Department
for Communities
& Local Government

English Housing Survey
ENERGY EFFICIENCY OF ENGLISH HOUSING 2013

ENGLISH
HOUSING
SURVEY

The United Kingdom Statistics Authority has designated these statistics as National Statistics, in accordance with the Statistics and Registration Service Act 2007 and Signifying compliance with the Code of Practice for Official Statistics.

Designation can be broadly interpreted to mean that the statistics:

- meet identified user needs;
- are well explained and readily accessible;
- are produced according to sound methods, and
- are managed impartially and objectively in the public interest.

Once statistics have been designated as National Statistics it is a statutory requirement that the Code of Practice shall continue to be observed.

Department
for Communities
& Local Government

English Housing Survey:

ENERGY EFFICIENCY OF ENGLISH HOUSING

Annual report on England's households and housing stock, 2013

July 2015
Department for Communities and Local Government

This document/publication is also available on our website at www.gov.uk/dclg

Any enquiries regarding this document/publication should be sent to us at:

English Housing Survey team
Department for Communities and Local Government
2 Marsham Street
London
SW1P 4DF
Telephone: 030 3444 0000

July, 2015

ISBN: 978-1-4098-4639-0

Contents

Acknowledgements

Each year the English Housing Survey relies on the contributions of a large number of people and organisations. The Department for Communities and Local Government (DCLG) would particularly like to thank the following people and organisations, without whom the 2013-14 survey and this report, would not have been possible:

- All the households who gave up their time to take part in the survey.
- NatCen who managed the English Housing Survey on behalf of the department and led the production of the 2013-14 Households Report.
- The Building Research Establishment (BRE) who managed the physical survey of properties and led the production of the 2013 Profile of English housing report, the 2013 Energy efficiency of English housing report and the 2013-14 Fire and fire safety report.
- The NatCen interviewers who conducted the household interviews and the CADS Housing Surveys surveyors who carried out the visual inspections of properties.
- And finally, the team at DCLG who worked on the survey and who were involved in the production of this report.

Introduction

1. The English Housing Survey (EHS) is a national survey of people's housing circumstances and the condition and energy efficiency of housing in England. In its current form, it was first run in 2008-09. Prior to that, the survey was run as two standalone surveys: the English House Condition Survey and the Survey of English Housing.

2. This report provides the latest survey findings on energy and energy efficiency of the English housing stock and is split into four chapters. The first chapter examines the energy efficiency and carbon dioxide emissions of the English housing stock in 2013, and how energy performance has changed since 2001. Chapter two examines the potential for further energy efficiency improvements in the housing stock. The third chapter focuses on those homes that had the worst energy efficiency in 2013 and examines the potential for improving their energy performance. In this chapter, there is a particular focus on the private rented sector. The final chapter provides an overview of the distribution and types of primary and secondary heating systems in English homes in 2013 and how these varied by dwelling characteristics.

3. The report builds on findings first released in the 2013-14 English Housing Survey Headline Report, which was published on the Department for Communities and Local Government (DCLG) website in February 2015.

4. Results which relate to the physical dwelling are presented for ‘2013’ and are based on fieldwork carried out between April 2012 and March 2014 (a mid-point of 1 April 2013). The sample comprises 12,498 occupied or vacant dwellings where a physical inspection was carried out and includes 12,008 cases where an interview with the household was also secured. Throughout the report, these are referred to as the ‘dwelling sample’ and the ‘household sub-sample’ respectively.

5. In tables, where the numbers of cases in the sample are too small for any inference to be drawn about the national picture, the cell contents are replaced with ‘u’. This happens when the cell is based on a sample of less than five cases. Where cell contents are in italics this indicates a total sample size of less than 30, and the results should be treated as indicative only.

6. Where comparative statements have been made in the text, these have been significance tested to a 95% confidence level. This means we are 95% confident that the statements we are making are true.

7. Additional annex tables, including the data underlying the figures and charts, are published on the DCLG website: https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey alongside many supplementary tables, which are updated each year but are too numerous to include in our reports. Further information on the technical details of the survey, and information and past reports on the Survey of English Housing and the English House Condition Survey, can also be accessed via this link.

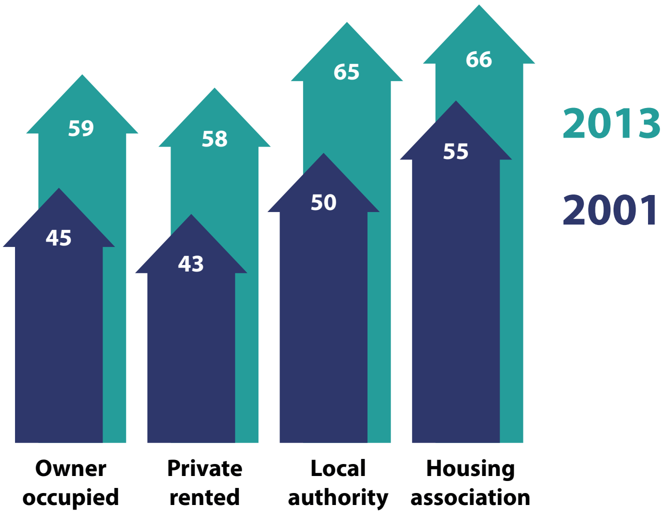
8. If you have any queries about this report, if you would like any further information, or have suggestions for analyses you would like to see included in future EHS reports, please contact ehs@communities.gsi.gov.uk

9. The responsible statistician for this report is: Jeremy Barton, English Housing Survey Team, Strategic Statistics Division, DCLG. Contact via ehs@communities.gsi.gov.uk

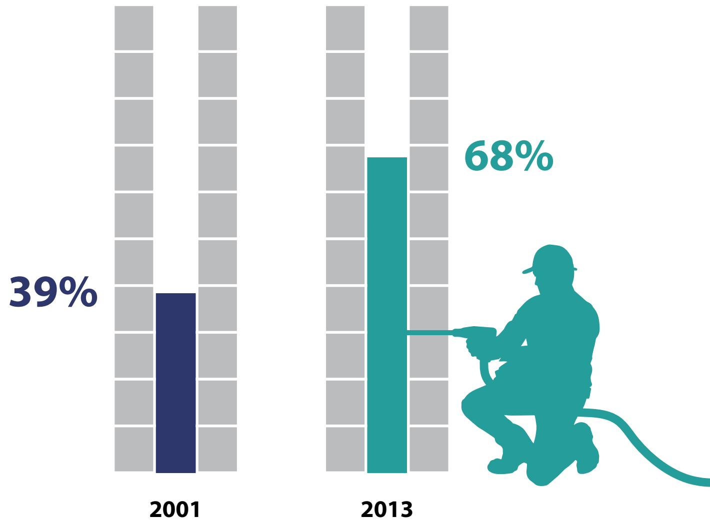
Department for Communities and Local Government
ENGLISH HOUSING SURVEY
NatCen Social Research
bre

Energy efficiency of English housing 2013

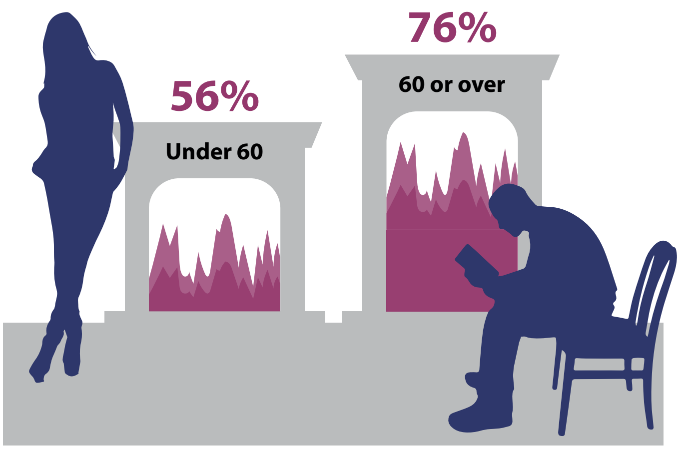
The private rented and local authority sectors showed the largest increases: average SAP* rose by 16 and 15 points respectively.



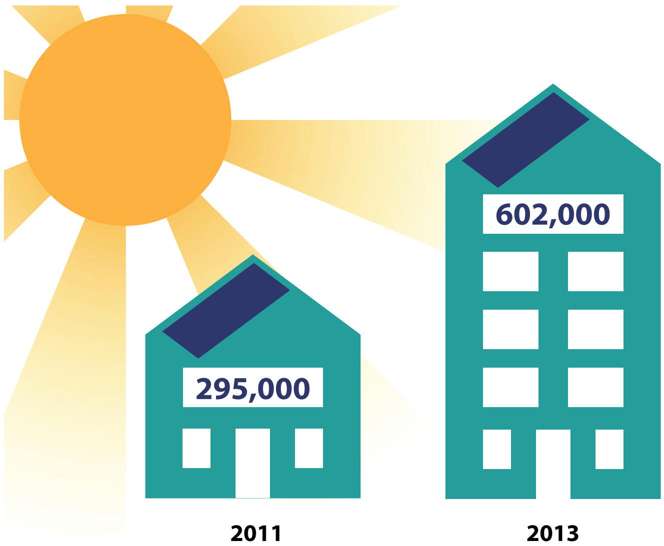
10.8 million homes (68%) were estimated to have cavity wall insulation in 2013, an increase from 5.8 million (39%) in 2001.



Households where the HRP was aged 60 years or over were more likely to have some form of secondary heating (76%), compared with households where the HRP was under 60 years (56%).



In 2013 an estimated 602,000 homes had some form of solar panel(s) for renewable energy, more than double the number in 2011 when around 295,000 had these.



*SAP is the Government's Standard Assessment Procedure for Energy Rating of Dwellings, where properties are scored between 1 and 100 based on energy costs associated with space heating, water heating, ventilation and lighting. A score of below 30 is considered very energy inefficient, while a score of 70 or more is considered very energy efficient.

Please see the main report for more information: https://www.gov.uk/government/collections/english-housing-survey

Main findings

Average energy efficiency ratings (measured by the SAP rating) increased markedly from 2001 to 2013 across all tenures

- The average SAP rating for all dwellings increased by 14 points from 46 in 2001 to 60 in 2013[1].

- The private rented and local authority sectors showed the largest increases in energy efficiency: average SAP rose by 16 and 15 points respectively. As a result, average SAP ratings for both the owner occupied and the private rented sectors were identical in 2013.

- Households where the HRP was over 60 years of age had less energy efficient homes (average SAP 57) than households where the HRP was younger (average SAP 60).

There was a marked increase in the number of homes with insulated cavity walls over time, but private rented homes were least likely to have any wall insulation

- In 2013 around 16 million homes had cavity walls. Some 10.8 million (68%) of these homes were estimated to have cavity wall insulation, an increase from 5.8 million (39% of all cavity wall dwellings) in 2001. This growth was particularly evident for local authority and owner occupied homes (up from 36% to 69% and from 39% to 70% respectively).

- Private rented homes were the least likely to have had their cavity walls insulated (55%) compared to other tenures. Housing association homes, which were generally newer, were the most likely group to have this insulation (73%).

One in four uninsulated cavity walled homes were assessed as hard to treat, but proportions were higher for rented properties, due in part to the greater prevalence of flats in the rented sectors

- It is estimated that of the 5.1 million dwellings that could potentially benefit from the installation of cavity wall insulation, 25% (1.3 million) had uninsulated walls which were assessed as hard to treat (i.e. fill).

[1] SAP is expressed on a scale of 1 (highly inefficient) to 100 (highly efficient, i.e. zero energy cost).

- Only 18% of owner occupied homes had uninsulated cavity walls that were problematic to treat, but 35% of private and housing association rented and 39% of local authority rented homes had hard to treat cavity walls.

Solid wall insulation was more common in housing association and local authority compared with private rented and owner occupied homes

- In comparison with cavity walls, of the estimated 6.8 million homes with solid walls in 2013, just 450,000 (7%) had either internal or external insulation applied to the majority of their outer walls.

- Both housing association and local authority homes with solid walls were far more likely to have insulation (27% and 22% respectively) compared with private rented (5%) and owner occupied homes (4%).

Since the turn of the millennium the proportion of fully double glazed homes increased

- The proportion of homes that were fully double glazed increased markedly from 51% in 2001 to 80% 2013.

- Housing association and local authority homes were more likely to be fully double glazed (91% and 89% respectively), compared with owner occupied (79%) and private rented homes (74%).

The number of homes with solar panels doubled since 2011

- In 2013 an estimated 602,000 homes had some form of solar panel(s) for renewable energy, more than double the number in 2011 when around 295,000 had these. The majority (82%) of these homes were in the private sector.

The majority of homes could theoretically benefit from at least one energy improvement measure

- In 2013, around 16.3 million homes (70%) could theoretically benefit from at least one energy improvement measure such as improving loft insulation or a boiler upgrade.

- Nine million homes could potentially benefit from replacing an existing conventional central heating boiler with a condensing boiler, 5.4 million homes could benefit from installing cavity wall insulation and 5.3 million could benefit from improving loft insulation.

If all the recommended EPC improvement measures were applied to the dwelling stock this would feed through to savings on the heating, lighting and ventilation components of average fuel bills and lead to a reduction in notional carbon dioxide emissions

- It is estimated that the average cost of implementing all potential energy improvement measures would be around £1,000 for every home that could have at least one energy upgrade. However, for 20% of applicable homes, the average cost to apply the required measures would be less than £325.

- The EHS estimates that the application of all energy upgrade measures could lead to a potential 14% reduction in these bills, from £990 to £855 (at standard 2013 energy prices) per year. In doing so the total energy bill could potentially fall from £23 billion to £20 billion.

- The result of applying all the recommended EPC improvements would be an average 22% reduction in notional carbon dioxide emissions equivalent to 1.1 tonnes per dwelling annually.

The proportion of homes with the worst energy efficiency was low, but private renters and older households were more likely to live in these homes

- In 2013, there were around 1.5 million homes (6%) with the worst energy efficiency (SAP bands F or G), of which 28% (419,000) were private rented. Only 19% of homes with better energy efficiency (SAP bands A to E) were private rented.

- Nearly half (45%) of the households living in these homes had an HRP who was over 60 years of age. In homes with better energy efficiency, 35% of households contained an HRP over 60 years.

Owner occupied dwellings were more likely to have secondary heating compared with rented dwellings, and older households were also more likely to have secondary heating than younger households

- In 2013, around 14.6 million homes (63% of dwellings) had some form of secondary heating. Owner occupied homes were much more likely to have secondary heating (72%) compared with both private rented (45%) and social rented homes (47%).

- Households where the HRP was aged 60 years or over were more likely to have some form of secondary heating (76%), compared with households where the HRP was under 60 years (56%).

Chapter 1
Energy performance

1.1. Improving the energy efficiency of a home can not only reduce household energy bills and lower greenhouse gas emissions, it can also improve the quality of life for the household. Since even small changes in energy performance and the way we use our home can have a significant effect in reducing total energy consumption, a number of policy measures and funding initiatives aimed at improving insulation and heating systems in homes have been introduced by successive governments.

1.2. This chapter examines the energy efficiency and carbon dioxide emissions of the English housing stock in 2013, and how this varied by tenure and key household characteristics. It next examines how energy performance has changed since 2001 by tenure, key problematic types of dwelling and key household groups. The chapter then focuses on the varied provision of individual energy efficiency measures such as loft and cavity wall insulation before examining how the prevalence of such measures has improved over time for the whole stock. Finally, some information is provided on the presence of renewable energy measures

1.3. Analysis of primary and secondary heating systems within the stock can be found in Chapter 4 of this report. Additional data on energy performance can be found in the live web tables DA7101 to DA7104[1].

1.4. The assessment of energy performance for the housing stock is not based on actual energy consumption and emissions, but on the consumption (and resulting emissions) assumed under a standard occupancy and standard heating pattern for each dwelling. This enables the performance of the housing stock to be assessed on a comparable basis between different types of stock as well as over time. Further information on this assessment can be found in Chapter 5 of the Technical Report, Annex 6.

[1] https://www.gov.uk/government/collections/english-housing-survey#2013-to-2014

Energy efficiency

1.5. The measures of energy performance of the housing stock used for this chapter are the energy efficiency (SAP) rating and carbon dioxide (CO_2) emissions, Box 1.1. From 2010 to 2012 the EHS used the SAP09 methodology for energy efficiency comparisons, but this report uses the updated SAP12 methodology. Appendix 1 of this chapter summarises the main differences between the two methods and how this change impacts on the EHS data.

Box 1.1: Key measures of energy performance

Energy efficiency rating: The SAP rating is based on each dwelling's energy costs per square metre and is calculated using a simplified form of the Standard Assessment Procedure (SAP) under the 2012 methodology. The energy costs take into account the costs of space and water heating, ventilation, and lighting, less any cost savings from energy generation technologies. The rating is expressed on a scale of 1-100 where a dwelling with a rating of 1 has extremely poor energy efficiency (high costs) and a dwelling with a rating of 100 represents a completely energy efficient dwelling (zero net energy costs per year). It is possible for a dwelling to have a SAP rating of over 100 where it produces more energy than it consumes, although such dwellings will be rare within the English housing stock.

The energy efficiency rating is also presented in an A to G banding system for Energy Performance Certificates, where Energy Efficiency Rating (EER) Band A is the most efficient band (i.e. low energy costs) and EER Band G is the least energy efficient band (i.e. high energy costs).

Carbon dioxide emissions: The carbon dioxide (CO_2) emissions of a dwelling are derived from its space heating, water heating, ventilation and lighting, less any emissions saved by energy generation, and are measured in tonnes per year. Unlike the SAP rating, CO_2 emissions are not standardised for the size of the dwelling and are therefore likely to be higher for larger homes.

1.6. The average SAP for all dwellings in England (including vacant homes) was 60 in 2013, although this was a little higher for social sector homes (66) compared with those in the private sector (58), Annex Table 1.1.

1.7. Private rented homes had a similar average SAP rating (58) to owner occupied homes, despite the greater scope for installing many of the key energy efficiency measures in the private rented sector (see Chapter 2 of this report), Annex Table 1.1. The unmet potential for installing energy efficiency measures was generally higher in the private rented sector for a number of reasons including:

- the installation of common energy performance measures such as loft and cavity wall insulation, was problematic for a large proportion of privately rented dwellings (see Chapter 3 of this report).
- the difficulties in incentivising landlords to undertake such measures
- the complications in getting agreement among leaseholder flats.

1.8. The private rented sector also had a higher proportion of dwellings in the lowest SAP rating bands (F and G) (see Chapter 3 of this report). The similar average SAP rating between owner occupied and private rented homes is, however, most likely to be due to the different distribution of dwelling types and ages within each sector, especially the higher proportion of flats (which are a generally more energy efficient configuration, with fewer external heat loss walls) in the private rented sector.

1.9. Not surprisingly the findings for CO_2 emissions largely mirrored those for average SAP ratings: the social sector performed better (3.2 tonnes per annum) than the private sector (5.6 tonnes per annum). This difference in performance is likely to be largely due to:

- the energy efficiency improvements undertaken in the social sector as part of the Decent Homes programme
- the different profile of the social stock, which had a smaller proportion of the oldest homes together with a higher proportion of purpose built flats
- social sector homes generally being smaller than those in the private sector[2]

1.10. Within the private sector, CO_2 emissions were lower among rented homes: 4.7 tonnes per annum compared with 6.0 tonnes per annum among owner occupied homes. This partly reflects the different distribution of dwelling types within each of these sectors, in particular the higher proportion of purpose built and converted flats within the private rented sector. Flats tend to be smaller than houses, and CO_2 emissions are likely to be lower for smaller homes, Annex Table 1.1.

1.11. Chapter 1 of the 2012 EHS Energy efficiency of English housing includes analysis of the average SAP rating and carbon emissions within the private and social sectors for various dwelling and heating characteristics; none of these findings are likely to have changed significantly between 2012 and 2013 and readers are referred to this report for further details on these breakdowns.

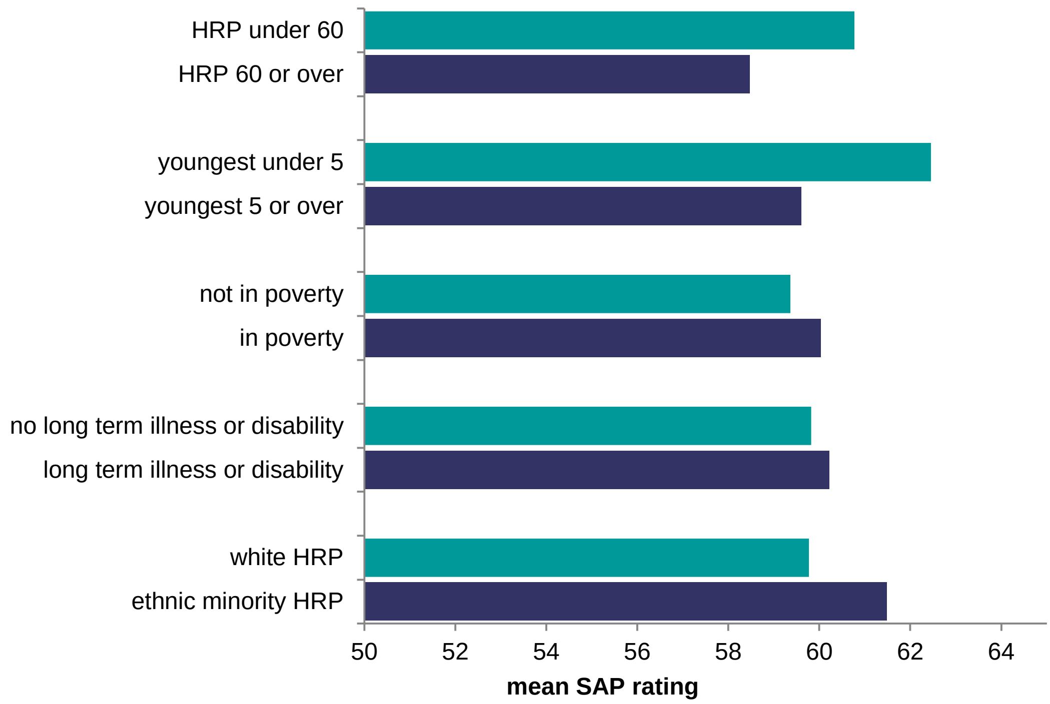
[2] see Chapter 1 of the 2013 Profile of English housing for further information

Energy efficiency – households

1.12. This section examines the energy efficiency in occupied homes only, with particular focus on certain key household groups: households including people who are potentially vulnerable on account of their age, long term illness or disability; and groups which tend to be disadvantaged such as ethnic minorities and those in poverty[3]. The differences in average SAP reflect the different distribution of tenures, dwelling types and ages of homes occupied by each of these household groups, especially the higher proportion of purpose built flats in the rented sectors.

1.13. Across all occupied homes the average SAP rating was 60. This was lower for households where the HRP was over 60 years of age (58) compared with those where the HRP was less than 60 years of age (61). Also, average SAP was higher for households where the youngest person was aged less than 5 years (62) compared with households where the youngest person was above this age (60). Overall, households with an ethnic minority HRP lived in more energy efficient homes (average SAP of 61) compared to their white counterparts (average SAP of 60), Figure 1.1.

Figure 1.1: Mean SAP by household characteristics (all tenures), 2013



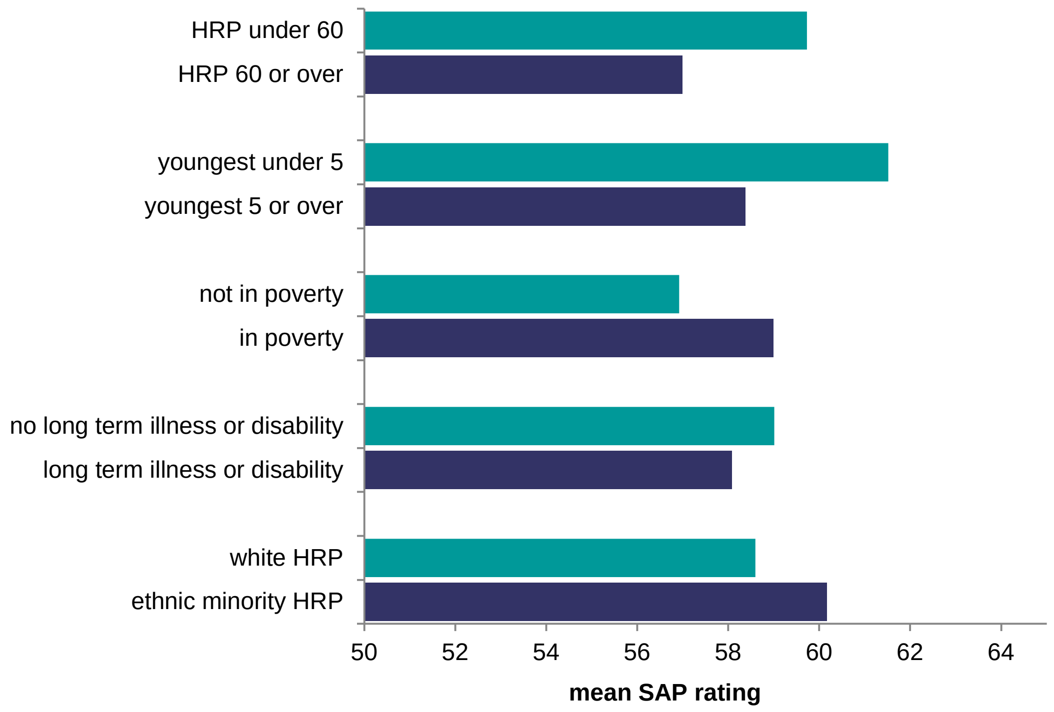
Base: all households
Note: underlying data are presented in Annex Table 1.2
Source: English Housing Survey, household sub-sample

[3] see the Glossary for definitions of these household groups

1.14. For occupied social sector homes, the average SAP rating was 66 and this was similar for all key household groups, Annex Table 1.2.

1.15. Occupied private sector homes had a lower average SAP, of 59, and findings for the key vulnerable or disadvantage groups were more varied than in the social sector, largely mirroring those for all occupied homes. Average SAP was, for example, higher for households where the youngest person was less than five years of age (62) compared with households where the youngest person was five or older (58). Average SAP was, however, lower for households where the HRP was over 60 years of age (57) than households where the HRP was younger (60), Figure 1.2.

Figure 1.2: Mean SAP by household characteristics (private sector homes), 2013



Base: all private sector households
Note: underlying data are presented in Annex Table 1.2
Source: English Housing Survey, household sub-sample

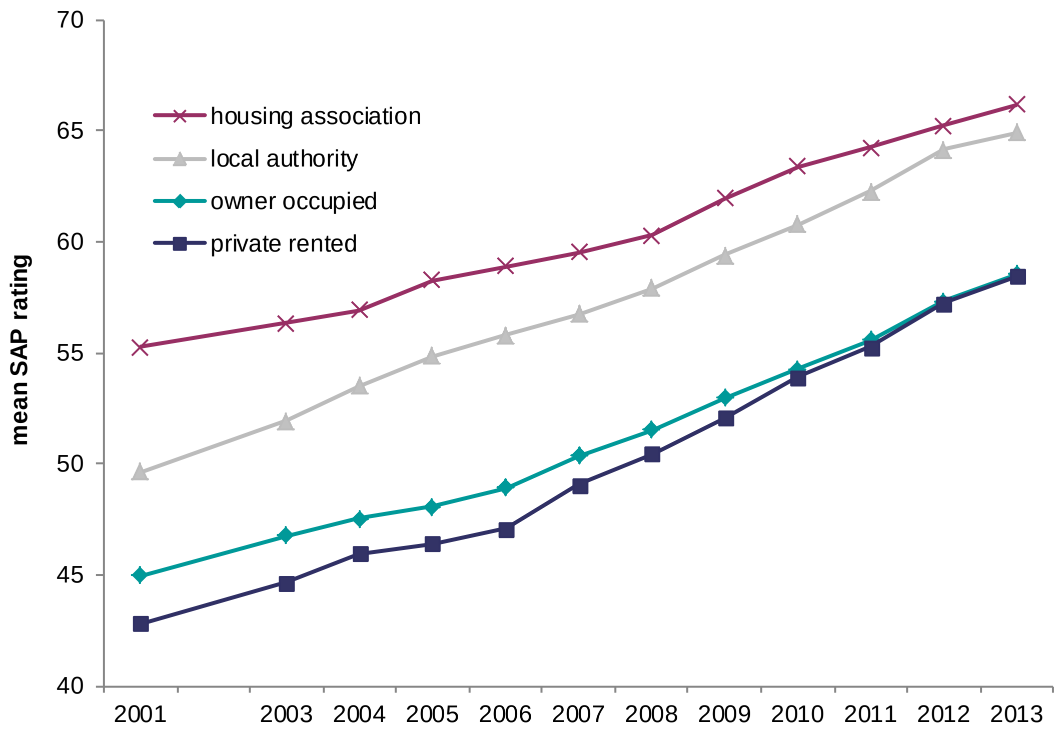
Energy efficiency over time – all dwellings[4]

1.16. The average SAP rating for all dwellings increased by 14 points from 46 in 2001 to 60 in 2013. The private rented and local authority sectors showed the largest increases: average SAP rose by 16 and 15 points respectively. As a result, average SAP for both the owner occupied and the private rented sectors were the same in 2013 and average SAP for both social tenures was

[4] this analysis uses SAP12 for each EHS survey year to ensure a consistent time series

more similar. Housing association properties remained the most energy efficient throughout this period. Figure 1.3

Figure 1.3: Energy efficiency, average SAP rating by tenure, 2001-2013



Base: all dwellings
Note: underlying data are presented in Annex Table 1.3
Sources:
2001-2007: English House Condition Survey, dwelling sample
2008 onwards: English Housing Survey, dwelling sample

Energy efficiency over time – dwellings with lower energy performance

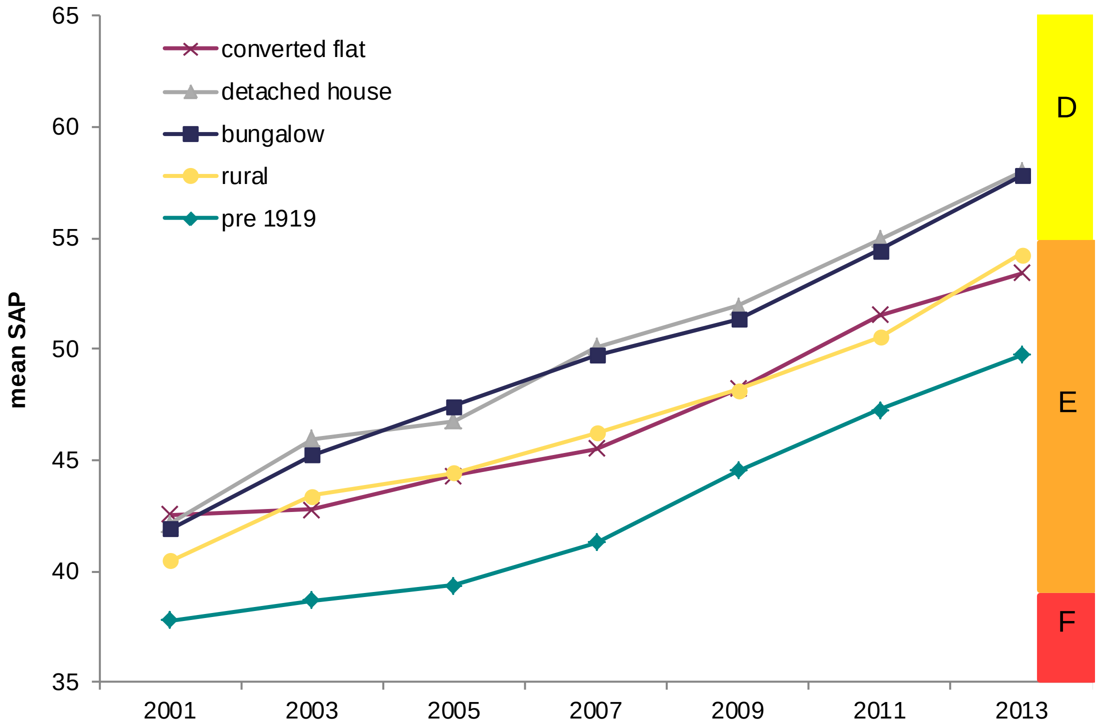
1.17. The following analysis examines some types of homes with the lowest energy efficiency in 2001 to determine how energy performance may have improved over time. These dwelling types are detached houses; semi-detached houses; bungalows; converted flats; pre 1919 built homes; and homes in rural areas.

1.18. Of these groups, detached houses and bungalows showed the greatest increase in average SAP (from 42 in 2001 to 58 in 2013) , Figure 1.4. For detached homes this improvement may be partly explained by the higher proportion of newly built dwellings in this group. The improvement for semi-detached homes almost mirrored that for detached homes and bungalows, Annex Table 1.4.

1.19. For dwellings built before 1919, the increase in average SAP was somewhat more modest (from 39 to 50), reflecting that these homes are among the most expensive and problematic to improve. Progress was slowest for converted flats, a highly variable group of dwellings which are often difficult to improve, although we need to bear in mind that the sample size for these homes is relatively small compared with other dwelling types.

1.20. Despite the improvement in performance for all these types of homes, they continued to have lower than average SAP, and the differences between the housing types persisted over time.

Figure 1.4: Energy efficiency, average SAP rating by problematic dwelling types, 2001-2013

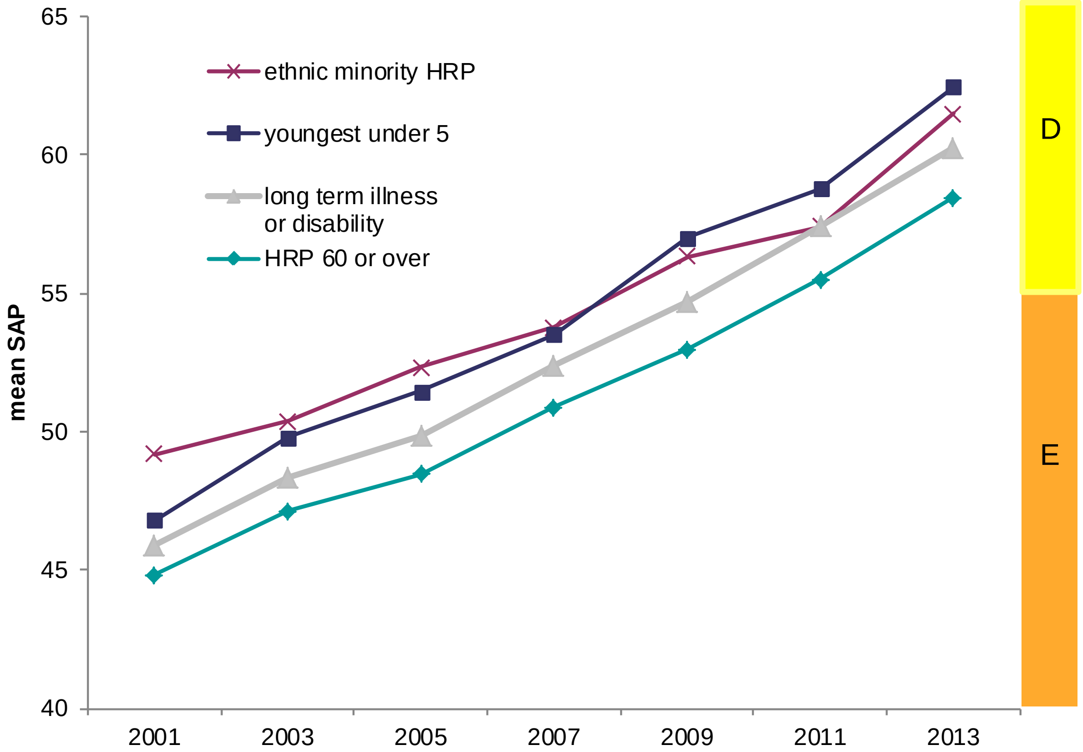


Base: all dwellings
Note: underlying data are presented in Annex Table 1.4
Sources:
2001-2007: English House Condition Survey, dwelling sample
2008 onwards: English Housing Survey, dwelling sample

Energy efficiency over time – occupied homes

1.21. All key household groups saw improvements in mean SAP over this period, especially families with one or more children aged under 5 years of age (from 47 in 2001 to 62 in 2013). Progress was slightly less rapid, but still notable, among ethnic minority HRP households: average SAP rose from 49 to 61 over this period, Figure 1.5. The pattern for households in poverty was very similar to that for all households, see Annex Table 1.5.

Figure 1.5: Energy efficiency, average SAP rating by key household groups, 2001-2013



Base: all households
Note: underlying data are presented in Annex Table 1.5
Sources:
2001-2007: English House Condition Survey, household sub-sample
2008 onwards: English Housing Survey, household sub- sample

Energy efficiency measures

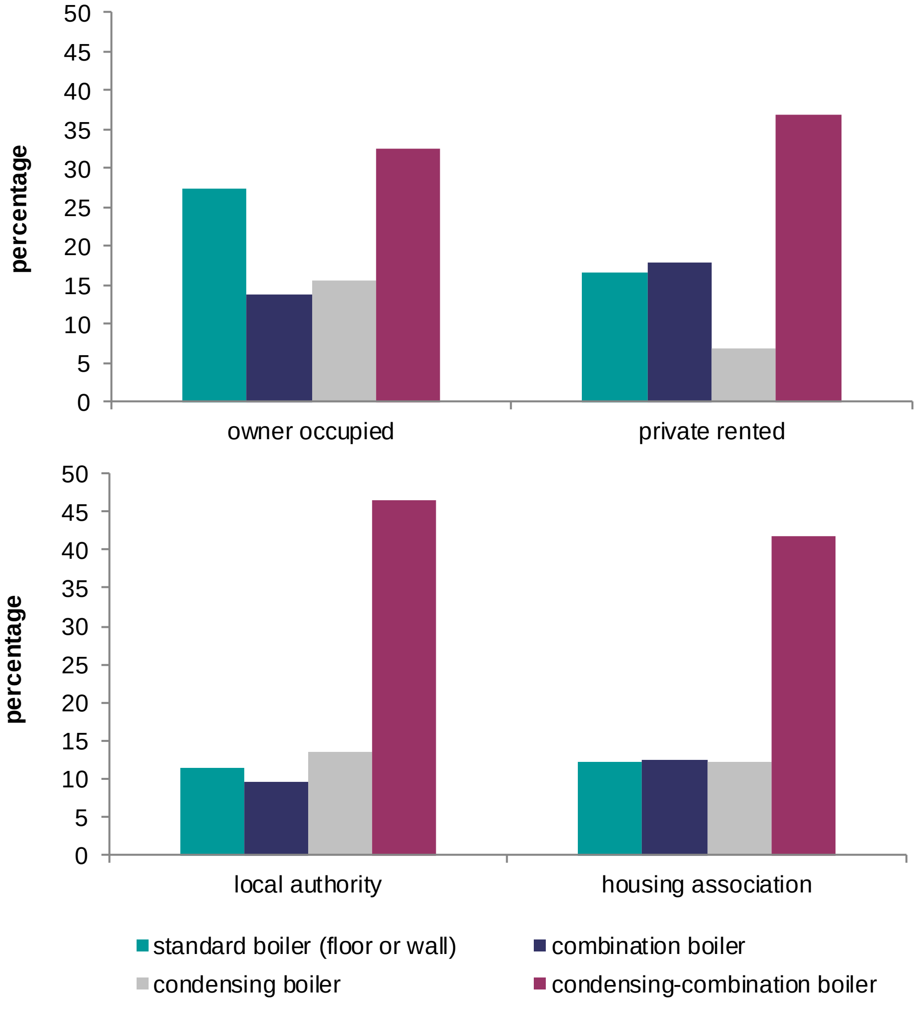
1.22. This section examines the key energy efficiency measures in our homes and how these have changed over time.

Boiler systems

1.23. Modern condensing boilers, if well-maintained, burn their fuel very efficiently, although there is an inevitably a small residual loss of some heat that escapes through the flue. They are more efficient due their having a larger heat exchanger, recovering more heat via the condensation process, and thereby sending cooler gases up the flue. Condensing-combination boilers are a type of condensing boiler that provide heating and domestic hot water without the need for a hot water storage cylinder. In 2013, condensing-combination boilers were the most common type of boiler across all tenures, present in 35% of all homes. In addition, 13% of homes had a condensing boiler with a cylinder, Annex Table 1.6.

1.24. Local authority and housing association homes were more likely to have either a condensing or condensing-combination boiler (60% and 54% respectively) compared with private homes, particularly private rented homes (44%). Owner occupied homes were most likely to have standard non-condensing boilers (27%). Back boilers[5] were the least common, present in just 3% of homes, Figure 1.6 and Annex Table 1.6.

Figure 1.6: Percentages of dwellings with most common boiler types by tenure, 2013



Base: all dwellings
Note: underlying data are presented in Annex Table 1.6
Source: English Housing Survey, dwelling sample

1.25. This analysis looks at the types of boilers used by the 20.2 million households who had some form of boiler provision. Of these households, over half (54%) had either a condensing or condensing-combination boiler whilst just over a quarter (26%) had a standard non-condensing boiler, Annex Table 1.7.

[5] these are located behind a room heater and are designed to provide hot water for space heating, and may also provide domestic hot water indirectly through a separate hot water storage cylinder

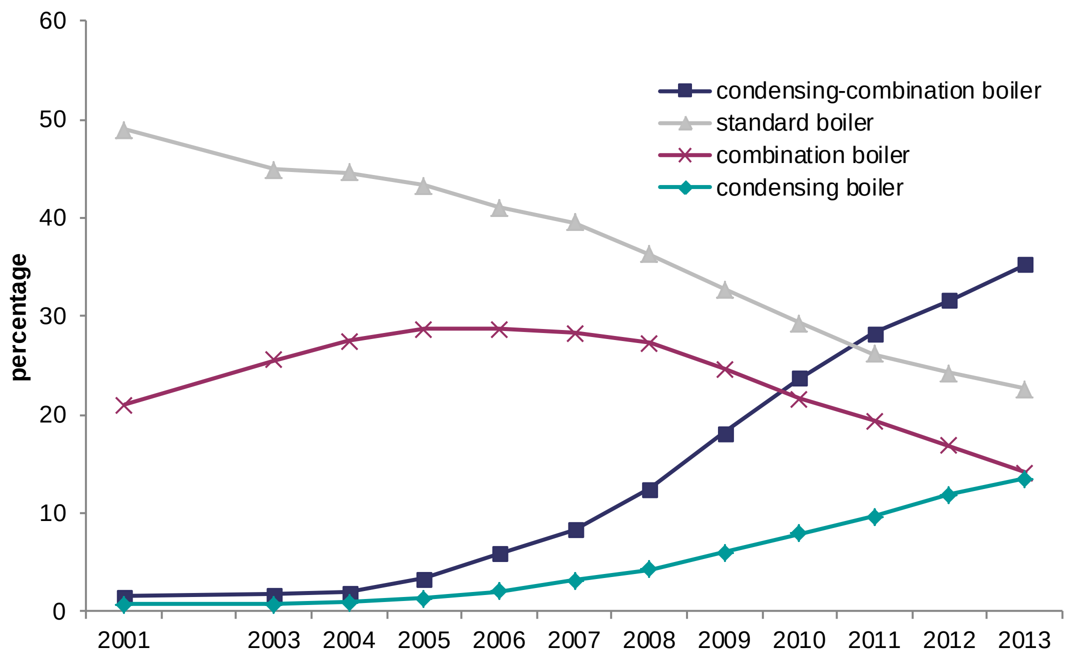
1.26. Households with an HRP aged 60 years or over were less likely to have some form of condensing boiler (51%) compared with those with a younger HRP (56%). These types of boiler were more prevalent among households where the youngest person was under five years of age (62%), Annex Table 1.7.

1.27. The distribution of boiler types was fairly similar irrespective of whether the household was classified as being in poverty. There were some variations in the nature of boiler provision by ethnicity. Overall, households with an ethnic minority HRP were more likely to have the more efficient condensing or condensing-combination boilers (60%) compared with white HRP households (54%). White HRP households were most likely to have a standard non-condensing boiler or a back boiler.

Boiler systems over time – all dwellings

1.28. There was a marked rise in the proportion of homes with either a condensing or a condensing-combination boiler, from 2% in 2001 to 49% in 2013. This rise followed changes to Building Regulations in 2005, which made it mandatory for replacement boilers to be of the more energy efficient condensing types where feasible. In consequence, there has been a steady decline in the proportion of homes with the less energy efficient standard non-condensing boilers and, in more recent years, a decline in the proportion with the non-condensing type of combination boilers, Figure 1.7.

Figure 1.7: Percentages of dwellings with given boiler types, 2001-2013



Base: all dwellings
Note: underlying data are presented in Annex Table 1.8
Sources:
2001-2007: English House Condition Survey, dwelling sample
2008 onwards: English Housing Survey, dwelling sample

Cavity wall insulation

Box 1.2: Cavity wall insulation

During the EHS physical survey, surveyors examine the dwelling for evidence of insulation. External walls of cavity construction normally provide greater energy efficiency than solid walls by reducing heat loss, and from around 1930 onwards this type of construction became more prevalent. Prior to 1990, the space between the two leaves of cavity walls was generally left uninsulated at the time of construction. Many of these walls have, however, been insulated retrospectively by injecting insulating material into this space.

In compliance with Building Regulations, an increasing proportion of dwellings built since 1990 with cavity walls had cavity wall insulation fitted at the time of construction (known as ’as built‘ insulation), although compliance could also be achieved through other techniques.

The EHS attempts to provide the best estimate of the total level of cavity wall insulation in the housing stock. However, the prevalence of ‘as built’ insulation in the post-1990 stock creates additional uncertainty in the results for this age band. Retrospective cavity wall insulation often leaves some evidence that would be recognised by an EHS surveyor, however ‘as built’ insulation can be impossible to identify with a non-intrusive survey. For reporting purposes therefore, all cavity-walled, post-1990 dwellings where there is no evidence of insulation identified by the surveyor are included with those that do have evidence of insulation.

Combining these two categories provides the most reliable estimate of the total number of homes with cavity wall insulation because, although there will be some post 1990 dwellings without cavity wall insulation, there will also be some dwellings built with insulated cavity walls in the 1980s but where there is no visible evidence of this. Further details of the difficulties in providing an estimate are given in chapter 5 of the Technical Report, Annex 6.

1.29. The EHS estimates that in 2013 around 16 million homes had cavity walls. Some 9.6 million dwellings had clear evidence of insulated cavity walls and a further 1.3 million were constructed post-1990, so many of these will have ’as built‘ insulation installed (see Box 1.2). Overall therefore, under the assumption that this entire group had insulation, in 2013 around 68% of dwellings with cavity walls were insulated, Annex Table 1.9.

1.30. Private rented homes were the least likely to have this insulation (55%). There is some evidence to suggest that private sector landlords have less incentive to undertake cavity wall insulation, where it does not exist[6]. In contrast, housing association homes, which were generally newer, were the most likely group to have this insulation (73%). The prevalence of cavity wall insulation was similar for local authority and owner occupied homes (69-70%).

1.31. Only 27% of the oldest homes built before 1919 had insulated cavities in 2013. Just over half (52%) of London homes with cavity walls had insulation, far lower than the proportion found for the rest of England (69%). London homes performed less well in this respect owing to the capital having a higher proportion of flats and older cavity walled homes, which tend not be insulated.

Households living in homes with cavity walls

1.32. As with boiler provision there were some variations in the incidence of cavity wall insulation in homes occupied by different types of households. Overall, some 68% of occupied homes with cavity walls were insulated. This proportion was higher for households where the HRP was aged 60 years or more (74%) and for households where someone had a long term illness or disability (73%), Figure 1.8. These groups have been targeted by Government schemes, such as Warm Front[7], CERT[8] and CESP[9], and the increased prevalence of this measure may reflect this.

1.33. Ethnic minority HRP households were notably less likely to have insulated cavity walls (56%) in their homes than their white counterparts (70%).This is partly because a higher proportion of ethnic minority HRP households lived in flats, and these were less likely to have insulated cavity walls (60%) than houses or bungalows (70%), Figure 1.8 and Annex Table 1.9.

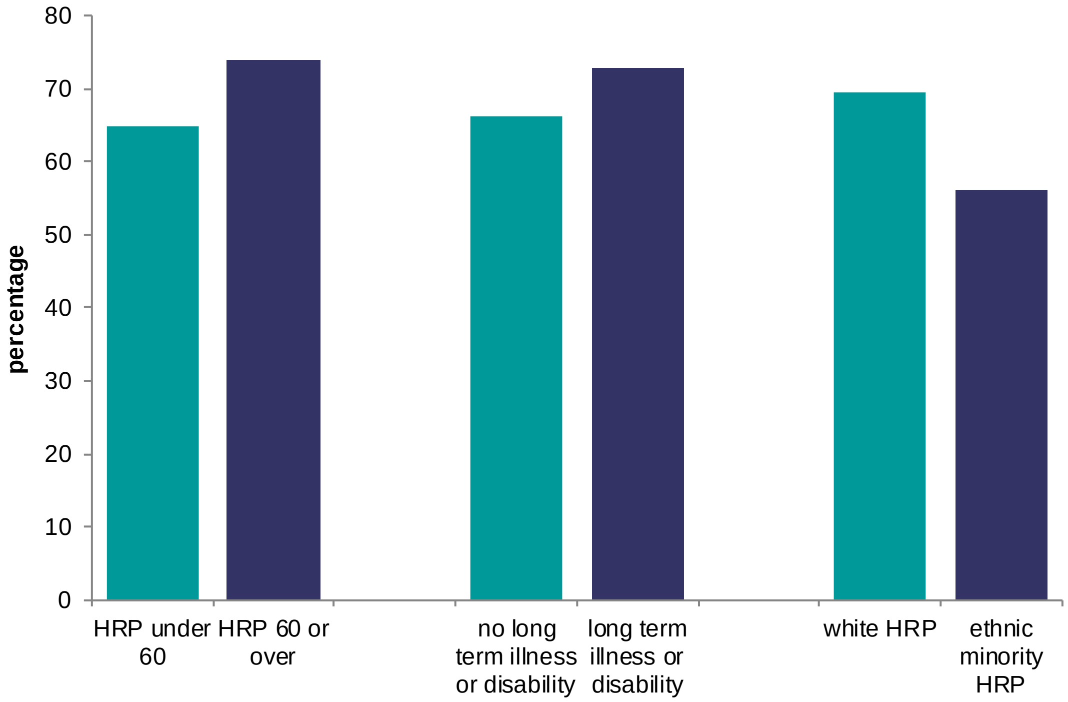
[6] For further discussion see DECC's research report *Green Deal and the Private Rented Sector* available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/43019/3506-green-deal-consumer-research-prs.pdf

[7] The Warm Front scheme operated from 2000 to 2013. It was a programme designed to help vulnerable households, including those in fuel poverty, to benefit from energy efficiency improvements such as home heating and loft insulation measures.

[8] The Carbon Emissions Reduction Target (CERT) ran between 1 April 2008 and 31 December 2012. CERT required certain gas and electricity suppliers to achieve targets for reducing carbon emissions within domestic properties.

[9] The Community Energy Saving Programme (CESP) obligation period ran from 1 October 2009 to 31 December 2012. CESP was designed to promote a 'whole house' approach and to treat as many properties as possible in defined geographical areas.

Figure 1.8: Percentages of insulated cavity walls by household type, 2013

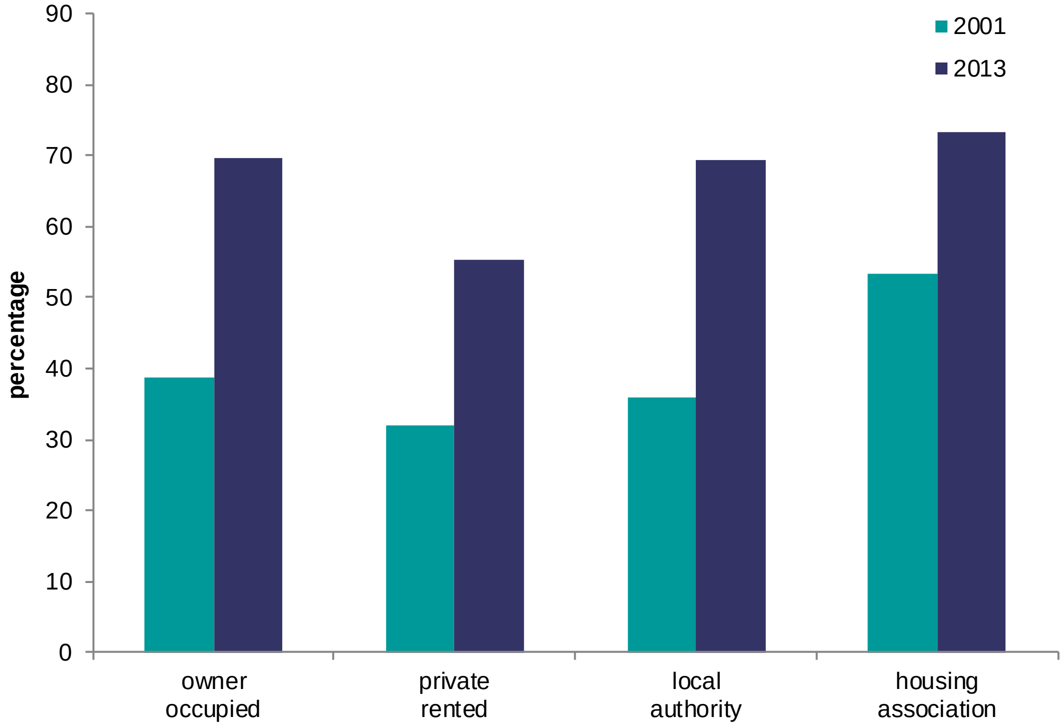


Base: all occupied homes with cavity walls
Note: underlying data are presented in Annex Table 1.10
Source: English Housing Survey, household sub-sample

Cavity wall insulation over time – all dwellings

1.34. There has been a marked increase in the number and proportion of homes with insulated cavity walls over time, from around 5.8 million (39% of all cavity wall dwellings) in 2001 to 10.8 million (68%) in 2013. This growth was particularly evident among local authority and owner occupied homes (up from 36% to 69% and from 39% to 70% respectively). Growth was less marked for housing association homes, but these homes had the highest proportion of insulated cavity walls in 2001, Figure 1.9.

Figure 1.9: Percentage of homes with insulated cavity walls by tenure, 2001 and 2013



Base: all dwellings with cavity walls
Note: underlying data are presented in Annex Tables 1.9 & 1.11
Sources:
2001: English House Condition Survey, dwelling sample
2013: English Housing Survey, dwelling sample

Solid wall insulation

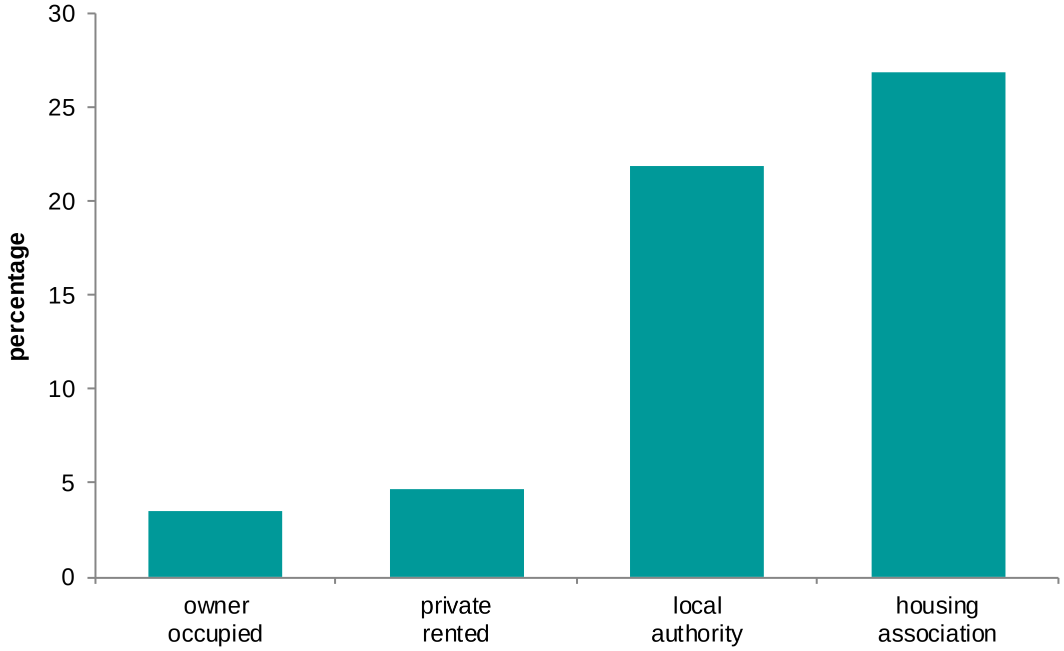
Box 1.3: Solid wall insulation

One common method of insulating solid walls is the application of external insulation. This involves fixing insulation boards or material to the outside walls and rendering over the top. Consequently, this means that the presence of projections such as bays or conservatories will affect the complexity and cost of the work as will the type and condition of the existing wall finish at the dwelling. There are additional factors which are likely to increase the costs and technical complexity of installation and these are explored in greater detail in Chapter 3 of this report.

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. See Box 2 of Chapter 3 of this report for more details.

1.35. There were 6.8 million homes with solid walls in 2013, of which 450,000 (7%) had either internal or external insulation applied to the majority of their outer walls. Both housing association and local authority homes with solid walls were far more likely to have insulation (27% and 22% respectively) compared with private rented (5%) and owner occupied homes (4%), Figure 1.10.

Figure 1.10: Percentages of dwellings with solid walls that had insulation, by tenure, 2013



Base: all dwellings with solid walls
Note: underlying data are presented in Annex Tables 1.12
Source: English Housing Survey, dwelling sample

1.36. In London there were around 2 million homes with solid walls, and around 6% of these had some form of internal or external insulation. The proportion of insulated solid walls was similar for the rest of England (7%), Annex Table 1.12

1.37. The proportion of key household groups, who lived in homes with insulated solid walls varied considerably by tenure and within the social sector. In the private sector, only 4%-5% of these household groups, who lived in homes with solid walls, had solid wall insulation. For those living in solid walled social sector homes, the percentage with solid wall insulation varied from 17% of ethnic minority HRP households, to 30% of households with an HRP aged 60 years or more and those with someone with a long term illness, Annex Table 1.13.

Double glazing[10]

1.38. In 2013, the vast majority (80%) of homes were fully double glazed and a further 10% had more than half of their windows doubled glazed. Only a small proportion (6%) had no double glazing. Housing association and local authority homes were more likely to be fully double glazed (91% and 89% respectively), compared with owner occupied (79%) and private rented homes (74%). These differences reflect the energy improvements in the social sector undertaken as part of the Decent Homes programme and highlight the large scope for improvement in the private sector, Annex Table 1.14.

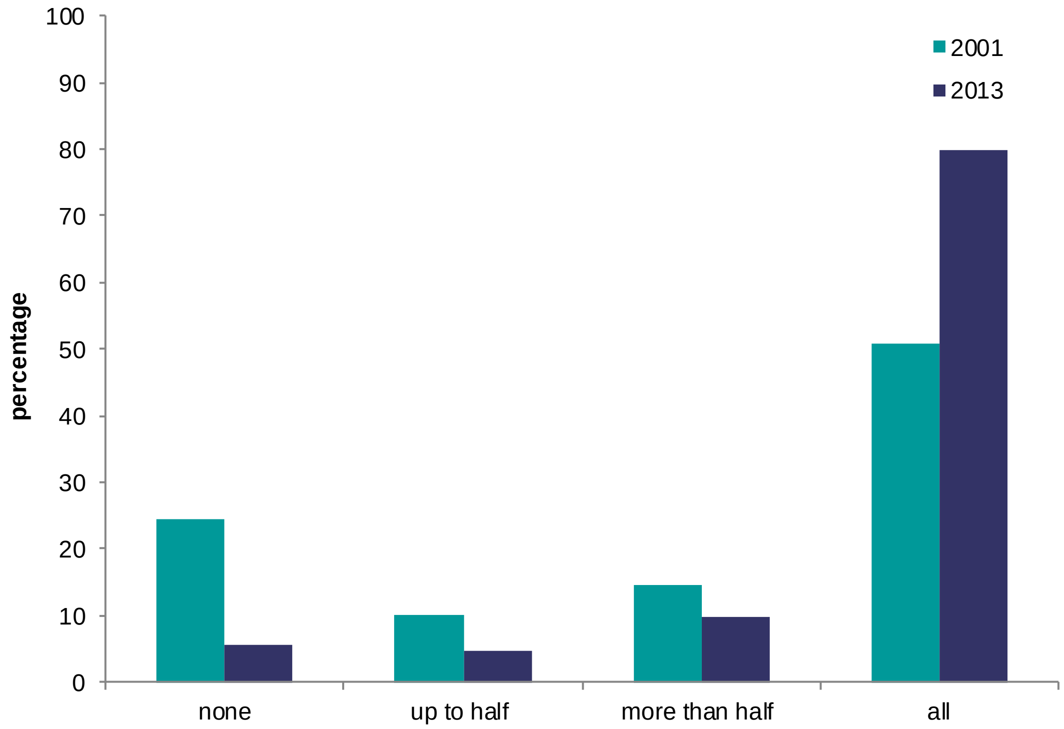
1.39. Overall, levels of double glazing were fairly similar for all types of households, and there were no notable differences among potentially vulnerable household groups, Annex Table 1.15

Double glazing over time – all dwellings

1.40. The proportion of homes that were fully double glazed increased markedly from 51% in 2001 to 80% 2013. Similarly, the proportion of homes with no double glazing fell from a quarter (25%) in 2001 to just 6% in 2013. This is mainly because, since 2006, Building Regulations have stipulated that all windows in new dwellings and most of those that are replaced in older dwellings should be double glazed, Figure 1.11.

[10] this covers factory made sealed window units only; see Glossary for further details

Figure 1.11: Degree of double glazing, 2001 and 2013



Base: dwellings
Note: underlying data are presented in Annex Table 1.16
Sources:
2001: English House Condition Survey, dwelling sample
2013: English Housing Survey, dwelling sample

Loft insulation

1.41. Current Building Regulations require new dwellings to have around 270mm of mineral wool loft insulation (or equivalent). It was not always possible in the survey to collect information on loft insulation, for example where the loft hatch was inaccessible or where the roof had a very shallow pitch with no access point. In addition, some homes have flat roofs which do not have a loft space. These cases together comprised 9% of all houses and top floor flats (roughly 1.8 million homes) in 2013[11], Annex Table 1.19. Details of the difficulties of installing or upgrading loft insulation are provided in Chapter 3 of this report.

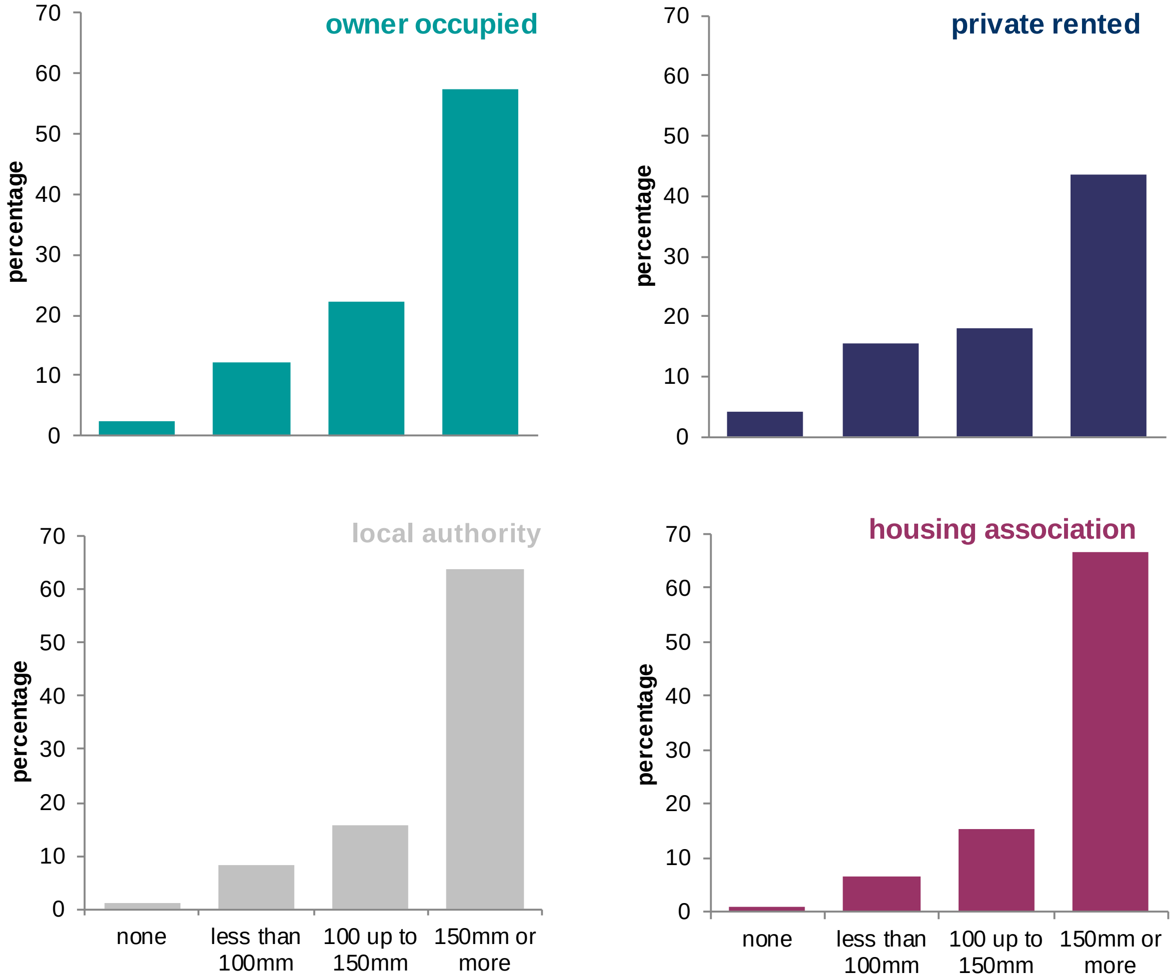
1.42. In 2013, 56% of dwellings with a loft space above had at least 150mm of insulation, but this varied by tenure. Although the private rented sector seemed to perform least well with 44% of homes with loft space having this level of insulation, Figure 1.12, we need to bear in mind that a further 19% of such homes had flat roofs or the information on loft space was not known,

[11] approximately 1.2 million homes had unknown levels of loft insulation, roughly 6% of all homes with a loft space

making it difficult to ascertain the potential for improvement, Annex Table 1.17.

1.43. Homes in the social sector were more likely to have insulation of 150mm or more: 67% of housing association homes and 64% of local authority homes had this level of loft insulation, Figure 1.12.

Figure 1.12: Percentage of dwellings with different amounts of loft insulation by tenure, 2013



Base: all houses and top floor flats
Note: underlying data are presented in Annex Table 1.17
Source: English Housing Survey, dwelling sample

Loft insulation – households

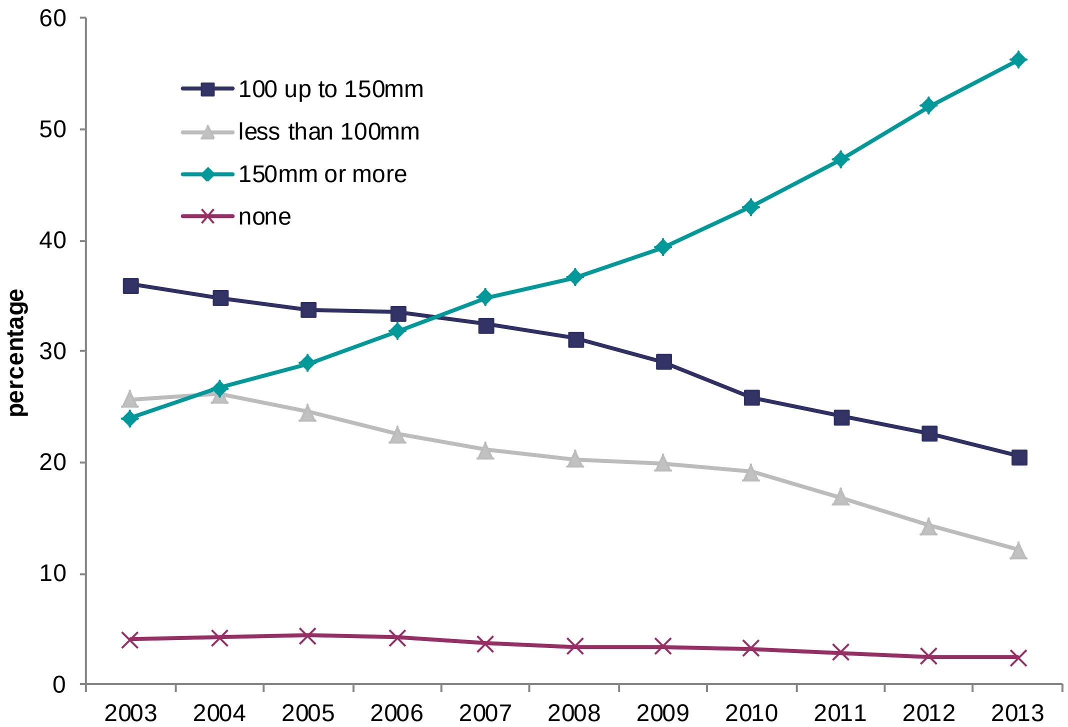
1.44. Of those occupied homes with loft space above, 57% had at least150mm of insulation. Households where the HRP was aged 60 years or over were more likely than households where the HRP was under this age to live in homes with this level of insulation, 62% compared with 53%. However, 10% of these households where the HRP was under 60 years of age lived in homes with either a flat roof or where insulation levels were unknown, Annex Table 1.18.

1.45. White HRP households were also more likely to have this higher level of insulation (57%) compared with ethnic minority HRP households (51%).

Loft insulation over time – all dwellings

1.46. Between 2003[12] and 2013, there was a marked increase in the proportion of homes with 150mm or more of loft insulation, from 24% to 56%. Conversely, the proportion of homes with less than 100mm of insulation halved from 26% to 13%. The proportion of homes with no insulation also fell steadily (from 4% to 2%), Figure 1.13.

Figure 1.13: Percentage of dwellings with different amounts of loft insulation, 2003-2013



Base: all houses and top floor flats
Note: underlying data are presented in Annex Table 1.19
Sources:
2003- 2007: English House Condition Survey, dwelling sample
2008 onwards: English Housing Survey, dwelling sample

1.47. Homes where the roof had a very shallow pitch with no access point and those that had flat roofs which did not have a loft space formed a consistent

[12] it is not possible to give equivalent 2001 figures for loft insulation as the English House Condition Survey only surveyed lofts in houses built before 1980 in this year

8%-10% of dwellings over the 2003 to 2013 period[13], Annex Table 1.19. These homes are analysed further in Chapter 2 of this report which focuses on the potential for improving energy efficiency.

Renewable energy

Box 1.4: The EHS and renewable energy

The EHS began collecting data on the presence of solar panels for hot water in 2008, and solar photovoltaic panels or domestic wind turbines for electricity production in 2009. Longer term monitoring of the presence of these items will be required before any definite trends can be discerned. Sample sizes for wind turbines are too small to provide robust estimates.

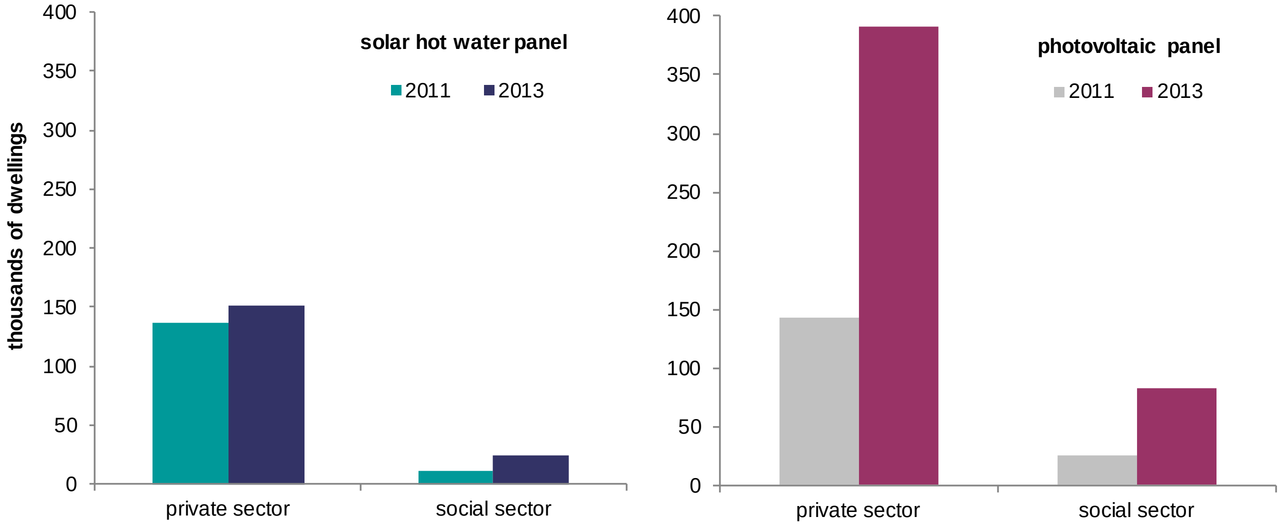
1.48. In 2013 there were an estimated 474,000 homes with photovoltaic panels and 176,000 with solar panels for hot water. The majority of these homes were in the private sector (83% and 86% respectively). Overall some 602,000 homes had some form of solar panel(s) for renewable energy, Annex Table 1.20.

1.49. There was a rise in the number of homes with these renewable energy measures from 2011 when around 295,000 had some form of solar panel. This increase may be partly due to the Feed-in Tariffs (FITs) scheme introduced in 2010, which rewarded investment in low-carbon technology.

1.50. The majority of these new installations were photovoltaic panels. Although the vast majority were in the private sector, the social sector has seen the highest proportional increase since 2011, Figure 1.14.

[13] like dwellings with flat roofs, these homes may be suitable for some roof insulation by either fitting insulated board below the current ceiling or lifting the roof cover and fitting insulation between the timbers

Figure 1.14: Number of renewable energy measures by type and tenure, 2011 and 2013



Base: dwellings with a renewable energy measure
Notes:
1) **some dwellings had both types of measure**
2) **underlying data are presented in Annex Table 1.20**

Sources: 2011 and 2013 English Housing Survey, dwelling sample

Appendix 1 SAP09 and SAP12 methodologies

1.51. The 2010, 2011 and 2012 EHS reports used the SAP09 methodology for energy efficiency comparisons, but this report uses the updated SAP12 methodology. The majority of the raw EHS data collected and used in the calculation are the same so the difference between the two sets of figures is due to different assumptions and values used in SAP12. Box 1.5 summarises the main differences between the two methods:

Box 1.5: Key differences between SAP09 and SAP12

In SAP12:

- climatic data has been extended to allow calculations using regional weather
- an allowance for height above sea level is incorporated into external temperature data
- CO_2 emission factors have been extensively revised
- fuel price and primary energy factors have been revised
- the options for heat losses from primary pipework have been extended

1.52. The 2012 changes in the SAP methodology are less far reaching than those which occurred following the transition 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).

Chapter 2
Potential for energy improvements

2.1. The previous chapter described the energy performance of the housing stock in 2013 and how this had improved over time. This chapter examines the potential for further energy efficiency improvements in the housing stock and how energy performance, as measured by the SAP rating and energy costs, would change if this potential for improvement were fulfilled. It looks at the profile of dwellings which would still remain among the least energy efficient even if these potential improvements were implemented, and the types of households who were likely to be living in them.

2.2. The cost improvement measures described in the analysis are based on the lower and higher cost recommendations covered by the Energy Performance Certificate (EPC)[1]. For 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. This limitation reduces the potential for some measures which would provide only a minimal improvement in energy efficiency in a dwelling and that, as a result, may not be cost effective to install. Furthermore, it should be noted that the suggested measures do not imply that current energy performance measures in the home are defective or that the home is deficient in terms of any particular standard.

2.3. For the potential reduction in carbon emissions through EPC measures see Chapter 1 of the 2012 EHS: Energy efficiency of English housing report.

Energy improvement measures and average costs of work

2.4. In 2013, around 16.3 million homes (70% of the total housing stock) could theoretically benefit from at least one of the energy improvement measures listed in Table 2.1. Some 10.8 million homes (48% of homes to which a low cost measure could apply) could potentially benefit from one or more of the lower cost measures, most commonly installing cavity wall insulation (5.4 million) or installing or topping up loft insulation (5.3 million). Overall, 12.1 million (52%) homes could potentially benefit from one or more of the higher

[1] see Glossary for further information. Details of the modelling are described in Chapter 5 of the Technical Report, Annex 6

cost measures, the most common of which was replacing an existing conventional central heating boiler with a condensing boiler (9.0 million).

Table 2.1: EPC recommended energy efficiency measures, 2013

all dwellings

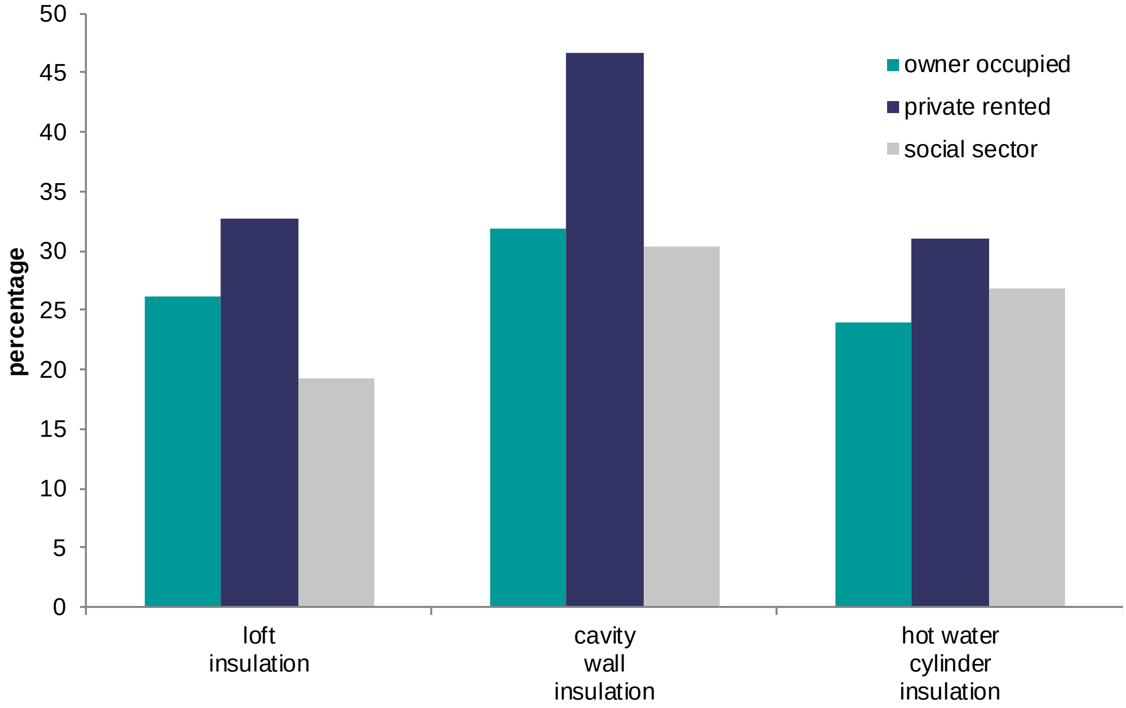
	size of applicable group[1] (000s)	number of dwellings (000s) that would benefit from the measure	percentage of applicable group
low cost measures (less than £500)			
loft insulation	20,264	5,329	26.3
cavity wall insulation	15,951	5,392	33.8
hot water cylinder insulation	11,494	2,951	25.7
any low cost measure	**22,601**	**10,779**	**47.7**
higher cost measures (more than £500)			
hot water cylinder thermostat	11,494	926	8.1
heating controls	20,692	4,639	22.4
boiler upgrade	20,580	8,965	43.6
install biomass system[2]	593	43	7.2
storage heater upgrade	2,125	1,438	67.7
replacement warm air system	113	67	59.5
any higher cost measure	**23,254**	**12,168**	**52.3**
any low or higher cost measure	**23,254**	**16,343**	**70.3**
mean cost of measures per dwelling (£)		*1,042*	
total cost of measures (£billion)		*17.03*	
sample size	*12,498*		

[1] size of applicable group is the number of dwellings where this improvement might be possible, e.g. for cavity wall insulation this is the number of dwellings with cavity walls, whether insulated or not.
[2] improvement only applied to homes with solid fuel heating
Notes:
1) improvement costs of low and high cost measures at 2013 prices
2) data in columns do not sum to the sub totals as dwellings may be able to benefit from more than one EPC measure
3) underlying data are presented in Annex Table 2.1
Source: English Housing Survey, dwelling sample

Low cost measures

2.5. The potential to improve energy performance through low cost measures was highest among private rented dwellings, even though the average SAP rating for these homes was similar to owner occupied homes (Annex Table 1.1). Almost half (47%) of private rented dwellings with cavity walls could potentially benefit from insulation; the remaining 53% either had filled cavity walls or could not feasibly have insulation installed. Loft insulation would improve a third (33%) of these homes (the applicable group comprised all houses and top-floor flats). Due to its relatively newer stock, and to work already done under the Decent Homes programme, the social sector had less potential for improving loft insulation and hot water cylinder insulation, Figure 2.1.

Figure 2.1: Eligible dwellings that would benefit from lower cost EPC recommended measures by tenure, 2013



Base: number of dwellings where this improvement might be possible, e.g. for cavity wall insulation the base is the number of dwellings with uninsulated cavity walls
Note: underlying data are presented in Annex Table 2.2
Source: English Housing Survey, dwelling sample

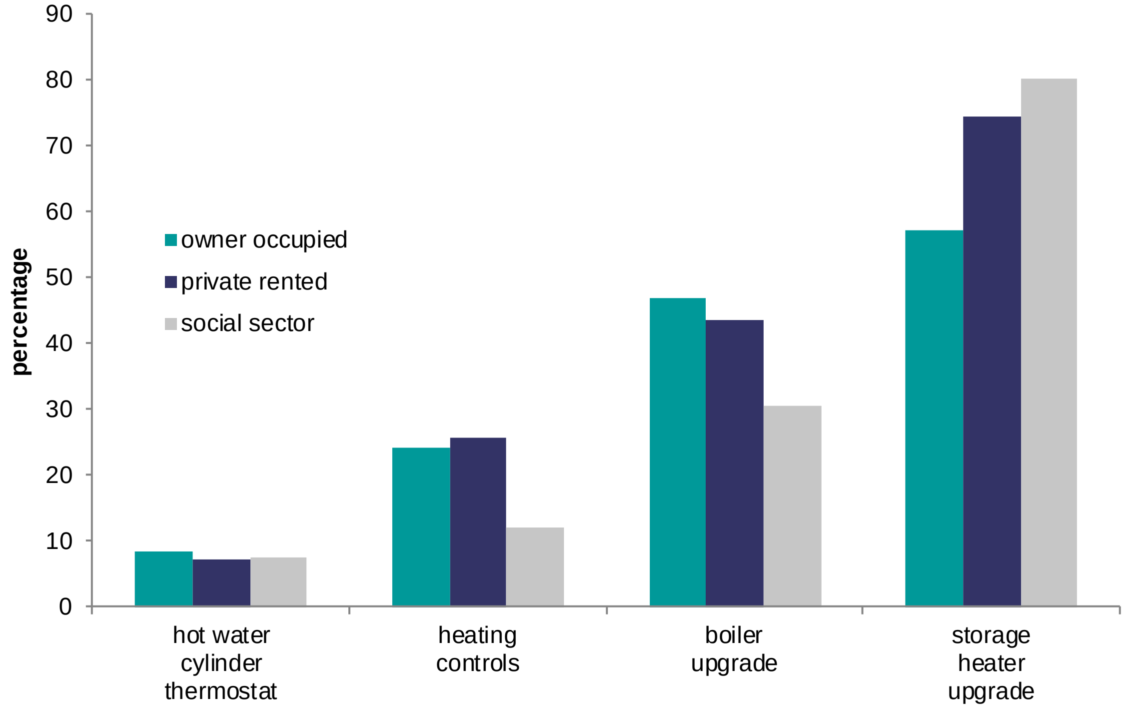
2.6. There was greater potential for flats to benefit from installing low cost energy efficiency measures particularly cavity wall insulation (44% of applicable homes), Annex Table 2.2.

2.7. It is not surprising that the newest homes built after 1990 were generally least likely to benefit from these lower costs measures. For homes built before this period, however, there was no clear relationship between the age of the dwelling and the potential for each lower cost EPC measure; for example, some 27% of homes built before 1919 with a loft space could potentially benefit from insulation compared with 25% of homes built between 1945-64 and 30% built between 1981-90.This suggests that many of the older homes in the stock had already received energy improvement measures to bring them up to modern standards, Annex Table 2.2.

Higher cost measures

2.8. Some 80% of social sector homes and 74% of private rented homes with storage heating would benefit from upgrading this type of heating system, compared with just over half (57%) of eligible owner occupied homes that would benefit from this measure. The social sector had less potential for installing heating controls and undertaking boiler upgrades (for the reasons provided for low cost measures above). Relatively few dwellings had the potential to install hot water cylinder thermostats, as most dwellings with hot water cylinders already had this feature regardless of tenure.

Figure 2.2: Eligible dwellings that would benefit from higher cost EPC recommended measures by tenure, 2013



Base: number of dwellings where this improvement might be possible, e.g. for a boiler upgrade the dwelling must have an existing boiler system, with the upgrade assuming the same fuel is used
Notes:
1) costs for installing a cylinder thermostat vary and may be relatively inexpensive, however the improvement has been included as a high cost measure to reflect cases where more extensive work is required to the overall heating controls
2) replacement warm air systems and installation of biomass systems have been omitted due to the small numbers of dwellings that would benefit
3) underlying data are presented in Annex Table 2.3
Source: English Housing Survey, dwelling sample

2.9. Houses were more likely to benefit from the installation of these higher cost measures (except storage heating upgrades), including the upgrading of the boiler. Over three quarters of flats with storage heating as the main form of heating (76%) would benefit from upgrading storage heating systems, Annex Table 2.3.

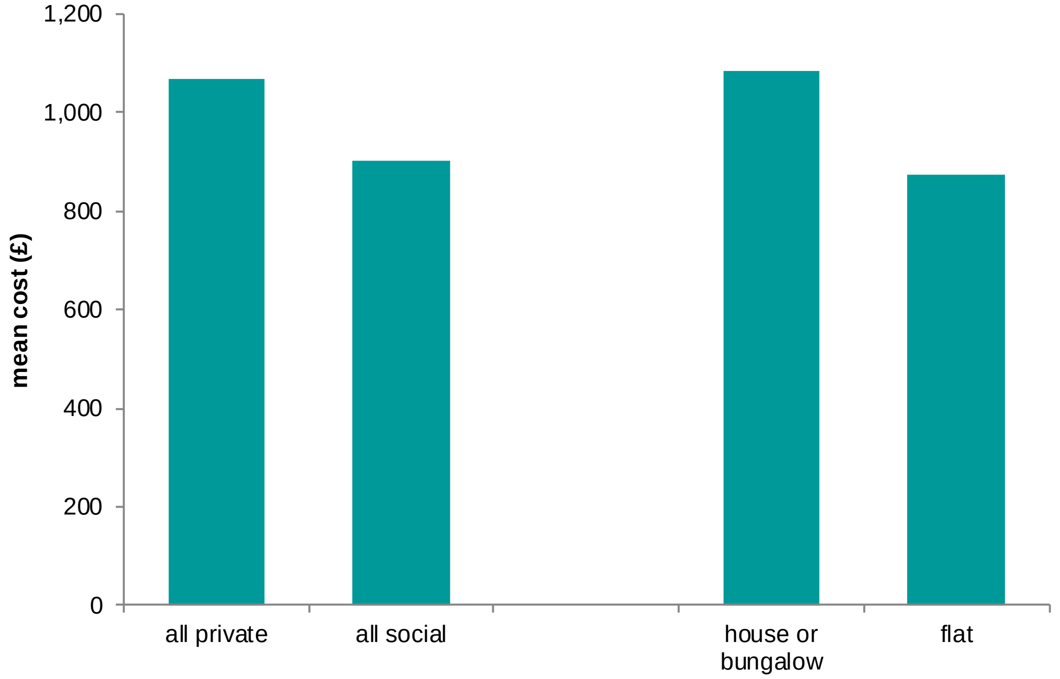
2.10. Overall there was no clear relationship between the age of the dwelling and the potential for each higher cost EPC measure, supporting the suggestion that many of the older homes in the stock had already received energy improvement measures. However, the proportion of eligible homes that would benefit from either a hot water cylinder thermostat or heating controls was lower for homes built after 1990, Annex Table 2.3.

Costs of EPC improvement measures

2.11. It is estimated that the total cost for implementing all these potential measures would be over £17 billion, with an average cost per dwelling of around £1,000 for homes that could have at least one energy upgrade given in Table 2.1. This figure conceals a considerable level of variation. The average cost to apply the required measures would be less than £325 in 20% of applicable homes. At the other end of the scale, the most expensive 20% would cost in excess of £1,500 to improve, Annex Table 2.4.

2.12. On average, private homes were more expensive to improve (£1,066) than social sector dwellings (£900). All types of rented homes were generally less expensive to improve, in part because they contained a higher proportion of flats. Flats were less expensive to improve on average (£875) than houses (£1,082), Figure 2.3.

Figure 2.3: Mean costs of potential EPC measures by tenure and dwelling type, 2013



Base: all dwellings where the installation of any EPC measure is feasible
Note: underlying data are presented in Annex Table 2.4
Source: English Housing Survey, dwelling sample

2.13. Due partly to EPC and other energy improvement works already undertaken, the oldest dwellings (pre-1919) did not have significantly different average costs from more recently built homes. (The type of wall insulation most suitable for these homes, solid wall insulation, is not one of the measures considered by this analysis). The lowest average costs were for homes built from 1945 to 1964, when the majority of social homes were built, Annex Table 2.4.

Households in homes which need improvements

2.14. Around 15.9 million households (70%) lived in a home that could theoretically benefit from at least one of the energy improvement measures. This section focuses on certain key household groups examined in Chapter 1 of this report[2]. Overall there were moderate variations between the types of households that would benefit from any of the EPC measures.

2.15. Households where the HRP was 60 years old or more were a little more likely to live in a home that could benefit from an EPC measure (73%) compared with households where the HRP was younger (69%), Annex Table 2.5.

2.16. Households containing someone with a long term illness or disability were slightly less likely to benefit from at least one of these EPC measures (69%) compared with households that did not have a member with this type of difficulty (71%). Households with children under 5 (65%) were also less likely to reside in a home requiring some form of energy improvement compared with households with older children (71%), Annex Table 2.5.

2.17. Ethnic minority HRP households and those in poverty were no more likely to live in a home that could potentially benefit from an EPC measure compared, respectively, with white HRP households and households not in poverty, Annex Table 2.5.

2.18. There was no clear relationship between the need for improvement measures and net household income[3], (Annex Table 2.5), although the average weekly income for households whose home would benefit from at least one measure was around £540 compared with £575 for households where no improvement measures were needed, Annex Table 2.6.

[2] As per Chapter 1 of this report, these groups comprise households containing people who may be considered vulnerable on account of their age, long term illness or disability, and households which tend to be disadvantaged: those with an ethnic minority HRP and those in relative poverty. See glossary for definitions.
[3] This is net household income before housing costs are deducted. See Glossary or 2013 Technical Report, Chapter 5, Annex 5.4 for further details.

Post-improvement performance

Post improvement – SAP and tenure

2.19. If all the potential energy improvement measures[4] were installed in all eligible dwellings, the mean SAP rating for the stock would rise from 60 to 65. The rise in the average SAP rating would be greater for both owner occupied and private rented dwellings (up 6 points) than for social sector homes (up by 4 points), although we need to bear in mind that the latter homes were already more energy efficient in 2013, Annex Table 2.7.

2.20. Applying all EPC measures assessed would almost double the overall proportion of dwellings in bands A to C (green colours in Figure 2.4) from 23% to 40%. In addition, the percentage of homes in the least efficient bands, (E to G, orange and red colours in Figure 2.4) would fall from 26% to 12%. Applying all these EPC measures would, therefore, represent a further marked improvement to the energy efficiency gains made from 2001 to 2013 (see Chapter 1). Nonetheless there would still be 12% of dwellings in the poorest energy efficient SAP bands (E to G). The energy characteristics of these homes (post improvement) are examined later in this Chapter. The dwelling characteristics of homes in SAP Bands F or G in 2013 are also examined in Chapter 3 of this report, providing an insight into why homes with the poorest energy efficiency are often more problematic to improve.

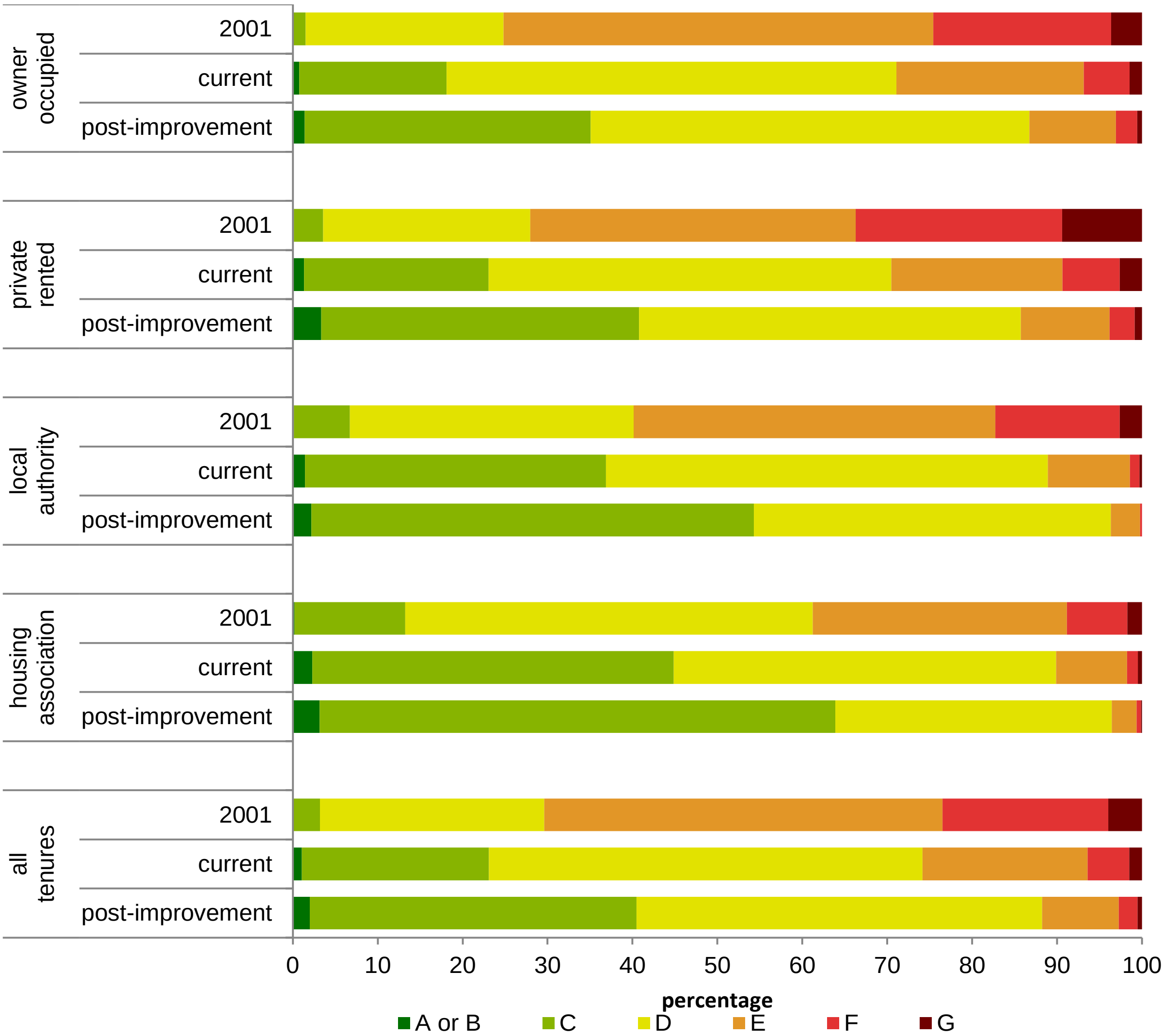
2.21. With regards to each tenure, if the full range of measures were applied this would result in:

- very few local authority and housing association homes in Bands E to G (4%), (orange and red colours)
- over half of local authority dwellings (54%) and almost two thirds of housing association homes (64%) in Bands A to C (green colours) up from 37% and 45% respectively
- some 35% of owner occupied homes and 41% of private rented homes in Bands A to C (green colours), up from 18% and 23% respectively, Figure 2.4

2.22. These variations in potential improvement by tenure are due to the different dwelling type and age profiles within tenures. The private sector had the largest proportion of both the oldest pre 1919 homes and of semi-detached and detached houses, which were all typically associated with the lowest energy efficiency ratings (see Chapter 1 of this report).

[4] Calculations of post-improvement Energy Efficiency Rating/CO_2 emissions include the effect of replacing a warm air system but, due to modelling complexity, not the effect of installing a biomass boiler. Given the relatively small number of dwellings that could benefit from such a boiler this will not have any significant effect on the overall indicators of post-improvement performance used in this section.

Figure 2.4: Percentage of dwellings in each Energy Efficiency Rating Band by tenure, 2001, current (2013) and post-improvement performance



Base: all dwellings
Notes:
1) **improvements refer to those listed in Table 2.1**
2) **underlying data are presented in Annex Table 2.8**

Sources:
2001: English House Condition Survey, dwelling sample;
2013: English Housing Survey, dwelling sample

Post improvement – energy costs

2.23. If all the recommended EPC improvements were applied to the stock this could impact positively on the heating, lighting and ventilation components of average fuel bills. The EHS estimates that, across the whole stock, the application of all measures could lead to a potential 14% reduction in these bills, from £990 per annum to £855 per annum (at standard 2013 energy prices). Furthermore, the total energy bill could potentially fall from £23.0 billion to £19.9 billion, Annex Table 2.7.

2.24. This potential reduction in annual average fuel bills would vary by tenure, reflecting both the current and potential energy performance of each sector. The fall in average fuel costs would be greater among owner occupied homes (£153 or 14%) and private rented homes (£136 or 15%). Falls would be more modest (10%) in both local authority and housing association homes where average costs were lower in 2013, Annex Table 2.7.

Post improvement – carbon dioxide (CO_2) emissions

2.25. The result of applying all the recommended EPC improvements would be a mean reduction in notional carbon dioxide emissions of 1.1 tonnes per dwelling per year, some 22% lower than the pre-improvement measures value. Again, there are variations in the decrease of CO_2 emissions among tenures, both by number of tonnes and by percentage. Private stock shows the largest reductions with owner occupied homes decreasing by 1.3 tonnes per dwelling per year whilst the social sector showed a more modest predicted reduction of 0.6 tonnes (18% less than the pre-improvement value). This is due to the lower current emissions and fewer measures being needed in these dwellings, Annex Table 2.7.

Post improvement – other dwelling characteristics

2.26. This section looks at the likely profile of the 2.7 million dwellings (12% of the stock) which would still have poor energy efficiency (SAP ratings E to G) supposing all the potential energy improvements detailed above were undertaken within the housing stock, Table 2.2.

2.27. Dwellings with certain heating, insulation and construction characteristics would be over represented in this group. These characteristics reflect some of the measures not considered by this analysis, in particular solid wall insulation and double glazing. Around 2.2 million (82% of dwellings with these SAP ratings) would have uninsulated solid walls. Some 38% would have less than 80% double glazing; 23% would have storage or room heaters as their main space heating system; and 13% of those with lofts would have no loft insulation. Around 8% of centrally heated band E to G homes would have non-condensing boilers, Table 2.2.

Table 2.2: Profile of dwellings in Energy Efficiency Rating bands E-G, after all potential EPC improvements have been undertaken

all dwellings in energy efficiency rating bands E to G after recommended energy improvements

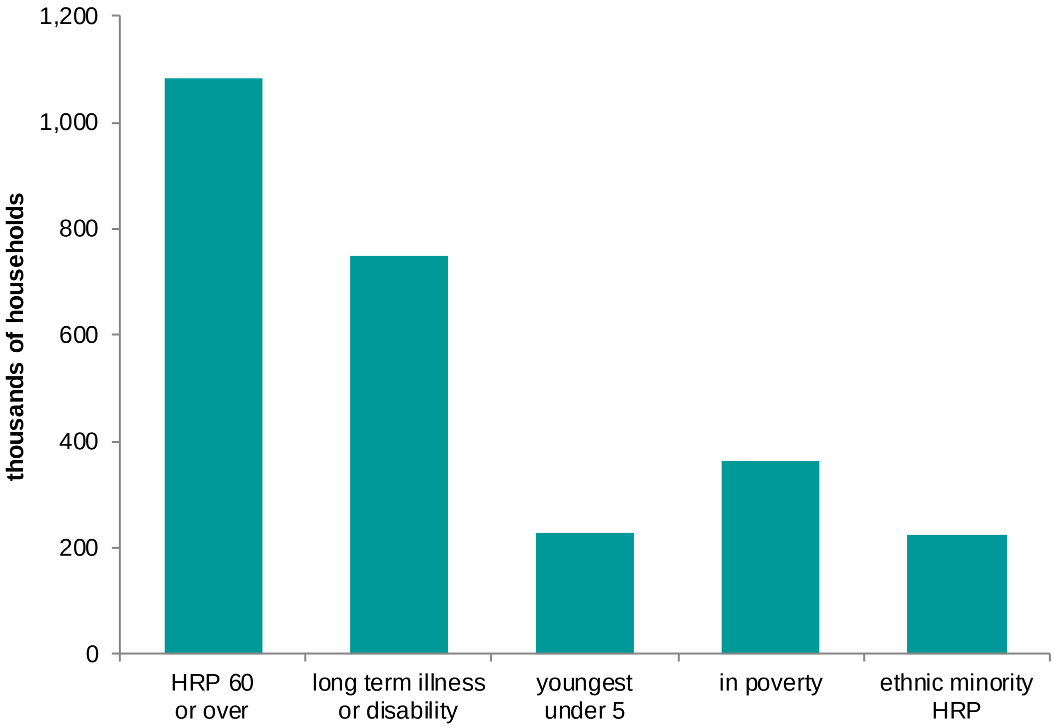
	dwellings in EPC bands E-G	
	number of dwellings (000s)	**percentage of dwellings**
main heating system		
central heating	2,104	76.8
storage heating	325	11.9
room heaters	310	11.3
degree of double glazing		
less than 80% double glazed	1,033	37.7
80% or more double glazed	1,705	62.3
boiler		
standard boiler	113	5.5
back boiler (to fire or stove)	36	1.7
combination boiler	13	0.6
condensing boiler	964	47.0
condensing-combination boiler	927	45.1
loft insulation		
none	340	13.1
less than 100mm	175	6.7
100 up to 150mm	274	10.5
150mm or more	1,816	69.7
wall type and insulation		
cavity with insulation	428	15.6
cavity uninsulated	23	0.8
solid with insulation	23	0.8
solid uninsulated	2,244	81.9
other	20	0.7
all dwellings	**2,739**	**100.0**
sample size	*1,145*	

Source: English Housing Survey, dwelling sample

Post improvement – households

2.28. Some 11% of all households (2.6 million) would still live in homes with poor energy efficiency (SAP ratings E to G) even if all the potential energy improvements were undertaken. As above, this analysis will focus on key household groups. Figure 2.5 below shows how many of these potentially vulnerable household groups would still live in homes with the poorest energy efficiency.

Figure 2.5: Numbers of households by group who would live in homes with poor energy efficiency (bands E to G) post-improvement, 2013.



Base: all households in energy efficiency rating bands E to G after recommended energy improvements
Note: underlying data are presented in Annex Table 2.9
Sources: English Housing Survey, household sub-sample

2.29. Among these 2.6 million households, households with an HRP aged 60 years or more would be over represented: they would comprise 42% of this group but 36% of all households. This is most probably due to the higher proportion of this household group who are owner occupiers, a tenure with relatively high numbers of band E to G dwellings. Households with children under 5, workless households and those containing someone with a long term sickness or illness would be relatively under represented. For other key household groups, such differences would not be noticeable. These findings probably reflect that a higher proportion of some potentially ‘vulnerable’ household groups reside in the social sector where current and post improvement energy performance is generally better. Households in the highest income quintile would be over represented (26% compared with 21% of all households) in homes with the lowest energy performance post improvement, Annex Table 2.9; again, this is likely to be due to the high proportion of these households who are owner-occupiers.

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.

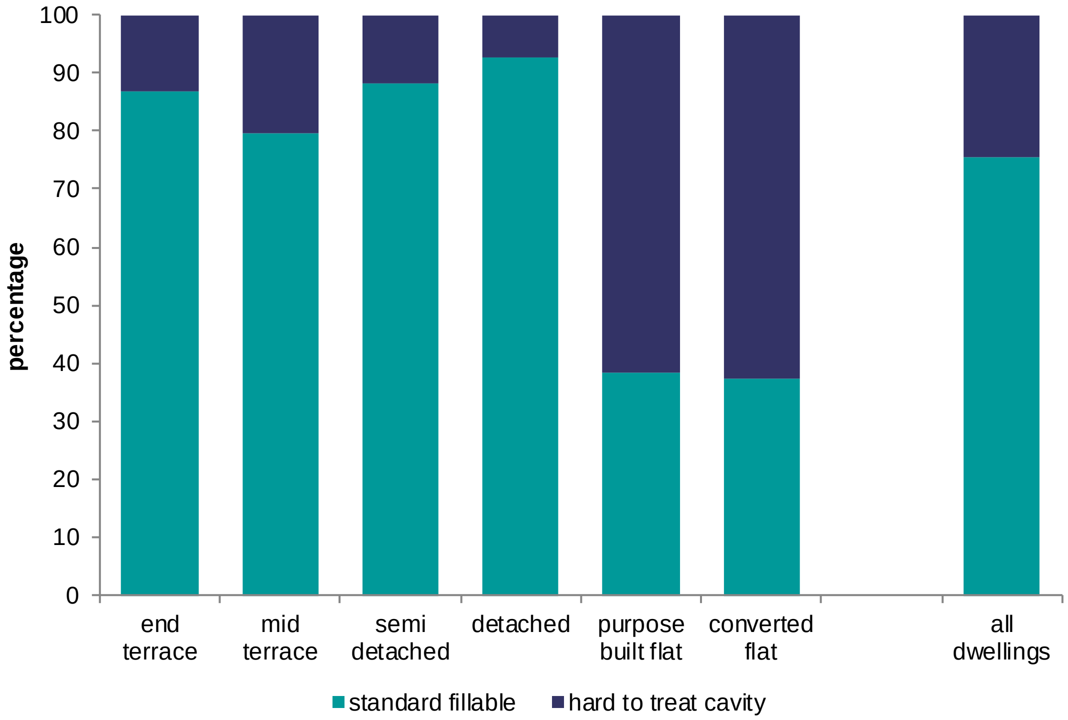
3.16 In addition some 45% of homes in SAP bands F or G with a hot water cylinder could benefit from hot water cylinder insulation, and 40% of eligible homes[7] from loft insulation; these are all relatively low-cost measures, Figure 3.1.

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

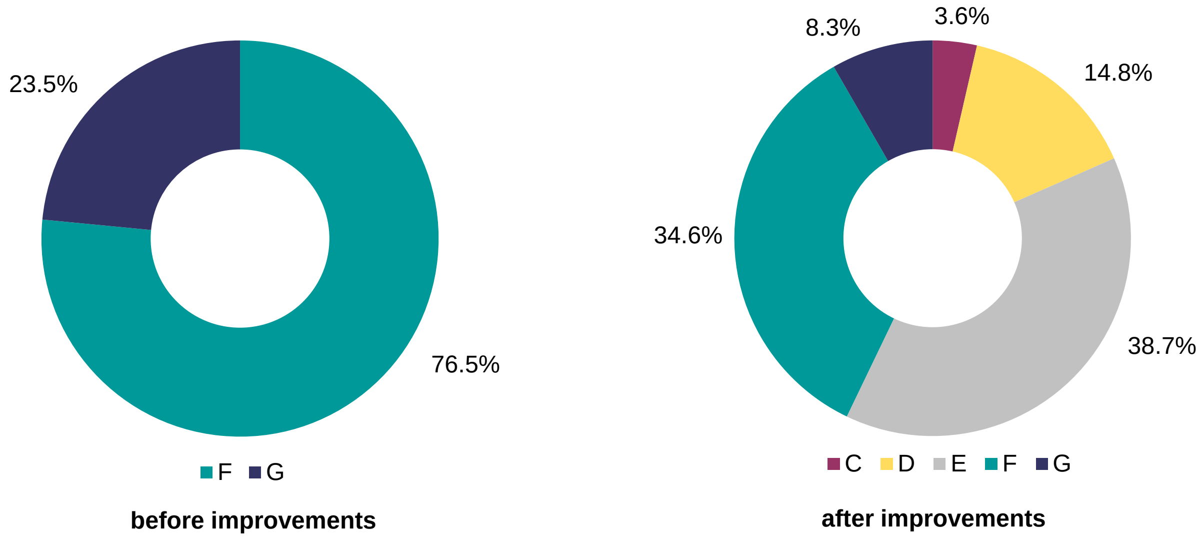


Base: number of dwellings where this improvement might be possible irrespective of the ease of installation, e.g. for cavity wall insulation the base is the number of dwellings with cavity walls
Note: underlying data are presented in Annex Table 3.6
Source: English Housing Survey, dwelling sample

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.

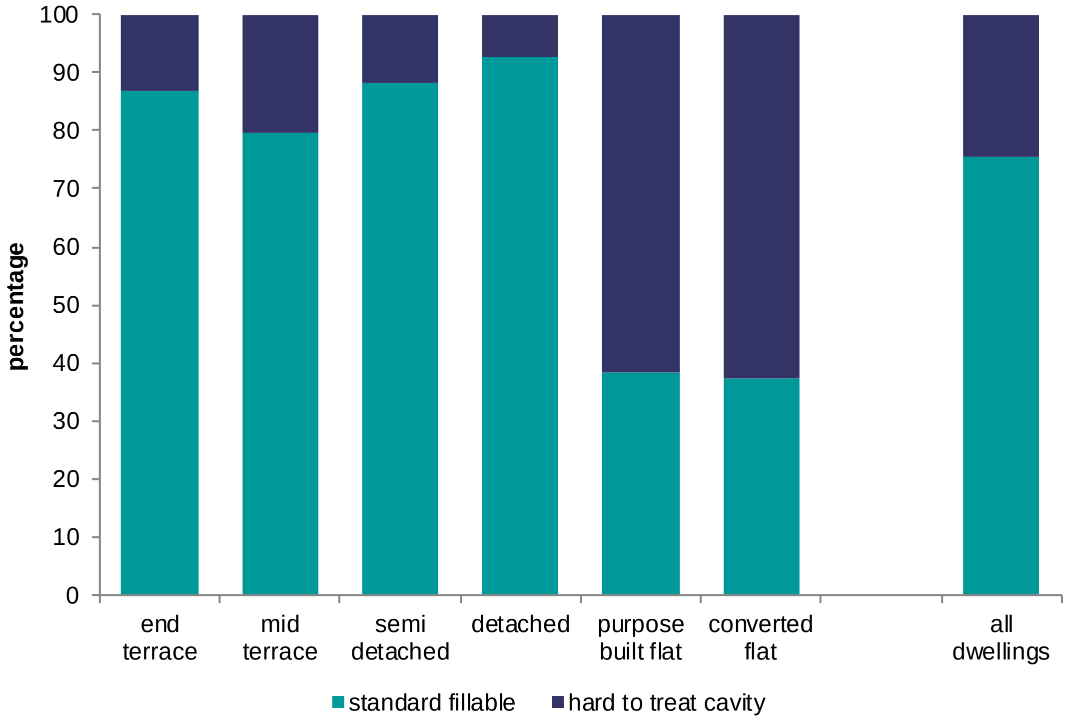
3.28 It is estimated that of the 5.1 million dwellings[10] that could potentially benefit from the installation of cavity wall insulation, three quarters (75%) had walls which were chiefly assessed as standard fillable whilst the remaining 25% (1.3 million) had uninsulated walls which were assessed as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

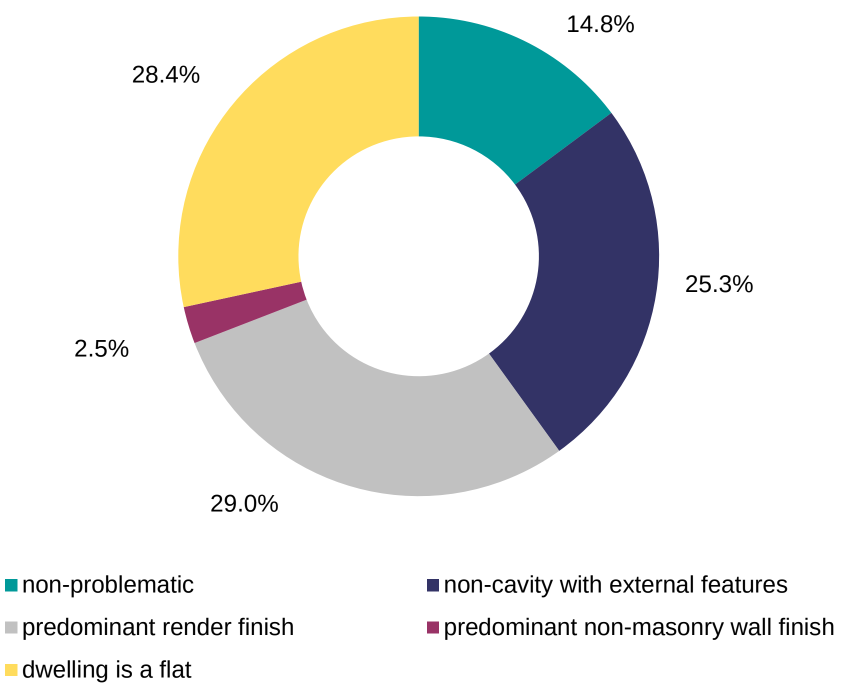
Walls with a predominantly non-masonry finish: improving dwellings with wall finishes such as stone cladding, tile, timber or metal panels would either add to the cost of the work or even preclude external solid wall insulation where the wall structure itself is stone or timber. Unlike brick walls, these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

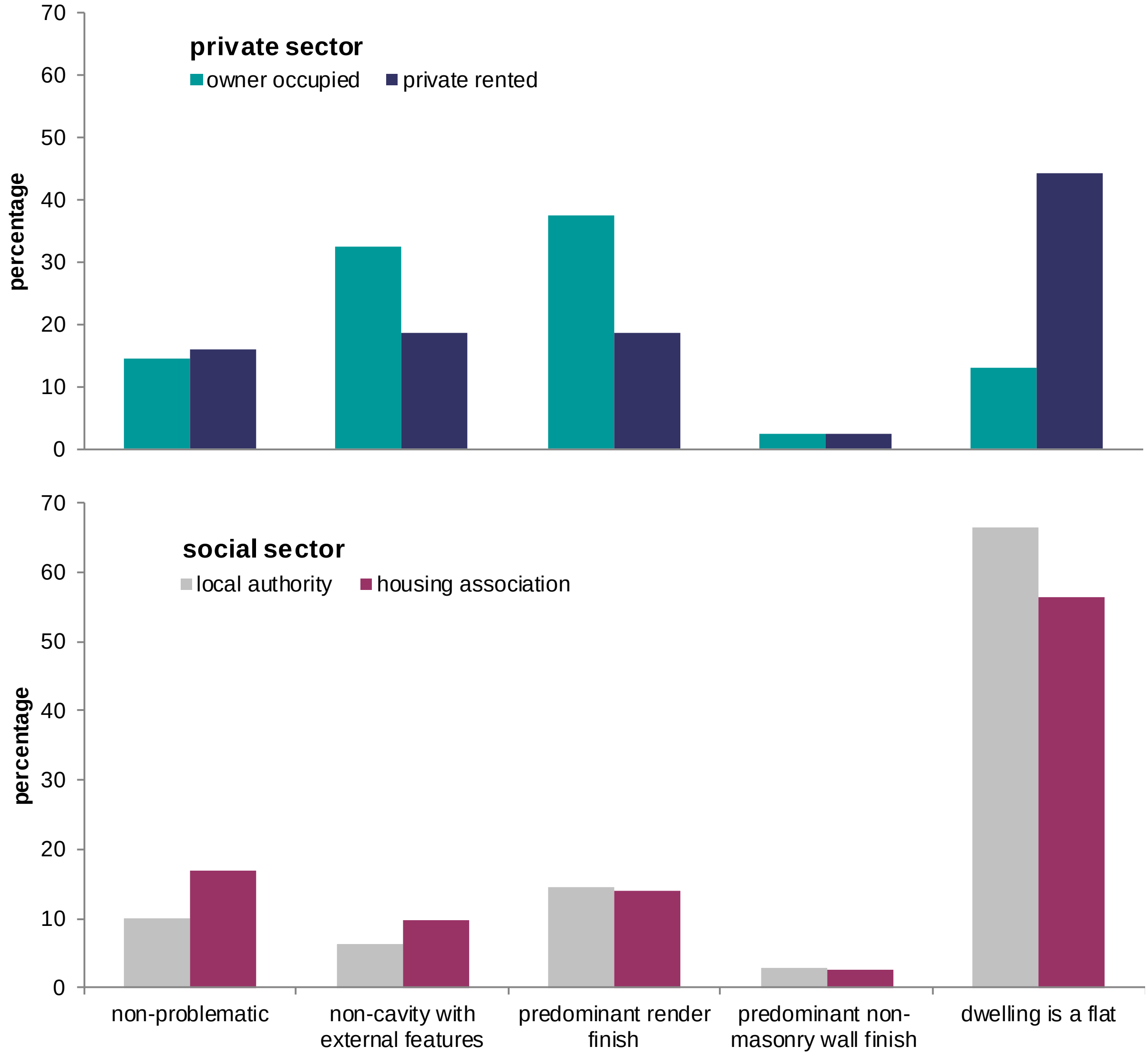


Base: all dwellings with theoretical potential to install solid wall insulation
Notes:
1) for problematic solid wall, percentages show the proportion of homes with the greatest degree of difficulty, for example, flats will rendered walls are categorised as flats
2) underlying data are presented in Annex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

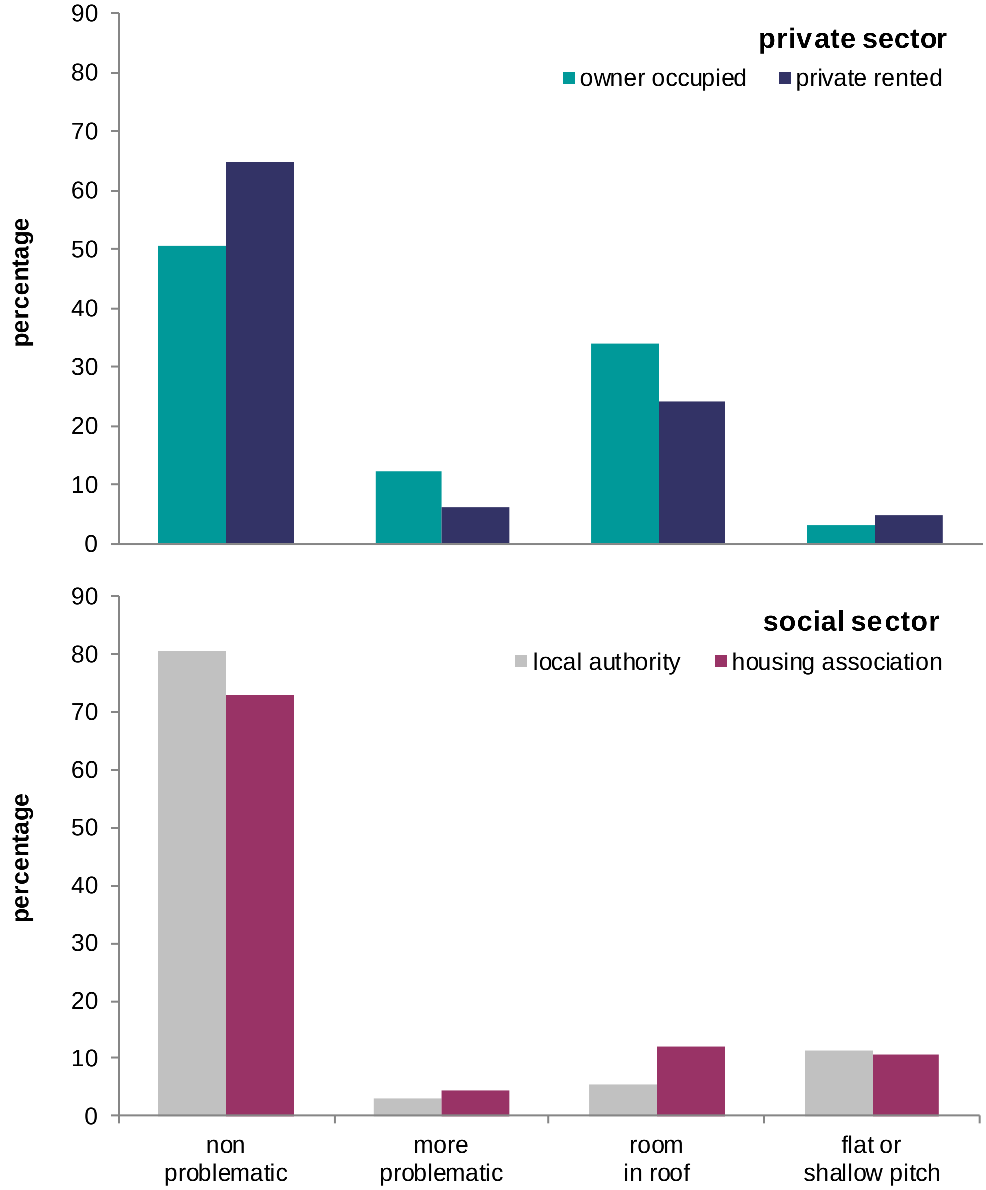
> **More problematic:** loft is fully boarded across the joists which would lead to extra work and expense.
>
> **Room in roof:** insulation would need to be added between the rafters which would involve very extensive work and considerable expense.
>
> **Flat or shallow pitched roof:** not feasible 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.

Chapter 4
Heating

4.1. This chapter provides an overview of the distribution and types of primary and secondary heating systems in English homes in 2013 and how these varied by dwelling characteristics. It also looks at whether some form of secondary heating was available to certain household groups who may be considered more vulnerable owing to, for example, their age or health, and how this varied according to tenure.

4.2. As part of the analysis on secondary heating, the chapter examines whether secondary heating was available for dwellings and households where the primary heating system was, or was not, central heating. Finally the chapter looks at the prevalence of secondary heating over time and how this varied by tenure.

4.3. Where the heating system has a gas boiler it is especially important that these are both fitted correctly and are well-maintained. This is because harmful carbon monoxide is produced when gas appliances are not fully burning their fuel, or if vents, chimneys or flues become blocked. Any form of heater, fire or boiler burning solid or liquid fuel (such as coal, wood, paraffin) could also produce carbon monoxide due to, for example, inadequacy or disrepair of ventilation or flues. As carbon monoxide is colourless, tasteless and has no smell, it is difficult to recognise, but fitting a carbon monoxide detector helps to detect its presence[1].

Primary heating systems

4.4. For the EHS a heating system is referred to as the primary heating system if:

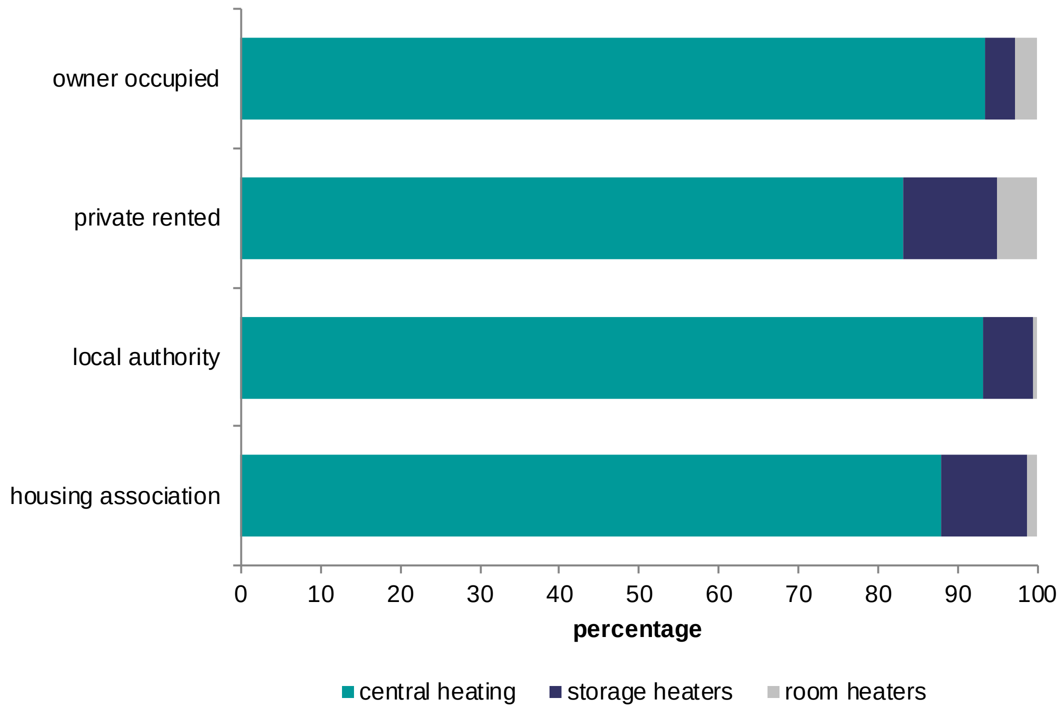
- there is a heating distribution system sufficient to provide heat to two or more rooms, for example, through radiators or warm air vents, or
- there are storage radiators in two or more rooms, or

[1] Since October 2010 Part J of building regulations in England has required a carbon monoxide alarm to be fitted in any new property where a solid fuel heating system is first installed. The Energy Act 2013 enables the Secretary of State to use secondary legislation to require private landlords to install smoke alarms and carbon monoxide detectors where there is considered to be a clear need and where the benefits of installation clearly outweigh the costs.

- there are other fixed[2] types of heaters that use the same fuel in two or more rooms

4.5. The great majority of homes (91%) were centrally heated in 2013, whilst 6% had storage heaters and the remaining 3% had individual room heaters. Although central heating was the most common type of heating across all tenures, it was more prevalent in owner occupied and local authority homes (94% and 93% respectively), Figure 4.1.

Figure 4.1: Heating systems by tenure, 2013



Base: all dwellings
Note: underlying data are presented in Annex Table 4.1
Source: English Housing Survey, dwelling sample

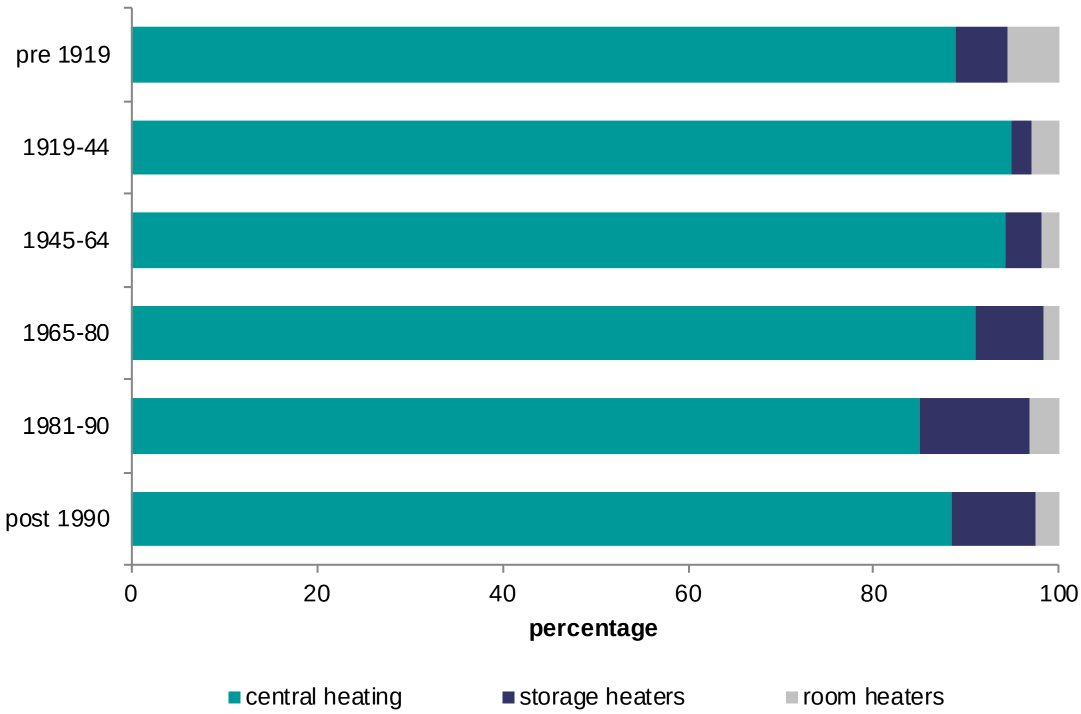
4.6. The vast majority of houses (95%) had central heating, compared with only three-quarters of flats (75%). Less than a fifth (19%) of flats had storage heaters, and the remaining 7% used individual room heaters, which are generally the least energy efficient and most expensive form of heating, Annex Table 4.1.

4.7. All types of rented homes were more likely to have storage heating as the primary heating source than owner occupied homes, reflecting the higher proportion of flats among these dwellings. This type of heating was, however, more common in private rented and housing association homes than the local authority tenure. This is likely to be due to the low numbers of local authority dwellings built since 1980 (see Chapter 1 of the profile of English Housing

[2] portable heaters are not considered as part of the fabric of the home and are not classed as primary heating

Report, Annex Table 1.1). Homes built after 1980 had a higher proportion of dwellings using storage heaters, Figure 4.2.

Figure 4.2: Heating systems by dwelling age, 2013



Base: all dwellings
Note: underlying data are presented in Annex Table 4.1
Source: English Housing Survey, dwelling sample

4.8. As part of the EHS physical survey, households in occupied homes were asked whether the primary heating system was the main heat source in winter. Some 98% of respondents indicated that the primary heating system was their main source of winter heating, though this proportion reduced to 94% where the primary system consisted of storage or room heaters rather than central heating, Annex Table 4.2.

Secondary heating systems

4.9. Where more than one distinct heating system is found in a home, the EHS records information about the secondary heating system, which is typically found in one room only. These systems may originally have been installed alongside the primary system, particularly in larger homes. Alternatively they may have been the only source of heating (such as gas or solid fuel fires) when the property was built, before being superseded by a new system, typically a form of central heating.

4.10. It is useful to examine the number and types of homes that contain secondary heating, as it may point to groups for whom the primary heating is insufficient.

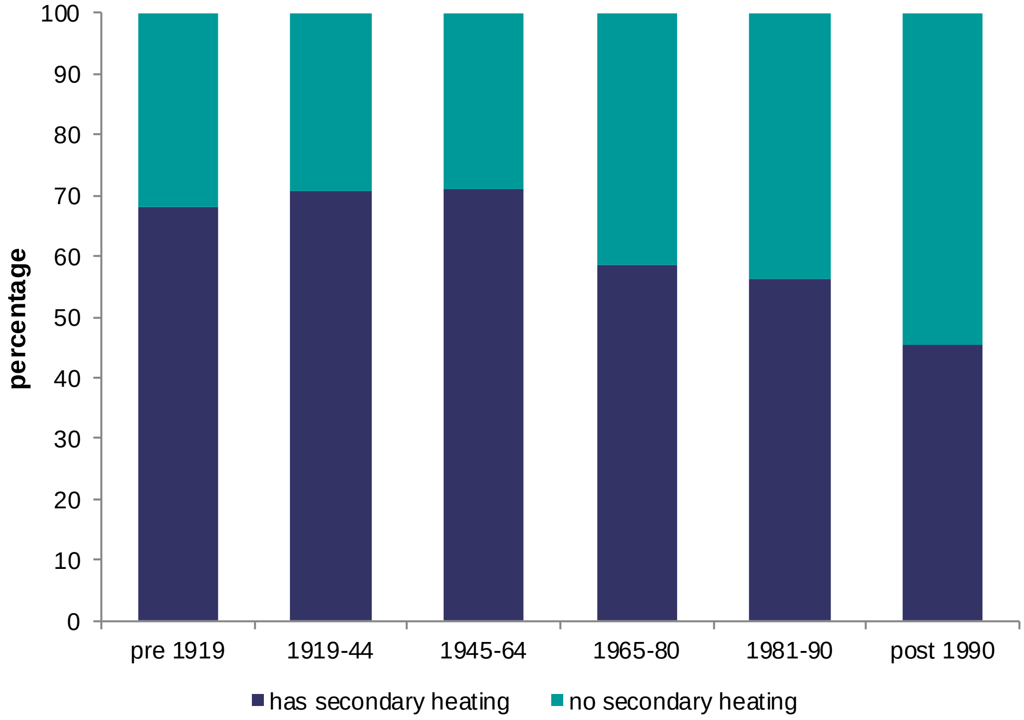
However it should be recognised that some types of secondary heating, such as wood burning stoves, may have been installed as a decorative home feature, rather than a heating necessity.

Prevalence of secondary heating systems by type of dwelling

4.11. In 2013, around 14.6 million homes (63% of dwellings) had some form of secondary heating. This varied greatly by tenure and dwelling characteristics. Owner occupied homes were much more likely to have secondary heating (72%) compared with both private rented (45%) and social rented homes (47%). Houses were far more likely to have secondary heating (71%) than flats (32%), with particularly high proportions for detached houses (82%), bungalows (75%) and semi-detached houses (74%), Annex Table 4.3.

4.12. The age of a home was also a good indicator as to whether secondary heating was available. The proportion of homes with secondary heating ranged from 68% in those built before 1919, to 71%, for homes built from 1944 to 1965. In contrast, the prevalence of secondary heating was lower for newer homes, and only 46% of those constructed after 1990 had such heating, Figure 4.3.

Figure 4.3: Secondary heating systems by dwelling age, 2013



Base: all dwellings
Note: underlying data are presented in Annex Table 4.3
Source: English Housing Survey, dwelling sample

Prevalence of secondary heating systems by whether primary system is central heating

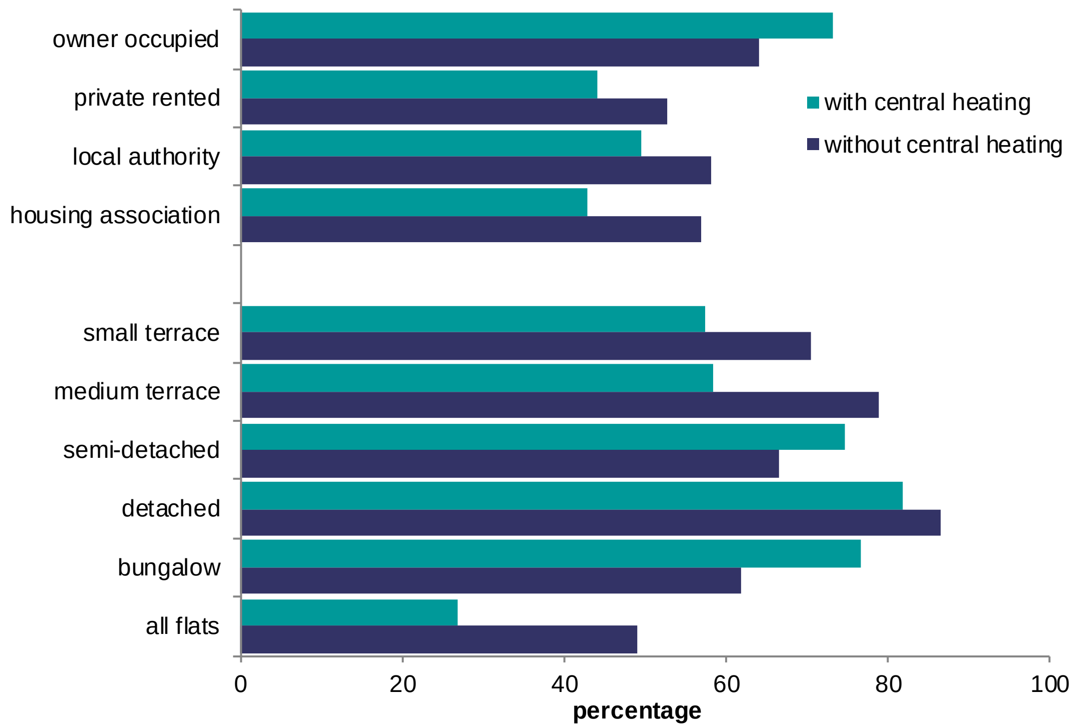
4.13. Secondary heating was slightly more common in homes with a primary central heating system (63%) compared with homes with other primary heating systems (59%), Annex Table 4.3.

4.14. Owner occupied centrally heated homes were more likely to have secondary heating (73%) compared with other owner occupied homes (64%). Conversely all types of rented dwellings were more likely to have secondary heating if they did not have central heating, Figure 4.4.

4.15. The type of primary heating system also affected whether secondary heating was present, and this varied by the type of dwelling; for example 79% of medium sized terraces without central heating had secondary heating compared with 58% of those with central heating. In contrast, semi-detached houses were more likely to have secondary heating if the home was centrally heated (75% compared with 66%), Figure 4.4.

4.16. Irrespective of their age, the proportion of dwellings with secondary heating was similar irrespective of whether the home had central heating or other types of primary heating, Annex Table 4.3.

Figure 4.4: Characteristics of homes with secondary heating by type of primary heating system, 2013



Base: all dwellings with/without central heating as primary heating system
Note: underlying data are presented in Annex Table 4.3
Source: English Housing Survey, dwelling sample

Types of secondary heating

4.17. The categories of heating systems in this analysis are those used in the EHS survey to provide the most appropriate information for use in calculating the energy efficiencies of heating systems, and in turn, the energy efficiency rating of the dwelling. Further information on these heating types can be found in Appendix 1 of this chapter.

4.18. These secondary heating types are:

- mains gas fires (less efficient open flue)
- mains gas fires (more efficient balanced or fan-assisted flue types)
- fixed electric heaters (or panel heaters wired to the mains supply)
- solid fuel systems[3] - open fires
- solid fuel systems - stoves and space heaters (which include a range of appliances from kitchen stoves to modern biomass room heaters)
- portable heaters

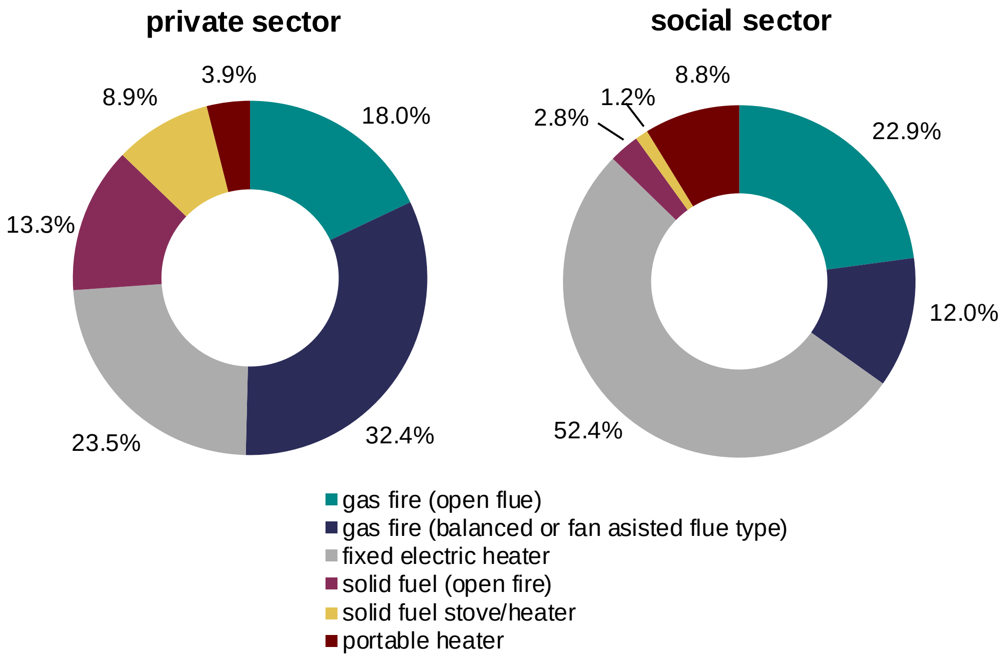
4.19. For homes with secondary heating, the most common forms were gas fires with balanced or fan-assisted flues (30%) and fixed electric heaters (27%); the least common form was portable heaters (5%). Some form of solid fuel secondary heating was present in 20% of homes: 12% of homes had solid fuel open fires and 8% had a solid fuel stove or heater, Annex Table 4.4.

4.20. Fixed electric heaters were a far more common source of secondary heating in the social sector (52%) compared with the private sector (24%). Within the private sector fixed electric heaters were also more common in private rented homes (33%) compared with owner occupied homes (22%) Figure 4.5 and Annex Table 4.4. This is partly due to the higher proportion of flats and relatively newer homes in the social sector; both newer homes and flats are less likely to have main gas (see Annex Table 2.4 of the Profile of English Housing Report). Also landlords may prefer to fit electric room heaters because they are relatively inexpensive to install and maintain compared with gas secondary heating systems.

4.21. Solid fuel in some form was used more commonly for secondary heating in private sector homes (22%) compared with those in the social sector (4%). This partly reflects the greater proportions of older homes and houses in the private sector; the latter are also more likely to have decorative fires such as wood-burning stoves, Figure 4.5.

[3] solid fuel includes coal, smokeless fuel, wood and anthracite (a compact variety of coal with a high carbon content)

Figure 4.5 Types of secondary heating systems by tenure, 2013



Base: all dwellings with secondary heating systems
Note: underlying data are presented in Annex Table 4.4
Source: English Housing Survey, dwelling sample

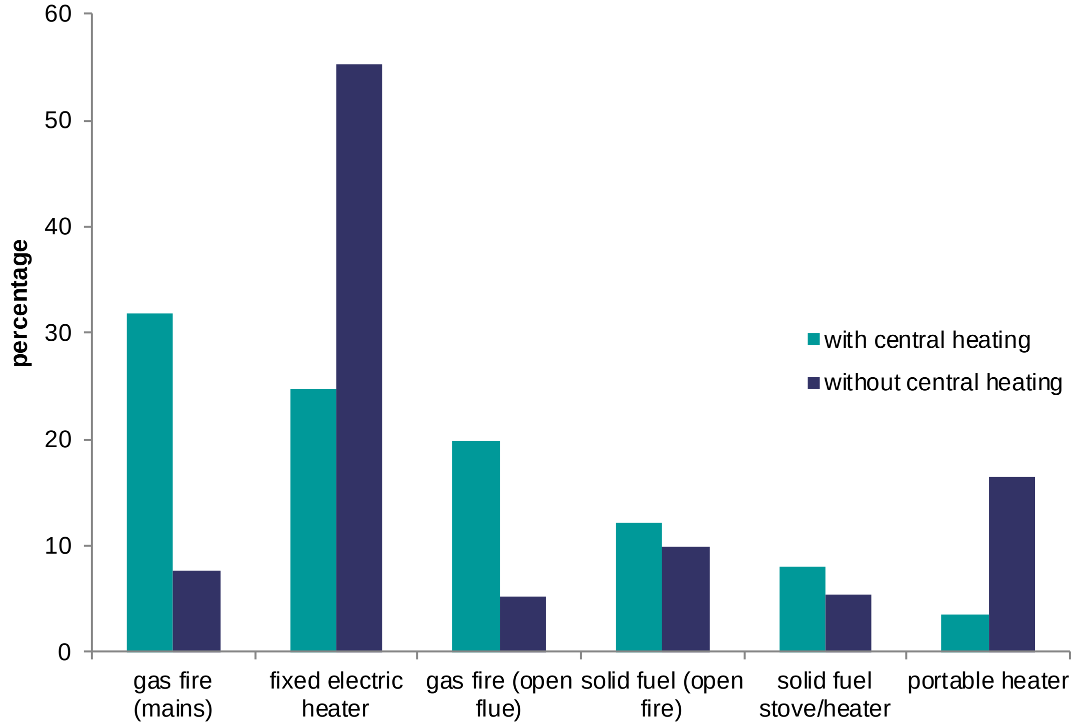
Type of secondary heating by whether primary system is central heating

4.22. The type of secondary heating system also varied according to whether the home was centrally heated. Given that most central heating systems are fuelled by gas, this is often a natural choice of fuel for secondary heating systems and using mains gas is likely to be the cheapest way to fuel the secondary heating. Over half (52%) of the secondary heating systems in centrally heated homes were also fuelled by gas. In contrast just 13% of non-centrally heated homes had a gas fire (mains or open flue) for secondary heating, Figure 4.6

4.23. For homes without central heating (55%), fixed electric heaters were the most common form of secondary heating. This proportion is notably higher than for centrally heated homes with this type of secondary heating (25%). The use of portable heaters for secondary heating was also far more common for homes without central heating; 17% compared with just 3% of centrally heated homes, Figure 4.6.

4.24. Although the use of solid fuel open fires was similar irrespective of whether the home was centrally heated, the use of solid fuel stoves was slightly higher for centrally heated homes (8% compared to 6%), Figure 4.6.

Figure 4.6: Types of secondary heating in dwellings with and without primary central heating, 2013



Base: all dwellings with secondary heating systems
Note: underlying data are presented in Annex Table 4.5
Source: English Housing Survey, dwelling sample

Prevalence of secondary heating systems by household type

4.25. Earlier analysis in this chapter showed that some form of secondary heating was more common in owner occupied homes. As owner occupation is the predominant form of tenure, this is one of the main reasons why, for all household groups (including those who may be more vulnerable), those living in the private sector were more likely to have a form of secondary heating than social renters, Figure 4.7.

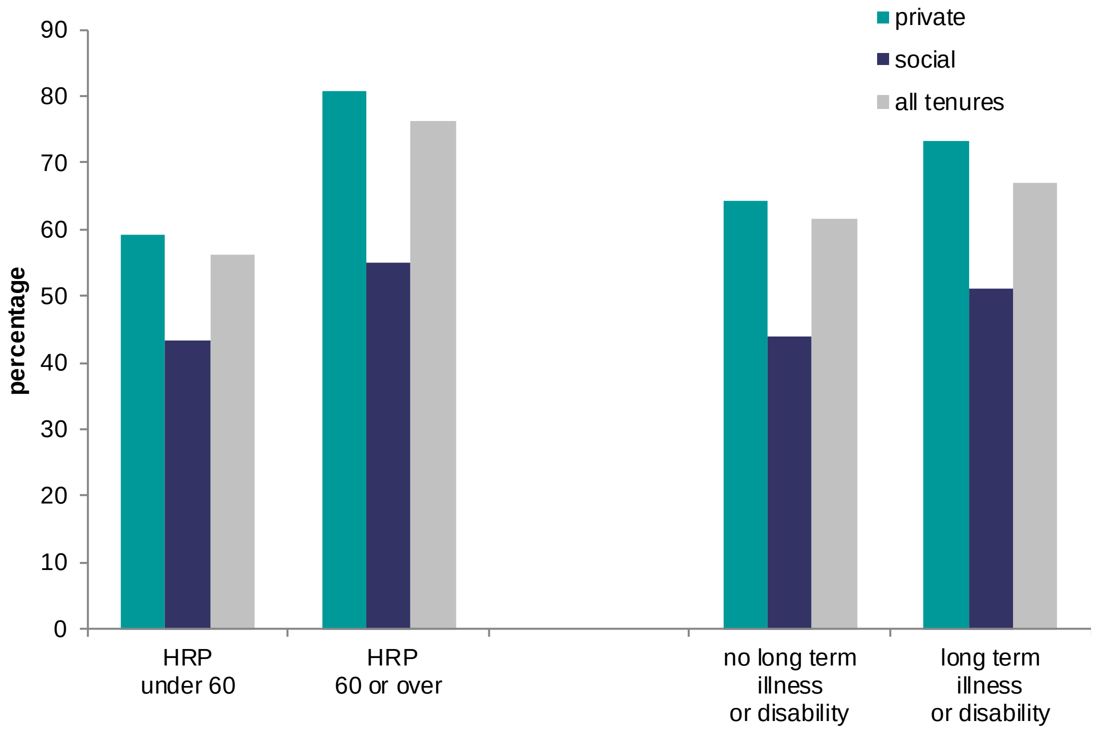
4.26. Households where the HRP was aged 60 years or over were more likely to have some form of secondary heating (76%), compared with households where the HRP was under 60 years (56%). This disparity was found in both the private and social sectors, Figure 4.7. The reasons for this disparity cannot easily be identified given that, for example, older people were no more likely to live in the oldest (and least energy efficient) homes (those built before 1919). Furthermore, the distribution of older people among different types of homes was fairly similar to younger households. Consequently, it is difficult to determine the extent to which the greater prevalence of secondary heating among older households could reflect:

- inadequacy of the primary heating system to heat the home to the preferred temperature

- the need to reduce fuel bills by using secondary heating to heat occupied rooms only

4.27. Around two-thirds (67%) of households containing a person with a long term illness or disability had secondary heating compared with 62% of households without these health difficulties. This disparity was found in both the private and social sector. As older people are more likely to have a long term illness or disability, this may be related to the finding above for the age of the HRP, Figure 4.7.

Figure 4.7: Secondary heating systems by household type and tenure, 2013



Base: all households
Note: underlying data are presented in Annex Table 4.6
Source: English Housing Survey, dwelling sample

4.28. Just over half of households where the youngest person was under 5 years (51%) had a secondary heating system compared with 65% of households where the youngest person was older. This disparity was evident across all tenures. Secondary heating was less prevalent in social sector households where the youngest person was under five years (40%), compared with those who lived in the private sector (53%), Annex Table 4.6.

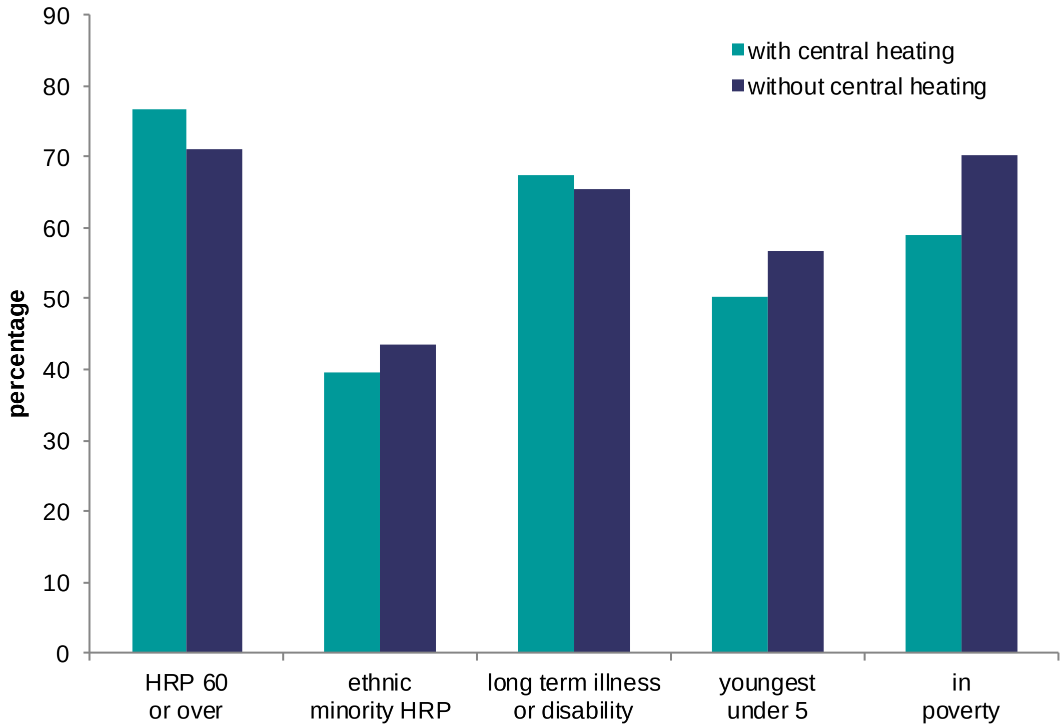
4.29. Households with an ethnic minority HRP were less likely to have secondary heating (40%) compared with white HRP households (66%). This disparity was found in both private and social sectors. Secondary heating was notably less prevalent among ethnic minority HRP households who lived in social sector homes (26%) compared with those who lived in the private sector (44%), Annex Table 4.6.

4.30. Overall, secondary heating was slightly less prevalent among households in poverty (61%) compared with households not in poverty (64%). This difference was evident in the private sector, but the prevalence of secondary heating was similar among social renters irrespective of whether the household was classified as being in poverty, Annex Table 4.6.

Prevalence of secondary heating systems for households by type of primary heating system

4.31. For some types of households, such as those with a long term illness or disability, the proportion with secondary heating was fairly similar irrespective of whether central heating was present or not. The most marked difference related to households who were in poverty: some 70% of such households without central heating had secondary heating, compared with 59% of those who lived in centrally heated homes, Figure 4.8.

Figure 4.8: Key household groups in homes with secondary heating by primary heating system, 2013



Base: households with secondary heating
Note: underlying data are presented in Annex Table 4.7
Source: English Housing Survey, household sub-sample

Secondary heating over time

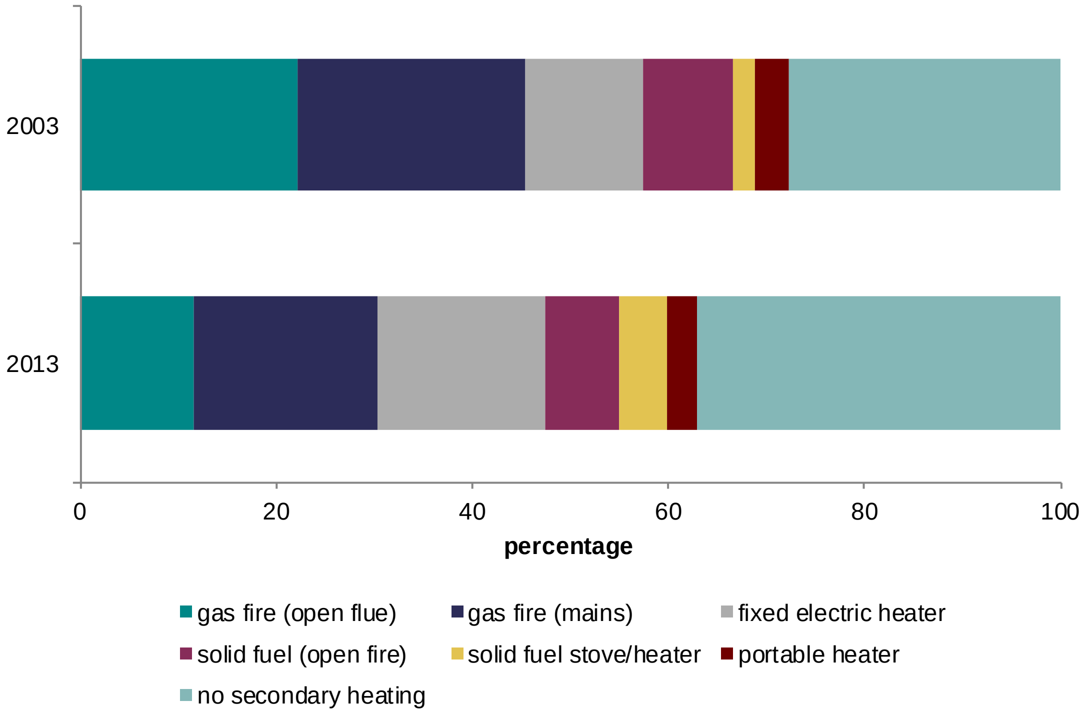
4.32. As the proportion of homes using central heating increased from 2003 (from 87% to 91%, (Annex Table 4.8), the use of secondary heating systems declined somewhat, with the percentage of homes having secondary heating falling from 72% to 63% in 2013, Annex Table 4.9.

4.33. It is very likely that most new homes built during this period would have had only central heating installed at the time of construction. At the same time some older homes would have undertaken some energy improvements such as the installation of new boiler systems to replace less efficient heating systems.

4.34. The most significant change was a fall in the proportion of the total housing stock which had gas fires with open flues as a form of secondary heating; a fall from 22% in 2003 to 12% in 2013. Over the same period the proportion of the total housing stock using fixed electric heaters as a secondary system increased from 12% to 17%, Figure 4.9.

4.35. The reason for this increase in electric secondary heating is unknown, but possible explanations include that this additional source of heating is being increasingly valued by households (such heaters are available at relatively low cost, and are able to provide rapid additional heat into a room). In addition, in the rented sector these heaters are often preferred to gas systems due to ease of installation and less stringent maintenance and safety requirements. It may also be that homes where electric fixed heaters were formerly used for primary heating are being upgraded to other types of primary system while retaining their former fixed electric heaters for secondary heating.

Figure 4.9: Type of secondary heating, 2003 and 2013



Base: all dwellings
Note: underlying data are presented in Annex Table 4.9
Sources:
1) 2003: English House Condition Survey, dwelling sample;
2) 2013: English Housing Survey, dwelling sample

4.36. The decrease in the total number of homes with secondary systems was similar for both the private and social sectors. The rise in fixed electric heaters was particularly notable in the social sector stock overall (25% in 2013 compared to 14% in 2003), Annex Table 4.9.

4.37. In 2013, some 3% of respondents in homes with secondary heating said they used these secondary heating systems as the main heating source in winter, rather than the primary system. This proportion had decreased from 8% in 2003[4], perhaps driven by an increase in central heating use, Annex Table 4.10.

[4] these findings need to be treated with caution due to non-response (around 6% of raw and weighted cases) in 2003

Appendix 1 Types of secondary heating

4.38. These categories of heating systems are used in the EHS survey to provide the most appropriate information that can be used to calculate the energy efficiencies of heating systems, and in turn, the energy efficiency rating of the dwelling.

- **mains gas fires (open flue)**

These take air for combustion from within the room and are therefore quite inefficient. As a result these fires will always be ‘open fronted’ which means the fuel bed and combustion gases are not ‘sealed’ from the room in which the fire is fitted.

- **mains gas fires (balanced or fan-assisted flue types)**

Balanced flue gas fires are room-sealed (closed fronted). The flue uses natural convection to draw the air from outside the building for combustion and expels it back to the outside through a separate compartment of the flue. The fire can only be on an external wall and the flue will be roughly 175 mm in diameter.

Fan assisted gas fires work like a balanced flue but with a fan, which means that they can use a smaller diameter flue pipe (about 125mm) which makes them more efficient. The fire can be on an inside wall and the fan will need an electricity supply.

This category of secondary heating system includes condensing gas fires

- **fixed electric heaters (or panel heaters wired to the mains supply)**
- **solid fuel systems - open fires**
- **solid fuel systems - stoves and space heaters**

Examples include modern biomass room heaters (wood burning stoves) and solid fuel range cookers

- **portable heaters**

An electric heater that is not fixed to the wall or wired in directly to a fused spur and is possible for a single person to carry easily from room to room.

Glossary

Area type:

- **city or other urban centre:** includes
    - *city centre*: the area around the core of a large city.
    - *other urban centre*: the area around towns and small cities, and also older urban
    - areas which have been swallowed up by a metropolis.

- **suburban residential**: the outer area of a town or city; characterised by large planned housing estates.

- **rural**: includes:
    - *rural residential*: a suburban area of a village, often meeting the housing needs of people who work in nearby towns and cities.
    - *village centre*: the traditional village or the old heart of a village which has been suburbanised.
    - *rural*: an area which is predominantly rural e.g. mainly agricultural land with isolated dwellings or small hamlets.

Carbon dioxide (CO_2) emissions: The total carbon dioxide emissions from space heating, water heating, ventilation and lighting, less the emissions saved by energy generation as derived from the Standard Assessment Procedure (SAP; defined below) calculations and assumptions. These are measured in tonnes/year and are not adjusted for floor area, but represent emissions from the whole dwelling. The highest and lowest emitting performers have also been grouped with cut-off points set at 3 tonnes per year for the low emitters and 10 tonnes per year for the highest. CO_2 emissions for each dwelling are based on a standard occupancy and a standard heating regime.

Double glazing: This covers factory made sealed window units only. It does not include windows with secondary glazing or external doors with double or secondary glazing (other than double glazed patio doors, which are surveyed as representing two windows).

Dwelling: A unit of accommodation which may comprise one or more household spaces (a household space is the accommodation used or available for use by an individual household). A dwelling may be classified as shared or unshared. A dwelling is shared if:

- the household spaces it contains are 'part of a converted or shared house', or
- not all of the rooms (including kitchen, bathroom and toilet, if any) are behind a door that only that household can use, and

- there is at least one other such household space at the same address with which it can be combined to form the shared dwelling.

Dwellings that do not meet these conditions are unshared dwellings.

The EHS definition of dwelling is consistent with the Census 2011.

Dwelling age: The date of construction of the oldest part of the building.

Dwelling type: Dwellings are classified, on the basis of the surveyor's inspection, into the following categories:

- **small terraced house:** a house with a total floor area of less than $70m^2$ forming part of a block where at least one house is attached to two or more other houses.
- **medium/large terraced house:** a house with a total floor area of $70m^2$ or more forming part of a block where at least one house is attached to two or more other houses.
- **end terraced house:** a house attached to one other house only in a block where at least one house is attached to two or more other houses.
- **mid-terraced house:** a house attached to two other houses in a block.
- **semi-detached house:** a house that is attached to just one other in a block of two.
- **detached house:** a house where none of the habitable structure is joined to another building (other than garages, outhouses etc.).
- **bungalow:** a house with all of the habitable accommodation on one floor. This excludes chalet bungalows and bungalows with habitable loft conversions, which are treated as houses.
- **converted flat:** a flat resulting from the conversion of a house or former non-residential building. Includes buildings converted into a flat plus commercial premises (such as corner shops).
- **purpose built flat, low rise:** a flat in a purpose built block less than six storeys high. Includes cases where there is only one flat with independent access in a building which is also used for non-domestic purposes.
- **purpose built flat, high rise:** a flat in a purpose built block of at least six storeys high.

Energy cost: The total energy cost from space heating, water heating, ventilation and lighting, less the costs saved by energy generation as derived from SAP calculations and assumptions. This is measured in £/year using constant prices based on average fuel prices for 2012 (which input into the 2012 SAP calculations) and do *not* reflect subsequent changes in fuel prices. Energy costs for each dwelling are based on a standard occupancy and a standard heating regime.

Energy Performance Certificate (EPC): The EPC provides a range of indicators based on current performance, whether the property would benefit in terms of improved performance from a range of low cost and higher cost measures, and the likely performance arising from the application of those measures. The EPC assessment is based on a simplified form of the energy efficiency SAP known as reduced data SAP.

The EHS currently provides the following EPC based indicators, calculated using the survey's own approach to SAP (see the Technical Advice Note on Energy Efficiency and Energy Improvements for further information):

- **current performance:**
    - *energy efficiency rating* (EER) and bands
    - *environmental impact rating* (EIR) and bands
    - *primary energy use* (kWh/m^2/year)
    - *energy cost* (£/year), but unlike the EPC these are based on 2012 constant prices
    - CO_2 (carbon dioxide) emissions (tonnes/year)

- **improvement measures:** as part of the EPC, certain improvement measures are suggested which would increase the energy efficiency of the dwelling. These include improvements to both heating and insulation measures.

    a) *higher cost measures* (more than £500):

    upgrade to **central heating controls**, for boiler driven systems, typically to a stage where a room thermostat, a central programmer and thermostatic radiator valves (TRV's) have been installed (although the range of upgraded controls can vary depending on the heating system);

    upgrading to a **class A condensing boiler** using the same fuel (mains gas, LPG or fuel oil), where a non-communal boiler is in place (this improvement measure is most appropriate when the existing central heating boiler needs repair or replacement);

    upgrading existing storage radiators (or other electric heating) to more **modern, fan-assisted storage heaters**;

    installation of a **hot water cylinder thermostat** where a storage cylinder is in use but no thermostat exists. The costs of installing a cylinder thermostat vary and may be relatively inexpensive, however the improvement has been included as a high cost measure to reflect cases where more extensive work is required to the overall heating controls;

replacement **warm-air unit** with a fan-assisted flue, where the original warm-air heating unit is pre-1998;

installation of a manual feed **biomass boiler** or **wood pellet stove** where an independent, non-biomass solid fuel system exists. This measure was assessed to identify the number of dwellings that would benefit from this measure but was not included in the post improvement energy efficiency rating or carbon dioxide emissions (reported in section 4) due a combination of the small amount of dwellings that would benefit and modelling complexity.

b) *lower cost measures* (less than £500):

installation or upgrade of **loft insulation** which is less than 250mm, where the dwelling is not a mid- or ground-floor flat and where the loft does not constitute a full conversion to a habitable room;

installation of **cavity wall insulation**, where the wall is of cavity construction;

installation or upgrade of **hot water cylinder insulation** to a level matching a 160mm jacket. Recommended where the current level is less than 25mm of spray foam or less than a 100mm jacket.

The survey is not able to include the following improvements: draft proofing and low energy lighting. Other more expensive measures that are not included are: solar water heating; double or secondary glazing; solid wall insulation; complete change of heating system to class A condensing boiler (including fuel switching); solar photovoltaics (PV) panels.

- **Cost of energy efficiency improvement measures**: the cumulative cost of implementing the measures that have been recommended for each dwelling is calculated by applying standard costs on a per unit area basis for loft and cavity wall insulation and a single unit cost for other measures.

Energy efficiency rating: A dwelling's energy costs per m^2 of floor area for standard occupancy of a dwelling and a standard heating regime and is calculated from the survey using a simplified form of the SAP rating (see below). The energy costs take into account the costs of space and water heating, ventilation and lighting, less cost savings from energy generation technologies. They do not take into account variation in geographical location. The rating is expressed on a scale of 1-100 where a dwelling with a rating of 1 has poor energy efficiency (high costs) and a dwelling with a rating of 100 represents zero net energy cost per year. It is possible for a dwelling to have a SAP rating of over 100 where it produces more energy than it consumes, although such dwellings will be rare within the English housing stock.

The detailed methodology for calculating SAP to monitor the energy efficiency of dwellings was updated in 2012 to reflect developments in the energy efficiency technologies and knowledge of dwelling energy performance. These changes in the SAP methodology were relatively minor compared with previous SAP methodology updates in 2005 and 2009. It means, however that a SAP rating using the 2009 method is not directly comparable to one calculated under the 2012 methodology, and it would be incorrect to do so. All SAP statistics used in reporting from 2013 are based on the SAP 2012 methodology and this includes time series data from 2001 to the current reporting period (i.e. the SAP 2012 methodology has been retrospectively applied to 1996 and subsequent survey data to provide consistent results in the 2013 and following reports).

Energy efficiency rating (EER) bands: The energy efficiency rating is also presented in an A-G banding system for an Energy Performance Certificate, where Band A rating represents low energy costs (i.e. the most efficient band) and Band G rating represents high energy costs (the least efficient band). The break points in SAP used for the EER Bands are:

- Band A (92–100)
- Band B (81–91)
- Band C (69–80)
- Band D (55–68)
- Band E (39–54)
- Band F (21–38)
- Band G (1–20)

Ethnic minority HRP: see household groups.

Gross annual income: The annual income of the household reference person and (any) partner. This includes income from private sources (regular employment, self-employment, government schemes, occupational pensions, private pensions and other private income), state benefits/allowances and tax credits, as collected on the EHS survey (this includes housing benefit/Local Housing Allowance but excludes council tax benefit and Support for Mortgage Interest) and interest from savings. It is a gross measure i.e. income before Income Tax or National Insurance deductions.

Heating system

a) main space heating type:

central heating system: most commonly a system with a gas fired boiler and radiators which distribute heat throughout the dwelling (but also included in this definition are warm air systems, electric ceiling/underfloor and communal heating). It is generally considered to be a cost effective and relatively efficient method of heating a dwelling.

storage heaters: 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. However, storage heating can prove expensive if too much on peak electricity is used during the day.

room heaters: this category includes all other types of heater such as fixed gas, 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 carbon dioxide emissions per kWh.

b) heating fuel:

gas: mains gas is relatively inexpensive and produces lower emissions per unit of energy than most other commonly used fuels. Liquefied Petroleum Gas and bottled gas are still associated with slightly higher costs and emissions.

electricity: standard rate electricity has the highest costs and CO_2 emissions associated with main fuels, but is used in dwellings without a viable alternative or a back-up to mains gas. An off-peak tariff such as Economy 7, is cheaper than bottled gas but with the same emissions as standard electricity.

oil: in terms of both costs and emissions, oil lies between main gas and electricity.

solid fuel: most solid fuels have similar costs to oil, with the exception of processed wood which can be more expensive than off-peak electricity. Fuels included are coal and anthracite, with CO_2 emissions above those of gas and oil; wood, which has the lowest emissions of the main fuels; and smokeless fuel, whose emissions are close to those of electricity. By law, some areas (usually towns or cities) are designated as smoke control areas where the use of solid fuels emitting smoke is illegal.

c) water heating system:

combined: provides heat to supply hot water for the dwelling.

separate: dwellings which have electrical space heating systems often use electric immersion heaters to heat water. Other dwellings may be fitted within instantaneous water heaters, such as electric showers.

d) boiler type:

standard: provides hot water or warm air for space heating with the former also providing hot water via a separate storage cylinder.

back: located behind a room heater and feeds hot water to a separate storage cylinder. They are generally less efficient than other boiler types.

combination: provides hot water or warm air for space heating and can provide hot water on demand negating the need for a storage cylinder, therefore requiring less room.

condensing: 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.

e) secondary heating system:

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. Sub-categories are included for reporting purposes, according to the approximate energy efficiency of the heater.

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.

Household: One person living alone, or a group of people (not necessarily related) living at the same address who share cooking facilities and a living room or sitting room or dining area. The EHS definition of household is consistent with the Census 2011.

Household reference person (HRP): The person in whose name the dwelling is owned or rented or who is otherwise responsible for the accommodation. In the case of joint owners and tenants, the person with the highest income is taken as the HRP. Where incomes are equal, the older is taken as the HRP. This procedure increases the likelihood that the HRP better characterises the household's social and economic position. The EHS definition of HRP is not consistent with the Census 2011, in which the HRP is chosen on basis of their economic activity. Where economic activity is the same, the older is taken as HRP, or if they are the same age, HRP is the first listed on the questionnaire.

Household groups: The report focuses on certain key household groups which include people who are potentially vulnerable on account of their age, long term illness or disability; and groups which tend to be disadvantaged such as ethnic minorities and those in poverty.

• ethnic minority HRP: where the HRP defines their ethnicity as other than white.

• illness or disability: a household where at least one person in the household has a long-term illness or disability. The respondent assesses this, and long-term is defined as anything that has troubled the person, or is likely to affect them, over a period of time.

• in poverty: a household with income below 60% of the equivalised median household income (calculated before any housing costs are deducted). Income equivalisation is the adjustment of income to take into account the varied cost of living according to the size and type of household (see the EHS Technical Report, Chapter 5, Annex 4 for further information).

• HRP 60 years or over: the household reference person is aged 60 years or more

• youngest under 5: the youngest person in the household is aged 4 or under.

Insulation:

- **wall insulation:**

  cavity walls: where a dwelling has external walls of predominantly cavity construction, it is defined as having cavity wall insulation if at least 50% of the cavity walls are filled with insulation. This could have been fitted during construction or retrospectively injected between the masonry leaves of the cavity wall.

  non-cavity walls: where a dwelling has not been defined as cavity walled, analysis is carried out using information regarding additional insulation applied either externally (e.g. insulated board attached to the external face with a render finish) or internally (e.g. insulated plasterboard fitted to the external walls inside each room, with a plaster finish). This is often referred to as solid wall insulation, but for reporting purposes any dwellings with non-cavity walls (e.g. timber, metal or concrete frames) are included in this analysis.

- **loft insulation:** the presence and depth of loft insulation is collected for all houses and top-floor flats. Insulation could be found between joists above the ceiling of the top floor of the dwelling or between the roof timbers where the loft has been converted to a habitable space. Where insulation could not be observed, information is taken from the householder or from imputed estimates based on the age and type of the dwelling.

Renewable energy: Data is collected on the presence of three types of renewable technology:

solar thermal panels: these are usually roof mounted and use direct sunlight to heat water, providing an additional source of domestic hot water to the internal boiler or other water heater. The most common types are evacuated tube and glazed flat plate collectors.

photovoltaic panels: a photovoltaic cell is a device that converts light into electric current, contributing to the domestic electricity supply. A large photovoltaic system could provide a surplus of energy, allowing a household to export electricity to the national grid.

wind turbines: a domestic small-scale wind turbine harnesses the power of the wind and uses it to generate electricity. The sample size of dwellings with this feature is currently too small to provide robust estimates for reporting.

SAP: The energy cost rating as determined by Government's Standard Assessment

Procedure (SAP) and is used to monitor the energy efficiency of dwellings. It is an index based on calculated annual space and water heating costs for a standard heating regime and is expressed on a scale of 1 (highly inefficient) to 100 (highly efficient with 100 representing zero energy cost). It is possible for a dwelling to have a SAP rating of over 100 where it produces more energy than it consumes although such dwellings will be rare within the English housing stock.

The method for calculating SAP was comprehensively updated in 2005 and in 2009, with an update of a more minor nature in 2012. This new SAP 2012 methodology is used in the 2013 EHS reports.

Size: The total usable internal floor area of the dwelling as measured by the surveyor, rounded to the nearest square metre. It includes integral garages and integral balconies but excludes stores accessed from the outside only, the area under partition walls and the stairwell area.

Storeys: The number of storeys *above* ground i.e. it does not include any basements.

Substantial disrepair: standardised basic repair costs of more than £35/m².

Tenure: Four categories are used for most reporting purposes, and for some analyses these four tenure categories are collapsed into two groups:

- **private sector**: includes:
    - *owner occupied*: includes all households in accommodation which they either own outright, are buying with a mortgage or are buying as part of a shared ownership scheme.
    - *private rented*: includes all households living in privately owned property which they do not own. Includes households living rent free, or in tied dwellings and tenants of housing associations that are not registered.
- **social sector**: includes:
    - *local authority*: includes Arms Length Management Organisations (ALMOs) and Housing Action Trusts.
    - *housing association*: mostly Registered Social Landlords (RSLs), Local Housing Companies, co-operatives and charitable trusts.

A significant number of Housing Association tenants wrongly report that they are Local Authority tenants. The most common reason for this is that their home used to be owned by the Local Authority, and although ownership was transferred to a Housing Association, the tenant still reports that their landlord is the Local Authority. There are also some Local Authority tenants who wrongly report that they are Housing Association tenants. Data from the EHS for 2008-09 onwards incorporate a correction for the great majority of such cases in order to provide a reasonably accurate split of the social rented category.

Vacant dwellings: The assessment of whether or not a dwelling is vacant is made at the time of the interviewer's visit. Clarification of vacancy is sought from neighbours. Surveyors are required to gain access to vacant dwellings where possible and undertake full inspections.

ISBN: 978-1-4098-4639-0