents or two or more unrelated individuals sharing a house (see below for the derivation of additional adult income). Note that this income variable does not include any housing related benefits/allowances.

1.19 Data on the income of other additional household members aged 16 or over (who are not the HRP or partner) are collected at the person level in the EHS interview survey. 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 amount is provided for the additional adult then this value is used for the income of the household member. New from 2015

[1] 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.

modelling onwards, where an additional adult household member selected working in terms of their employment status, stated as being in receipt of paid work, but provided a gross income value of zero, then their gross income is overwritten and set to missing, and an income amount imputed based upon the standard imputation method for additional adult income as outlined below.

1.20 If an income has not been provided for the additional adult, an amount for their income is then 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), grouped geographical location for those in work, and (new from 2015 modelling onwards), presence of an income source. 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.

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

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

2. 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.

1.22 The EHS Reports tend to refer to income in terms of the gross income of the HRP and partner. This is used throughout the Households Report (and associated tables) to relate household income to factors such as tenure and housing benefit receipt. However, the 2015-16 Housing costs and affordability report also explored 'equivalised' income measures These are extensions of the net income measure outlined in this section and is discussed in detail below.

Equivalised income

1.23 A measure known as 'in poverty' is reported on in the EHS Reports and associated tables. This is based upon an income measure that is 'equivalised' before housing costs are taken into account. All analysis makes clear the precise measures being used.

1.24 The purpose of income equivalisation is based on the concept that the cost of living varies according to size and type of household. It recognises that, for example, a household of three people requires a higher income than a one person household to achieve the same standard of living. Accordingly an

equivalence scale (the modified OECD[2] scale) is employed, taking each household's size and composition into account, to make sensible comparisons.

1.25 Equivalised income measures have been constructed for the EHS in order to assess the relationship between relative poverty and housing conditions and amenities, not to provide estimates of poverty as such. Across Government, poverty is assessed principally through the Households Below Average Income (HBAI)[3] series. Information on household incomes is not collected in as much detail by the EHS as it is by the Family Resources Survey (the data source for the HBAI series). Therefore there are some limitations to which components can be included in the income measures produced for the EHS. Annex Tables 5.4.2, 5.4.3, 5.4.4 list the HBAI components of the BHC and AHC measures and describe how the information is addressed through the EHS.

[2] Organisation for Economic Co-operation and Development

[3] http://statistics.dwp.gov.uk/asd/index.php?page=hbai

Annex Table 5.4.2: BHC Income components in HBAI and EHS

HBAI Income component	Treatment in the EHS
Income from all household members	The EHS collects income data for the Primary Benefit Unit from the respondent (HRP or any partner). Income data for any additional adult household members is also collected.
Net earnings from employment	Collected
Profit or loss from self-employment	Self-employment income is collected in the EHS and it is included as an income component. The EHS does not collect information on negative self-employment income amounts (i.e. if the respondent experienced a self-employment loss) and thus income losses are not included.
Social security benefits and Tax Credits	Collected for the HRP and any partner
Income from occupational and private pensions	Asked about explicitly in EHS interview
Investment income	Collected
Maintenance payments	Would only be picked up as an 'other' source of income
Income from educational grants and scholarships	Would only be picked up as an 'other' source of income
Cash value of certain forms of income in kind	Not collected

Annex Table 5.4.3: BHC deductions in HBAI and EHS

HBAI BHC Income deduction	Treatment in the EHS
Income tax payments	Deducted using standard rules
National Insurance contributions	Deducted using standard rules
Council tax	Deducted based on information from the council tax band for the property and the council tax rate from the local authority
Contributions to occupational pension	Not collected
Insurance premium payments made in case of sudden loss of earnings	Not collected
Maintenance and child support payments	Not included
Parental contributions to students living away from home	Not collected
Student loan repayments	Not collected

Annex Table 5.4.4: AHC deductions in HBAI and EHS

HBAI AHC Income deduction	Treatment in the EHS
Rent	C ollected
Water rates, community or council water charges	Not collected
Mortgage interest payments	Some mortgage data collected but not in sufficient detail to be able to derive an accurate mortgage interest variable. Total mortgage repayments used as a proxy.
Structural insurance premiums	Not collected
Ground rent and service charges	Not included

1.26 The HBAI report uses two different equivalised income measures: Before Housing Costs (BHC) and After Housing Costs (AHC). The income components that make up the EHS equivalised BHC income variable include: net income of the HRP and any partner, net income from additional adults in the household, modelled winter fuel payment and the addition of council tax

benefit and housing benefit/Local Housing Allowance. For each household the BHC income measure adds up the income from these specified sources and then deducts the amount of council tax payable. These income sources are outlined in Annex Table 5.4.5 together with the method of calculating each income component. The AHC is derived by deducting rent and mortgage payments from the BHC measure, as outlined in Annex Table 5.4.6.

Annex Table 5.4.5: Income components of the BHC equivalised income

Components of the BHC income measure	Method of calculating the income component
Net income of the HRP and any partner	The income variable hhincx is used. See the section above on 'Income'.
Net income from additional adults in the household	The EHS interview survey collects gross income data at a basic level for all other additional household members that are 16 or over which is used in the derivation of the income variable HYEARGRx (see the section above on 'Income'). The gross income amount (as used for HYEARGRx) is converted to a net amount by deducting the applicable Income Tax and National Insurance.
Winter Fuel Payment	The applicable amount of WFP for the household is modelled based on the number of household members that have reached the qualifying age for WFP.
Council tax benefit/support	The BHC income measure includes income from council tax benefit. The EHS interview survey collects information on council tax benefit receipt of the HRP and any partner. Council tax benefit is assigned based on this information combined with knowledge of theoretical eligibility and the amount of council tax due.
Housing benefit/Local Housing Allowance (LHA)	The BHC income measure includes income from Housing benefit/LHA. See the section on 'Rents and housing benefit' for the calculation of housing benefit/LHA using EHS data. The derived variable amthbenx is used.

Deduction of council tax payable	The BHC income measure deducts council tax paid by the household. 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. The council tax band for each dwelling is collected via a data matching exercise undertaken by the Valuation Office Agency. The council tax band information is only for use in the production of statistics.

Annex Table 5.4.6: Income components of the AHC equivalised income

Components of the AHC income measure	**Method of calculating the income component**
Deduction of rent	The AHC income measure deducts the amount of rent paid by the household (if applicable). See the section on 'Rents and housing benefit' for the calculation of rent using EHS data. The derived variable RentExS is used.
Deduction of mortgage payment	The AHC income measure deducts the mortgage payments paid by the household (if applicable). See the section on 'Mortgage Payment' for the calculation of mortgage payments using EHS data. The derived variable mortwkx is used.

1.27 The HBAI series and poverty estimates are based on a modified OECD scale (modified so that a couple with no children is considered the reference point and has an equivalence factor equal to unity). The EHS follows this approach and determines the number of 'first' adults (i.e. HRP), other adults, children aged 14 years and over and children under 14 for each sample case in the dataset. This provides the necessary information to be able to apply the OECD equivalisation factors in order to produce an equivalised income, Annex Table 5.4.7.

Annex Table 5.4.7: OECD equivalisation factors

Equivalence scales	Modified OECD scaled to couple without children = 1	
	BHC	AHC
First adult	0.67	0.58
Spouse	0.33	0.42
Subsequent adults	0.33	0.42
Children aged under 14 years	0.20	0.20
Children aged over 14 years	0.33	0.42

Note: additional adult household members reported during the EHS interview survey to be living in Halls of Residence are excluded from the analysis.

1.28 The measured household income is divided by this equivalisation factor so that any household with a factor of less than one (e.g. a single person household) will have their income inflated, reflecting the fact that they are relatively better off than a larger household with the same income. Households with a factor greater than one have their incomes reduced, reflecting the fact that they are relatively worse off than a smaller household. The incomes of households containing two adults without children will not change.

1.29 The EHS Reports often use the BHC equivalised weekly income measure ranked and grouped into five equal sized categories. Thus the first quintile relates to the households with the lowest 20% of BHC equivalised weekly incomes and the fifth quintile relates to the households with the highest 20% of BHC equivalised weekly incomes. As previously mentioned, a term referred to as 'in poverty' is also used in the EHS Reports Households are defined to be 'in poverty' if their equivalised income is below 60% of the median household income before housing costs (BHC) are taken into account.

Rents and housing benefit

1.30 Information on rents and housing benefit are presented in detail in the EHS Households Report in analysis of social and private renters. The amount of rent and housing benefit also feeds into the calculation of Equivalised income (see above).

1.31 Household rents and housing benefit receipt are collected in the EHS interview survey and apply only to households that rent their own home or households in a shared ownership scheme. Renting households that live rent-free are not asked the series of rent and housing benefit questions in the interview survey. For rent-free cases the rent and housing benefit amounts are set to zero.

1.32 The total weekly rent payable for the property (variables rentwkx) includes the rent paid by the householder plus any housing benefit/Local Housing Allowance (LHA) received (variable amthbenx). These variables are calculated based on the householder's response to the set of detailed rent and housing benefit questions asked in the EHS interview. For households with a rent holiday, an adjustment is made so that the actual total amount of rent/housing benefit paid over the course of the year (over n weeks) is averaged out over the full year (as if paid over 52 weeks).

1.33 Households that pay rent but do not provide an amount for their rent/housing benefit, because the amount was either unknown or refused, are assigned an estimated total weekly guide rent amount. This is based on tenure, number of bedrooms and area where they live, (for private renters variables such as the type of landlord and level of furnishing are also used in the imputation), using the sources of rent data outlined in Annex Table 5.4.8. For these cases, the estimated total weekly rent payable (rentwkx) is calculated by adding the total weekly guide rent to the estimated modelled amount for services e.g. heating and regular meals etc. that are included in the rent (where applicable as specified by the householder). See paragraphs 33 to 35 for more information on services.

Annex Table 5.4.8: Data sources used for missing rent amounts

Tenure of the renting household	Type of missing data	Rent data source for missing values
Local authority	Rent amount missing	DCLG Local Authority Housing Statistics is used in conjunction with EHS data using the year in question and modelled accordingly
Housing association and shared owners	Rent amount missing	Two successive years of data is drawn from the Statistical Data Return submitted by Private Registered Providers (to reflect a mid-year rent value)
Private renters	Rent amount missing	EHS data using the year in question and modelled accordingly

1.34

1.35 Households that receive housing benefit/LHA but do not provide an amount or households that do not know if they receive housing benefit/LHA are assigned an estimated housing benefit/LHA amount as follows:

- 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 (as opposed to the total weekly rent payable, since housing benefit does not cover the cost of services such as heating and regular meals).
- If the household states that they are in receipt of partial housing benefit/LHA 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 rent amount payable and their theoretical entitlement to housing benefit.

1.36 An extension of the derived variable for total weekly rent payable for the property (labelled rentwkx) is the total weekly rent payable for the property excluding the cost of services e.g. heating, council tax etc (labelled rentExS). The EHS interview survey asks the householder if the rent amount included any of the following services:

- Council tax
- heating
- water and sewerage
- lighting
- hot water
- fuel for cooking
- regular meals
- TV licence

1.37 If the amount of rent the householder provided does not include any of these services, then the total weekly rent payable for the property is the same as the total weekly rent payable for the property excluding the cost of services i.e. rentwkx equals rentExS.

1.38 If the rent amount provided by the householder does include one or more of the services stated above then the householder is asked to provide a rent value excluding the selected services. Based on this rent information, an amount is calculated for total weekly rent payable for the property, excluding the cost of services. If a rent amount excluding services is not provided by the householder then an estimated amount for the selected services is modelled according to the methods shown in Annex Table 5.4.9 in order to derive a rent amount excluding the cost of services.

Annex Table 5.4.9: Imputation procedure for service amounts

Service	Method of imputation
Council tax	The amount is derived using the council tax band information for the property and the council tax rate from the local authority. For any cases where the respondent selects that council tax is included in their rent but also selected full housing benefit then the amount is set to 0.
Water and sewerage	This is calculated using the mean average water and sewerage rate for a household in England for the given year multiplied by a dwelling factor (that reflects the size/type of property) multiplied by a factor for that geographical area
Heating	Amounts are calculated based on DWP deductions from rent (as used in the assessment of housing benefit)
Lighting	
Hot-water	
Fuel for cooking	
Regular meals	
TV license	Based on the cost of a colour TV license (the TV license fee is set to zero where the HRP/partner is 75 years or over)

1.39 The EHS Households Report mainly focuses on the weekly rent amount payable for the property, excluding the cost of services, e.g. heating, council tax etc. Between the 2007-08 and 2008-9 data there were some methodological changes to the way in which rent data were processed in the EHS compared to the previous Survey of English Housing (SEH). These changes are detailed in the EHS Households Report 2008-09 where an assessment of the impact of the methodological changes between 2007-08 and 2008-09 on the private rent estimates and further details of the changes to the calculation of social rents are provided.

1.40 The rent and housing benefit amounts are thoroughly checked for inconsistencies and errors to make sure as far as possible that the data is reasonable and that missing data has been imputed correctly. Implausible values are interrogated and only changed when almost certain that the data is incorrect. Any changes made are flagged indicating the nature and extent of any imputation (variables rentflg and rentExSflg).

Modelling of mortgage repayments

1.41 Mortgage repayments are calculated from raw data collected from respondents on payments for all mortgages/loans secured on the dwelling, deducting any notional amounts for building and contents insurance, mortgage protection, and other insurance payments where they have been accidentally included. Endowment policy premiums are included in repayments. Information collected is converted to weekly amounts (variable mortwkx).

1.42 Where repayment amounts are unknown or missing, data is imputed. Where alternative data is available, using the formula below for monthly mortgage repayment:

$$\frac{(\text{value of current main mortgage} \times \text{annual interest rate}/12)}{(1-1/((1+\text{annual interest rate}/12)^{(\text{length of main mortgage in months})}))}$$

1.43 The 'current main mortgage' refers to the highest value mortgage if there is more than one loan secured on the property. Where the value of the current main mortgage is not provided, it is derived from original purchase price minus deposit paid, if these data are available. The purchase price is imputed if unknown, based on current market value, year dwelling bought (if available) and DCLG annual house price inflation indices for each area. From 2010, the EHS ceased collecting current market valuations on a regular basis from the Valuation Office Agency (VOA) for all households participating in the interview survey who had a physical inspection of their dwelling. In the interview survey, households are now asked to provide a recent (in last 12 months) valuation of their dwelling, and, if not available, their own estimate of the market value. This valuation/estimate is now used in the modelling as a proxy for current market value. Any missing values are imputed using data from the Regulated Mortgage Survey based on dwelling type and geographical area. Valuations are checked for outliers, which are reviewed and corrected if necessary and possible, based on other information on the property. Payments for other loans secured on the property are not included in this imputation process.

1.44 If the length of the main mortgage is unknown, it is modelled where data are available, based on the age of HRP and when the main mortgage was taken out (or if missing, when the dwelling was bought), assuming a maximum mortgage length of 25 years and that it will be paid off when the HRP is 60 years old.

1.45 The annual interest rate is taken from monthly data provided by the council of mortgage lenders (CML). An average is calculated for the period covered by the EHS survey.

1.46 Monthly mortgage payments are set to not applicable (-9) for tenancies. If the owner owns the dwelling outright, payments are zero. All shared owners are treated as owners and mortgage payments are derived as above and where necessary adjusted for the proportion of ownership if data imputed. Flexible/all

in one/offset mortgages are also derived as above. Payments for equity release mortgages are imputed and are modelled as above.

1.47 Monthly repayment amounts are then converted to weekly payments. The data are thoroughly checked for inconsistencies, outliers and errors although data are only corrected where deemed totally implausible and it is possible to determine an alternative more reliable imputed value.

1.48 It should be noted that the weekly mortgage variable contains amounts for a mixture of mortgage types for example repayment and interest only cases, when the information was provided by the household. However, all imputed cases, irrespective of the mortgage type (for example, interest only mortgages) are calculated as repayment mortgages (interest and capital).

Equity

1.49 The value of a household's equity in their property is calculated for all owner occupied (including shared owner) households who participate in the interview survey. It is based on the current market value of the property minus the amount of mortgage outstanding (for shared owners this is checked and adjusted where necessary to ensure their equity is calculated in proportion to their ownership).

ie. Equity = current market value – amount of mortgage outstanding including other loans on the property

1.50 All owner occupiers are asked in the interview for an estimated current valuation of their property. This is used to derive an approximate equity value as detailed above (variables 'equityr' and 'equityr5').

1.51 Research conducted on the EHS 2008 data demonstrated that owner occupiers are more likely to overestimate the value of their homes than underestimate it, and only 40% of household estimates are within 10% of the VOA valuation. Those who moved in just over a year ago, who are on the highest incomes or in the highest value properties are most likely to overestimate value. Those homes most likely to be underestimated in value contain singletons and couples aged over 60 and those resident for at least 20 years. As a result of respondents tending to overestimate property value, equity based on this source of market value ('equityr' and 'equityr5') is likely to be an overestimate.

1.52 Missing equity valuations are imputed using data from the regulated mortgage survey based on dwelling type and area. Valuations are checked for outliers and corrected if it is possible to determine a more reliable imputed value.

1.53 Where data used in the above formula is not available, equity is set to unknown (-88888888) or not applicable (-99999999) for tenancies.

Household composition

1.54 Each year, English Housing Survey (EHS) data is used to create a number of household typologies. These descriptors are a way of classifying households according to the relationships between the household members and are used throughout the EHS reports to provide context on household circumstances and characteristics.

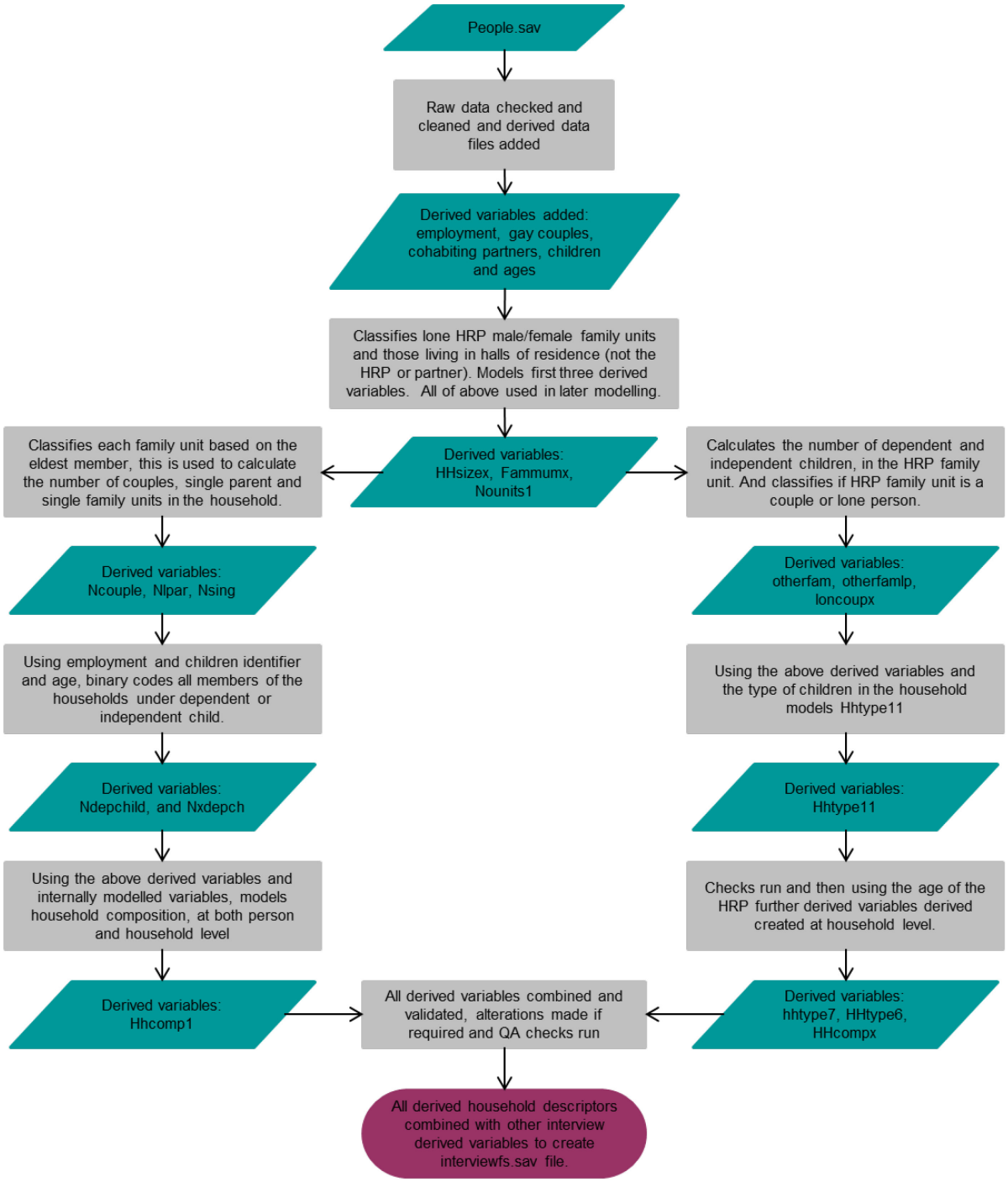
1.55 The current EHS household survey is the result of the 2008 merger of the Survey of English Housing (SEH) and the English House Condition Survey (EHCS). Both these surveys collected similar information and modelled some similar household derived descriptors, however their methods and assumptions were not always the same for deriving these similar classifications. A key difference was that SEH modelled its descriptors based on the eldest person in the household whereas the EHCS used the Household Reference Person (HRP). For the majority of the simple derived descriptors this made no difference or only minor changes were required to harmonise them, however some descriptors are still not derived from the same assumptions. This has the potential to cause confusion when they are combined in analysis. This report aims to clarify the modelling assumptions of these conflicting cases. It will outline how the simpler derived variables (Annex Table 5.4.10) feed into the more complex ones (Annex Table 5.4.11 and Annex Table 5.4.12).

1.56 The flow chart below (Figure 5.4.1) outlines the modelling process of the household descriptors. As part of the modelling, the raw data is cleaned to correct any inconsistent relationship data mainly relating to the family unit. This is done within the modelling only and the raw data files remain unchanged. For this reason, although correct, there may be inconsistency between some derived descriptors and the raw data. The derived indicators are considered to be correct and in line with all guidance for classifying individuals and family units. It is these variables that are used for reporting.

1.57 Many of the simpler derived variables are either directly related to the HRP, for example Cohabhrp or Cohabprt, or derive the quantity of a particular type of household member or household type within the household, for example the number of couples in the household (ncouple). These simple derived variables are listed in Annex Table 5.4.10, which highlights both the modelling key issues and recoding and the potential data conflicts which may cause a descriptor to be at odds with another descriptor.

1.58 Some of these simpler derived variables and raw data are used to model the more complex final household composition descriptors, hhtype11, hhytype7, hhtype6, hhcompx (originating from the EHCS) and Hhcomp1 (originating from the SEH). This can be seen in the flowchart (Figure 5.4.1) as well Annex Table 5.4.11 and Annex Table 5.4.12.

Figure 5.4.1: Simple flowchart of the modelling of the derived household



Annex Table 5.4.10: Simple household descriptors

Derived descriptor	Descriptor variable label	Modelling key issues	Data conflict issues
Cohabhrp	If HRP is cohabiting	Includes same sex couples, even if they are not in the same family unit as the HRP	May conflict with hhcomp1 which is not based on HRP. Also may conflict with other descriptors such as fanmumx, NoUnits1, otherfam and othfamlp if it is a same sex couple
Cohabprt	If HRP partner is cohabiting	Includes same sex couples, even if they are not in the same family unit as the HRP	May conflict with hhcomp1 which is not based on HRP. Also may conflict with other descriptors such as fanmumx, NoUnits1, otherfam and othfamlp if it is a same sex couple
Hhsizex	Number of persons in the household	Excluding those aged 16+ living away in halls of residence/boarding school, who are not the HRP or partner.	-
Famnumx	Number of family units in household	The number of family units in the household, excludes those age 16+ living in halls of residence who are not the HRP or partner (unlike old SEH definition). Also, same sex couples are counted as separate family units, despite being treated as a couple living together in other variables (e.g. 'loncoupx', 'hhcompx'). Originates from EHCS.	May conflict with other descriptors due to some same sex couples being recoded as a couple, but in different family units.
NoUnits1	Banded number of family units in household	Famnumx banded, see above for modelling issues.	See above

Derived descriptor	Descriptor variable label	Modelling key issues	Data conflict issues
Nlpar	Number of lone parent families in household	For some household that state they are married or cohabitating (Xmarsta2), but there is no partner in the household, they are recoded from ncouple to nlpar if there are children in the same family unit in the household. For consistency with EHCS. Excludes those aged 16+ that in halls of residence who at not the HRP or partner.	-
Ncouple	Number of couples in household	Some cases in the data set, that state they are married (under Xmarsta2) and have children but there is no partner in the household, these are recoded to lone parents. Excludes those aged 16+ that in halls of residence who at not the HRP or partner.	Same sex couples not in a civil partnership/married may conflict with other descriptors such as famnumx, NoUnits1, as they are in separate family units.
Nsing	Number of one-person family units in household	Same sex couples are recoded from nsing to couples, this is a model issue. Excludes those age 16+ that live in halls of residence who are not the HRP or partner.	It is possible to be a single family household under nsing and a dependent or independent child, for example dependent foster children.
Ndepchild	Number of dependent children in household	All dependent children are those under age 16 or those aged 16 to 18 that are in full time education. This based on all children in the household, irrespective of which family unit they are in, but not those living in halls or residence.	All children in the home, not just the main family unit, if other family units are present in the household. It is possible to be a dependent child and a single family household under nsing for example in the case of non-relatives and foster children. This variable will not always match with EHCS household composition descriptors as they are modelled based on the children in the HRP family unit only. The modelling does not consider other children in the household.

Derived descriptor	Descriptor variable label	Modelling key issues	Data conflict issues
Nxdepch	Number of non-dependent children in household	All children age 16+ that not in full time education or children that aged 19 or older. (Children aged 16-18 in full time education are considered dependent). Excludes those living in halls of residence.	All children in the home, not just the main family unit, if other family units are present in the household. It is possible to be an independent child and be coded against nlpar, nsing and ncouple, if the parents of the adult child live in the same household. This variable will not always match with EHCS household composition descriptors as they are modelled based on the children in the HRP family unit only. The modelling does not consider other children in the household.
Otherfam	Additional families present in household	Based on the recoding on famnumx, the number of separate family units. Excludes those aged 16+ that in halls of residence who at not the HRP or partner.	May conflict with other ncouple due to some same sex couples being recoded under couples.
Othfamlp	Type of additional families in household	Based on otherfam and the size of each family unit. Excludes those aged 16+ that in halls of residence who at not the HRP or partner.	May conflict with other ncouple due to some same sex couples being recoded under couples.
Loncoupx	Single householder or with partner	Based on HRP household only, will include same sex couples even if they are not in the same family unit as the HRP	May conflict with other famnumx, NoUnits1 otherfam and othfamlp due to HRP same sex couples.

1.59 Although the modelling of the household composition descriptors is, by and large, not complicated, the difference in assumptions is important; and not always clear. For the majority of households, where the household consists of just one family unit, the derived descriptors are consistent. Complications arise when there is more than one family unit in the household or where the HRP is an independent child within the sole family unit.

1.60 Annex Table 5.4.11 shows the household composition descriptors that originate from the EHCS. It illustrates how the descriptors are derived, the key modelling assumptions and any recoding that takes place to deal with modelling difficulties and to harmonise the descriptors. The EHCS household composition descriptors are modelled based on the HRP family unit by firstly, defining the HRP family unit and then, if present, any additional family units in the household. For this reason, dependent children that are not part of the

main family unit are not considered children in the household, but as separate family units coded as an independent single person. Hhtype11 is the first derivation of these four derived household composition descriptors. The other three, hhtype7, hhtype6 and hcompx, are all derived from hhtype11 and the age of the HRP for the more detailed classifications. Understanding the derivation of hhtype11 should explain the coding of the other variables.

1.61 This model assumes:

- Same sex couples are treated as couples,
- Those in halls of residences that are not the HRP or partner are not included in the modelling.
- Dependent children are all those under 16 or aged between 16 and 18 and in full time education and part of the main family unit i.e. the family unit of the HRP and partner.
- Couple households with only independent children are classed as couples, and single parent households with independent children only are classed as other multi-person households.

Annex Table 5.4.11: Household composition descriptors that originate from the EHCS

Hhtype11 - Household type - full 11 categories			**Hhtype7** (recoded from hhtype11) **- Household type - 7 categories**	**Hhtype6** (recoded from hhtype7 using age of HRP) - **Household type - 6 categories**	**Hhcompx** (recoded from Hhtype6 using age of HRP) **- Household composition**
Variable code and value label	**Modelling key issues**	**Recoding or possible data conflict issues**	**Variable code and value label**	**Variable code and value label**	**Variable code and value label**
1. Couple no child(ren)	All in the same family unit, but possible to have one person single family unit only	Possible to have an additional single family unit if not HRP	1 .Couple no dependent child(ren)	1 .Couple no dependent child(ren)	Becomes: 1. couple, no dependent child(ren) under 60 or 2. couple, no dependent child(ren) aged 60 or over

Hhtype11 - Household type - full 11 categories			**Hhtype7** (recoded from hhtype11) **- Household type - 7 categories**	**Hhtype6** (recoded from hhtype7 using age of HRP) - **Household type - 6 categories**	**Hhcompx** (recoded from Hhtype6 using age of HRP) **- Household composition**
Variable code and value label	**Modelling key issues**	**Recoding or possible data conflict issues**	**Variable code and value label**	**Variable code and value label**	**Variable code and value label**
2. Couple dependent child(ren) only	All in the same family unit, but possible to have a lone person single family unit in the household as well.	Possible to have an additional single family unit if not HRP	2. Couple with dependent child(ren)	2. Couple with dependent child(ren)	3. Couple with dependent child(ren)
3. Couple with dependent and independent children	All in the same family unit, but possible to have a lone person single family unit in the household as well.	Possible to have an additional single family unit if not HRP	2. Couple with dependent child(ren)	2. Couple with dependent child(ren)	3. Couple with dependent child(ren)
4. Couple with independent child(ren) only	All in the same family unit, but possible to have a lone person single family unit in the household as well.	Possible to have an additional single family unit if not HRP	1 .Couple no dependent child(ren)	1 .Couple no dependent child(ren)	Becomes: 1. couple, no dependent child(ren) under 60 or 2. couple, no dependent child(ren) aged 60 or over
5. Lone parent with dependent child(ren) only	All in the same family unit, but possible to have a lone person single family unit in the household as well.	Possible to have an additional single family unit if not HRP	3. Lone parent with dependent child(ren)	3. lone parent with dependent child(ren)	4. Lone parent with dependent child(ren)

Hhtype11 - Household type - full 11 categories			**Hhtype7** (recoded from hhtype11) **- Household type - 7 categories**	**Hhtype6** (recoded from hhtype7 using age of HRP) - **Household type - 6 categories**	**Hhcompx** (recoded from Hhtype6 using age of HRP) **- Household composition**
Variable code and value label	**Modelling key issues**	**Recoding or possible data conflict issues**	**Variable code and value label**	**Variable code and value label**	**Variable code and value label**
6. Lone parent with dependent and independent children only	All in the same family unit, but possible to have a lone person single family unit in the household as well.	Possible to have an additional single family unit if not HRP	3. Lone parent with dependent child(ren)	3. Lone parent with dependent child(ren)	4. Lone parent with dependent child(ren)
7. Lone parent with independent child(ren) only	All in the same family unit, but possible to have a lone person single family unit in the household as well.	Possible to have an additional single family unit if not HRP	4. Other multi-person households	4. Other multi-person households	5. Other multi-person households
8. Two or more families	Other additional families, the second family units need to contain 2 or more people in it, the HRP family unit can be a single person	If the HRP is a single person and lives with a couple or another family unit 2+people it will be coded 8 however this will not be the case for HHcomp1 (coded 1 see modelling explanation below).	4. Other multi-person households	4. Other multi-person households	5. Other multi-person households
9. Lone person sharing with other lone persons	More than one family unit in the household, but with only one person in each of them	-	4. Other multi-person households	4. Other multi-person households	5. Other multi-person households

Hhtype11 - Household type - full 11 categories			**Hhtype7** (recoded from hhtype11) **- Household type - 7 categories**	**Hhtype6** (recoded from hhtype7 using age of HRP) - **Household type - 6 categories**	**Hhcompx** (recoded from Hhtype6 using age of HRP) **- Household composition**
Variable code and value label	**Modelling key issues**	**Recoding or possible data conflict issues**	**Variable code and value label**	**Variable code and value label**	**Variable code and value label**
10. One male	One person family households	-	5. One male	Becomes: 5. one person under 60 or 6. one person aged 60 or over	Becomes: 6. one person under 60 or 7. one person aged 60 or over
11. One female	One person family households	-	6. One female	Becomes: 5. one person under 60 or 6. one person aged 60 or over	Becomes: 6. one person under 60 or 7. one person aged 60 or over

Note: The variable hhtype7 does have a seventh category 'one person (sex unknown)' but this category is currently redundant due to no missing EHS data on the gender of individuals.

1.62 It is important to note that there are a few households that are not derived based on the HRP, to provide better consistency with the SEH. These households are where the HRP is a young unmarried adult child living with their parents in the household. Under EHCS rules, if an adult child is single and they don't have children of their own they should be part of the main family unit, with their parent/s (not in a separate family unit as the raw data suggests). So where there is a 'normal' family set up for example a couple with two children where one is the HRP, the household composition of these cases is recoded based on the overall composition of the family unit. If the data is not recoded, the household is coded 8 'as two or more families' which is not in accordance with the guidance. Usually this is just effects a few households in the data set each year.

1.63 Annex Table 5.4.12 shows the SEH household composition descriptor (hhcomp1), its coding, key modelling issues and recoding or potential data conflicts. This descriptor is derived firstly based on the eldest person in the household, however in the modelling, additional family units of couples and single parents will over-ride the eldest person in the household if they are a single person family unit. This means that households that may have been coded two or more families under EHCS method, can be coded as married/cohabiting couple or a lone parent (male or female) under the SEH method.

Annex Table 5.4.12: Household composition descriptors that originate from the SEH

Hhcomp1 - Household composition		
Variable code and value label	**Modelling key issues**	**Recoding or possible data conflict issues**
1. Married / cohabiting couple	A married/cohabiting with or without children (independent or dependent). There can be additional single person family units in the household. Note - couples households over-ride the eldest household if the eldest household is a single household.	Some cases are recoded to lone parent, because modelled on married status, and there are some households that state they are married but there is no partner in the household, so these are recoded to match hhtype11 that codes these cases as single parents. (Also ncouple and nsing are recoded see above). This may not fit with the derived variables based on an HRP profile, for example Cohabhrp.
2. Lone parent, male HRP	A lone parent with child(ren) dependent or independent or both with a male HRP. There can be additional single person family units in the household. Single parent households over-ride single households if they are the eldest household.	Could be coded as two or more families under hhtype11, if there is an additional single family unit who is the HRP. If this is the case the HRP might not be the lone parent.
3. Lone parent, female HRP	A lone parent with child(ren) dependent or independent or both with a female HRP. There can be additional single person family units in the household. Single parent households over-ride single households if they are the eldest household.	Could be coded as two or more families under hhtype11, if there is an additional single family unit who is the HRP. If this is the case the HRP might not be the lone parent.
4. Multi family household, male HRP	Has at least two family units and it is either made up of: at least a couple family unit and single parent family unit or 2 couples or 2 single parents family units or 2 or more single people in their own family unit. It is not possible to have a single family unit with a family unit of 2 or more people in this derivation; these will be code 1 to 3 above.	-

Hhcomp1 - Household composition		
Variable code and value label	**Modelling key issues**	**Recoding or possible data conflict issues**
5. Multi family household, female HRP	Has at least two family units and it is either made up of: at least a couple family unit and single parent family unit or 2 couples or 2 single parents family units or 2 or more single people in their own family unit. It is not possible to have a single family unit with a family unit of 2 or more people in this derivation; these will be code 1 to 3 above.	-
6. One male	One person households - single family unit	-
7. One female	One person households - single family unit	-

1.64 Although, the majority households derived descriptors are consistent with the raw data and one another there are circumstances where these may conflict. In the first instance, any conflict between the derived household descriptors and the raw data, the derived descriptors would be correct (following the guidance for classifying individuals and households) and the household raw data inconsistent. Once the descriptors are modelled, a few households are recoded which means they are not consistent with the original modelling rules, but this has to be done to reduce data conflict between key descriptors. Even so, there are still some household descriptors which will still conflict with others. The key areas of conflict are:

- Number of dependent children in the household (ndepchild) with hhtype11, hhtype7 hhtype6 and hhcompx, where it's possible to be coded as a household with no dependent children in it, when in fact the household contains dependents in separate family unit to the HRP.
- Hhcomp1 can conflict with hhtype11, hhtype7, hhtype6 and hhcompx, these are due to the treatment of additional single person households, depending on modelling assumptions of either an EHCS or SEH based descriptor.
- Hhcomp1 may conflict with Cohabhrp and Cohabprt as it is not modelled based on the HRP.
- Ncouple, loncoupx, Cohabhrp and Cohabprt may conflict with due to the modelling of cohabiting same sex couples otherfam, othfamlp famnumx and NoUnits1; although these are not easy to identify through top level analysis.

Annex 5.5: **Housing conditions**

5.38 The EHS collects very detailed information about the overall condition and quality of the housing stock using a detailed physical inspection by trained surveyors. A number of the measures and indicators e.g. presence of damp problems, electrical safety etc. are derived almost directly from what the surveyor has entered on the physical survey form and in that sense are straightforward and are covered in the glossary to the main reports. For other measures, the judgements that the surveyors have to make can be complex and the modelling has to combine several of these into a composite indicator. This section provides more information regarding three more complex housing condition measures:

- the Housing Health and Safety Rating System (HHSRS)
- decent homes
- disrepair (repair costs)

5.39 The complexity of derived variables relating to these three housing condition indicators varies by degree and nature. For the HHSRS, the most complex aspect relates to the surveyor assessments at the survey dwelling, which are underpinned by their extensive training and support to help ensure their HHSRS assessments are consistent and robust.

5.40 In contrast, the creation of the repairs costs relies in part on the outputs from the complex dimensions modelling (see annex 7 of this Chapter), and further, but less complex, modelling of data collected through the surveyor observations on the level of disrepair and suggested treatment to remedy any disrepair at the survey dwelling. These observations are also supported by extensive training and support.

5.41 The assessment of whether the survey dwelling meets the Decent Homes Standard is not assessed directly by the surveyor but is modelled post fieldwork using both outputs from the repair cost and HHSRS modelling and additional data collected by the surveyor.

Housing Health and Safety Rating System

5.42 This section presents an overview of the Housing Health and Safety Rating System (HHSRS) and how the various hazards are measured and modelled using data from the EHS. It is divided into three sections:

- what is the HHSRS?
- how does the EHS measure and model Category 1 hazards?
- data quality and reliability

What is the HHSRS?

5.43 The HHSRS is the government's evidence based risk assessment procedure for residential properties. It replaced the Housing Fitness Regime on the 6 April 2006 in England. The HHSRS also replaces the Fitness Standard as an element of the Decent Homes Standard. The HHSRS is a means of identifying defects in dwellings and of evaluating the potential effect of any defects on the health and safety of occupants, visitors, neighbours and passers-by. The system provides a means of rating the seriousness of any hazard so that it is possible to differentiate between minor hazards and those where there is an imminent threat of major harm or even death. The emphasis is placed on the potential effect of any defects on the health and safety of occupants, visitors, and particularly vulnerable people. Altogether 29 hazards are included, Annex Table 5.5.1.

Annex Table 5.5.1: The 29 hazards covered by HHSRS

Physiological requirements
- dampness and mould growth
- excess cold
- excess heat
- asbestos (and MMF)
- biocides
- carbon monoxide and fuel combustion products
- lead
- radiation
- uncombusted fuel gas
- volatile organic compounds

Psychological requirements
- crowding and space
- entry by intruders
- lighting
- noise

Protection against infection
- domestic hygiene, pests and refuse
- food safety
- personal hygiene, sanitation and drainage
- water supply

Protection against accidents
- falls associated with baths etc.
- falling on level surfaces
- falling on stairs etc.
- falling between levels
- electrical safety
- fire
- flames, hot surfaces etc.
- collision and entrapment
- explosions
- position and operability of amenities etc.
- structural collapse and falling elements

5.44 The HHSRS scoring procedure uses a formula to generate a numerical hazard score for each of the hazards identified at the property – the higher the score, the greater the severity of that hazard. Potential hazards are assessed in relation to the most vulnerable class of person who might typically occupy or visit the dwelling. For example, for falls on stairs and falls on the level, the vulnerable group is defined as persons over 60 years, and for falls between levels it is children under 5 years old.

5.45 The hazard score formula requires the HHSRS inspector to make two judgements.

- the likelihood of an occurrence which could result in harm to a vulnerable person over the following 12 months. The likelihood is to be given as a ratio – e.g., 1 in 100, 1 in 500, etc.
- the likely health outcomes or harms which would result from the occurrence. From any occurrence there may be a most likely outcome, and other possible ones which may be more or less severe. For example, a fall from a second floor window could result in a 60% chance of a severe concussion, but there may also be a 30% chance of a more serious injury and a 10% chance of something less serious. The four classes of harms and the weightings given to them are listed in Annex Table 5.5.2.

Annex Table 5.5.2: Classes of harms and weightings used in the HHSRS

Class	Examples	Weightings
Class I	Death, permanent paralysis below the neck, malignant lung tumour, regular severe pneumonia, permanent loss of consciousness, and 80% burn injuries.	10,000
Class II	Chronic confusion, mild strokes, regular severe fever, loss of a hand or foot, serious fractures, very serious burns and loss of consciousness for days.	1,000
Class III	Chronic severe stress, mild heart attack, regular and persistent dermatitis, malignant but treatable skin cancer, loss of a finger, fractured skull, severe concussion, serious puncture wounds to head or body, severe burns to hands, serious strain or sprain injuries and regular and severe migraine.	300
Class IV	Occasional severe discomfort, chronic or regular skin irritation, benign tumours, occasional mild pneumonia, a broken finger, sprained hip, slight concussion, moderate cuts to face or body, severe bruising to body, 10% burns and regular serious coughs or colds.	10

5.46 From the judgements made by the HHSRS inspector, a hazard score can be generated for each hazard, Annex Table 5.5.3.

Annex Table 5.5.3: Calculation of HHSRS hazard score

Class of Harm Weighting			Likelihood 1 in		Spread of Harm (%)		
I	10,000	÷	100	X	0	=	0
II	1,000	÷	100	X	10	=	100
III	300	÷	100	X	30	=	90
IV	10	÷	100	X	60	=	6
					Hazard Score	=	196

5.47 To provide a simple means for handling and comparing the potentially wide range of scores and avoid placing too much emphasis on the exact numbers, a series of ten hazard score bands have been devised, Annex Table 5.5.4. Bands A, B, and C are the most serious and grouped together as presenting a Category 1 hazard; local authorities have a statutory duty to consider some form of action where these are present.

Annex Table 5.5.4: HHSRS hazard score bands

Band	Equivalent Hazard Scores
A	5,000 or more
B	2,000 – 4,999
C	1,000 –1,999
D	500 – 999
E	200 – 499
F	100 – 199
G	50 – 99
H	20 – 49
I	10 – 19
J	9 or less

5.48 DCLG, and others, have published a number of guidance documents for HHSRS practitioners and private landlords. For guidance published by DCLG see: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/15810/142631.pdf

How does EHS measure and model Category 1 hazards?

5.49 For the EHS, surveyors are required to collect a wide range of information in what is a relatively short and non-intrusive property inspection. The survey cannot therefore replicate in full the HHSRS assessment that would be carried out by a local authority environmental health practitioner. The approach used has been developed by the Building Research Establishment working in close co-operation with experts from the University of Warwick who were involved in the development of the HHSRS methodology.

5.50 Of the 29 HHSRS hazards only three (which occur very rarely in the stock) are not assessed by the EHS. These are asbestos (and manufactured mineral fibres), biocides and volatile organic compounds.

5.51 The EHS uses three different methods to assess whether any of the 26 Category 1 hazards exist in dwellings:

- Fully measured hazards as part of the physical survey for the most common types of hazards. The surveyor first assesses whether the risks presented for each of these hazards are significantly worse than average for the age and type of dwelling concerned. If this is the case, they then score both a likelihood of an incident occurring and the expected range of outcomes. An actual HHSRS score is not computed in the field but where risks are assessed as significantly worse than average surveyors obtain this score later during validation of their survey data prior to submission. From April 2012, EHS surveyors fully measured six hazards.
- Hazards flagged only when an 'extreme' risk is found as part of the physical survey. This approach is used for some of the rarer hazards where surveyors are instructed that 'extreme risk' equates to a Category 1 hazard. From April 2012, EHS surveyors assessed 16 hazards by this approach.
- Four hazards modelled post fieldwork from other data collected on the physical survey form. This approach is used where the surveyor is less able to directly assess the risk from these hazards.

5.52 Annex Figure 5.5.5 shows a worked example of HHSRS assessment. In making their HHSRS assessments surveyors are instructed to ignore the current occupancy and assume a member of the group most vulnerable to the particular hazard occupies the property. Annex Table 5.5.6 shows how information on each hazard is collected.

Annex Figure 5.5.5: Worked example of HHSRS assessment

FALLS ON STAIRS ETC

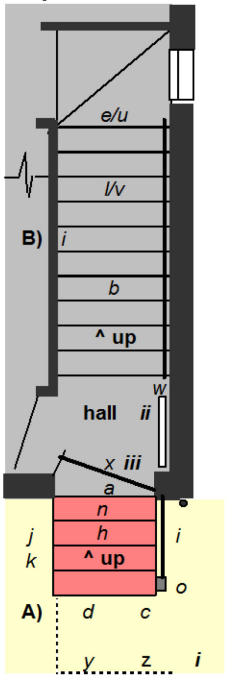
HHSRS VERSION 2

Vulnerable group Persons aged 60 years or over
Related hazards None

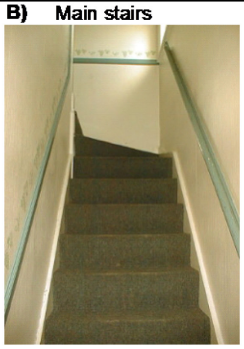
Multiple locations Yes No
Secondary hazards Yes No

A) Front door steps

A/B) Plan



B) Main stairs



C) Steps at gate

DESCRIPTION OF HAZARD/S

Dwelling: 1930s, Semi-detached house

A) **Front door steps:** These are of smooth painted concrete and have no top 'landing'. The bottom riser is high and uneven (300 mm max). There is a wobbly tubular steel handrail on one side but no guarding at all, despite the narrow width. There is no external porch light and little street lighting.

B) **Main stair:** The main internal stairs have two winders at the top and are moderately steep. There is a handrail only along the outside wall of the straight flight. There is a projecting radiator in the small hall and some glass in the front door close to the foot of the stairs.

C) **Steps at gate:** The steps close to the front gate are of rough spalling concrete. They have high uneven risers and a narrow tread. There is a crude rotten timber handrail but no guarding.

LIST OF RELEVANT MATTERS

LIKELIHOOD		A	B	C
a	Tread lengths	1	1	2
b	Riser heights	3	1	2
c	Variation in T&Rs	3	1	2
d	Nosing length	-	-	-
e	Poor friction quality	3	-	1
f	Openings - in stairs	-	-	-
g	Alternating treads	-	-	-
h-i	Lack/height handrails	3	2	2
j-l	Lack/height guarding	3	-	1
m	Stair width	2	-	-
n	Length of flight	-	1	-
o-q	Inadequate lighting etc	3	-	3
r	Door/s onto stairs	-	-	-
s	Inadequate landing	3	-	-
t	Construction/repair	2	-	3
u	Thermal efficiency	2	-	1

OUTCOMES		A	B	C
a	Length of flight	-	1	-
b	Pitch of stairs	-	2	-
c	Projections etc #	-	2	3
d	Hard surfaces #	2	1	2
e	Construction/repair	2	-	3
f	Thermal efficiency	3	-	2
# Secondary hazards		**A**	**B**	**C**
i	Concrete kerb	2	-	-
ii	Projecting radiator	-	2	-
iii	Glass in front door	-	1	-
iv	Condition of paths	3	-	2

Key 3 Seriously defective 1 Not satisfactory
2 Defective - Satisfactory/NA

COMPLETION OF SECTION 22 OF EHS FORM

LIKELIHOOD

Falling on stairs etc.

Significantly higher than average: Y (circled) / N

Likelihood of a person over 60 having a fall leading to harm

		1800	1000	560	320 (Average)	180 (Average Pre 1919)	100	56	32	18 (circled)	6	2

Justification The main stairs are assessed as giving the same likelihood of a major fall as the average for inter-war houses, (i.e. around 1 in 320), the limited handrail provision cancelling out any benefits of the broad winders. However, the added presence of the front access steps - particularly dangerous in icy weather and at night - substantially increases the overall annual probability of such a fall - to 1 in 18.

OUTCOMES

Likely outcome if a person over 60 should fall — Action required

	0.1	0.2	0.5	1	2.2	4.6 (circled)	10	21.5	31.6	46.4	100
Class 1 Extreme %											
Class 2 Severe %							10 (circled)				
Class 3 Serious %								21.5			

Justification The stairs are designed to be carpeted but the resulting lower harms are offset by the small hall, projecting radiator and single glazing in the door, albeit this is not at low level. However, the presence of the external front door steps and steps near the front gate, both flanked by rough tarmac and a concrete kerb, significantly increase the risk of a fatal or severe fall occurring, particularly in cold weather or at night.

Likelihood Class 1 Outcome	1 in 1800	1 in 1000	1 in 560	1 in 320	1 in 180	1 in 100	1 in 56	1 in 32	1 in 18	1 in 6	1 in 2
0.1%							E	D	C	B	A
0.2%						E-	E	D	C	B	A
0.5%						E	E	D	C	B	A
1.0%						E	E+	D	C	A-	A
2.2%				F	E-	E	D	C	B	A	A
4.6%				E-	E	D	C	B-	B (circled)	A	A
10.0%			E-	E	D	C	B-	B	A	A	A
21.5%		E	E	D	C	B	B	A	A	A	A
31.6%		E	D	C	C	B	A	A	A	A	A
46.4%	E	E	D	C	B	B	A	A	A	A	A
100%	D	C-	C	B	A	A	A	A	A	A	A

ACTION REQUIRED

Justification Replacing the steps to the front door and at the gate will be picked up under Section 18. This will bring the property's rating back to average for its age and type.

Action required?	Action	Coded elsewhere?		Quantity	
Y	Install handrail	Y	N	Metres:	
Y	Install balustrade	Y	N	Metres:	
Y	Cover dangerous balustrade/guarding	Y	N	Metres:	
Y	Repair/replace internal staircase (S5)	Y			
Y	Redesign internal, common or external staircase (design, not condition)		N	Number:	
Y	Repair/replace external/common staircase (S9)	Y			
Y	Repair/replace external steps (S11, S18)	Y (circled)	N	Number:	
Y	Cover slippery stairs	Y	N	Flights:	
Y	Repair/replace/provide additional lighting (S5, S9, S11)	Y	N	Number:	
Y	Remove obstacle		N	Number:	

Annex Table 5.5.6: Summary of how EHS collects and models information about HHSRS hazards

Hazard	How assessed	Average HHSRS score	Specified vulnerable age group
Excess cold*	Modelled	926	Age 65 or over
Falling on level surfaces*	Fully measured	181	Age 60 or over
Falling on stairs etc.*	Fully measured	134	Age 60 or over
Radiation*	Modelled	91	None
Collision and entrapment	Flagged if an extreme risk	57	Age under 5
Flames, hot surfaces etc.*	Fully measured	42	Age under 5
Crowding and space*	Modelled	19	None
Fire*	Fully measured	17	Age 60 or over
Dampness and mould growth*	Fully measured	11	Age under 14
Entry by intruders	Flagged if an extreme risk	11	None
Falls associated with baths	Flagged if an extreme risk	7	Age 60 or over
Noise*	Flagged if an extreme risk	6	None
Falling between levels*	Fully measured	4	Age under 5
Food safety	Flagged if an extreme risk	2	None
Electrical safety*	Flagged if an extreme risk	2	Age under 5
Carbon monoxide and fuel combustion products*	Flagged if an extreme risk	1	Age 65 or over
Personal hygiene, sanitation and drainage*.	Flagged if an extreme risk	1	Age under 5
Explosions	Flagged if an extreme risk	1	None
Position and operability of amenities etc.	Flagged if an extreme risk	1	Age 60 or over
Structural collapse and falling elements	Flagged if an extreme risk	1	None
Excess heat	Flagged if an extreme risk	0	Age 65 or over
Asbestos (and MMF)	Not assessed	0	None
Biocides	Not assessed	0	None
Lead*	Modelled	0	Age under 3
Uncombusted fuel gas	Flagged if an extreme risk	0	None
Volatile organic compounds	Not assessed	0	None

Lighting	Flagged if an extreme risk	0	None
Domestic hygiene pests and refuse.*	Flagged if an extreme risk	0	None
Water supply	Flagged if an extreme risk	0	None

Notes:
1) average scores are for all dwellings and taken from Version 2 of the HHSRS guidance. The averages have been calculated for the age range of the population most vulnerable to each type of hazard.
2) the 15 hazards which were scored or modelled for 2006 and 2007 are identified by an asterisk. This group is still used in the current reporting of the 'Decent Homes' HHSRS criterion.

5.53 In the 2006 and 2007 English House Condition Survey (EHCS), fewer hazards were fully scored and some of the hazards that are now measured or flagged were modelled using other data (see the EHCS technical report from 2007 for full details: http://webarchive.nationalarchives.gov.uk/20120919132719/www.communities.gov.uk/publications/housing/ehcstechnicalreport2007).

5.54 From 2008, reporting of HHSRS covers all of the 26 hazards covered by EHS so figures are not strictly comparable with the 2006 and 2007 HHSRS data. Reporting on decent homes (see decent homes section later in this note), continues to use the 'old' (15 hazards) version of HHSRS for continuity over time. Annex Table 5.5.7 summarises the assumptions and data used for the 4 hazards that are modelled from other data.

Annex Table 5.5.7: Modelling HHSRS hazards using EHS data

Hazard	Category 1 hazard defined as:
Excess Cold	Estimates the number of households living in homes with a threat to health arising from sub-optimal indoor temperatures using the Standard Assessment Procedure (SAP)[4]. This hazard is based on dwellings with an energy efficiency rating of less than 35 based using the original SAP 2001 methodology. The updated SAP 2009 methodology, used for the 2010-2012 EHS reports, recalculated the comparable threshold to be 35.79. From 2013, the EHS report has used the updated SAP 2012 methodology and the comparable excess cold threshold was recalculated to 33.52. This approach ensured that the number and % of dwellings failing on excess cold would be the same under both the SAP09 and SAP12methodology for the 2013 (and following) data sets
Radiation	The dwelling is located in one of the critical 16 post code sectors, based on a radon exposure map of England AND the dwelling was built before 1980.
Lead	The dwelling is located in one of 4 post codes with very soft water (based on the drinking water quality map of England) AND built before 1945 AND with lead piping present either before or after the mains stop cock.
Crowding and space	The occupants per habitable room ratio is calculated. If this exceeds 2 the dwelling has a category 1 hazard regardless of size. If it is equal to 2 and the number of habitable rooms is 2 or more the dwelling also has category 1 hazard.

Data quality and reliability

5.55 Surveyors working on the EHS have received extensive training and support to help ensure their HHSRS assessments are consistent and robust. This includes residential training involving classroom and field exercises together with e-learning exercises. Refresher programmes are provided annually, together with manuals providing benchmark examples for reference when making their judgements. New surveyors are accompanied in the field and there is on-going close supervision throughout fieldwork. Calibration exercises are being implemented to monitor variability in surveyors' HHSRS assessments over time.

5.56 While these measures ensure a good level of consistency in judgements, some surveyor variability is to be expected. The EHS approach to the HHSRS provides surveyors with a systematic approach with which to make these judgements.

[4] SAP is the Governments standard procedure for Energy ratings of dwellings.

Decent homes

5.57 This section gives a detailed definition of the four criteria that a dwelling is required to meet to be considered 'decent' under the Decent Homes Standard, and explains how they are applied to the EHS data. A dwelling must meet all of the four criteria listed below to be classed as decent:

A) it meets the current statutory minimum standard for housing

B) it is in a reasonable state of repair

C) it provides reasonably modern facilities and services

D) it provides a reasonable degree of thermal comfort

Criterion A: the dwelling meets the current statutory minimum standard for housing

5.58 The current statutory minimum standard for housing is the HHSRS. To be decent, the dwelling must be free from Category 1 hazards (see previous section).

5.59 The presence of Category 1 hazards is assessed as described in the previous section. For this criterion only the 15 hazards which have been assessed since 2006 are included to ensure consistency over time.

Criterion B: the dwelling is in a reasonable state of repair

5.60 A dwelling satisfies this criterion unless:

- one or more key building components are old and, because of their condition, need replacing or major repair; or
- two or more other building components are old and, because of their condition, need replacement or major repair.

5.61 Key building components are those which, if in poor condition, could have an immediate impact on the integrity of the building and cause further deterioration in other components. If any of these components are old, and need replacing or require immediate major repair, then the dwelling is not in a reasonable state of repair. They are the external components plus internal components that have potential safety implications and include:

- external walls
- roof structure and covering
- windows/doors
- chimneys
- central heating boilers
- electrics

5.62 Other building components are those that have a less immediate impact on the integrity of the dwelling. Their combined effect is therefore considered, with a dwelling not in a reasonable state of repair if two or more are old and need replacing or require immediate major repair. Such components include kitchen and bathroom amenities, central heating distribution and storage heating.

5.63 The terms ‘old’ and ‘in poor condition’ are also quite tightly defined as below:

- **old**: the component is older than its expected or standard lifetime. The component lifetimes are listed in Annex Table 5.5.8
- **in poor condition**: the component needs major work, either full replacement or major repair. The definitions used for different components are as listed in Annex Table 5.5.9

5.64 Establishing whether dwellings surveyed in the EHS meet this criterion depends on the assessment both of the ages of key and other building components and of their condition.

5.65 The EHS surveyors record their assessment of the ages of the main external building elements together with key services and amenities. They are also given the shortcut option of recording whether elements are original i.e. the same as the building itself. Where the age of a component cannot be assessed, it is assumed to be original i.e. the same age as the dwelling. In the relatively small proportion of cases where components are recorded as the 'same age as dwelling', it is necessary to calculate the probability that they have exceeded their lifetime. This is because age of dwelling is recorded in relatively wide bands rather than as a single year.

5.66 For example, for houses, windows are assumed to have exceeded their lifetime if they are more than 40 years old (for flats, the windows lifetime is 30 years old). Where houses were built between 1965 and 1974 and still had the original windows, many of these would have windows that were over 40 years old. A simple and robust approach is used, assuming that roughly equal numbers of dwellings were built in each year of this age band. Houses built between 1965 and 1973 (are over 40 years old and) represent 9 years out of the 10 year age band, so all original windows in houses built in 1965-1974 are given a probability of 0.9 of being over 40 years old.

5.67 For most dwellings, the assessment of whether or not they satisfy the disrepair criterion is clear cut. For the remainder, for each building component which is in poor condition, the probabilities of being beyond the normal lifetime are combined to give a total probability, taking into account the split into major and minor elements. If this total is greater than 0.5, the dwelling is classed as non-decent due to disrepair.

5.68 Annex Table 5.5.8 shows the lifetimes of building components used to assess whether the components are 'old' in the terms of the disrepair criterion. These lifetimes are used to construct the national estimates of the number of dwellings that are decent and those that fail.

Annex Table 5.5.8: Component lifetimes used in the disrepair criterion

Building components (key components marked *)	Houses and bungalows	All flats in blocks of below 6 storeys	All flats in blocks of 6 or more storeys
Wall structure*	80	80	80
Lintels*	60	60	60
Brickwork (spalling)*	30	30	30
Wall finish*	60	60	30
Roof structure *	50	30	30
Roof finish *	50	30	30
Chimney *	50	50	N/A
Windows *	40	30	30
External doors *	40	30	30
Kitchen	30	30	30
Bathrooms	40	40	40
Heating – central heating gas boiler *	15	15	15
Heating – central heating distribution system	40	40	40
Heating – other	30	30	30
Electrical system *	Modern	Modern	modern

5.69 As age of electrical system is not collected in the EHS, it is considered to be 'old' if it is not modern, i.e. it has lead or rubber covered wiring, there are separate fuse boxes for each circuit, or earthing wires are unsheathed/green covered.

5.70 Annex Table 5.5.9 sets out the definitions used within the disrepair criterion to identify whether building components are 'in poor condition'. For more detailed information on how surveyors are instructed to record disrepair, see the repair costs section of this note.

Annex Table 5.5.9: definition of 'poor condition' used in disrepair criterion

	Definition of 'in poor condition' used in EHS
Wall structure	Replace 10% or more, or repair 30% or more
Wall finish	Replace/ repoint/ renew 50% or more
Chimneys	1 chimney needing partial rebuilding or more
Roof structure	Replace 10% or more or strengthen 30% or more
Roof covering	Replace or isolated repairs to 50% or more
Windows	Replace at least one window or repair/ replace sash or member to at least two (excluding easing sashes, reglazing, painting)
External doors	Replace at least one
Kitchen	Major repair or replace 3 or more items out of 6 (cold water drinking supply, hot water, sink, cooking provision, cupboards, worktop)
Bathroom	Major repair or replace 2 or more items (bath, wash hand basin, WC)
Electrical system	Replace or major repair to system
Central heating boiler	Replace or major repair
Central heating distribution	Replace or major repair
Storage heaters	Replace or major repair

Criterion C: The dwelling has reasonably modern facilities and services

5.71 A dwelling is considered not to meet this criterion if it lacks three or more of the following facilities:

- a kitchen which is 20 years old or less
- a kitchen with adequate space and layout
- a bathroom which is 30 years old or less
- an appropriately located bathroom and WC
- adequate noise insulation
- adequate size and layout of common entrance areas for blocks of flats

5.72 The ages used to define the 'modern' kitchen and bathroom are lower than those for the disrepair criterion. This is to take account of the modernity of kitchens and bathrooms, as well as their functionality and condition.

5.73 There is some flexibility inherent in this criterion, in that a dwelling has to fail on three of these tests to be regarded as failing the modernisation criterion itself. Such a dwelling does not have to be fully modernised for this criterion to be passed: it would be sufficient in many cases to deal with only one or two of the facilities that are contributing to the failure.

5.74 The two tests for age of bathroom and kitchen are relatively straightforward to apply using EHS data. The method of assigning age probabilities described above is also used to determine whether kitchens and bathrooms have exceeded their lifetimes as specified in the modernisation criterion. The probabilities of being non-decent on these two components are added to results on the other modernisation measures in order to determine whether the dwelling should be classed as non-decent.

5.75 There is some ambiguity inherent in terms such as 'adequate' and 'appropriate' used for the other four criteria. The EHS (and its predecessor the EHCS) defines these operationally as follows:

- A kitchen failing on adequate space and layout would be one that was too small to contain all the required items (sink, cupboards, cooker space, worktops etc.) appropriate to the size of the dwelling.
- An inappropriately located bathroom or WC is one where the main bathroom or WC is located in a bedroom or accessed through a bedroom (unless the bedroom is not used or the dwelling is for a single person). A dwelling would also fail if the main WC is external or located on a different floor to the nearest wash hand basin, or if a WC without a

wash hand basin opens on to a kitchen in an inappropriate area, for example next to the food preparation area.

- Inadequate insulation from external airborne noise would occur where there are problems with traffic (rail, road or aeroplanes) noise. Reasonable insulation from these problems should be ensured through installation of double glazing.
- Inadequate size and layout of common entrance areas for blocks of flats would occur where there is insufficient room to manoeuvre easily, for example where there are narrow access ways with awkward corners and turnings, steep staircases, inadequate landings, absence of handrails, low headroom etc.

Criterion D: the dwelling provides a reasonable degree of thermal comfort

5.76 The definition requires a dwelling to have both efficient heating and effective insulation. Both of these are defined very precisely in terms of what is present rather than by the overall energy performance of the dwelling.

5.77 Under this definition, efficient heating is defined as any gas or oil programmable central heating or electric storage heaters / programmable solid fuel, or communal heating or LPG central heating or similarly efficient heating systems. Heating sources which provide less energy efficient options do not meet this criterion.

5.78 Because of the differences in efficiency between gas/oil heating systems and the other heating systems listed, the level of insulation that is appropriate also differs:

- For dwellings with gas/oil programmable heating, cavity wall insulation (if there are cavity walls that can be insulated effectively) or at least 50mm loft insulation (if there is loft space) is an effective package of insulation.
- For dwellings heated by electric storage heaters / programmable solid fuel or LPG central heating a higher specification of insulation is required to meet the same standard: at least 200mm of loft insulation (if there is a loft) and cavity wall insulation (if there are cavity walls that can be insulated effectively).

5.79 Assessing whether the EHS sample dwellings pass or fail the decent homes thermal comfort criterion is complex because it involves an array of survey information related to insulation, heating and structural properties. The data collected on the form and the modelling assumptions have been changed and refined since the original 'baseline' figures were published in 2001. For more information on how these changed from 2001 to 2007 see the EHCS 2007 Technical Report: (http://webarchive.nationalarchives.gov.uk/20120919132719/www.communities.gov.uk/publications/housing/ehcstechnicalreport2007).

5.80 The 2008 data experienced modelling changes in the assumptions on cavity wall insulation to incorporate the use of the summary section on cavity wall insulation newly collected on the EHS 2008 physical survey form. There were no modelling changes in 2009.

5.81 The key modelling and form changes affecting thermal comfort since 2010 are:

- Where no loft insulation information is available for a room in the roof or a flat roof, appendix S of the SAP 2012 information booklet is used in conjunction with the actual date of construction or, if it is a loft conversion, the date of the loft conversion to determine an estimated amount of loft insulation (the banded construction date is used if the actual construction date is unknown).
- Changes in assumptions on cavity wall insulation to incorporate extended use of the summary section on cavity wall insulation collected on the EHS physical survey form following a wording change to the overarching cavity wall insulation summary question.
- Homes built after 2002 with cavity walls are assumed to have full cavity wall insulation.

Repair costs

5.82 This section presents an overview of how repair costs are derived from the EHS and is divided into three sections:

- the different repair cost measures used
- what types of work are excluded and included
- an outline of how the raw data is used to generate the costs

5.83 Information about repair costs is used for two basic purposes:

- to assess how much it would cost to carry out the specified work to the dwelling to give some idea of the likely level of investment needed. This is termed ‘required expenditure’ or ‘actual costs’.
- to assess whether parts of the stock are in a better or worse state of repair than others. This is measured through ‘standardised costs’.

Required expenditure

5.84 This is an estimate of what the specified work to the individual dwelling would actually cost. These costs therefore take account of variations in prices across the country and assume different project sizes depending on each dwelling’s type and tenure. In the owner occupied and private rented sector, the contract

size for work to houses is taken to be one. In the social rented sector, the contract size is taken as the number of dwellings on the estate unless the house is not on an estate and therefore assumed to be a street property with a contract size of one. For flats, the contract size for exterior works is the size of the block regardless of tenure. This measure assumes that all work is carried out by contractors who operate in accordance with health and safety regulations. The costs do not include any VAT or mark up for profit. These costs should not be used for assessing differences in condition between different tenures or dwelling types because they vary according to dwelling size, tenure and location (note: on the EHS database these costs are shown as 'actual costs'). When making such comparisons among different dwelling characteristics, it would be more appropriate to use 'standardised repair costs' as explained below.

Standardised repair costs

5.85 This is an index of disrepair that expresses costs in pounds per square metre (£/m^2) based on prices for a mid-point in the range of prices in England. The same assumptions about contract size are made for houses in all tenures (contract size = 5 dwellings) and are then divided by the total floor area of the dwelling. The resulting index can be used to compare the relative levels of disrepair for dwellings of different sizes, in different tenures and different locations.

5.86 The extent of work required to a dwelling depends on the judgements made by the surveyor about the urgency of that work. The two different measures of required expenditure and standardised costs are therefore presented with reference to three different time scales:

Urgent repairs

5.87 This is a measure of serious and immediate problems in the dwelling, and includes all interior work. Where surveyors record that work is needed to an exterior building element, they indicate whether work specified was urgent. To be classed as 'urgent', the ***problem must meet at least one of the following criteria:***

- it threatens the immediate safety of occupants or passers-by or is a health hazard
- it is currently promoting noticeable and rapid deterioration in other parts of the building
- it is at present causing difficulty or discomfort to the occupants (or would do so if the dwelling were occupied)
- the security of the building is threatened

(*variables on database = cstactux and cststdux*)

Basic repairs

5.88 These cover all works that the surveyor has identified as necessary to carry out within five years, including any urgent work as described above. These do not include replacement of building elements nearing the end of their life where the surveyor has recorded that this action could be delayed by more than five years, often by short term patch repairs. (*variables on data base= cstactbx and cststdbx*)

Comprehensive repairs

5.89 These cover all repairs as specified above together with any replacements that the surveyor has assessed as being needed in the next 10 years. For all exterior elements, whether repairs are needed or not, surveyors record the number of years before the element needs replacing either following specified repair work or simply as the remaining life expectancy. This measure provides a better basis for identifying work which would form part of a planned programme of repair by landlords. (*variables on data base = cstactcx and cststdcx*)

What types of work are included and excluded?

5.90 The costs described above include all of the following types of work:

- all work to the external fabric of the building: chimneys, roof, roof and soil drainage, windows, doors, dormers, bays, porches, balconies, damp proof course and treatment of inappropriate gradients/levels of ground adjacent to the dwelling
- additional work to deal with structural instability: e.g. underpinning, tying in of walls, treatment of fungal or insect infestation, replacement of cavity wall ties, etc
- work to the internal fabric: ceilings, floors, internal and partition wall surfaces, internal doors and stairs
- work to amenities and services inside the dwelling: kitchen, bathroom, WC, electrical wiring, plumbing, gas pipes, heating, and water heating
- work to common areas and access ways in blocks of flats: floors, walls, ceilings, doors, screens, windows, lighting and balustrades
- work to shared facilities on estates: stores and common rooms, communal parking facilities, surfaces and fences and common services. Note that this only covers any shared facilities that might be

used by the occupants of the survey dwelling and which, for large estates, are located within 100 metres of the survey module.

5.91 The costs **exclude**:

- work to fences and boundary walls
- work to underground drainage
- hidden work to structure or foundations
- work to plant associated with shared facilities, e.g. lift motors, communal boilers, washing machines in laundry rooms, etc.
- shared facilities not used/useable by the dwelling itself
- VAT, professional fees, overheads or profit.

5.92 It is also important to remember that repair costs are based on a snapshot of the housing stock at the time of the survey and no provision is made for any routine regular maintenance that would (or should) be carried out e.g. servicing of boilers, lifts etc. or clearing of gutters.

Calculating repair costs

5.93 The EHS uses four types of information to calculate base repair costs:

- The surveyors' assessments of the type of repair needed and its extent.
- The surveyor's description of the materials from which the element is constructed (for external elements only).
- Building dimensions and configuration derived from surveyors' measurements and observations, for example, the shape of the dwelling.
- Unit prices for different types of job from the 1996 National Schedule of Rates (NSR), adjusted for inflation using the Building Cost Information Service (BCIS) national price index. The BCIS data is used to convert basic standardised repair costs (£/m²) to 2015 prices so that the level of disrepair over time can be examined.

5.94 The surveyor assesses each element in turn: usually surveying the interior first, and then the exterior of the dwelling. Internally an assessment of the main rooms is made (the main living room, main bedroom plus hall, kitchen and bathroom. The work identified as needed in the sample of rooms is scaled up to reflect the total number of rooms in the dwelling. All of the internal amenities and services are surveyed individually.

5.95 For the common areas in blocks of flats, surveyors select only part of the common areas to survey – the main entrance, stairway and corridor/deck used by the survey dwelling. These are assumed to be representative of the whole of the common areas and scaled up accordingly.

5.96 Externally the surveyor assesses each element in turn, looking at the building from two vantage points ('views') which between them encompass the whole building.

5.97 In assessing the type and extent of work needed, surveyors follow a sequence of decisions that are made explicit on the survey form:

- identify whether there is a fault
- determine the nature of the action
- determine the scale of the action
- determine the timing of the action (for exterior elements only)

5.98 These assessments will depend on a large number of factors. What standard of repair should be aimed for? Will the work be spread over time or is it all to be done straightaway? How long must the building remain in good condition once the work is done? How much is it worth spending on the building? According to how these questions are answered, the final repair cost can vary considerably. EHS therefore sets fairly stringent ground rules and assumptions for surveyors to follow.

5.99 In making their assessments, surveyors are instructed to assume that dwellings have an indefinite life – repairs are recorded even where it is felt to be uneconomic.

5.100 When determining the nature of the action required, they are instructed to treat the work as a programme of actions stretching into the future which means to repair rather than replace unless:

- this is impracticable
- it means that the element will still need replacing within 5 years
- the element needs replacing for other reasons, e.g. it is unsuitable for its intended purpose. Here, the standard of work should result in the element being fully functional without any allowance for modernisation, upgrading or purely cosmetic improvements.

5.101 In deciding how much of the element requires the specified action, they are instructed not to employ economies of scale. The quantity of work required is recorded in different ways for different types of elements:

- in tenths, for elements treated as areas, e.g. walls, roofs, or lengths e.g. roof features. The building measurements and other information enable us to calculate the total number of square metres of each element in each view or room e.g. external walling at the rear, ceiling in the kitchen etc. and these are then multiplied by the proportions indicated by the surveyor to obtain an actual quantity

- in number of units needing work, for elements which can be treated as individual entities, e.g. doors, windows, baths
- in square or linear metres for work to elements where there is insufficient data to estimate the total quantity within the building e.g. flooring in common areas

5.102 For the last two, the quantity given is multiplied by the unit cost for the job specified. For elements where the work is specified as a proportion, this is first converted to a quantity (m2 or linear metres) from the dimensions taken of the dwelling/building and then this quantity is multiplied by the unit price (per m2 or per m) for the type of work specified. In all cases it is assumed that a like for like replacement is undertaken and the costs selected reflect the materials from which the element is currently constructed, e.g. a slate roof is always replaced with a slate roof.

5.103 The cost calculated is for the individual dwelling. Therefore for flats the cost of works to the common areas and exterior, recorded for the whole building, is divided by the number of flats and this is added on to the interior, amenities and services costs for the individual dwelling.

Dealing with missing data

5.104 The cases included in the physical survey database are those where a full survey was conducted, but even where the form was completed fully the surveyor may have omitted to provide some information needed to calculate repair costs. Such omissions are, however, increasingly rare, particularly after the introduction of the digital pen technology.

5.105 Where data is missing costs are imputed using data for dwellings of a similar age and type:

- if the surveyor has clearly indicated that repairs are needed to an element, but not what those repairs are, then an average cost for that element is taken from dwellings of a similar age and type where repairs are needed to that same element.
- if the surveyor has not indicated whether repairs are needed to an element, then an average cost for that element is taken from all dwellings of a similar age and type.

Add-ons, uplifts, preliminaries and modifications to base costs

5.106 Once the ‘base’ costs have been calculated as above, additional sums are added to account for preliminaries and access equipment:

- preliminaries: items required before the work can commence e.g. site hut, security fencing

- access equipment: includes the costs for scaffolding, cradles and other equipment needed to work safely at height.

5.107 There are also factors added to account for 'uplifts' or economies of scale which are calculated differently for the 'required expenditure' and 'standardised costs' versions as described above. Finally, the country is divided into nine continuous geographic areas possessing a broad level of cultural homogeneity each of which is assigned a separate price factor to represent the differing costs of labour and materials in that area. These price factors are then are used to further refine the 'required expenditure' costs.

5.108 It is important to remember that costs do not include any VAT, professional fees,overheads or profit.

Annex 5.6: **Energy Efficiency**

5.151 The English Housing Survey (EHS) collects a large amount of detailed information relating to building construction, heating and insulation. This provides a detailed profile of the energy performance and carbon emissions of the existing housing stock and how far these could be improved using different types of measures. This note sets out:

- **Main components of energy efficiency** – how the individual components contributing to overall efficiency are defined and modelled.
- **Standard Assessment Procedure (SAP) of buildings energy performance** – the methods and assumptions used to calculate SAP (energy efficiency) ratings and carbon dioxide emissions.
- **Energy performance certificates (EPC)** – how an assessment is made of what measures could be installed to improve energy efficiency and reduce carbon emissions, and what the impact of installing these possible improvements would be. It also briefly discusses households' awareness of EPCs and the improvements they suggest.
- **Barriers to improving insulation** – classifying the ease of installation or specific barriers to loft, cavity and solid wall insulation.

Main components of energy efficiency

Primary heating systems

5.152 The EHS records up to two forms of space heating system and all water heating systems present in each dwelling. Where two types of space heating system are present, the EHS designates the one that covers the largest proportion of the dwelling as the primary heating system and collects detailed information on its overall type, the fuel used, boiler details (where relevant) and heating controls. The primary space heating type is classified as central heating system, storage heaters or room heaters.

Central heating system

5.153 This is most commonly a system with a gas fired boiler and radiators, distributing heat throughout the dwelling. Also included in this definition are warm air systems, communal heating and electric ceiling/underfloor heating, (included in 'other systems' in the 2012 dataset). Central heating is generally considered to be a cost effective and relatively efficient method of heating a

dwelling, although the cost effectiveness and level of carbon dioxide (CO_2) emissions will be closely linked to the type of fuel.

Storage heaters

5.154 These are predominately used in dwellings that have an off-peak electricity tariff. Storage heaters use off-peak electricity to store heat in clay bricks or a ceramic material; this heat is then released throughout the day. These are more cost effective than fixed or portable room heaters, but storage heating can prove expensive if too much on peak electricity is used during the day. Their efficiency is calculated based on their age and the type of controls present.

Room heaters

5.155 This category includes all other types of heater such as fixed electric or portable electric heaters. This type of heating is generally considered to be the least cost effective of the main systems and produces more CO_2 emissions per kWh.

Secondary heating systems

5.156 Where more than one space heating system or appliance has been recorded and the primary system identified as above, the additional appliance is coded as the secondary system and, along with the secondary fuel, used in the SAP calculation and other analysis. These systems may have been originally installed alongside the primary system, perhaps in a larger home. More often they would have been the only source of heating when the property was built, before being superseded by a new system, typically a form of central heating. The secondary space heating type is classified as follows:

- *Fixed room heaters:* the majority of secondary systems fall into this category, which includes various types of mains gas fires, solid fuel fires and stoves, and direct acting electric panels and radiators which are wired into the mains electricity.
- *Storage radiators:* individual storage heaters which are subsidiary to the main heating system are included here.
- *Portable heaters:* where the only secondary heating is through a portable electric or paraffin heater. This includes cases where the SAP methodology has concluded that the main fixed heating is insufficient to heat the dwelling to a satisfactory level, so a portable secondary system is imputed to allow an energy efficiency rating to be calculated.

Boilers

5.157 Where the heating system has a boiler, the EHS collects basic information on its generic type. The EHS also collects information about the make and model of the boiler and its age so that an accurate estimate of its overall fuel efficiency can be derived. There are four main types of boilers:

- *Standard boiler:* these provide hot water or warm air for space heating, with the former also providing hot water via a separate storage cylinder.
- *Back boiler:* these older models are located behind room heaters and feed hot water to a separate storage cylinder. They are generally less efficient than other boiler types.
- *Combination boiler:* provides hot water or warm air for space heating and can provide hot water on demand, thus negating the need for a storage cylinder and therefore requiring less room.
- *Condensing boiler:* standard and combination boilers can also be condensing. A condensing boiler uses a larger, or dual, heat exchanger to obtain more heat from burning fuel than an ordinary boiler, and is generally the most efficient boiler type. Changes to Building Regulations have seen an increase in condensing boilers as they have become mandatory for all replacements.

Water heating

5.158 All existing water heating systems are recorded by the surveyor. Where more than one water heating system is present, the system used for analysis and modelling is selected in the order of the categories below. The categories of water heating systems used in the report are:

- *With central heating:* the water is primarily heated by the same system as the primary space heating, usually a standard boiler with a separate storage cylinder or a combination boiler heating water on demand.
- *Dedicated water boiler:* a separate boiler to the space heating system, possibly using a different fuel, provides the hot water. This category includes dedicated back boilers and communal systems for water heating only.
- *Immersion heater:* hot water is provided by a single or dual electric immersion heater in the storage cylinder. These are less energy efficient than central or separate boilers, but are often found as a ‘top-up’ system for other systems.
- *Instantaneous water heater:* the least energy efficient water heating appliances heat small amounts of water on demand in a similar way to a kettle and distribute the hot water to one or more points.

Wall types and wall insulation

5.159 The construction of the external walls and whether they contain any additional insulation is an important determinant of heat loss. The EHS collects detailed information on the overall construction type, age of the building, added wall insulation and what proportion of the external walls consists of different types.

Cavity walls

5.160 A cavity wall is one constructed of two brick or block walls separated by a cavity that is at least 50mm wide. They are generally found in houses dating from about 1930 onwards, although some older examples exist. Many dwellings (especially older private sector homes) have a mix of wall types because they have had one or more extensions added at different times.

5.161 Dwellings are only classed as 'cavity wall' where at least 50% of the total external wall area is cavity brickwork. This means that a small house built with solid 9" brick walls in 1900 which had a cavity brickwork extension that was larger than the original building added in 1960 would be classed as having 'cavity walls'.

5.162 Dwellings with cavity walls can have none, part or all of the cavity wall area insulated. The insulation can be built into the original wall construction or installed later and can reduce fuel costs by up to 15%.

Post-1995 dwellings

5.163 In addition to cases that have been identified in the EHS physical survey as having evidence of cavity wall insulation and those without evidence of cavity wall insulation, a third category is established: post-1995 dwellings with predominantly cavity walls without evidence of full cavity wall insulation. It is likely that these dwellings had cavity wall insulation installed at the time of construction (known as 'as built' insulation), however the non-intrusive survey undertaken in the EHS would not always be able to identify this. In order to provide a more realistic estimate of the number of insulated cavity walls, all post-1995 cavity wall dwellings are assumed to be fully insulated, even if this was not apparent in the physical survey.

5.164 The 1990 and 1994 Building Regulations both specify an external wall U-value, however compliance could be achieved through other mechanisms as an alternative to cavity fill. Therefore an increasing proportion of new dwellings were built with cavity wall insulation in the early 1990s, and it is thought to have become the predominant practice after 1995. The age band in which as built insulation is assumed to have been installed has been revised for the 2015 report in order to bring the methodology in line with the SAP and RdSAP modelling methodologies. Details of the previous methodology can be found in the 2014 Technical Report.

Solid walls

5.165 Where dwellings do not have cavity walls, external or internal wall insulation can be installed to improve energy efficiency where the thermal properties of the external walls are poor. Where a surveyor has recorded that external wall insulation had been applied to at least 50% of a non-cavity walled dwelling, or that at least 50% of the rooms have had internal insulation applied, it was classed as having an insulated solid wall.

Loft insulation

5.166 Adequate loft insulation can make significant savings to both heating costs and CO_2 emissions, making this a cost effective method of insulation. It involves fitting insulating foam or fibre between the joists or rafters in a loft, which reduces heat from within the thermal envelope[5] below escaping through the roof. From 2015 onwards, the performance of loft insulation is adjusted to reflect the performance of the material compared to mineral wool. Rigid foam board is assumed to perform twice as well as mineral wool and Vermiculite beads are modelled to perform two-thirds as well as mineral wool.

5.167 The EHS physical survey involves an inspection of the loft where the surveyor notes whether insulation is present and measures its thickness. The collection of loft insulation data was changed after the 2001 English House Condition Survey (EHCS), so analysis of data from 2003 onwards cannot be directly compared to previous data (see the EHCS 2003 technical report for details). In cases where surveyors are unable to access lofts or where the dwelling is a house or top-floor flat with a flat or shallow pitched roof, the amount of insulation in the dwelling was classed as unknown in the Energy Efficiency of English Housing Report. However for the purpose of calculating a SAP rating, an amount was imputed using the mean value for dwellings of that age, tenure and broad geographical area. These classifications were used because earlier regression analysis indicated that these factors were the main determinants of the amount of loft insulation present.

Low energy lighting and conservatories

5.168 Analysis in the 2011 Homes Report examined headline figures for homes which predominantly use low energy lighting and those with conservatories. This used the interior section to calculate the proportion of surveyed rooms with low energy lights at the time of survey, whist data relating to the size, glazing type and heating of conservatories was also taken from the raw physical survey data. This data has not been re-analysed in subsequent EHS reports, but these areas may be re-visited in future.

[5] The thermal envelope of the dwelling is the physical barrier between the warm interior and the cold air outside or in unheated spaces such as a loft for example.

Renewable energy measures

5.169 Since 2009, EHS surveyors have recorded the presence of solar photovoltaic panels and domestic wind turbines for electricity generation, whilst the presence of solar hot water panels has been collected since 2001. Since 2011 EHS reports have included analysis of any observed renewable energy technologies.

5.170 In the full SAP methodology a calculation is used to determine the electricity production of PV panels, using peak power of the type of PV panel multiplied by factors such as dwelling orientation and overshading. Prior to 2014, this level of detail was not collected, so an assumed peak power of 2.5kWh was applied to each case. From the 2014-15 survey year onwards, the area of PV panels has been collected, which allows peak power to be calculated more accurately for each dwelling, using the equation: (Peak power (kWh) = 0.12 x PV area), in line with RdSAP conventions.

5.171 Prior to 2014, detailed information on biomass heating fuels was not available, so biomass heating systems were assumed to use wooden logs as their primary heating fuel. From the 2014-15 survey onwards, an update to the EHS form allows for more detailed information on the type of biomass heating fuel to be collected. This allows heating systems with renewable heating fuels to be modelled more effectively.

Standard Assessment Procedure (SAP) of buildings energy performance

SAP ratings

5.172 The Standard Assessment Procedure (SAP) is the Government's recommended system for home energy ratings. SAP ratings allow comparisons of energy efficiency between different dwellings to be made. The SAP rating is expressed on a logarithmic scale, which normally runs from 1 (very inefficient) to 100, where 100 represents zero energy cost. The rating can be greater than 100 for dwellings that are net exporters of energy; however these are extremely rare in the existing dwelling stock. In extremely inefficient cases the formula that defines the rating can result in negative values, but values less than one are coded to a SAP of one.

5.173 The Building Regulations require a SAP assessment to be carried out for all new dwellings and conversions. Local authorities, housing associations, and other landlords also use SAP ratings to estimate the energy efficiency of existing housing. The version of SAP used in the survey is currently SAP 2012. This version is used in the current EHS dataset (employed retrospectively to provide a consistent measure from 1996 to the most recent

survey year). EHS reports dating from 2010 to 2012 used the previous (SAP 2009) version of SAP.

5.174 The 2012 changes in the SAP methodology are far less reaching than those which occurred following the move from SAP05 to SAP09 in 2010. Differences in SAP ratings calculated under SAP2009 and SAP2012 mainly occur for dwellings using solid fuel; for further details see The Government's Standard Assessment Procedure for Energy Rating of Dwellings 2012 edition (SAP worksheet Table 15 p.231), http://www.bre.co.uk/filelibrary/SAP/2012/SAP-2012_9-92.pdf

5.175 The SAP ratings give a measure of the annual unit energy cost of space and water heating for the dwelling under a set heating regime which assumes specific heating patterns and room temperatures. 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, which include:

- thermal insulation of the building fabric
- the shape and exposed surfaces of the dwelling
- materials used for construction of the dwelling
- efficiency and control of the heating system
- the fuel used for space and water heating, ventilation and lighting
- ventilation and solar gain characteristics of the dwelling
- renewable energy technologies

5.176 SAP is not affected by the individual characteristics of the household occupying the dwelling, nor by its geographical location. The calculation is based on a fixed heating pattern of 21°C in the main living area and 18°C elsewhere. It is also based on standard occupancy assumptions with the household size correlating with the total floor area of the dwelling.

5.177 The EHS uses a computerised version of the SAP methodology to calculate the SAP rating for each dwelling included in the physical survey sample. Most of the data required to calculate SAP are available from the survey, either directly from the questions asked or as a result of further modelling. Those data items that are not collected have very little impact on the final calculated rating. Where data items are missing these are dealt with using default information based on information from dwellings of the same age, built form, tenure, number of floors and size.

5.178 The Energy Efficiency Rating (EER) is derived by translating the SAP ratings into an A to G banding system where band A represents low energy costs and band G represents high energy costs, Annex Table 5.6.1.

Annex Table 5.6.1: SAP rating and Energy Efficiency Rating (EER) bands

SAP rating	EER band
1 to 20	G
21 to 38	F
39 to 54	E
55 to 68	D
69 to 80	C
81 to 91	B
92 or more	A

Carbon dioxide emissions

5.179 The carbon dioxide (CO_2) emissions are calculated using the same SAP document and method as for the SAP rating except that it uses CO_2 emissions factors for each fuel in place of unit prices to derive the CO_2 emissions rate per m^2 of floor area. The same logarithmic scale as used for SAP converts the CO_2 emissions rate into the Environmental Impact Rating (EIR), which also runs on a 1–100 scale where 1 represents very high emissions per m^2 and 100 is achieved at zero net emissions. The EIR can rise above 100 if the dwelling is a net exporter of energy.

Comparison with actual energy data

5.180 The SAP methodology that is used to calculate both energy efficiency and CO_2 emissions tends to provide higher estimates of energy requirements and associated emissions for heating, lighting and ventilating dwellings than estimates derived from actual household energy consumption. This is primarily because the assumed heating regime (achieving a temperature of 21°C in the living area of the dwelling and 18°C in the rest of the dwelling for a standard number of hours), and the assumed hot water and lighting requirements (depending on a level of occupancy determined by the floor area of the home rather than actual occupancy) are more likely to result in an overall over estimation than under estimation of actual energy consumption for most dwellings. However, such standardised assumptions are necessary in order to compare the energy performance of one part of the housing stock with another and over time.

Energy performance certificates (EPC)

Energy performance certificate (EPC) improvement measures

5.181 Following the implementation of the European Energy Performance of Buildings Directive in 2007, all homes are required to have an Energy Performance Certificate (EPC) when they are sold or let. The EPC provides an overall assessment of the current energy performance of the property and makes recommendations regarding a range of lower and higher cost heating, insulation and lighting upgrades that would improve its energy performance. The EHS is able to provide a whole stock assessment of homes that could benefit from these measures.

5.182 SAP was updated to SAP 2012, version 9.92, in October 2013. In June 2014, Appendix S and Appendix T of the SAP booklet were updated to RdSAP as part of SAP 2012. The revisions significantly altered the way that RdSAP software implements improvements as part of the EPC production process. The methodology for assessing the EPC improvement measures using the EHS data has therefore been substantially revised in light of these revisions. The new methodology has been applied to the EHS 2015 data. The change in methodology means that results for previous years should not be directly compared.

5.183 Details of the upgrade measures recommended on an EPC are provided in Appendix T of the SAP 2012 specification, available at: https://www.bre.co.uk/filelibrary/SAP/2012/SAP-2012_9-92.pdf. Measures are no longer categorised as low cost, higher cost and further measures and the order for considering recommendations has been updated. The most relevant being that Measure Q (solid wall insulation) is now third priority, and measures R, S and T (upgrading boilers with/without fuel switching) have moved up in priority. Seven additional improvement measures have been added to the specification and the criteria and/or improvement specification has changed for some existing measures.

Annex Table 5.6.2: List of improvements specified in SAP 2012 appendix T that are included in the updated methodology[6]

Item	Measure	Calculated in previous methodology	Any change to measure since previous version?
A	Loft insulation	Yes	Improve to 270mm (previously 250mm)
A2	Flat roof insulation	No	
A3	Roof room insulation	No	
B	CWI	Yes	
Q	SWI	No	
W1	Floor insulation (suspended floor)	No	
W2	Floor insulation (solid floor)	No	
C	HW cylinder insulation	Yes	
D	Draught proofing	No	
E	Low energy lighting	No	
F	Cylinder thermostat	Yes	
G	Heating controls for wet CH system	Yes	TRVs without room thermostat can be also without programmer
H	Heating controls for warm air system	Yes	
J	Biomass boiler	Yes	
K	Biomass room heater with boiler	Yes	Water cylinder upgraded in addition to heating system
I	Upgrade boiler, same fuel	Yes	
R	Install condensing oil boiler	No	
S	Condensing gas boiler no fuel switch	No	

[6] The SAP 2012 Appendix T also includes some 'Alternative measures' which are measures shown on an EPC if relevant but are never selected for inclusion unless an assessor specifically includes it. These alternative measures (Q2, J2, Z1, Z2 and Z3) are not included in this update to the EHS EPC modelling. Measure P is considered in the same way as the "alternative" measures because it is only considered if the assessor de-selects measure O.

T	Condensing gas boiler fuel switch	No	
L2	Replacement/New storage heaters	Yes	Change from fan assisted with automatic charge control to high heat retention type. Electric secondary heating no longer included
M	Replacement warm air unit	Yes	Split by fuel type, applies to non-condensing, mains gas units, and LPG units installed before 1998
N	Solar water heating	No	
O	Double glazing	No	
O3	Glazing replacement	No	
X	Insulated doors	No	
U	Photovoltaics	No	
V2	Wind turbine	No	

5.184 In the method used in the EHS, measures are only recommended for implementation if that measure alone would result in the SAP rating increasing by at least 0.95 SAP points. The suggested measures do not necessarily imply that current measures in place in the home are defective nor that the home is deficient in terms of any particular standard.

5.185 The calculation of Improvements N (solar hot water) and U (photovoltaics) deviate slightly from Appendix T in that additional data collected in the EHS on dwelling roof pitch and orientation are used.

5.186 The EHS does not include EPC measure T2 or Y because the survey is unable to assess how effective they would be in improving the performance of individual dwellings.

Notional costs of installing the recommended EPC measures

5.187 The EHS also estimates the notional costs of installing the recommended measures. The methodology for estimating these costs has also been revised and are now calculated using indicative costs that have been produced and included within the Product Characteristics Database (PCDB). Indicative costs for EPC measures are provided in table 181 of the PCDB (available at http://www.boilers.org.uk/download.php). For the majority of measures, a low and high range of costs is provided and the mean of these is used. The costs are also calculated using the low and high prices to give an indication of the

impact that the range has on the overall cost of improving the stock. Measure E (low energy lighting), L2 (storage radiators) and X (insulated doors) have an associated cost per item dependant on a variable e.g. number of rooms for L2. The costs for these measures are therefore specific to each dwelling.

Annex Table 5.6.3: Indicative costs of the EPC measures

Item	Measure	PCDB Indicative cost (£) (mean, (low, high))	
A	Loft insulation	£225	(£100, £350)
A2	Flat roof insulation	£1,175	(£850, £1,500)
A3	Roof room insulation	£2,100	(£1,500, £2,700)
B	CWI	£1,000	(£500, £1,500)
Q	SWI	£9,000	(£4,000, £14,000)
W1	Floor insulation (suspended floor)	£1,000	(£800, £1200)
W2	Floor insulation (solid floor)	£5,000	(£4,000, £6,000)
C	HW cylinder insulation	£23	(£15, £30)
D	Draught proofing	£100	(£80, £120)
E	Low energy lighting	£5 per unit	(£5, £5) per unit
F	Cylinder thermostat	£300	(£200, £400)
G	Heating controls for wet CH system	£400	(£350, £450)
H	Heating controls for warm air system	£400	(£350, £450)
J	Biomass boiler	£10,000	(£7,000, £13,000)
K	Biomass room heater with boiler	£10,000	(£7,000, £13,000)
I	Upgrade boiler, same fuel	£2,600	(£2,200, £3,000)
R	Install condensing oil boiler	£5,000	(£3,000, £7,000)
S	Condensing gas boiler no fuel switch	£5,000	(£3,000, £7,000)
T	Condensing gas boiler fuel switch	£5,000	(£3,000, £7,000)
L2	Replacement/New storage heaters	£500 per unit	(£400, £600) per unit
M	Replacement warm air unit	£1,875	(£1,250, £2,500)
N	Solar water heating	£5,000	(£4,000, £6,000)

O	Double glazing	£4,900	(£3,300, £6,500)
O3	Glazing replacement	£1,200	(£1,000, £1,400)
X	Insulated doors	£500 per unit	(£500, £500) per unit
U	Photovoltaics	£6,500	(£5,000, £8,000)
V2	Wind turbine	£20,000	(£15,000, £25,000)

Pre- and Post-improvement performance and costs

5.188 The EHS also estimates the total carbon dioxide emissions, primary energy use and fuel costs by end-use before and after any recommended improvements have been installed. The EPC methodology has been updated so that for running costs and savings, total emissions and primary energy, the calculations are done using regional weather and fuel prices taken from the SAP fuel price library for the July of the survey year e.g. http://www.bre.co.uk/filelibrary/SAP/2012/SAP-fuel-prices-January-2015.xls. The SAP rating and EI rating are still calculated using UK average climate data and the fuel prices published in Table 12 of the SAP 2012 document.

5.189 It is also important to emphasise that these are *notional* estimates based on standard assumptions about occupancy and consumption patterns. What improvements would be realised in practice will depend critically on actual occupancy and consumption patterns.

Barriers to improving insulation

5.190 Chapter 2 of the EHS Potential Stock Improvements Report examined the potential to install loft, cavity wall and solid wall insulation, and explored the practical and other barriers to actual installation that can occur, in order to provide a more realistic indication of the potential for carrying out these improvements. Categories classifying the ease of installation or specific barriers for each insulation type were created from EHS physical data on dwelling fabric and shape..

Loft insulation

5.191 Categories for the ease of installing or topping up loft insulation were as follows. All lofts that were not designated as non-problematic were classed as hard to treat:

- *Non-problematic:* these were identified as potentially upgradeable under the EPC improvement measure analysis and in these cases installation would be straightforward with no barriers.

- *More problematic:* these were identified as potentially upgradeable under the EPC improvement measure analysis but where the loft was fully boarded across the joists, which would lead to extra work and expense.
- *Room in roof:* these cases may already have sufficient insulation installed when built or during the loft conversion, but if insulation needed to be added between the rafters very extensive work and considerable expense would be involved.
- *Flat or shallow pitched roof:* again, these cases may already have sufficient insulation installed when built but otherwise it is not feasible to install loft insulation as there is no access into the loft or no loft space.

Cavity wall insulation

5.192 For the 2012 report onwards, the main classification and analysis for the 'fillability' of cavity walls aims, as far as possible, to provide a count of hard to treat cavity walls consistent with the Energy Companies Obligation (ECO) definition, although the EHS is unable to fully replicate this, https://www.ofgem.gov.uk/ofgem-publications/84197/ecosupplementaryguidanceonhard-treatcavitywallinsulation.pdf

5.193 Categories for the 'fillability' of uninsulated cavity walls were created using information on the area of external wall finish as surveyed and other factors such as the presence of external features such as conservatories and the dwelling type. All cavity walls that were not designated as non-problematic were classed as hard to treat.

5.194 *Standard fillable:* With these cases, no compelling physical barrier to installation exists. These are typically houses with masonry cavity walls and masonry pointing or rendered finishes and no conservatory attached.

5.195 *Hard to treat cavity walls:* These are homes with cavity walls that could in theory be filled, but which exhibit at least one of the following difficulties.

- They are in a building with 3 or more storeys, where each storey has cavity walls. The need for scaffolding to install insulation in these higher buildings would contribute to the complication and cost of improving these homes.
- The gap found in the cavity wall is found to be narrower than in standard walls, typically less than 50mm. Although an attempt could be made to insulate these homes by injecting foam, the limited cavity space may lead to an uneven spread of the insulating material, resulting in substandard thermal properties.
- The dwelling is of predominantly prefabricated concrete, metal or timber frame construction. Although more recent examples of these

homes will have had insulation applied during construction, these are generally unsuitable for retrospective treatment. In the case of timber frame construction, the industry recommendation is not to inject insulation as this can hamper ventilation between the frame and the external wall that may lead to rot in the timber frame.

- The cavity wall includes one or both leaves formed of natural stone, or has an outer leaf finished predominantly with tiles or cladding. Natural stone can give an uneven cavity, causing difficulties when injecting insulation, whilst non-masonry finishes can also make the process more difficult.

5.196 Additional analysis was carried out on the 2015 EHS data to provide, as far as possible, an alternative count of hard to treat cavity walls consistent with the Energy Companies Obligation (ECO) definition using additional potential barriers to insulation; exposure of walls, any disrepair to walls or the presence of stone walls. The 2015-16 EHS report on potential stock improvements contains findings from that analysis.

Solid wall insulation

5.197 Categories for the ease of installing external solid wall insulation were created using information on the area of external wall finish as surveyed and other factors such as the presence of external features such as conservatories, porches and bays and the dwelling type. All solid walls that were not designated as non-problematic were classed as hard to treat:

- *Non-problematic:* no serious barriers.
- *Masonry-walled dwellings with attached conservatories or other features:* these are otherwise non-problematic, but fixing the insulation round any projections like conservatories, porches or bays requires additional work and therefore additional expense.
- *Dwellings with a predominant rendered finish:* although dwellings with a rendered finish can be treated with external solid wall insulation, this may add to the costs of the work as the render may need to be removed, repaired or treated before the insulation can be installed.
- *Dwellings with a predominant non-masonry wall finish:* improving dwellings with wall finishes such as stone cladding, tile, timber or metal panels would either add to the cost of the work or even preclude external solid wall insulation where the wall structure itself is stone or timber.
- *Flats:* if the dwelling is a flat, then this treatment can be problematic for two reasons. Firstly, there are likely to be issues related to dealing with multiple leaseholders (getting their agreement and financial contribution to the work). Secondly, the height of the module for high-rise flats would present significant complications in applying external solid wall insulation.

Annex 5.7 **Dimensions**

5.214 Once all EHS physical surveys have been submitted by the surveyors for the survey year the data are converted into a series of raw physical survey SPSS files. The first complex model to run using the raw physical survey EHS data is the Quantities (or "Dimensions") model.

5.215 The purpose of this model is to take a series of observations and measurements recorded by the EHS surveyors carrying out the physical survey and convert these into all of the required dimensions e.g. floor area, external wall area, window area, roof area, etc. These dimensions are then used as inputs into a number of processes, including costing of repairs and energy modelling.

5.216 In the process of running the Dimensions model, BRE staff undertake a number of consistency and plausibility checks on the raw physical survey data. The purpose of these checks is to firstly detect and eliminate certain logical inconsistencies that could not be processed by the Dimensions model and secondly to identify highly implausible answers from the Dimensions model outputs which, if deemed necessary after detailed investigation, can lead to correction of the EHS raw physical survey data.

5.217 The EHS raw physical survey data are stored in an SPSS database format and, after edits due to HMO and data comparison validation are applied, the dataset is used as the input into the dimensions modelling process.

Raw physical file checks

Wall thickness

5.218 The 'wall structure' section of the EHS 2013/14 form included a new variable 'Wall thickness (cm)' (*Fexws1wt, Fexws2wt*) for which surveyors were asked to measure the wall thickness for each wall type (eight types possible) recorded on the front and back views. This new information is used within the Dimensions model in the calculation of the floor area, replacing the previous default wall thickness assumption of 0.2m.

5.219 A flag is created for cases with a warning for wall thickness, front view and back view; these are cases where the wall thickness is not typical of the wall type selected. Each case is investigated by looking at the physical survey form in detail in conjunction with the photos/surveyor comments and a note is made for each case of what is likely to have caused the warning on the form. Based upon the information gained, the action is decided upon for each case. This could be no action required or it could be that the physical survey data

looks incorrect, either the wall thickness value or the way the surveyor has coded something as wall that should not be counted as wall. The spreadsheet is passed to a second analyst to quality assure the outcomes. The appropriate modifications are applied to the raw physical survey data. In 2015, 142 cases were flagged and investigated with 6 cases subsequently being edited.

5.220 An average wall thickness is calculated, by multiplying the thickness of each wall type by its area (in tenths) and dividing by 10. The resulting values are rounded to the nearest whole number to maintain the level of accuracy present in the original data. The variable is used as an input into the Dimensions model for the conversion of dimensions from external measurements to internal measurements.

Levels

5.221 A series of checks, written in SPSS syntax, are performed in order to identify possible logical inconsistencies in the raw data associated with the number of storeys in the building and the floor occupied by the dwelling. If the inconsistencies were left unchanged it would result in problems in the running of the Dimensions model.

5.222 The EHS uses the British system of denoting floor levels, where the ground floor is designated G, then the next level 1, then 2, 3, etc. Therefore a dwelling with 3 storeys should only have rooms, flats, or measured levels on floors G, 1, and 2. The most common type of error relating to floors is one where the surveyor switches to the American designation and uses 1 to indicate the ground floor. Other types of error linked to floor levels include failure to identify an attic as habitable and failure to include the basement in the count of the number of storeys. The level checks for inconsistency include:

- a room on a level that does not exist (e.g. 3rd floor of a three storey module)
- a room on a level that is not part of the flat (e.g. room on the 3rd floor but flat on the 2nd floor)
- a measured level that is not part of the module (e.g. dimensions for 3rd floor when the dwelling only has three storeys)
- a flat on a level that does not exist (e.g. flat on the 3rd floor when the module only has three storeys)
- An additional part of the dwelling that starts on a higher storey than the main part of the dwelling

5.223 All cases that are identified as having inconsistencies are manually examined by inspecting the EHS physical survey form and surveyor photographs in order to determine why the error has occurred and how the data should be changed. The cause of the error and the actions required to resolve the issue

are then documented. In 2014 71 cases were flagged as having possible inconsistencies. Of these, 34 were found to have an error and were therefore corrected.

5.224 When it is established that there is an error in the raw data, SPSS syntax is used to alter the required variable/s. The altered physical files are then saved in a new location. The levels checks are repeated in order to confirm that all issues have been resolved.

Dimensions calculations

5.225 The Dimensions calculation engine takes the altered physical files and uses the data to compute all the required dimensions e.g. floor area, external wall area, window area, roof area, etc. as outlined in flow chart, Figure 5.7.1.

5.226 The model begins by taking the surveyor measurements for the floors measured by the surveyor and then extrapolates from these the size of any unmeasured floors. Once a plan of each floor has been calculated the ceiling heights can be used to calculate or extrapolate (depending on the location of the five measured rooms within the building) the overall height of each floor. This in turn can be used as the basis for an overall wall area.

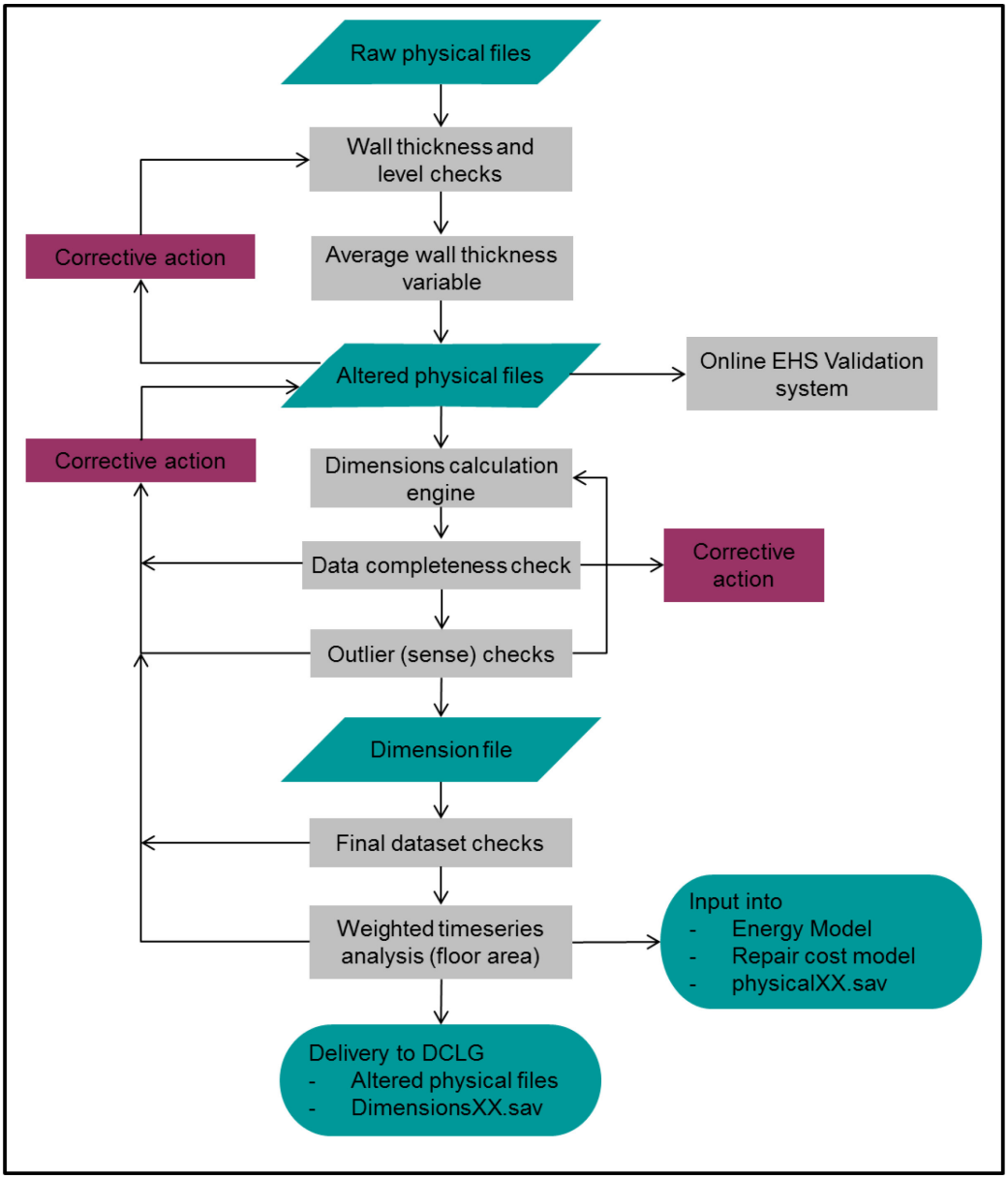
5.227 Wall areas are complex as there is the potential for additions beyond the surveyor's initial measurements (through base walls, gables and the like) and reductions brought about by attachment to other properties. It is also necessary at this stage to consider the location of the additional part, which may affect the size of the dwelling envelope[7].

5.228 With the areas of the walls calculated for each face of the dwelling the level of fenestration on each face is assessed by using the fenestration ratio (the proportion of the gross surface area of the external wall which is given over to windows, voids and wall) as recorded by the surveyor with reference to the exposed area of the face.

5.229 The area of the roof is calculated by taking the area of each floor and comparing it to the floor above. Where the latter is smaller the difference is considered to be exposed roof. This is then increased to allow for an eaves overhang, and then the results are summed across all levels up to the top floor, creating a total roof area that will typically be larger than the footprint of the dwelling. The same piece of code is also used to look at the amount of eaves perimeter on each level and total these across all levels.

[7] The envelope in this context relates to the design and construction of the exterior of the dwelling and consists of its roof, sub floor, exterior doors, windows and exterior walls.

Figure 5.7.1: Dimension model process



5.230 In the event that the dwelling is a flat a number of additional algorithms are used to separate out the interior dimensions of the flat itself, and the exterior dimensions which relate to the "module". It is important for the energy modelling that dimensions relate to the flat itself, but for repair costs the overall cost of repairs to the module must be shared among all dwellings within the envelope, and therefore external dimensions should apply to the module.

5.231 The preliminary results are stored in SPSS database format.

Data completeness checks

5.232 In previous years, some cases were not processed by the Dimensions model due to missing data for the flat floor level. In these instances, the missing information was added, the model rerun and a new validation check was added to the EHS online validation system. The validation check ensured that no cases were subject to this problem in 2015.

Outlier (sense) checks

5.233 A number of checks are then performed on the derived dimensions to validate the outputs. The checks are designed to identify:

a) implausible wall areas
b) implausible floor areas
c) implausible window areas
d) incorrect number of flats
e) incorrect roof type

5.234 A statistical function written in SPSS syntax is used to identify outlying cases in terms of floor, wall and window area. Cases that have unusually large or small areas given the dwelling's size (in terms of the number of rooms) are flagged up. The survey form and photographs of each outlying case are manually examined to determine whether the outlier is genuie, or the result of an error. Errors can occur where key data have not been entered (such as an integral garage), dimensions mis-measured (such as entering 72 instead of 7.2) or features over- or underestimated. BRE defer to the surveyors judgement unless convinced the data are incorrect (i.e. the evidence from the photographs). If an error in the raw data is identified, the cause of the error and the actions required to resolve it are recorded. For 2015 over 450 cases were identified as outliers for floor, wall or window areas, and of these 65 cases were found to have an error of some kind.

5.235 For the check on the number of flats, the dimensions of the surveyed flat are checked against the total floor area of the module to determine whether the number of flats per module seems realistic. Where it does not, BRE staff will examine the floor plans and photographs in an attempt to understand the surveyor's error, which usually stems from the module definition, and to determine the correct number of flats.

5.236 Certain roof types (Chalet and Mansard) can only occur where the dwelling has an attic. On occasion surveyors may mistake steep pitched roofs for chalet roofs. In this situation, the data for pitched and chalet roofs is swapped over.

Alterations to physical data

5.237 In relation to the above checks, where there is missing information, BRE will attempt to fill in the missing data or otherwise resolve the error. For the applicable cases, the alterations syntax is updated to alter the required variable/s and the new altered physical files replace those created following the levels checks. If necessary, the EHS validation system may also be altered to help avoid similar issues occurring in future years. The Dimensions model is then rerun using the altered physical files.

Alterations to dimensions model code

5.238 Occasionally, the data completeness checks and the sense checks highlight amendments that are required to the Dimensions model code. Where necessary, the code is altered and tested to ensure it is working correctly.

5.239 The Dimensions model is rerun using the altered physical files and a series of first run 'final' dimensions files are created in SPSS database format.

5.240 The above procedure is repeated when the ‘second run’ of the EHS raw physical data is available (post-HMO edits, post-comparison edits, core EHS cases only) and once the dimensions file has been run through the first run of the energy model.

5.241 Basic checks are performed on the final derived dataset from the Dimensions model (‘DimensionsXX.sav’) using the previous year’s dataset as a template e.g. a check that all variables are present and labelled correctly, that all variable values are present (via a frequency check) and that all missing values are set as missing following the EHS conventions.

5.242 On delivery of the single year paired sample grossing factor, timeseries analysis is carried out using the EHS floor area variables (*floorx and floory*) cross referenced by a number of dwelling characteristics to look at the trends over time and to put the data in context with previous EHS data. Further investigation would take place should the weighted results highlight an unexpected change in the data.

5.243 The Dimensions modelling is complete. The ‘DimensionsXX.sav’ is used to derive the original EHS floor area variable (floorx) and the new Building Regulations floor area variable (floory) which are added to the derived physicalXX.sav dataset. The altered physical files are then delivered to DCLG along with the ‘DimensionsXX.sav’ and these datasets are used internally as an input into the repair cost model and the energy model. Please see the data dictionary for ‘DimensionsXX.sav’ which explains explains more about the derivation of the individual variables.

Annex 5.8: **Poor quality environments**

5.244 Although analysis on local environments, based on data collected during the physical survey, is not included in the annual EHS 2015 reports this information is designed to assist for users accessing the EHS datasets.

5.245 'Neighbourhood' or 'local environment' problems from the survey are based on the professional surveyors' assessments of problems in the immediate environment of the home on a scale of 1 ('no problems') to 5 ('major problems'). These assessments are based on observed problems (in some cases verified with the resident) rather than any specialised measurement instruments or recourse to other environmental data.

5.246 The survey assesses three types of problems contributing to a poor quality environment:

- Upkeep: the upkeep, management or misuse of the private and public space and buildings (specifically, the presence of: scruffy or neglected buildings; poor condition housing; graffiti; scruffy gardens or landscaping; litter, rubbish or dumping; vandalism; dog or other excrement; nuisance from street parking; condition of road/pavements and street furniture);
- Traffic and transport: road traffic and other forms of transport (specifically the presence of: intrusive motorways and main roads; railway or aircraft noise; heavy traffic; and ambient air quality);
- Utilisation: abandonment or non-residential use of property (specifically, vacant sites; vacant or boarded up buildings; intrusive industry; or non-conforming use of a residential area).

5.247 A home is regarded as having a significant problem of a given type if it is assessed to have codes 4 or 5 on the scale in respect of any of the specific environmental problems assessed and grouped under that type.