Chapter 3
Hard to treat and energy inefficient properties

3.1 This chapter focuses on those homes that had the worst energy efficiency (SAP rating in bands F or G) in 2013. It profiles these homes, examines their potential for improving energy performance, and demonstrates where installing such improvement measures would be especially problematic (so-called 'hard to treat' homes). The chapter explores the degree of difficulty in installing three key types of energy saving improvements: solid wall insulation, cavity wall insulation and loft insulation. Additional findings relating to energy inefficient dwellings can be found in the web tables DA7101 to DA7104[1].

3.2 In this chapter, there is a particular focus on the private rented sector. Subject to Parliamentary approval, from April 2018 government regulations will require new private rented homes to have a minimum energy efficiency standard of Energy Performance Certificate (EPC) rating band E[2].

Homes with the worst energy efficiency (SAP bands F or G)

3.3 Chapter 2 of the 2012 EHS Energy Efficiency of English Housing Report provides information on the profile of the least energy efficient homes over time (1996 – 2012). As the findings on trends over time are unlikely to have changed significantly in 2013, this section focuses on the 2013 position, profiling these homes in greater detail.

Profile of dwellings in SAP bands F or G

3.4 In 2013, there were around 1.5 million homes (6%) with the worst energy efficiency. Private rented homes were over represented in this group: they comprised 28% of such homes compared with 19% of the total housing stock,

[1] https://www.gov.uk/government/statistics/english-housing-survey-2012-energy-efficiency-of-english-housing-report
[2] DECC, Private Rented Sector Energy Efficiency Regulations (Domestic). https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/401381/Dom_PRS_Energy_Efficiency_Regulations_-_Gov_Response_FINAL__04_02_15_.pdf

highlighting the greater scope for energy improvements in this sector. In contrast the social sector was under represented, comprising just 4% of these homes. This reflects the generally newer housing stock in this sector together with the energy efficiency improvements that had already been undertaken by social landlords, Table 3.1.

3.5 Detached dwellings and converted flats formed higher proportions of the least energy efficient homes (27% and 10% respectively) than they did of the total housing stock, whereas purpose built flats were under represented (8%). The majority of the least energy efficient homes were the oldest homes, built before 1919 (61%). These oldest homes were more likely to be of solid wall construction, which can more expensive to insulate where required.

3.6 Dwellings in rural areas, which contain a relatively higher proportion of older homes, were over represented: 45% were in bands F or G, compared with 18% of the total stock.

Table 3.1: Profile of homes by whether in least energy efficient bands, 2013

all dwellings

	SAP bands A to E	SAP bands F or G	all SAP bands
		percentage of dwellings	
tenure			
owner occupied	63.2	67.6	**63.5**
private rented	18.6	28.0	**19.2**
social sector	18.2	4.4	**17.3**
dwelling type			
terraced house	28.1	23.8	**27.8**
semi detached	25.1	22.3	**25.0**
detached	16.9	26.9	**17.5**
bungalow	9.1	8.7	**9.1**
converted flat	3.7	9.8	**4.1**
purpose built flat	17.1	8.5	**16.5**
dwelling age			
pre 1919	17.2	60.8	**20.0**
1919 to 1944	16.9	17.3	**16.9**
1945 to 1964	20.0	9.8	**19.4**
1965 to 1980	21.3	8.7	**20.5**
post 1980	24.6	3.3	**23.3**
area			
city and other urban centres	21.5	21.8	**21.5**
suburban residential areas	62.5	33.6	**60.7**
rural areas	16.0	44.6	**17.8**
region			
London	14.7	9.5	**14.4**
rest of England	85.3	90.5	**85.6**
all dwellings	**100.0**	**100.0**	**100.0**
sample size	*11,885*	*613*	*12,498*

Base: all dwellings
Note: underlying data are presented in Annex Table 3.1
Source: English Housing Survey, dwelling sample

Private rented sector homes with poorest energy efficiency

3.7 As private rented homes are over represented among the least energy efficient dwellings, this section looks at some characteristics of the 419,000 private rented homes in SAP bands F or G in 2013. With almost three quarters of these 419,000 homes being built before 1919 (73%), it is not surprising that 78% had uninsulated solid walls. Converted flats, which were predominantly built before 1919, comprised 12% of the total private rented stock but made up over one fifth (22%) of these homes. Rural homes, which contain a higher proportion of older homes compared with urban and suburban areas, formed a higher proportion of these homes (40%) than they did of the total private rented stock (14%), Annex Table 3.2.

3.8 Only half (50%) of private rented homes with the poorest energy efficiency were centrally heated, and 27% relied on room heaters for primary heating, the large majority of which were fuelled by electricity, a more expensive option for direct heating. Over half (52%) of these homes did not have a boiler, while 27% had standard floor or wall boilers. A far lower proportion (7%) had more energy efficient condensing or condensing combination boilers compared with 44% in the private rented sector as a whole. Some 12% of these energy-inefficient homes had uninsulated lofts, compared with just 3% of all private rented homes, Annex Table 3.3.

3.9 Category 1 excess cold under the HHSRS[3] and thermal comfort are among the criteria assessed under the Decent Homes standard[4]. Some 84% of these energy inefficient private rented homes failed to meet the Decent Homes standard, although many of these homes are likely to have additional poor housing issues. Over one third, for example, had serious levels of disrepair (35%)[5]; the proportions for the whole private rented stock for non-decency and serious disrepair were 30% and 18% respectively, Annex Table 3.3.

Profile of households in the least energy efficient homes

3.10 Around 1.4 million households lived in homes with a SAP rating in bands F or G, and their demographic characteristics differed in some respects from those for all households in England, Annex Table 3.4.

3.11 Households with dependent children, particularly those where the youngest household member was under 5 years of age, were under represented comprising 6% of these households compared with 12% of all households. Ethnic minority HRP households were also under represented, comprising 5% of households in the least energy efficient homes compared with 11% of total households. By contrast, households where the HRP was over 60 years of age were over represented, accounting for 45% of these households compared with 36% of all households in England, Table 3.2.

3.12 There were some interesting findings in relation to household income, with no clear relationship between income and the likelihood of living in a home with the worst energy efficiency. Households in the highest income quintile were over represented among households residing in these homes, Table 3.2.

[3] Housing health and safety rating system– see Technical Report Chapter 5 Annex 5 for more details
[4] see Technical Report Chapter 5 Annex 5 for more details
[5] Standardised repair costs of £35m² or more. See Profile of English housing report Chapter 1 for further details of standardised repair costs.

Table 3.2: Profile of households by whether in least energy efficient bands, 2013

all households

	SAP bands A to E	SAP bands F or G	all SAP bands
		percentage of households	
household composition			
couple, no dependent child(ren)	36.2	37.7	**36.3**
couple with dependent child(ren)	21.2	15.7	**20.9**
lone parent with dependent child(ren)	7.5	2.9	**7.2**
other multi-person households	8.1	8.8	**8.2**
one person under 60	12.2	15.2	**12.3**
one person aged 60 or over	14.8	19.6	**15.1**
age of HRP			
under 60 years	64.9	55.0	**64.3**
60 years or over	35.1	45.0	**35.7**
age of youngest person			
under 5 years	12.6	6.1	**12.2**
5 years or over	87.4	93.9	**87.8**
income groups			
1st quintile (lowest)	18.7	19.8	**18.7**
2nd quintile	20.0	18.8	**19.9**
3rd quintile	19.5	18.8	**19.5**
4th quintile	20.8	17.2	**20.6**
5th quintile (highest)	21.0	25.4	**21.3**
living in poverty			
not in poverty	87.1	84.9	**86.9**
in poverty	12.9	15.1	**13.1**
workless			
not workless	82.5	84.1	**82.6**
workless	17.5	15.9	**17.4**
long term illness or disability			
yes	32.2	27.9	**31.9**
no	67.8	72.1	**68.1**
ethnicity of HRP			
white	89.0	95.3	**89.4**
all minority	11.0	4.7	**10.6**
all households	**100.0**	**100.0**	**100.0**
sample size	*11,457*	*551*	*12,008*

Base: all households
Note: underlying data are presented in Annex Table 3.4
Source: English Housing Survey, household sub-sample

Profile of households in the least energy efficient private rented homes

3.13 This section briefly profiles the approximately 370,000 households who lived in the least energy efficient private rented homes[6]. Some key household groups who may be considered vulnerable were under represented in these homes. Only 11% were occupied by households where the youngest child was less than 5 years of age and 8% were occupied by ethnic minority HRP households, while these types of households comprised 20% and 17% respectively of all private rented homes. Conversely, households where the HRP was aged 60 years or more comprised 18% of privately rented homes in SAP bands F or G but some 10% of all private renters, Annex Table 3.5.

Feasibility of installing EPC measures in energy inefficient homes

3.14 This section examines the types of energy improvements that it would be feasible to install in the least energy efficient homes (SAP bands F or G). The analysis does not take into account any problematic issues which may affect ease of installation (discussed later in this chapter), or the financial costs involved.

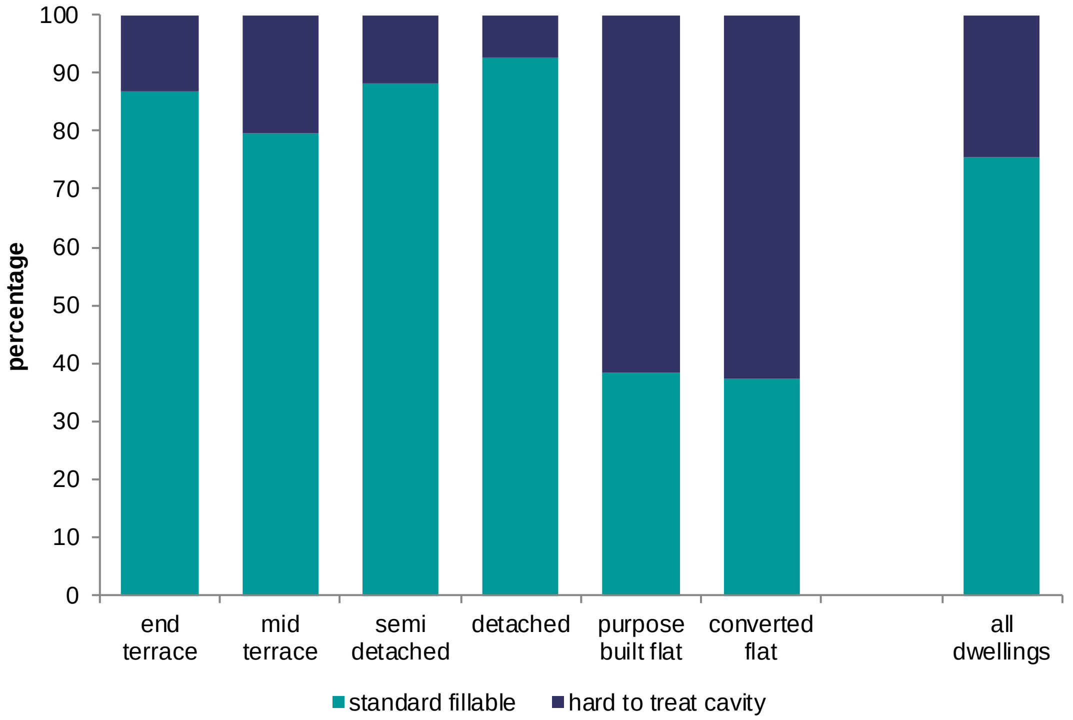
3.15 Of the 418,000 homes in SAP bands F or G with uninsulated cavity walls, 71% could theoretically benefit from cavity wall insulation, Figure 3.1, although this proportion may be lower in practice due to any compelling barriers to installation such as the existence of a narrow cavity.

3.16 In addition some 45% of homes in SAP bands F or G with a hot water cylinder could benefit from hot water cylinder insulation, and 40% of eligible homes[7] from loft insulation; these are all relatively low-cost measures, Figure 3.1.

3.17 Some 70% of eligible homes would benefit from upgrading to a condensing boiler, and just over one half (51%) would benefit from the upgrading of existing storage radiators (or other electric heating) to more modern, fan-assisted storage heaters. In addition 44% of eligible homes could potentially benefit from the upgrading of central heating controls; typically to a stage where a room thermostat, a central programmer, and thermostatic radiator valves (TRVs) have been installed.

[6] owing to the small sample size for these households using the combined 2 year dataset it has not been possible to undertake more in-depth analysis
[7] an eligible home is one in which this improvement measure might be feasible

Figure 3.1: Potential energy performance upgrades for dwellings in SAP band F or G, 2013

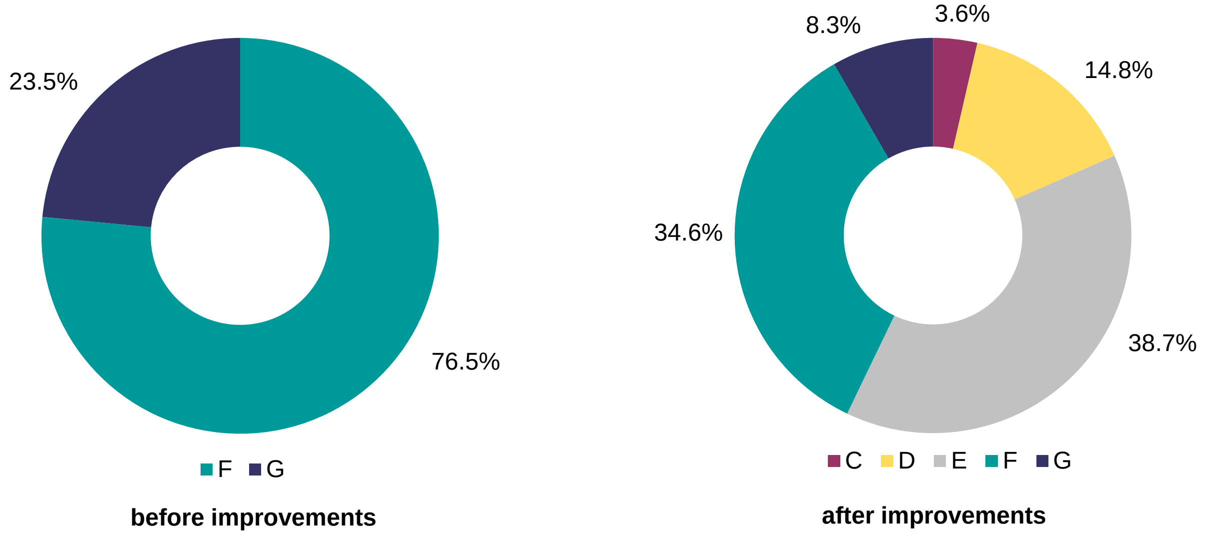


Base: number of dwellings where this improvement might be possible irrespective of the ease of installation, e.g. for cavity wall insulation the base is the number of dwellings with cavity walls
Note: underlying data are presented in Annex Table 3.6
Source: English Housing Survey, dwelling sample

3.18 If all the feasible low and high cost energy improvement measures were applied, the average SAP rating for these homes would increase from 27 to 41 points. This would still be much lower than the dwelling average of 60 in 2013, Annex Table 3.7.

3.19 Approximately 18% (around 275,000) of the 1.5 million dwellings in SAP bands F or G would move up to band C or D. Some 39% (579,000) would move to band E, but 43% (641,000) would remain in bands F or G (although the proportion in band G would fall markedly), Figure 3.2.

Figure 3.2: SAP rating before and potential SAP rating if energy improvement measures were applied, 2013



Base: all energy inefficient dwellings where improvements might be possible irrespective of the ease of installation, e.g. for cavity wall insulation the base is the number of dwellings with cavity walls
Note: underlying data are presented in Annex Table 3.8
Source: English Housing Survey, dwelling sample

3.20 In addition, the installation of these recommended energy improvement measures would result in a saving of almost £500 per year for an average household's total energy costs (down from £2,150 to £1,670), Annex Table 3.7.

3.21 Of the 641,000 dwellings that would remain in SAP bands F or G after these EPC measures had been installed, 80% would be solid wall properties with no wall insulation. The difficulties in undertaking this expensive form of insulation are discussed later in this chapter, Annex Table 3.9.

3.22 For the private rented homes that would remain in these SAP bands after EPC improvements (around 170,000)[8]:

- the vast majority (86%) would have been built prior to 1919 and 84% would have uninsulated solid walls
- less than half (44%) would be centrally heated and 36% would rely on fixed room heaters for their main source of heating
- some 68% would be houses and 32% would be flats (Annex Table 3.10)

3.23 A high proportion of all the dwellings that would remain in SAP bands F or G could be improved by more expensive, further measures, such as solid wall insulation and replacement of room heaters with central heating.

[8] This analysis is based on a sample size of 83 homes. Consequently the findings should be treated with caution.

3.24 Around 133,000 households would still live in private rented homes with the worst energy efficiency even after the defined low and high cost EPC measures had been installed. This is either because all feasible EPC measures would not result in a sufficiently high enough increase in SAP or that these homes would simply not be feasible to improve using such measures. About a quarter (24%) would be occupied by those in the highest income quintile and 23% by households where the HRP was over 60 years of age. Some 13% would be occupied by households in the lowest income quintile, and 9% occupied by households in poverty, Annex Table 3.11.

Homes with hard to treat walls and lofts

3.25 As wall insulation and loft insulation are integral components of government energy efficiency strategies, it is important to understand the scope to provide energy savings through the key measures of cavity wall, solid wall and loft insulation. This section investigates the relative ease of installing each of these measures within the housing stock. It then identifies the types of homes that are most difficult to improve. The analysis of the relative ease of installing insulation is not intended to provide any definitive guidance on how these homes should or should not be treated in order to make them more energy efficient, as this advice can only be undertaken on a case by case basis.

Cavity wall insulation

3.26 The degree of difficulty in insulating cavity walls is outlined in Box 1. Mirroring the methodology used for the 2012 EHS Energy Efficiency Report, this approach aims to provide a count of dwellings with hard to treat cavity walls consistent with the Energy Companies Obligation (ECO) definition[9], although the EHS is unable to fully replicate this. As stated in Box 1, some dwellings with uninsulated cavity walls may have more than one barrier to insulation, but this analysis seeks to provide an indication of the total number of homes with harder to treat cavity walls in the housing stock rather than estimate the degree to which multiple difficulties may exist.

[9] For the ECO definition see https://www.ofgem.gov.uk/sites/default/files/docs/2014/05/eco_supplementary_guidance_on_hard-to-treat_cavity_wall_insulation_0.pdf

Box 1: Degree of difficulty in treating cavity walls

Standard fillable: no compelling physical barrier to installation exists. These typically occur in bungalows or 2 storey houses with standard masonry cavity walls and masonry pointing or rendered finishes.

Hard to treat cavity walls: These are cavity walls that could in theory be filled, but which exhibit one or more of the following difficulties:

1. They are in a building with 3 or more storeys, where each storey has cavity walls. The limitation of some insulation systems and the need for scaffolding to install insulation in these higher buildings would contribute to the complication and cost of improving these homes.
2. The gap found in the cavity wall is found to be narrower than in standard walls. 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.
3. The dwelling is of predominantly prefabricated concrete, metal or timber frame construction. Although more recent homes of these types will have had insulation applied during construction, the walls 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.
4. The cavity wall has an outer leaf finished predominantly with tiles or cladding which can act as a barrier to the successful injection of insulating material.

3.27 There are additional issues that impact on the ease of cavity wall insulation that are not currently covered by this EHS analysis. Two issues relate to the degree of disrepair to the walls, and to their degree of exposure. External walls with faults or serious disrepair (such as cracks in the brickwork), or walls with regular exposure to severe wind driven-rain, have a higher risk of water penetrating into the cavity wall, so increase the risk of dampness. Cavity wall insulation may be problematic in such cases as any dampness would soak into the cavity fill and pass into the internal fabric of the dwelling.

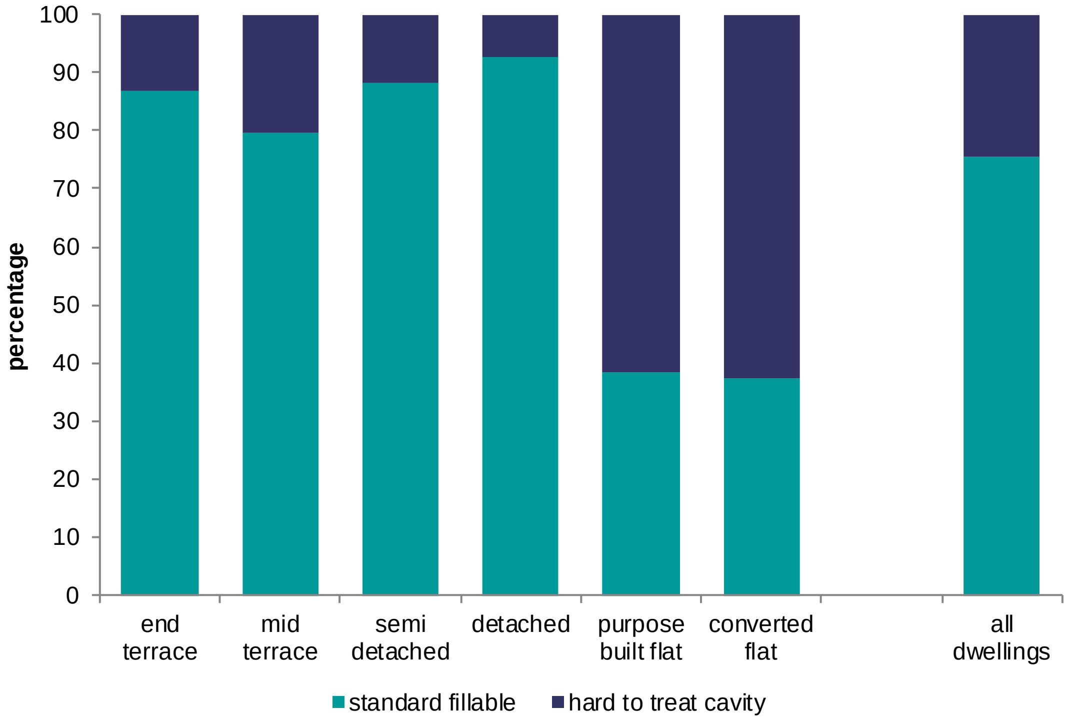
3.28 It is estimated that of the 5.1 million dwellings[10] that could potentially benefit from the installation of cavity wall insulation, three quarters (75%) had walls which were chiefly assessed as standard fillable whilst the remaining 25% (1.3 million) had uninsulated walls which were assessed as hard to treat, Annex Table 3.12.

[10] For this analysis, the number of dwellings that could potentially benefit from cavity wall insulation will not match the number identified for the EPC improvements identified in Chapter 2 of this report. This analysis excludes those post 1990 cavity walled dwellings where there is no evidence of insulation (as it assumes homes of this age are likely to have this installed).

3.29 Ease of cavity wall insulation varied by tenure, notably between owner occupied and rented homes. Only 18% of owner occupied homes had uninsulated cavity walls that were problematic to treat. The proportion of homes with hard to treat cavity walls was more similar among private rented and social rented homes (35-39%).

3.30 These findings are due to the varied distribution of dwelling types in each tenure, particularly the greater prevalence of flats in the rented sectors. Due to the height of blocks of flats, some 62% of purpose built and 63% of converted flats, with uninsulated cavity walls, were classified as hard to treat. In contrast just 7% of detached houses, which are predominantly owner occupied, had hard to treat uninsulated cavity walls, Figure 3.3.

Figure 3.3: Ease of installing cavity wall insulation by dwelling type, 2013



Base: all dwellings with theoretical potential to install cavity wall insulation
Note: underlying data are presented in Annex Table 3.12
Source: English Housing Survey, dwelling sample

3.31 There was no clear relationship between dwelling age and degree of difficulty of installing cavity wall insulation, owing to the mix of different dwelling types in each age band. However, around a third of homes built either before 1919 or from 1965-1980 had a higher proportion of hard to treat cavity walls (35% and 32% respectively). Pre 1919 homes included relatively high proportions of houses with 3 or more storeys and of converted flats, whilst homes built between 1965 and 1980 were both more likely to be flats and to be of concrete frame construction, Annex Table 3.12.

Solid wall insulation

3.32 This section examines the ease with which solid walls may have external insulation applied. Homes for which this measure is applicable have been classified into ‘non-problematic’ and ‘hard to treat’. For this analysis, applicable homes include those classed as having hard to treat cavity walls, for which the type of insulation applied to solid wall provides an alternative insulation option. This approach maximises the amount of applicable housing stock that can be assessed for some form of wall insulation. Box 3 below illustrates how hard to treat walls are categorised further by specific issues that are likely to impact on the cost and difficulty of applying solid wall insulation.

3.33 As with the above analytical approach on the potential barriers to cavity wall insulation, this analysis seeks to provide an indication of the total number of homes with harder to treat solid walls in the housing stock rather than estimate the degree to which multiple difficulties may exist.

3.34 Additional details on how solid wall insulation is undertaken together with associated cost estimates are provided in Box 2[11].

Box 2: Installing solid wall insulation

The energy improvements delivered by solid wall insulation vary considerably depending on the precise construction and thickness of the original wall (e.g. single leaf brick, 9-inch brick, stone or concrete).

External solid wall insulation is applied by fixing insulating boards to the outside of the building and covering them with a weatherproof render and sometimes false stone or brick cladding.

Internal insulation can be added in a similar way using insulated plasterboard and a standard plaster finish or by constructing a timber frame inside the existing wall and filling this with mineral wool insulation, with a plasterboard and plaster finish. This work entails added costs associated with moving power points, radiators, kitchen and bathroom fittings etc. as well as making good, adjusting floor coverings and decorations. Also, the affected rooms will be slightly smaller than before – a key consideration in some small terraced houses and converted flats.

Estimates for the cost of insulating a typical solid walled dwelling range from £9,000 to £25,000 for external insulation, and from £4,500 to £15,000 for internal insulation. These costs can be mitigated by combining the work with other necessary improvements such as renewing damaged plaster or render.

[11] See http://www.energysavingtrust.org.uk/Insulation/Solid-wall-insulation

Box 3: Degree of difficulty in treating solid walls

Non-problematic: non-cavity walls, or cavity walls identified as hard to treat, which do not include the barriers listed below.

Hard to treat: by increasing level of difficulty.

Where more than one difficulty exists, the highest level of difficulty takes precedence in the categorisation, for example, any flat with rendered walls falls into the 'flats' category and a house with rendered walls and a conservatory falls into the 'walls with a predominant rendered finish' category. For the purposes of this analysis, therefore, the first three categories refer to houses only. Flats are likely to have their own unique problems irrespective of, for example, the type of wall finish.

Masonry wall with attached conservatories or other features: fixing the insulation round any projections like conservatories, porches or bays requires additional work and therefore additional expense.

Walls with a predominant rendered finish: 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.

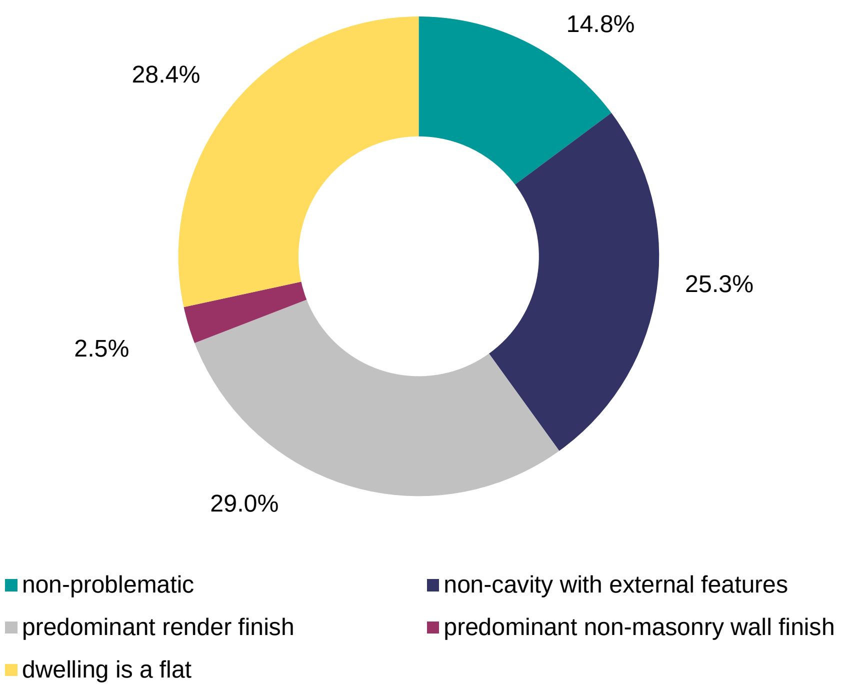
Walls with a predominantly non-masonry finish: improving dwellings with wall finishes such as stone cladding, tile, timber or metal panels would either add to the cost of the work or even preclude external solid wall insulation where the wall structure itself is stone or timber. Unlike brick walls, these types of wall finish may give an uneven surface on which to attach the insulated layer.

Flats: These 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). Also, the height of the module for high-rise flats would present significant complications in applying external solid wall insulation.

There are other barriers such as planning restrictions that apply in conservation areas or listed building status that will affect the real potential for installing solid wall insulation but EHS does not collect data on these.

3.35 It is estimated that, of the 8.1 million homes that could potentially benefit from solid wall insulation, some 6.9 million (85%) had hard to treat solid walls for at least one of the reasons provided in Box 3. In 29% of cases, homes had walls with a predominantly rendered rather than plain masonry wall finish, whilst a further 28% were flats, Figure 3.4.

Figure 3.4: Ease of installing solid wall insulation, 2013

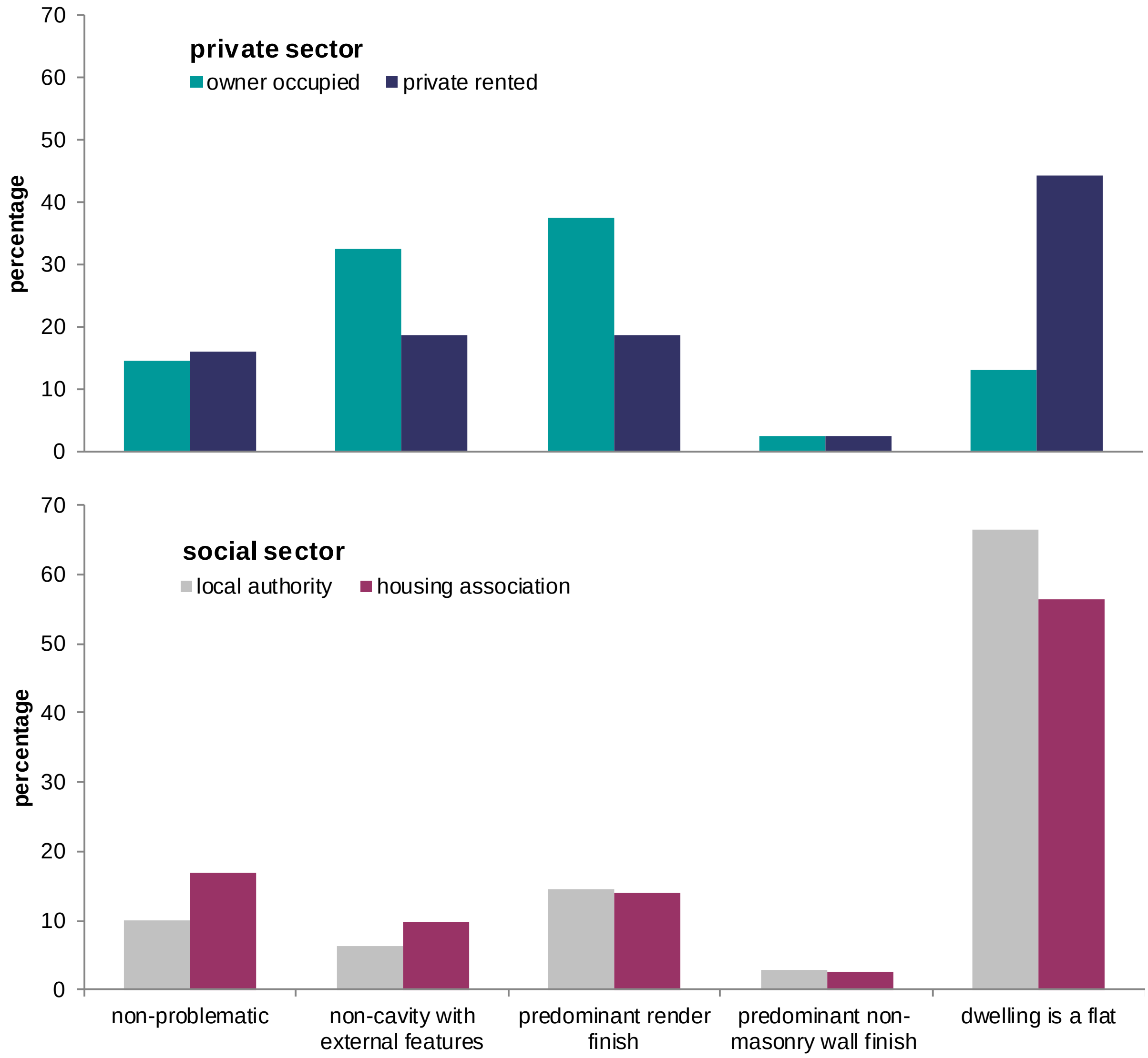


Base: all dwellings with theoretical potential to install solid wall insulation
Notes:
1) for problematic solid wall, percentages show the proportion of homes with the greatest degree of difficulty, for example, flats will rendered walls are categorised as flats
2) underlying data are presented in Annex Table 3.13
Source: English Housing Survey, dwelling sample

3.36 The proportion of homes with hard to treat solid walls was fairly similar for most tenures (83-86%), with the exception of local authority homes where the proportion was even higher at 90%, Annex Table 3.13.

3.37 There was greater variation, however, in the prevalence of each of the four types of barriers among the different tenures. Not surprisingly, the difficulties in applying solid wall insulation to flats were more commonly found among rented dwellings; particularly those owned by local authorities (66%).The main barriers to insulation for owner occupied homes were rendered walls (37%) and the presence of external features (32%), Figure 3.5.

Figure 3.5: Ease of installing solid wall insulation by tenure, 2013



Base: all dwellings with theoretical potential to install solid wall insulation
Note: underlying data are presented in Annex Table 3.13
Source: English Housing Survey, dwelling sample

3.38 Some 88% of semi-detached homes and 85% of detached homes had barriers to solid wall insulation. This was mainly due to a high proportion of these homes having predominantly rendered walls (48% and 43% respectively). Terraced houses with solid or hard to treat cavity walls were less likely to be problematic (72-74%). For mid terraced houses this is mainly due to the lower proportion of homes with predominantly rendered walls, Annex Table 3.13.

3.39 Both pre-1919 and post-1990 homes had a lower proportion of hard to treat solid walls (79% and 75% respectively) compared with other aged homes. The most common barrier to solid wall insulation varied by dwelling age; for example, over half of homes built from 1919 to 1944 had solid walls which were hard to treat owing to existing rendered finishes (53%), whilst 32% of homes built prior to 1919 had solid walls which were hard to treat due to external features, Annex Table 3.13.

Households in homes with hard to treat solid walls

3.40 Around 6.7 million households lived in homes where the installation of solid wall insulation was problematic. Some 29% of these households (1.9 million) were occupied by households where the HRP was aged 60 years or more and the same proportion were either couples or lone parents with dependent children. Around 13% (860,000) were households where the youngest child was under 5 years of age, Annex Table 3.14.

3.41 Some 17% were households with an ethnic minority HRP. Around 15% of households were in poverty, but at the other end of the spectrum 25% of households were in the highest income quintile. Generally speaking, other households who lived in homes with hard to treat solid walls were evenly distributed across the other income quintiles (18-20%), Annex Table 3.14.

Loft insulation

3.42 The presence of a loft and its type will impact on the relative ease of fitting insulation in the roof space; these hard to treat categories are described in Box 4. The figures and analysis in this section cover 8.0 million dwellings: the 5.3 million identified in Chapter 2 of this report where there was potential to upgrade the insulation using the EPC methodology, plus an additional 2.7 million homes where the existence of a flat roof or a fully converted loft space could prevent further work on improving the energy efficiency of the roof. The analysis does not include those dwellings that have no roof above, e.g. flats that do not have any rooms on the top floor of a building.

3.43 It is estimated that over half of these 8.0 million homes, 4.5 million (56%) had lofts that should be non-problematic to upgrade, leaving 44% harder to treat, Annex Table 3.15.

Box 4: Ease of installing or topping up loft insulation

Non problematic: installation would be straightforward with no barriers.

Hard to treat by increasing level of difficulty/feasibility:

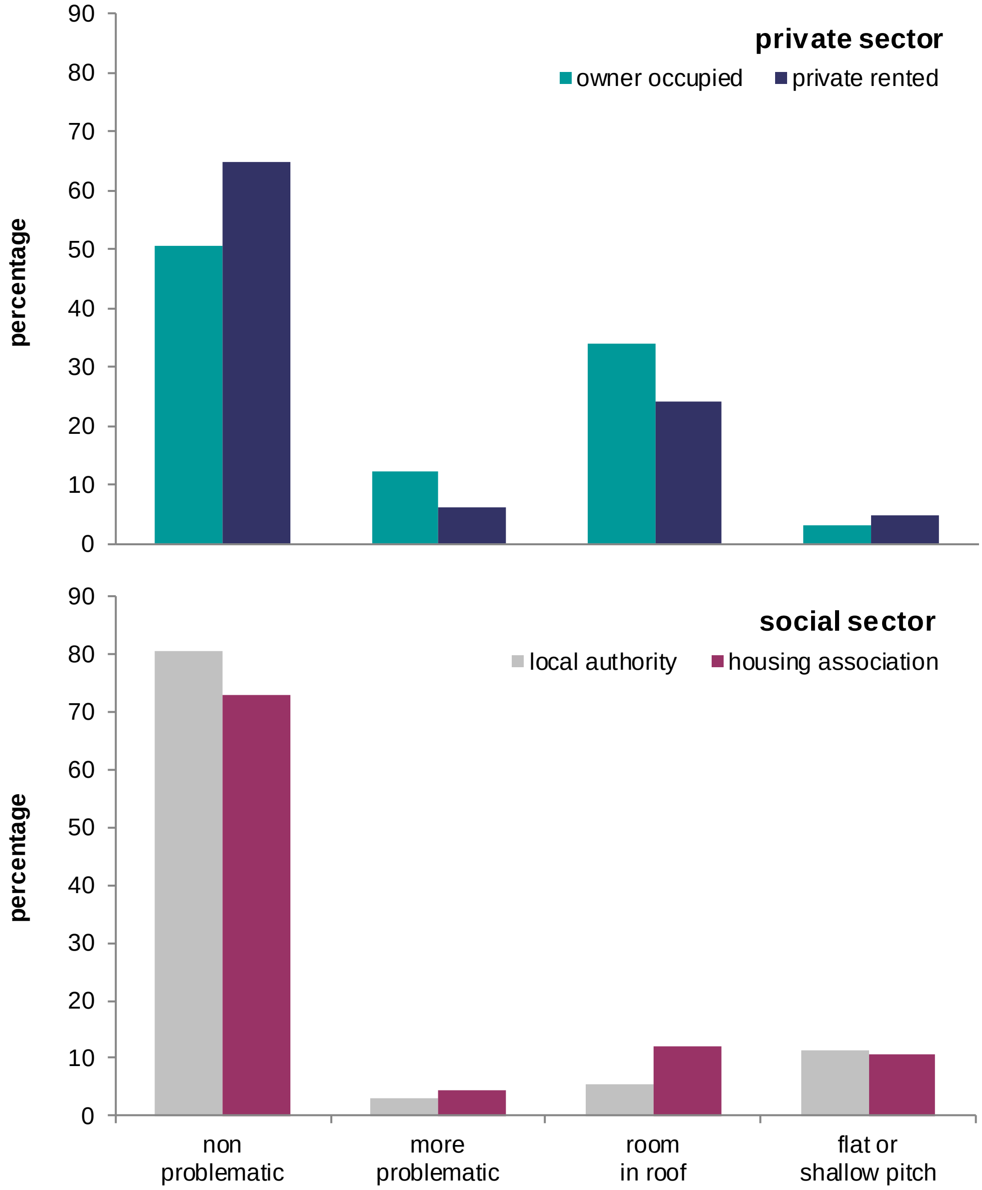
> **More problematic:** loft is fully boarded across the joists which would lead to extra work and expense.
>
> **Room in roof:** insulation would need to be added between the rafters which would involve very extensive work and considerable expense.
>
> **Flat or shallow pitched roof:** not feasible to install loft insulation as there is no access into the loft or no loft space.

Unlike the hard to treat categories for cavity wall and solid wall insulation, where a dwelling may fall into more than one category, those for loft insulation are more distinct in nature. Although a room in the roof would also be fully boarded, improving energy efficiency would occur through insulating the roof slope rather than the ceiling.

3.44 The main barrier in these harder to treat homes was the presence of a permanent room in a loft (30%). The loft was fully boarded in a further 10% of homes and 4% of homes had a flat or shallow pitched roof. For those dwellings with either a permanent room in the loft space or a flat or shallow pitched roof, improving thermal insulation may not be feasible or necessary as the existing level of insulation was unknown, Annex Table 3.15.

3.45 Owner occupied homes were most likely to have lofts that were problematic to upgrade with thicker insulation (49%) than rented homes, particularly local authority homes (20%). Some 34% of these owner occupied homes could not have insulation topped up due to the presence of a permanent loft room. This barrier was less common among rented homes, especially local authority homes (5%). The presence of a flat or shallow pitched roof was the most common problem (11%) for local authority homes, Figure 3.6.

Figure 3.6: Barriers to installing loft insulation by tenure, 2013



Base: all dwellings with theoretical potential to improve loft insulation and those that may have insufficient loft insulation
Note: underlying data are presented in Annex Table 3.15
Source: English Housing Survey, dwelling sample

Case studies – energy inefficient homes

3.46 Below are three fictitious case studies that have been created to provide stereotypes of dwellings with poor energy efficiency ratings, outline potential improvements, barriers to further improvement, and the estimated effect these improvements would have on the SAP rating, CO_2 emissions and fuel costs. These post-improvement values are estimated using the standard SAP methodology, after applying the EPC measures discussed in each example to a dwelling that is typical of that case study. They do not take into account the household size or composition or the occupants' actual fuel usage.

Case study 1: Detached house in need of energy improvements – problematic to treat

Source: BRE photo library

3.47 Since its original construction around 1910 this detached home has acquired additional living space through a garage extension. A large conversion of the loft space, which had 50mm of insulation installed between the rafters, has provided additional bedroom space. The dwelling has benefitted from the installation of double glazing but its walls, which are of predominately solid construction, are uninsulated. The property has mains gas and is centrally heated by a standard non-condensing boiler. Hot water is provided by the central heating boiler and the storage cylinder has had a 25mm insulating jacket fitted but no hot water cylinder thermostat has been installed. The current SAP rating is 40 (SAP band E) and the dwelling has annual CO_2 emissions of 11.5 tonnes, whilst the annual fuel costs are around £2,000.

3.48 Owing to the presence of the room in the loft space it may not be feasible to upgrade the loft insulation as this space is now difficult to access. In addition, although applying external wall insulation would be feasible, the presence of bay windows and a porch at front of the dwelling would increase the cost of this measure. Fitting an internal layer of plaster board with insulation to the solid walls would be a more realistic way of preventing heat loss in a home of this size, as well as retaining the current exterior appearance of the house. The higher cost measures of an upgrade to a condensing boiler and installing a hot water thermostat would increase the dwelling's SAP rating to 52 (still in SAP band E). The annual CO_2 emissions would fall to 8.0 tonnes and the annual fuel costs to £1,600. With the work costing approximately £1,150 the payback period would be around 3 years. These costs exclude the installation of any solid wall insulation that could potentially be applied.

Case study 2: Bungalow in need of energy improvements – not problematic to treat

Source: BRE photo library

3.49 The private rented semi-detached bungalow on the left was built between 1965 and 1975, and is occupied by a couple both of whom are over 60 years of age. It has mains gas central heating installed but this heating system lacks thermostatic radiator valves or temperature controls. The dwelling has double glazing but the loft insulation depth is less than 100mm and the cavity walls are uninsulated. The property is heated by a non-condensing combination boiler. It currently has a band D energy efficiency rating of 56, with annual CO_2 emissions of 3.9 tonnes and fuel costs of £800.

3.50 The installation of cavity wall insulation would not be problematic and the loft insulation could easily be topped up to 250mm. In addition upgrading to a condensing boiler would improve the energy efficiency rating to 67 (still in band D), with annual CO_2 emissions falling to around 2.5 tonnes and fuel costs to a little over £600. With installation costs of £1,700, the payback period would be significantly longer than in the first case study at 8-9 years, due to the smaller reduction in annual fuel costs.

Case study 3: purpose built flat – problematic to treat

Source: BRE photo library

3.51 These 2nd and 3rd floor maisonette style flats were built in the 1960s, with each having two bedrooms. They have cavity walls that are uninsulated, but the windows have been double glazed. The heating is provided by storage heaters which are in need of an upgrade, and hot water comes from an electric immersion heater attached to a poorly insulated hot water cylinder. Each flat has a current SAP rating of 43 and annual CO_2 emissions of 6.1 tonnes, with annual fuel costs of £1,000 per year.

3.52 The storage heaters can be upgraded to more modern slim line heaters and a thick jacket fitted to the hot water cylinder. These upgrades would be likely to bring about a rise in the SAP rating to 55, taking these homes from band E to band D. The annual CO_2 emissions would be reduced to 4.7 tonnes and the fuel costs to £760, giving a 3-4 year payback period on upgrade costs of around £840.

3.53 Further improvements would in theory be possible through cavity wall insulation, which would increase the SAP rating for each flat to 70. The annual CO_2 emissions would then be reduced to 3.2 tonnes and the fuel costs to

£520; however this measure would be more expensive than a standard installation due to the additional difficulty in retrospectively inserting insulation in top floor flats. As with case study 1, insulated plasterboard could possibly be applied internally but would negatively impact on the internal space available. A final issue arises when considering improvements to the flat roof above each dwelling. Any insulation installed when the flats were built will be relatively energy inefficient compared with current standards, with few flat roofs built pre-1980 having any insulation fitted during construction. An upgrade could be applied internally along with a refurbished ceiling; however this can lead to problems with condensation above the new ceiling. The preferred option would be to fit insulation, followed by a new weatherproof layer, above the existing roof.