Energy Use in Homes 2006

A series of reports on domestic energy use in England

Energy Efficiency

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This is one of a series of three reports on the energy characteristics of the stock as observed by the 2006 English House Condition Survey.

The reports in this series are:

1. Space and Water Heating
2. Thermal Insulation
3. Energy Efficiency

The English House Condition Survey is funded and provided courtesy of Communities and Local Government. More information about this survey can be found at www.communities.gov.uk/ehcs

The 2005 EHCS Energy Analysis has been prepared by BRE Housing with the funding and support of the Department of Energy and Climate Change (DECC) through a contract managed by the Energy Saving Trust. This publication is Crown Copyright. For any further information please contact nowakt@bre.co.uk

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Energy Use in Homes 2006: Energy Efficiency

Executive Summary

The Standard Assessment Procedure (SAP) is the Government's recommended system for home energy rating. The SAP energy efficiency rating is based on the energy costs for space and water heating within each dwelling, representing a measure of the dwelling's energy efficiency. This report is based on the 2005 SAP methodology which employs a scale of 1 to 100 for the rating, with a higher rating indicating a better level of energy efficiency.

The average SAP rating for the stock in 2006 is 48.7, representing an increase of 0.6 SAP points since 2005 and a 13 point increase since 1991. In 2006 9.5 % of dwellings have a SAP rating less than 30 and 22.7 % achieve a SAP rating greater than 60.

Physical characteristics of a dwelling can strongly influence SAP rating. Dwelling age is a particularly important factor. Generally, the mean SAP rating decreases as the dwelling age increases, with a lower proportion of older stock having SAP ratings greater than 60 and more having ratings less than 30 when compared to newer stock. The type of dwelling also highly influences SAP rating. Purpose built flats perform particularly well with 59 % achieving a SAP rating greater than 60 – twice the proportion of mid-terraced houses, with the second highest percentage. However converted flats have the worst mean SAP rating at 43, six SAP points below the overall 2006 average SAP rating for the whole English housing stock. Among houses, the number of external walls is an important factor, with detached dwellings gaining the lowest average rating, and mid-terraces the best.

Other factors related to the specifications of the dwelling can determine SAP ratings, with the type of heating system and thermal insulation measures integral to the SAP calculation. The more effective these measures are, the more likely a higher SAP rating can be obtained. Therefore, unsurprisingly, dwellings with cavity wall insulation, the thickest loft insulation and entire dwelling double glazing have higher SAP ratings than those with lower levels or none of these insulation measures. Those dwellings with central heating tend to score higher SAP ratings than those without (i.e. those using portable and room heaters).

The social sector has the highest energy efficiency rating with a mean SAP of 57 in 2005 compared to the private sector with a mean SAP rating of 47. This is related to the type of heating prevalent and lack of thermal insulation measures in the private housing stock when compared to social dwellings. Private rented stock, although still below the overall mean, has seen the largest increase in its SAP rating since 1991, moving its current mean rating very close to that of the owner occupied sector.

The average SAP rating also reduces as the household income increases. The lowest income quintile has the highest proportion of SAP ratings greater than 60 with 30 %. This figure decreases for each successive income quintile until, at the highest income quintile, the value has reduced to 18 %. This shows that targeting of energy efficiency measures in dwellings containing low income households has pushed the mean SAP rating of this group from being one of the lowest in the 1990's to the highest in 2006.

2006 Energy Efficiency Update Report

Summary

- The mean SAP rating has increased steadily since 1991, with a further rise since the 2005 update report.
- In 2006, around twice as many dwellings have achieved a SAP of 60 or more (23 %) than those with a SAP rating less than 30 (10 %). This latter category still represents 2.1 million English dwellings. In 1991 there were 5.6 million homes with a SAP of less than 30, representing more than double the 2006 proportion.
- The social sector, which has grown significantly during the last 15 years, has the highest energy efficiency rating with a mean SAP of 57 in 2006 compared to the private sector with a mean SAP rating of 47. Owner occupied homes have seen the slowest increase in their energy efficiency ratings since 1991.
- The targeting of energy efficiency measures at dwellings containing low income households has pushed the mean SAP rating of this group from being one of the lowest in the 1990's to the highest in 2006.

Introduction

The Standard Assessment Procedure (SAP) is the Government's recommended system for home energy rating. The SAP energy efficiency rating is based on the energy costs for space and water heating within each dwelling, representing a measure of the dwelling's energy efficiency. Until 2004 the Energy Efficiency Update Reports had been based on the 2001 SAP Methodology. This report continues analysis using the 2005 SAP methodology which employs a scale of 1 to 100 for the rating, with a higher rating indicating a better level of energy efficiency. The data and graphs for all years presented in this report have been derived using the 2005 SAP Methodology.

The calculation of the rating uses the estimated annual cost of energy required to achieve a standard temperature regime within the home, and to provide the household with appropriate supplies of hot water. The requirement for energy depends upon the size of the dwelling, so to achieve a measure of energy efficiency the energy use per square meter of floor area is used rather than the total energy requirement.

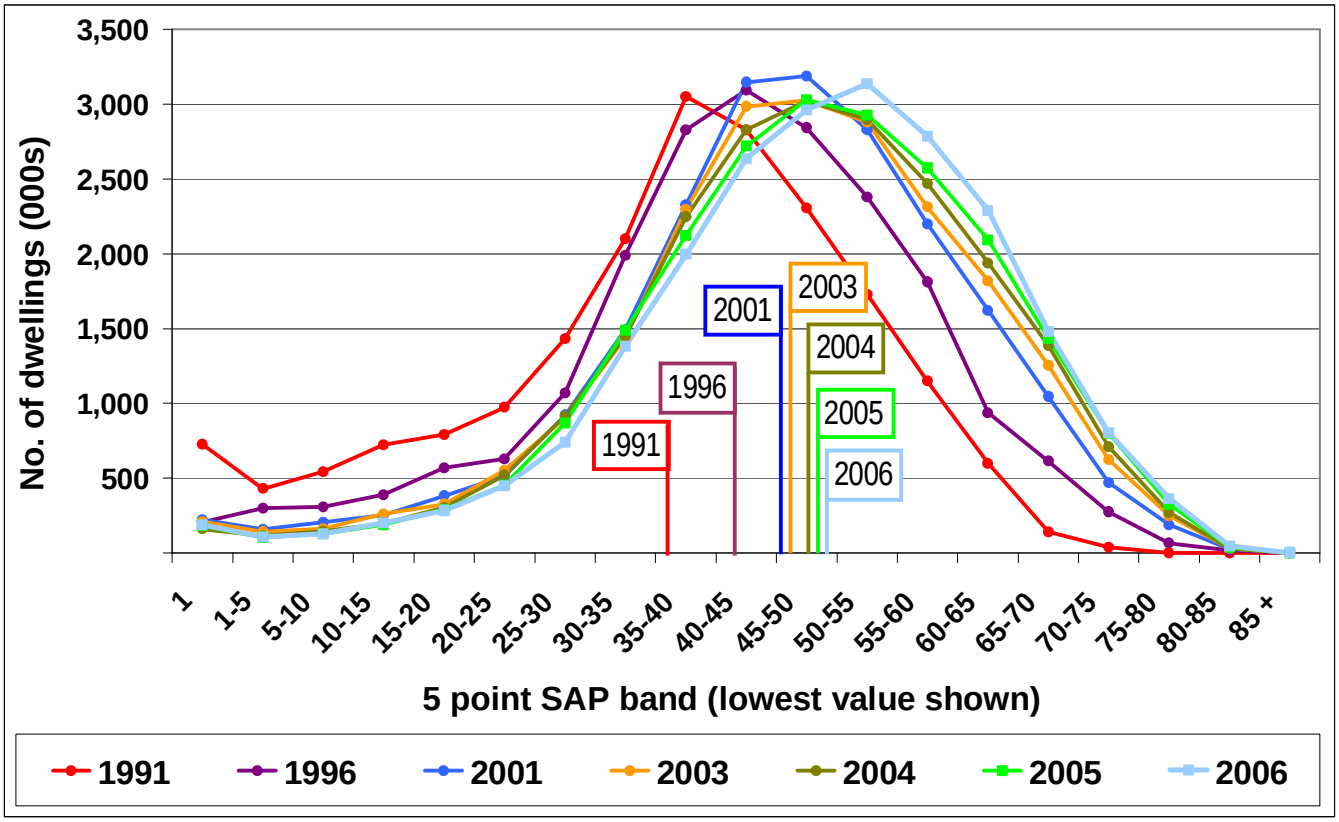

Figure 1: Distributions of 1991 to 2006 SAP ratings, lines to the axis show the mean SAP rating for each year.

This report examines SAP ratings as observed by the 2006 English House Condition Survey (EHCS). Since 2002 the EHCS has been in a continuous format, providing annual data which is then analysed in two-year datasets. This report presents temporal analysis based on the continuous survey and will also look at data from previous surveys conducted in 1991, 1996 and 2001.

Figure 1 on the previous page compares the SAP distributions of the 1991, 1996, 2001, and 2003 - 2006 EHCS datasets. Over time we see several effects on this distribution, reflecting improvements in thermal insulation and heating standards. The peak of the distribution has moved by around 14 SAP points towards the higher end, along with the overall mean SAP of the stock, which has increased by 13 points in 15 years, from 36 in 1991 to 49 in 2006.

The distribution shift that occurs in Figure 1 towards the right from 1991 to 2006 reflects a combination of energy efficiency improvements made to dwellings and the effect of new building stock increasing each year (new build have higher SAP ratings due to stricter Building Regulations).

The overall shape of the distribution has become more symmetrical and more closely centred on the mean, as more low efficiency dwellings have been upgraded to conform to stricter building regulations. The following report will use EHCS data to examine typical SAP ratings categorised by distinct dwelling characteristics, whilst providing a link between household types and the energy efficiency of their dwellings. The report will then examine changes in mean SAP ratings for the total stock, and individual categories, over time.

The mean SAP rating will be used as a measure of relative energy efficiency throughout the report, as will a measure of the proportion of the stock falling above or below a certain rating. A SAP score of 60 can be considered an acceptable standard under the SAP 2005 methodology for good energy efficiency.

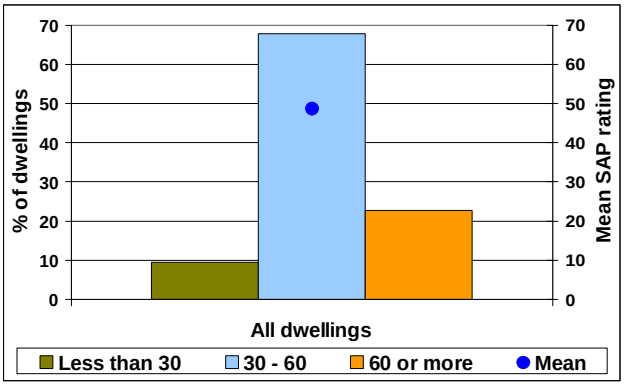

Figure 2: Spread of SAP ratings across all dwellings

Figure 2 shows the spread of the SAP rating across all dwellings in 2006. The largest percentage of dwellings falls in the SAP rating range 30-60 with a mean value of 49. Twenty-three percent of dwellings have a SAP rating greater than 60, leaving a remaining 9.5 % of dwellings with a SAP rating below 30.

Dwellings with a SAP rating of less than 30 are considered to be below minimum standard in terms of energy efficiency. In this report the key measure of energy efficiency is the balance between the 'less than 30' and 'greater than 60' bands.

Comparison Over Time

The average SAP rating of the housing stock has increased by 13 points between 1991 and 2006, gaining a little under a point per year until 2001 since when the increase has slowed slightly. The proportion of dwellings achieving scores above 60 has risen from just 4 % in 1991 to 23 % in 2006, an increase from 0.8 million dwellings to 5 million. The proportion of stock rated at less than 30 has fallen from 29 % (5.6 million dwellings) in 1991 to 9.5 % (2.1 million dwellings) in 2006. The central proportion with ratings between 30 and 60 initially increased from 67 % in 1991 to 74 % in 1996, indicating a sharp drop in the lowest ratings, but without the energy efficiency standards to attain higher SAP scores. Since 1996 this SAP band has decreased each year to 68 % in 2006, as new homes and refurbishments achieving new building regulations have expanded the 'greater than 60' band. However, the lowest rating band is now seeing little year-on-year decrease, partly due to the hard to treat stock dealt with in the accompanying report. These patterns are illustrated in Figure 3.

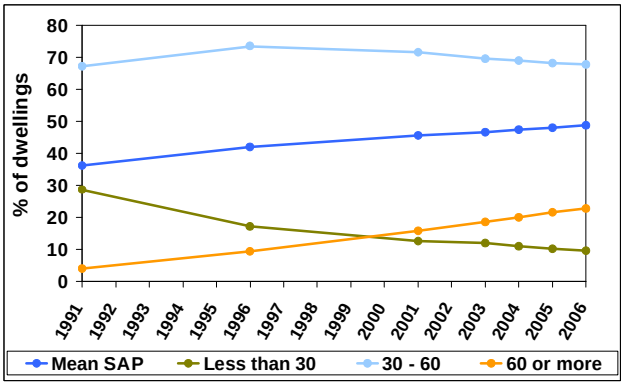

Figure 3: Timeline of SAP ratings for the total stock

Dwelling Type Analysis

Dwelling Type

Using the mean and high/low SAP bands to examine energy efficiency by dwelling in Figure 4, we see that no single dwelling type precisely matches the pattern shown in Figure 2. This is reflected in the range of mean ratings,

with the greatest difference being between purpose built flats and converted flats[1]. The latter have a mean of 43, which is 5 points below the stock average, whilst purpose built flats have a mean of almost 61, 15 points above average.

Case Study 1: Old converted flat

A series of case studies are presented throughout the report, looking at specific dwelling types and analysing how their SAP ratings may be increased through energy efficiency improvements. The mean SAP for each category is taken from the 2006 data and the total mean for the case study is the average for all the EHCS cases with the listed categories. Note that for a poor SAP example the total mean will be less than the mean ratings of each feature, sometimes substantially, due to the cumulative effect of several inefficient measures.

The first case specifies an old converted flat, most of which are found in urban areas, which is heated only by electric room heaters and has a poorly insulated loft. The average ratings for each of these characteristics, shown in Table 1, are all below the overall stock average.

Category	Mean SAP for this category	% of stock
Converted flat	43.0	3.0
Pre-1919	39.5	21.2
Loft ins < 100 mm	43.0	26.7
Electric room heater	30.2	3.9

Table 1: Case study 1 before improvements

This combination of energy inefficient features means that a typical dwelling with these characteristics has a SAP of around 4.

Category	Mean SAP for this category	% of stock
Converted flat	43.0	3.0
Pre-1919	39.5	21.2
Loft ins > 200 mm	52.3	16.0
Storage heater	41.7	7.0

Table 2: Case study 1 after improvements

If we consider similar dwellings but with an increase in loft insulation to at least 200 mm and the conversion from inefficient room heaters to modern storage radiators, as in Table 2, we see the typical SAP rating increase to 49, an increase of 45 points. It is likely that this dwelling will also have solid walls, limiting further improvement.

[1] The converted flat category also includes a small number of non-residential flats.

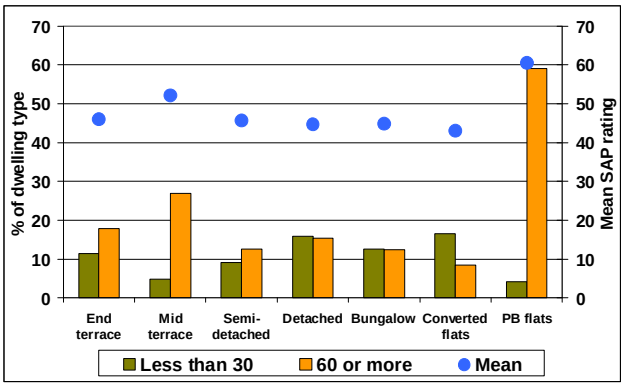

Figure 4: Comparison of highest and lowest SAP ratings by dwelling type

The good performance of purpose built flats is due to their typically small size and smaller number and area of external surfaces, giving a lower heat loss due to conduction through these surfaces. Purpose built flats are also more likely to be more recently constructed and therefore benefit from higher insulation and heating standards. The difference in types of flat is emphasised by the proportion with a SAP rating of 60 or more: 59 % of purpose built flats compared with only 8 % of converted flats.

The size and shape of houses also has a close relationship with the energy efficiency rating: mid-terraced dwellings have the second highest mean SAP with 52. These are typically smaller than semi-detached and detached dwellings, and, by definition, have fewer external walls, reducing heat losses.

Figure 5 compares the SAP distribution of detached houses (not including bungalows) with purpose built flats for 2006. Detached houses are typically larger in size with a larger number of external walls; hence the second lowest mean SAP rating at 44. As mentioned above, purpose built flats are typically smaller in size with fewer external walls; hence the high percentage of purpose built flats to the right of the distribution, with the peak at around 65.

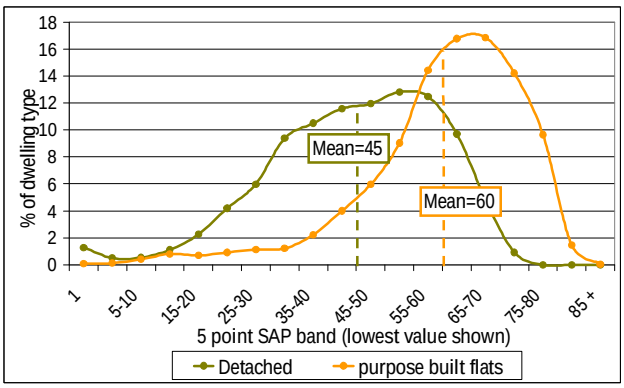

Figure 5: Distribution of SAP for detached houses and purpose built flats

All categories of dwelling type have seen a steady rise in mean SAP ratings between 1991 and 2006 (Figure 6), with the exception of converted flats which shows a fluctuating pattern, partially explained by the significant decrease in the numbers of this dwelling type over time. Purpose built flats show the largest total mean SAP increase, a rise of 19 points, making this the dwelling type with the highest mean in each survey since 1996.

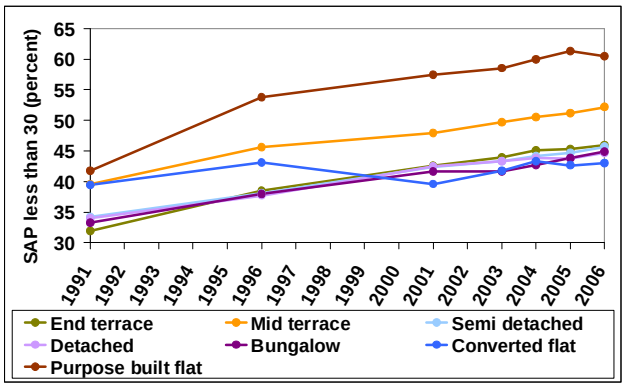

Figure 6: Timeline of mean SAP ratings by dwelling type

Mid-terraced houses are the closest match to the performance of purpose built flats. The mean SAP rating for end terrace, semi-detached, bungalows and detached homes have followed a very similar pattern from 1991 to 2006, increasing from around 33 in 1991 to around 45 in 2006.

Figure 7 gives an alternative view of the relative improvements in energy efficiency which shows the change in the percentage of stock with a SAP rating less than 30 over time, split by dwelling type.

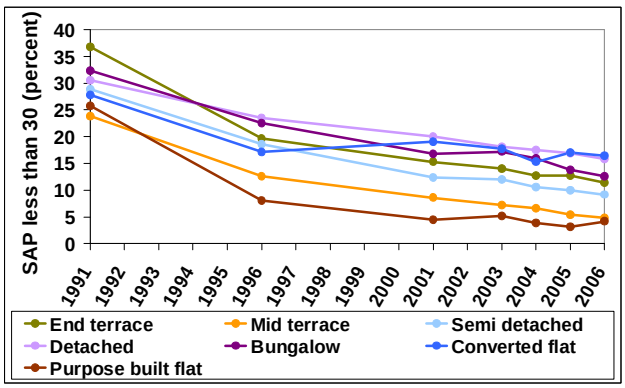

Figure 7: Timeline of percentage of SAP less than 30 by dwelling type

Dwelling Age

There is a distinct correlation between dwelling age and SAP rating. The SAP distribution of pre 1919 and post 1990 houses using 2006 data is shown in Figure 8. The distribution curve for post 1990 houses is much further towards the right than for pre-1919 houses. Homes built before 1919 have an average SAP rating of 39, with 23 % of this age group rating below 30 and only 5 % achieving above 60. Dwellings built since 1990 attain far higher SAP ratings, with an average of 65. Just 1 % of this category has a SAP rating less than 30, whilst 75 % achieve a SAP rating greater than 60. This most recent construction date category is one of the few areas in which the majority of dwellings are found outside the central 30 – 60 SAP rating band, identified at the beginning of this section.

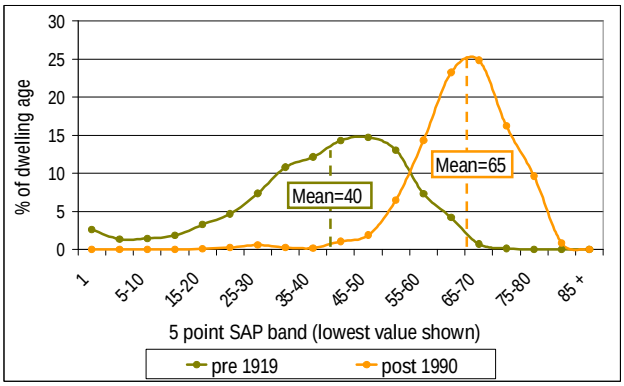

Figure 8: Distribution of SAP within the oldest and newest housing stock

The trend of higher SAP ratings in newer dwellings continues between 1919 and 1980 (see detailed tables), with mean SAP ratings of 44 where the construction date is between 1919 and 1944, 48 between 1945 and 1964, 52 between 1965 and 1980 and a mean of 56 in the 1980 to 1990 age band.

Examining the construction date bands by mean SAP rating we see a similar trend for each category, with the order of the age bands unchanged in each survey year (Figure 9). Between 1991 and 2006 we see each mean rising by between 8 and 13 SAP points.

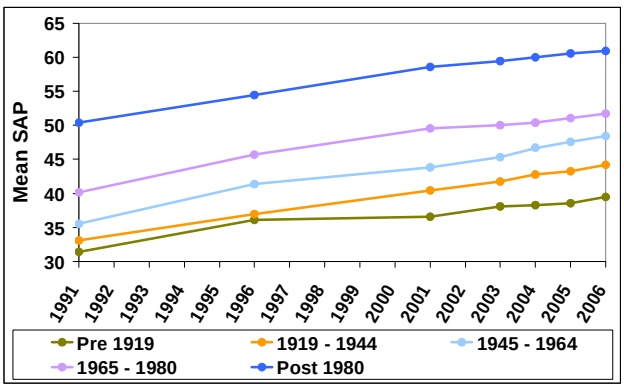

Figure 9: Timeline of mean SAP ratings by dwelling age

After 1996 the smallest increase has come in the oldest stock (pre-1919), suggesting a high level of stock in this category that cannot easily have its energy efficiency

measures improved. This is dealt with in more detail in the Hard to Treat Homes focus report. The proportion of post 1980 dwellings with SAP values greater than 60 has increased steeply from 21 % in 1991 to 64 % in 2006, reflecting the standards to which new build stock has adhered during that time.

Floor Area

The impact of dwelling size (here measured in total floor area) can be seen in Figure 10. The stock has been split into five equal floor area bands and the mean and banded SAP ratings compared. The higher average SAP ratings are found in homes with smaller floor areas with SAP ratings decreasing as the floor area increases. The proportion of dwellings with ratings above 60 falls from 41 % of the lowest floor area band to 14 % of the highest floor area band, whilst the proportion of dwellings with a SAP rating less than 30 increases from 8 % of the smallest floor area band to 15 % of the largest floor area band.

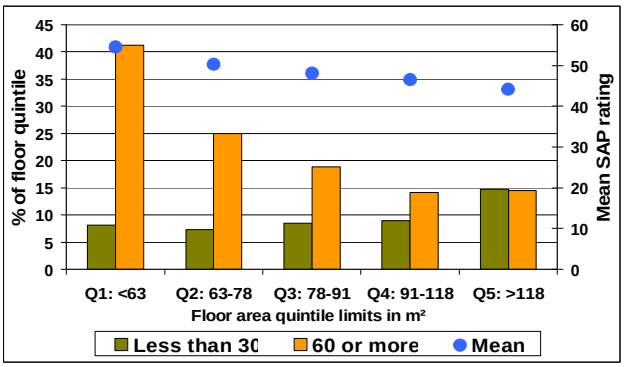

Figure 10: Comparison of highest and lowest SAP ratings by floor area quintile

The distribution of the SAP within the highest and lowest floor area quintile is shown in Figure 11. The largest floor area quintile is evenly distributed with a mean SAP rating of 44. The smallest floor area quintile is distributed to the right of the largest with a mean SAP rating of 55. This shift towards the right can be partly attributed to a high number of energy efficient purpose built flats within the 1st quintile.

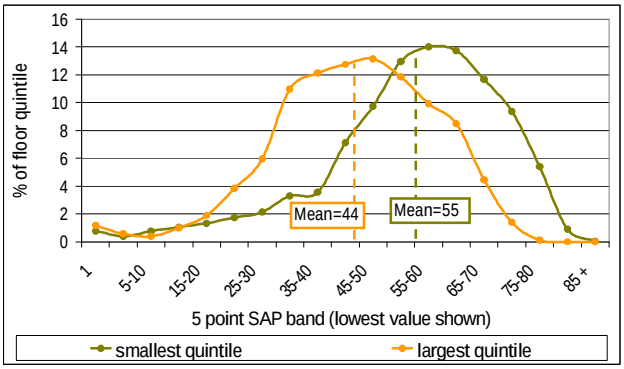

Figure 11: Distribution of SAP between the highest and lowest floor area quintile

Case Study 2: Private rented mid-terrace

The second case study looks at mid-terrace property, which is being rented in the private sector. Table 4 indicates the mean ratings across the stock for these separate characteristics and for the non-standard heating systems which can be found in private rented stock. Here the house has space heating through a back boiler, but still uses an alternative source for water heating, such as an immersion heater.

Category	Mean SAP for this category	% of stock
Private rented	46.6	11.9
Mid terrace	52.2	19.3
Non CH water	38.3	14.0
Back boiler	46.1	9.7

Table 4: Case study 2 before improvements

An example of a combination of these sub-standard heating features, along with the below average insulation typified in private rented homes gives a SAP of 21. This would be worse were it not a mid-terrace with relatively low heat losses.

Category	Mean SAP for this category	% of stock
Private rented	46.6	11.9
Mid terrace	52.2	19.3
CH water	50.4	86.0
Condensing combi	54.7	5.9

Table 5: Case study 2 after improvements

A similar house which has had a new central heating system installed including a highly efficient combination condensing boiler typically has a SAP rating of 58, a rise of 37 points, and now well above average for the stock as a whole, although this assumes that the private landlord can see the benefits of the installation. Table 5 shows the mean ratings for the new characteristics separately.

Energy Efficiency Measures

The SAP rating is, of course, driven by the levels of insulation and types of heating system present in each dwelling, as well as the size and shape of the dwelling, so strong correlations between the system and the score would be expected. However, it is useful to look at the impact that such measures have on the rating, as these measures often predominate in a particular dwelling or household type with a correspondingly high or low mean SAP rating.

Heating Systems

A comparison of central heating systems against non-central heating is shown in Figure 12, with the latter category including all fixed and portable room heaters. A more detailed breakdown of individual heating systems is given in Table 6.

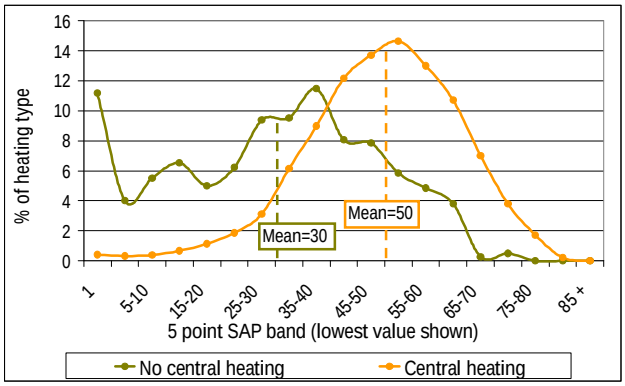

Figure 12: Comparison of SAP distribution by primary heating category

Dwellings using non-central heating systems have significantly lower SAP ratings, with a mean of 30, compared with 49.5 for centrally heated homes. Only 5 % of non centrally heated dwellings have SAP ratings above 60, whilst 23 % of centrally heated stock have a SAP rating greater than 60.

Boiler systems with radiators make up 86 % of the total heating systems in the English housing stock. This category has the greatest influence on the overall mean SAP rating. As shown in Table 6, dwellings with conventional boiler systems have a mean SAP of 50, with 7 % of boiler systems with radiators having a SAP rating less than 30 and 23 % with a SAP rating greater than 60.

Type of Heating System	% Less than 30	% More than 60	Mean SAP
Boiler system with radiators	7	23	50
Storage radiators	30	20	42
Warm air system	5	23	50
Room heater	46	5	30
Other systems	64	0	22
Communal	1	76	67
Portable heaters only	85	0	13
Total	10	23	49

Table 6: Comparison of SAP ratings among heating systems

Communally heated homes make up 2 % of the total heating systems and have the highest mean SAP rating out of the seven heating categories at 67. In total 76 % of communal systems have a SAP rating greater than 60 and only 1 % of this category has a SAP rating less than 30.

The high SAP rating of communally heated homes can be attributed to a large proportion (84 %) being found in purpose built flats. As described above, the good performance of purpose built flats in general is due to their typically small size with a smaller external surface area giving them a lower heat loss value.

Room and portable heaters (which, when combined, make up the non-central heating category shown in Figure 12) have the two lowest mean SAP ratings out of the seven heating system categories with 30 and 13 respectively. Eighty-five percent of homes using only portable heaters have a SAP rating less than 30 and none have a SAP greater than 60. Combined, these categories only contribute towards 4 % of the total heating systems in English dwellings; therefore have little influence on the overall mean SAP value. The low SAP rating of non-centrally heated homes is characterised by older stock dominating the use of room heaters: 8 % of pre-1919 dwellings compared with less than 1 % of post-1990 stock.

Fuel Use

As with the heating system, the SAP rating of a dwelling depends strongly on the primary fuel used for its heating, indeed it is the combination of fuel cost and efficient use that drives the key stages of the SAP calculation. Figure 13 shows the comparison of SAP ratings for non-communally heated stock by primary heating fuel, split between gas, oil, solid fuel and electrical systems.

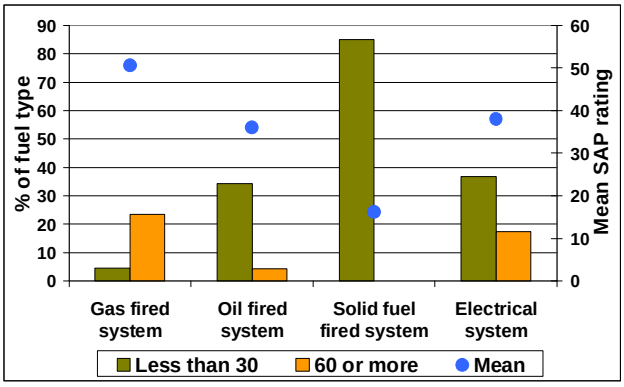

Figure 13: Comparison of SAP ratings by primary heating fuel

Gas is the predominant fuel (86 % of the total fuel type) and therefore has the most influence on the overall mean SAP. Gas has the highest mean SAP at 50.5 and is also the only fuel with a higher proportion of stock with ratings above 60 than below 30. Dwellings with oil, solid fuel and

electric systems all have means below the stock average with values of 36, 16 and 38 respectively, and with no dwellings heated by solid fuel achieving a SAP rating of above 60. The 8 % of homes using electricity include 27 % of all purpose built flats, already identified as being energy efficient due their shape, which contribute to the higher SAP ratings for electrically heated homes.

The distribution of the heating fuel with the highest and lowest average SAP (gas and solid fuel) is shown in Figure 14. Solid fuel fired systems include coal, wood, anthracite and manufactured smokeless fuels. In total these heating systems represent around 0.3 million homes (1.5 % of the English housing stock) and are found far more frequently in rural dwellings than urban stock; a further comparison will be made between these categories later in the report.

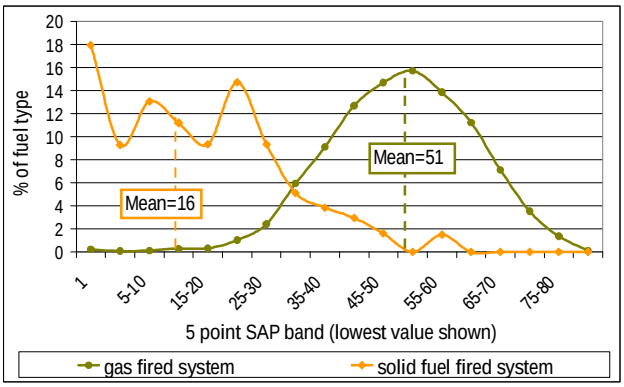

Figure 14: Comparison of SAP distribution by gas and solid fuel fired systems

Thermal Insulation

A further driver of the SAP rating system is thermal insulation measures within a dwelling, therefore a strong correlation between high SAP ratings and effective insulation measures is expected and this is supported by the 2006 data. Figure 15 shows that dwellings with unfilled cavity walls have a higher average SAP rating (at 49) than non-cavity walled stock (41), with insulated cavity walls (56) out-performing both in terms of mean SAP.

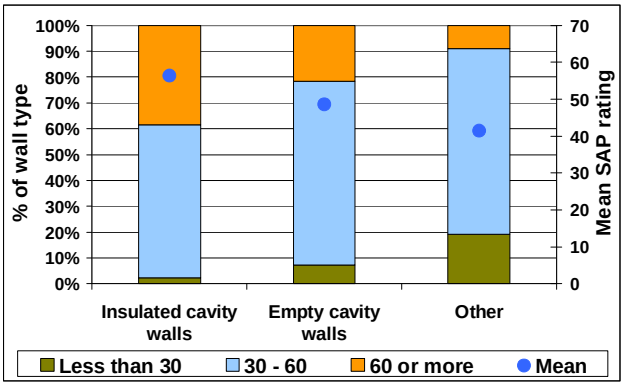

Figure 15: Comparison of SAP ratings by wall type

Those with filled cavities are predominantly newer dwellings with insulation fitted at the time of construction, while solid walls are found more commonly in older stock. Retrospectively fitting insulation to a solid wall can significantly improve the SAP rating, but is often prohibitively expensive.

In Figure 16 we also see a pattern of higher SAP ratings with thicker levels of loft insulation. The mean SAP increases from 35 where no insulation is present to 52 where insulation is greater than 200 mm. The 101 – 150 mm band is the point at which the proportion of ratings above 60 outweigh the percentage below 30.

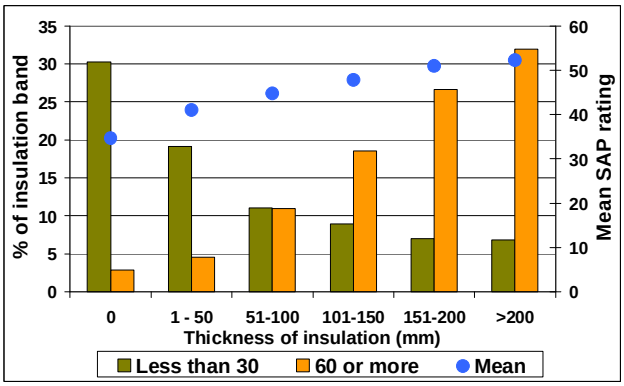

Figure 16: Comparison of highest and lowest SAP ratings by depth of loft insulation

The difference in the SAP distribution between homes with no loft insulation and homes with greater than 200 mm of loft insulation is illustrated in Figure 17. The >200 mm loft insulation distribution curve is shifted further towards the right than the distribution curve for dwellings with no loft insulation.

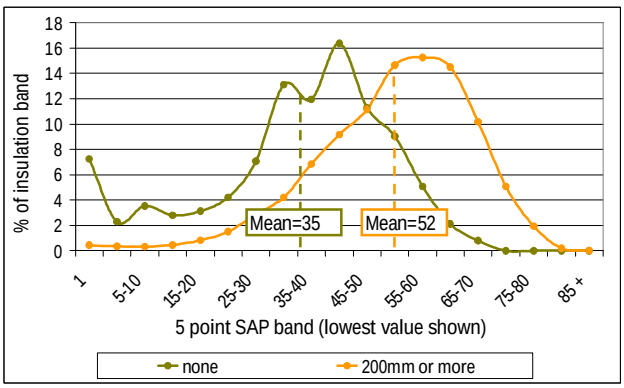

Figure 17: SAP distribution by loft insulation thickness

Another construction element affecting thermal insulation is the extent of double-glazing used in a dwelling, although the total heat loss is not as great through windows as through the walls and roof. The pattern of higher SAP with a greater coverage of double glazing is as much to do with

the presence of other energy efficiency measures in homes with double glazing as with the glazing itself.

For example, although dwellings with full double glazing make up 60 % of the total stock, they account for 73 % of homes with insulated cavity walls and just 42 % of those with non-cavity walls. Likewise, dwellings with full double glazing account for 69 % of homes with loft insulation greater than 200 mm and only 44 % of homes with no loft insulation.

Keeping this in mind, we find that stock which uses double-glazing in all windows has an average SAP rating of 52, whilst dwellings with little or no double-glazing typically have a SAP rating of 42. It has also been found that entirely double-glazed dwellings comprise of 76 % of the 'SAP greater than 60' category and only 32 % of the 'SAP less than 30' category.

Dwelling Location Analysis

Government Office Region (GOR)

Figure 18 compares the highest and lowest SAP ratings by GOR. Individual differences between each GOR exist but the mean only fluctuates by five SAP rating points between the nine GORs. London and the North East have similar SAP profiles, but have achieved these through different housing stock. London has a large quantity of purpose built flats with low heat losses, whilst the North East has the highest percentage of cavity walls and the thickest loft insulation. As a result they each have the highest proportion of stock with a SAP rating of 60 or more at 28 %, the lowest proportion of households with a SAP rating of less than 30 at 6 % and the highest overall mean SAP ratings of 51 and 51.5.

At the opposite end of the spectrum, the South West has the largest proportion of dwellings with a SAP rating of less than 30 at 13 % and the lowest overall mean SAP rating of 46.5.

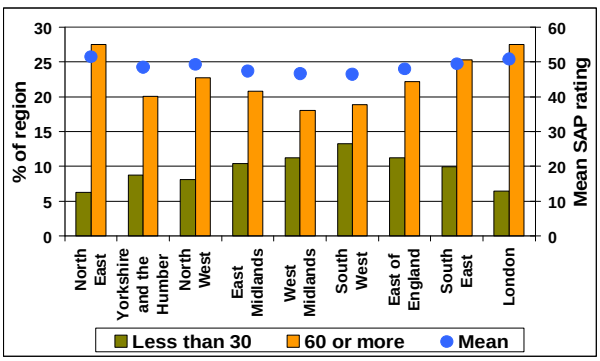

Figure 18: Comparison of highest and lowest SAP ratings by region

The distribution of the SAP within the London and South West GOR is shown in Figure 19. The distribution graph shows that the curve for London is slightly further to the right than the curve for the South West, which indicates that London has a slightly higher mean SAP rating than the South West.

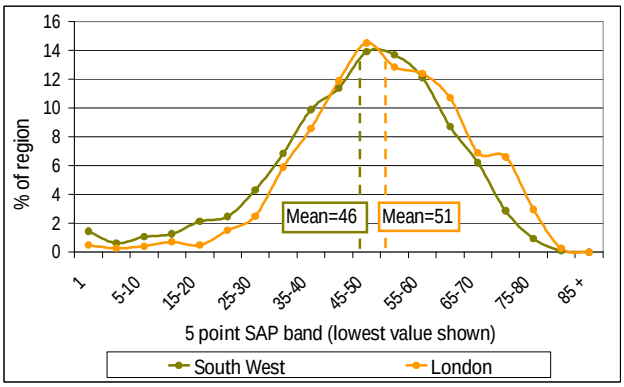

Figure 19: Distribution of SAP within the South West and London regions

The energy efficiency performance of the South West can be partially attributed to a relatively high proportion of stock in this region off the gas network and, as a consequence, more non-centrally heated homes, with a relatively high use of heating oil. There is also a lower than average proportion of dwellings with insulated cavity walls in the South West. The high mean SAP in London can be attributed to the very high proportion of flats found in the region, despite the greater age of this stock and relatively low incidence of cavity walls and thicker loft insulation.

Table 7 displays a league table of each individual region by mean SAP in 2006, with ratings for the same regions at 5 year intervals since 1991. London consistently had the highest regional SAP, until the North East took over recently. This region, coupled with Yorkshire and Humberside have seen the greatest increase in SAP since 1991, moving the latter from the second lowest mean to the fifth highest. The lowest three regions have remained below the rest due to their lower access to mains gas or low levels of cavity walls.

Region	1991	1996	2001	2006
North East	37.5	43.5	47.6	51.5
London	39.4	46.0	49.0	50.8
South East	38.1	43.4	46.4	49.5
North West	36.5	42.7	45.7	49.3
Yorks and Humber	34.0	41.0	44.8	48.5
Eastern	36.8	42.1	45.4	48.0
East Midlands	34.4	39.6	43.7	47.4
West Midlands	34.0	38.5	43.9	46.7
South West	33.1	39.5	43.5	46.5

Table 7: Mean SAP by region since 1991

A further set of comparisons can be drawn by looking at the neighbourhood surrounding a dwelling, shown in Figure 20.

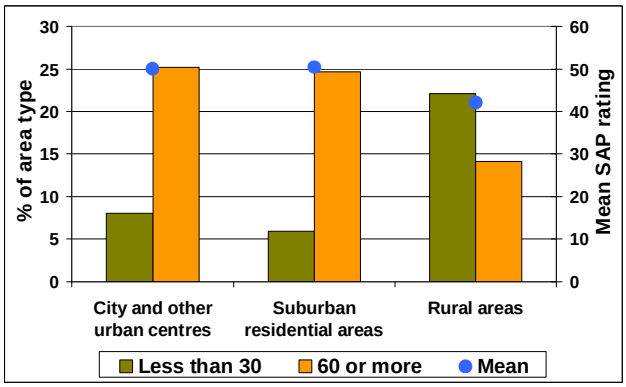

Figure 20: Comparison of SAP distribution by area category

Dwellings in city centre[2] and other urban centres[3] and suburban[4] locations both achieve an average SAP rating of 50, whilst dwellings located in rural areas[5] average a much lower SAP rating of 42. Twenty-one percent of rural dwellings have a SAP less than 30 compared with only 9 % for city centre/urban centre dwellings and 7 % for suburban residential dwellings.

Central heating is predominant in both rural and suburban dwellings; however the high proportion of detached dwellings found in rural stock relies on oil or solid fuels to a far greater extent than the gas powered city and suburban homes. They also have a lower incidence of the more efficient combination boilers; all effects which lead to the lower observed mean SAP rating.

Tenure Analysis

Tenure

As demonstrated in the accompanying Energy Use in Homes reports, varying levels of insulation and proportions of different heating systems are associated with the different tenure categories, and this is reflected in their typical SAP ratings. Figure 21 compares SAP ratings to quantify the effects of energy efficiency measures within the tenures.

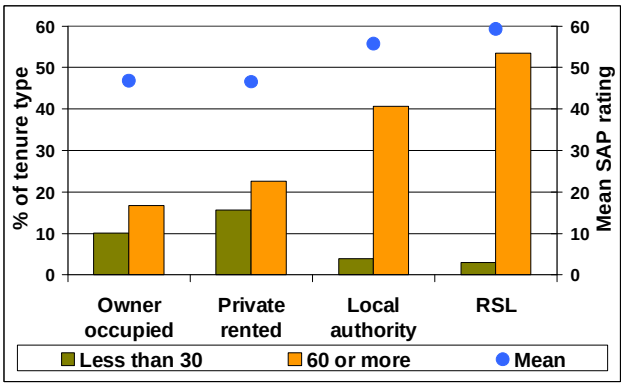

Figure 21: Comparison of SAP distribution by tenure

This shows that private rented and owner occupied dwellings both have the lowest average SAP rating at 47. Sixteen percent of private rented and 10 % of owner occupied fall into the 'SAP less than 30' category, with 23 % and 17 % respectively having a SAP greater than 60. These statistics are significantly lower than the most energy efficient tenure, the RSL sector, which averages 59, with only 3 % of its stock in the lowest SAP band (less than 30) and 53 % above a SAP rating of 60. Local authority dwellings reach an average SAP rating of 56, with 4 % of its stock in the lowest SAP band (less than 30) and 41 % above a SAP rating of 60.

Comparing the tenure categories to physical features (as discussed earlier under energy efficiency measures), it can be seen that 9 % of private rented dwellings use non-central heating for their primary space heating and 25 % for their water heating systems, compared with 4 % and 14 % for the stock as a whole. In particular this sector relies on electricity as a primary fuel source. The private rented tenure also has the lowest incidence of insulated cavity walls and contains the highest proportion of solid walls as well as having a higher proportion of uninsulated lofts than other tenures. These are all contributory factors to the low energy efficiency performance in this sector.

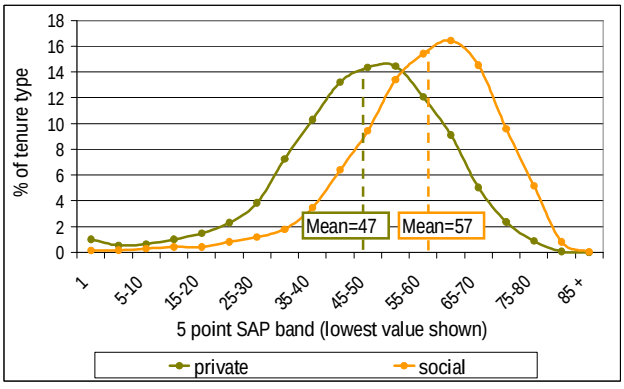

Figure 22: SAP distribution by tenure type

Figure 22 further demonstrates the variation in the SAP distribution ratings between the tenures by grouping private (owner occupied and private rented) and social (LA

[2] The area immediately surrounding the core of large cities.
[3] The area around the core of towns and small cities.
[4] The outer area of a town or city.
[5] Traditional villages or the heart of old villages or isolated dwellings and small hamlets.

and RSL) tenures together. The private sector distribution curve displays a even distribution curve with a mean SAP rating of 47. The social sector curve is distributed further to the right with a mean SAP rating of 57, 10 SAP points greater than the average private sector value. The social sector has 47 % of the housing stock with a SAP greater than 60 compared to only 17 % in the private sector, whilst the social sector has only 4 % of the housing stock below a SAP of 30 compared to 11 % in the private sector.

Case Study 3: Social sector purpose built flat

Table 8 shows the mean ratings for aspects of the third case study. This is a purpose built flat in one of the social tenures, both categories with high typical SAP ratings. However, the age and location of this block of flats mean that the windows are single glazed and each flat has a separate system of heating, in this case using storage radiators.

Category	Mean SAP for this category	% of stock
Purpose built flat	60.5	14.0
Social sector	57.4	17.9
No DG	41.9	12.3
Storage heaters	41.7	7.0

Table 8: Case study 3 before improvements

The lack of efficient heating or double glazing gives this case a SAP of 47: slightly below average for the stock, despite the tenure and dwelling type.

Category	Mean SAP for this category	% of stock
Purpose built flat	60.5	14.0
Social sector	57.4	17.9
Fully DG	52.0	59.5
Communal	66.8	1.7

Table 9: Case study 3 after improvements

Considering a situation in which the local authority or RSL has converted the block of flats to a communal heating system and installed double glazing throughout, we find that the typical SAP rating has increased to 68, a rise of 21 points, with the mean ratings for these improved features shown in Table 9.

Figure 23 demonstrates the rise of the social tenures in terms of energy efficiency since 1991. The local authority and the registered social landlord (RSL) tenure have had the highest mean SAP rating since 1991. The RSL tenure has increased by the greatest number of SAP points from a mean of 40 in 1991 to a mean of 59 in 2006 (a 19 point increase). The owner occupied tenure has had the lowest mean SAP rating rise from 1991 to 2006, increasing by only nine points. The private rented sector has gone from having the lowest mean SAP of 28 in 1991, increasing to 47 in 2006, placing it on a par with the owner occupied tenure.

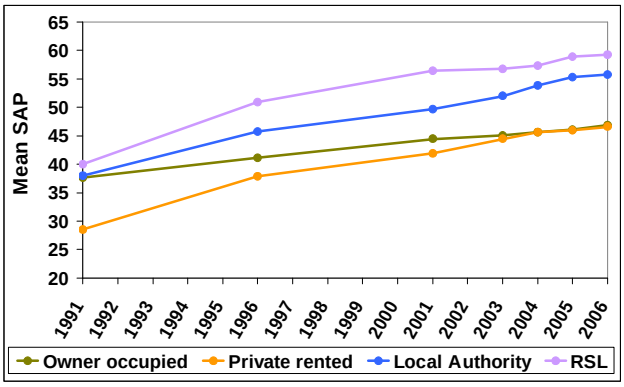

Figure 23: Timeline of mean SAP ratings by tenure

The change in the percentage of dwellings with a SAP rating less than 30 over time can be seen in Figure 24. In 2006 the local authority and RSL have the lowest proportion of homes with a SAP rating less than 30 with 4 % and 3 % respectively, falling from 29 % and 24 % in 1991. The owner occupied tenure went from having the lowest proportion of stock with a SAP less than 30 with 23 % in 1991 to having the second highest proportion in 2006 with 10%.

The private rented tenure has seen the greatest decrease in the percentage of dwellings with a SAP less than 30, decreasing from 48 % in 1991 to 16 % in 2006. However, this tenure still has the greatest percentage of stock with a SAP less than 30 and therefore the greatest potential for improvement. However, this tenure is more closely associated with stock that is difficult to improve than other tenures.

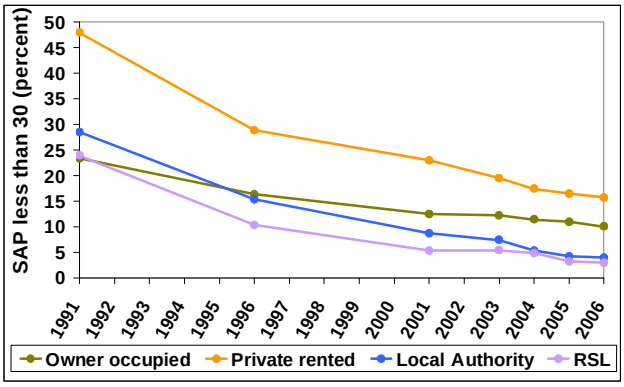

Figure 24: Timeline of percentage of SAP less than 30 by tenure

Household Analysis

Household Type

Household composition is split into seven categories; couple under 60, couple over 60, couple with children, lone parent with children, large adult household, one person under 60 and over person over 60. The SAP ratings vary according to the type of household, but in Figure 25 these categories are grouped into those with similar mean SAP scores creating categories for adults only, families and single people.

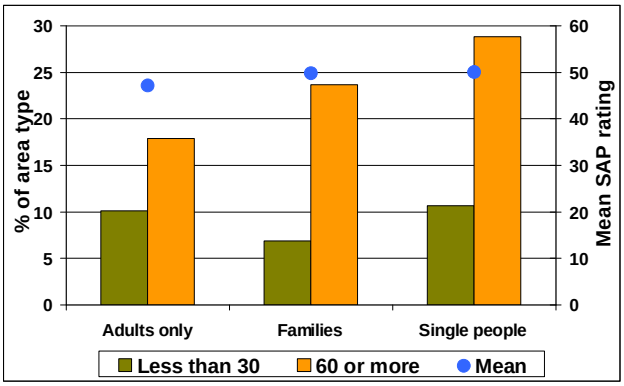

Figure 25: Comparison of SAP distribution by household type

The highest average rating occurs in dwellings containing single people (one person over/under 60) with a mean average SAP of 50. This reflects the high incidence of this category residing in purpose built flats. The second highest average rating occurs in dwellings consisting of families (parent(s) with dependent children) with an average SAP of just below 50. Families are the most likely to use gas central heating systems, as well as the most likely to have a boiler and to centrally heat their water – both beneficial energy efficiency measures. Twenty-two percent of lone parents with dependent children live in RSL dwellings, which have the highest SAP ratings. Lastly, adult only households (couples and other multi-person households) have the lowest average SAP with 47. This can be partly attributed to adult only households being the most likely to live in detached houses and the least likely to live in more modern energy efficient dwellings (post 1980).

A timeline of change in mean SAP for the three categories of household composition (adults only, families and single people) is shown in Figure 26. The graph illustrates that all three household categories have increased in their mean SAP rating year on year from 1991 to 2006. In 1991 family households had the highest mean SAP rating with a value of 40. However, since 1991 single person households have gone from having the lowest mean SAP rating with 36 to having the highest mean SAP rating in 2006 with a value of 50. From the early 1990's onwards, adult only households have had the lowest mean SAP.

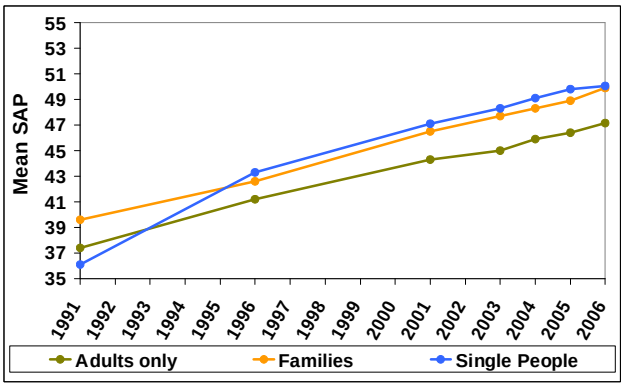

Figure 26: Timeline of mean SAP ratings by household composition

Figure 27 displays the SAP distribution curve for the highest and lowest household representative age category (16 to 29 and 65 and over). From this distribution graph it can be seen that older household representatives have a lower average SAP than younger household representatives. Dwellings containing households in which the Household Reference Person (HRP)[6] is 65 or over have an average SAP of 47, compared to 53 where the HRP is aged from 16 to 29. This is partly due to a relatively high proportion of younger households living in purpose built flats and a higher proportion also living in London, which has the highest regional mean SAP.

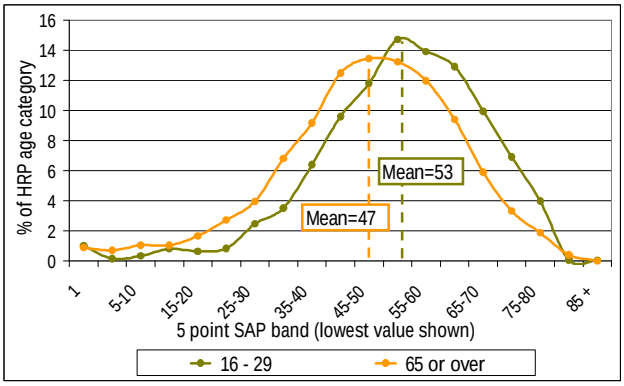

Figure 27: Comparison of SAP distribution by age of household response person

Income

Examining the mean energy efficiency ratings against income it can be seen that the average SAP rating reduces as the household income increase. Figure 28 separates the net income of all households into quintiles

[6] The HRP is the person in whose name the dwelling is owned or rented. Where there are joint householders the person with the highest income and then highest age is the HRP.

and looks at the SAP distribution within each quintile. A household in the lowest income quintile (less than £9,000) has an average SAP of 50.5. For the second, third and fourth income quintiles the average SAP rating is 50, 49, and 48 respectively. For the highest income quintile, (greater than £33,000) the average SAP rating is 47.

Figure 28 also shows that the lowest quintile has the highest proportion of SAP ratings greater than 60 with 30 %. This figure decreases for each successive income quintile where at the highest income quintile the value has reduced to 18 %.

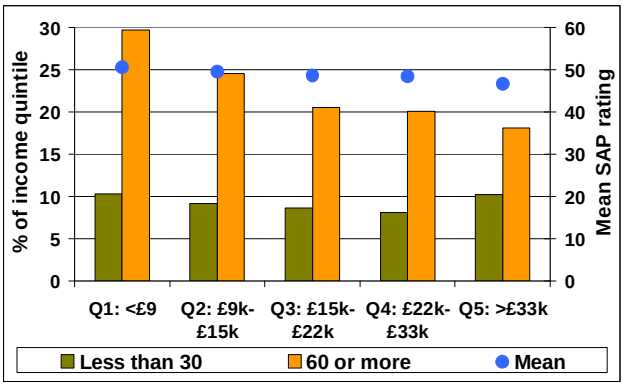

Figure 28: Comparison of highest and lowest SAP ratings by income quintile

One reason for this can be found in the types of dwelling that high and low income households typically live in. Forty-five percent of detached houses are occupied by households in the highest income quintile, while 40 % of purpose built flats occur in the lowest. The high income households in large detached dwellings will be able to afford energy efficiency measures, but the size of the dwelling will restrict its ability to attain a very high SAP rating. Conversely the low income households will benefit from the high average SAP rating achieved by purpose built flats and terraced dwellings.

Although the lowest income households have the highest average SAP and the highest percentage of household with a SAP of 60 or more, this category also has the greatest proportion of dwellings with a SAP rating less than 30. This is linked to the high representation of low income households, often single people, found in bungalows and private rented stock.

Figure 29 displays the timeline of the mean SAP rating by income split into five equal quintiles. In 1991 the two highest income quintiles, i.e. those households in receipt of the greatest earnings, had the highest mean SAP rating at 39 for quintile four and 41 for quintile five. In 1996 these two highest income quintiles became the categories with the lowest mean SAP, both with a rating of 42. In 2006 income quintiles four and five remained the bands with the lowest mean SAP at 48 and 47 respectively. The three lowest income quintiles have gone from having the lowest mean SAP in 1991 from between a rating of 36 to 37 to the highest three mean SAP ratings in 2006.

Case Study 4: Rural detached house

The final case study shows the mean SAP ratings for a large detached house in a rural location, the shape of which gives higher heat losses and hence below average ratings, shown in Table 10. In addition the house uses a solid fuel boiler for space and water heating and, although it has cavity walls (which may not have been the case for previous studies) they are uninsulated.

Category	Mean SAP for this category	% of stock
Rural	42.1	19.4
Detached	44.7	17.0
Solid fuel	16.2	1.5
Empty cavity wall	48.6	38.6

Table 10: Case study 4 before improvements

This dwelling has a typical SAP rating of 15, with only the cavity wall characteristic being around the stock average.

Category	Mean SAP for this category	% of stock
Rural	42.1	19.4
Detached	44.7	17.0
Gas	50.6	84.4
Filled cavity wall	56.4	30.2

Table 11: Case study 4 after improvements

It is possible that the house is not on the gas network due to its location, but assuming that a gas central heating system can be installed and the walls are suitable for CWI injection (Table 11), the SAP rating will increase to around 54, a rise of 39 points, with these more efficient features added.

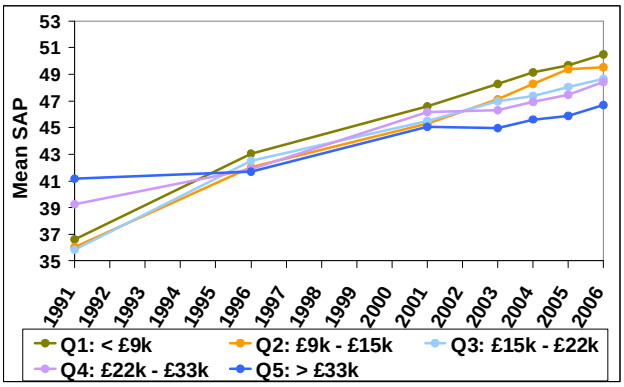

Figure 29: Timeline of mean SAP ratings by income quintile

This suggests that ongoing efforts to target low income households in improving the energy efficiency of their housing since 1991 have been successful and will continue to be so, with the lowest income quintiles showing strong increasing trends over the time period shown. The trend also reflects the tenures to which each income band belongs, with many low income households now living in the newer, more energy efficient social housing, whilst higher earners are still in the private sector – an area which has seen the smallest increase in SAP ratings.

Household Satisfaction with Heating

A relatively recent development in the EHCS interview survey allows us to look at householders' attitudes to their energy efficiency systems, in particular their satisfaction with water and space heating systems, their insulation effectiveness and whether they are able to keep comfortably warm in winter. Figure 30 shows the satisfaction with space heating, categorised into very, fairly, not very and not at all effective. In each survey there is a clear pattern of greater satisfaction with higher mean SAP ratings. A higher than average proportion of room and portable heaters are used by those responding 'not very effective' or 'not at all effective', with solid fuel or electricity also featuring strongly in these categories.

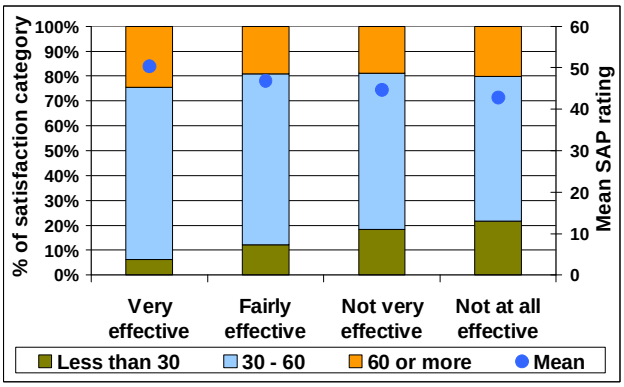

Figure 30: Comparison of SAP ratings by household satisfaction with space heating

The trend observed in Figure 30 is similar to attitudes associated with hot water, insulation and draught proofing i.e. the more effective the households assessments were for their insulation and draft proofing, the greater the mean SAP rating.

Conclusions and Future Issues

The overall mean SAP of the English housing stock has increased by 12 points from 1991 to 2006. The improvement in the SAP rating year on year reflects a combination of energy efficient improvements made to dwellings and the effect of new, more efficient building stock increasing each year.

This report has identified several areas in which a historically low mean SAP rating has increased significantly, such as in private rented stock and among low income households. It has confirmed categories in which we now expect high levels of energy efficiency, for example the RSL tenure, newer dwellings and those with higher insulation levels and purpose built flats. It has also confirmed categories in which we now expect low levels of energy efficiency, for example in dwellings with no central heating (particularly those that rely on portable and room heaters), older, detached and rural stock.

Future reports will identify whether these problematic areas are being improved and will also take the opportunity to examine other measures of environmental importance such as energy consumption and carbon dioxide emissions.

Energy Efficiency Update Tables 2006

These tables give detailed breakdowns of the banded SAP and mean SAP ratings against key variables, as an appendix to the Energy Efficiency Update Report 2006.

Index

Table 1.1 Analysis of SAP - total stock

count(000s), (column%)

SAP Band	Dwellings
Up to 30	2,096
	(9.5)
30 - 60	14,898
	(67.8)
60 or more	4,995
	(22.7)
Total	21,989
	(100.0)
Mean SAP	48.7

Base: All Dwellings

Table 1.2 Analysis of SAP - by dwelling type

count(000s), (row%), (column%)

	Less than 30	30 - 60	60 or more	Total	Mean SAP
end terrace	245	1,519	384	2,149	46.0
	(11.4)	(70.7)	(17.9)	(100.0)	
	(11.7)	(10.2)	(7.7)	(9.8)	
mid terrace	204	2,903	1,146	4,253	52.2
	(4.8)	(68.3)	(27.0)	(100.0)	
	(9.7)	(19.5)	(22.9)	(19.3)	
semi detached	555	4,726	757	6,039	45.7
	(9.2)	(78.3)	(12.5)	(100.0)	
	(26.5)	(31.7)	(15.2)	(27.5)	
detached	591	2,566	577	3,734	44.7
	(15.8)	(68.7)	(15.4)	(100.0)	
	(28.2)	(17.2)	(11.5)	(17.0)	
bungalow	250	1,489	248	1,987	44.9
	(12.6)	(75.0)	(12.5)	(100.0)	
	(11.9)	(10.0)	(5.0)	(9.0)	
converted flat	123	559	63	744	43.0
	(16.5)	(75.1)	(8.4)	(100.0)	
	(5.8)	(3.8)	(1.3)	(3.4)	
purpose built flat, low rise	111	1,022	1,629	2,762	60.6
	(4.0)	(37.0)	(59.0)	(100.0)	
	(5.3)	(6.9)	(32.6)	(12.6)	
purpose built flat, high rise	17	114	191	322	59.1
	(5.4)	(35.4)	(59.2)	(100.0)	
	(0.8)	(0.8)	(3.8)	(1.5)	
Total	2,096	14,898	4,995	21,989	48.7
	(9.5)	(67.8)	(22.7)	(100.0)	
	(100.0)	(100.0)	(100.0)	(100.0)	

Base: All Dwellings

Table 1.3 Analysis of SAP - by construction date

count(000s), (row%), (column%)

	Less than 30	30 - 60	60 or more	Total	Mean SAP
pre 1919	1,076	3,459	242	4,776	39.5
	(22.5)	(72.4)	(5.1)	(100.0)	
	(51.3)	(23.2)	(4.8)	(21.7)	
1919-44	411	3,202	388	4,002	44.2
	(10.3)	(80.0)	(9.7)	(100.0)	
	(19.6)	(21.5)	(7.8)	(18.2)	
1945-64	297	3,350	715	4,362	48.4
	(6.8)	(76.8)	(16.4)	(100.0)	
	(14.2)	(22.5)	(14.3)	(19.8)	
1965-80	264	3,220	1,354	4,838	51.7
	(5.5)	(66.6)	(28.0)	(100.0)	
	(12.6)	(21.6)	(27.1)	(22.0)	
1981-90	27	1,139	670	1,836	56.4
	(1.5)	(62.0)	(36.5)	(100.0)	
	(1.3)	(7.6)	(13.4)	(8.3)	
post 1990	20	528	1,627	2,174	64.7
	(0.9)	(24.3)	(74.8)	(100.0)	
	(1.0)	(3.5)	(32.6)	(9.9)	
Total	2,096	14,898	4,995	21,989	48.7
	(9.5)	(67.8)	(22.7)	(100.0)	
	(100.0)	(100.0)	(100.0)	(100.0)	

Base: All Dwellings

Table 1.4 Analysis of SAP - by floor area

count(000s), (row%), (column%)

	Less than 30	30 - 60	60 or more	Total	Mean SAP
Quintile 1: < 63m^2	358	2,224	1,812	4,394	54.6
	(8.1)	(50.6)	(41.2)	(100.0)	
	(17.1)	(14.9)	(36.3)	(20.0)	
Quintile 2: 63m² - 78m²	321	2,984	1,096	4,402	50.3
	(7.3)	(67.8)	(24.9)	(100.0)	
	(15.3)	(20.0)	(22.0)	(20.0)	
Quintile 3: 78m² - 91m²	373	3,194	831	4,398	48.1
	(8.5)	(72.6)	(18.9)	(100.0)	
	(17.8)	(21.4)	(16.6)	(20.0)	
Quintile 4: 91m² - 118m²	395	3,381	621	4,398	46.5
	(9.0)	(76.9)	(14.1)	(100.0)	
	(18.9)	(22.7)	(12.4)	(20.0)	
Quintile 5: > 118m²	649	3,114	635	4,398	44.2
	(14.8)	(70.8)	(14.4)	(100.0)	
	(31.0)	(20.9)	(12.7)	(20.0)	
Total	2,096	14,898	4,995	21,989	48.7
	(9.5)	(67.8)	(22.7)	(100.0)	
	(100.0)	(100.0)	(100.0)	(100.0)	

Base: All Dwellings

Table 1.5 Analysis of SAP - by tenure type

count(000s), (row%), (column%)

	Less than 30	30 - 60	60 or more	Total	Mean SAP
owner occupied	1,550	11,323	2,569	15,442	46.9
	(10.0)	(73.3)	(16.6)	(100.0)	
	(73.9)	(76.0)	(51.4)	(70.2)	
private rented	409	1,614	588	2,611	46.6
	(15.7)	(61.8)	(22.5)	(100.0)	
	(19.5)	(10.8)	(11.8)	(11.9)	
local authority	83	1,154	849	2,086	55.8
	(4.0)	(55.3)	(40.7)	(100.0)	
	(4.0)	(7.7)	(17.0)	(9.5)	
RSL	54	807	989	1,850	59.3
	(2.9)	(43.6)	(53.4)	(100.0)	
	(2.6)	(5.4)	(19.8)	(8.4)	
Total	2,096	14,898	4,995	21,989	48.7
	(9.5)	(67.8)	(22.7)	(100.0)	
	(100.0)	(100.0)	(100.0)	(100.0)	

Base: All Dwellings

Table 1.6 Analysis of SAP - by household type

count(000s), (row%), (column%)

	Less than 30	30 - 60	60 or more	Total	Mean SAP
Couple under 60	390	2,853	736	3,979	47.4
	(9.8)	(71.7)	(18.5)	(100.0)	
	(20.0)	(19.9)	(15.5)	(18.9)	
Couple 60 or over	398	2,578	549	3,525	46.3
	(11.3)	(73.1)	(15.6)	(100.0)	
	(20.4)	(18.0)	(11.6)	(16.7)	
Couple with children	363	3,661	1,090	5,114	49.2
	(7.1)	(71.6)	(21.3)	(100.0)	
	(18.6)	(25.5)	(22.9)	(24.3)	
Lone parent with children	95	940	481	1,516	52.2
	(6.3)	(62.0)	(31.7)	(100.0)	
	(4.9)	(6.6)	(10.1)	(7.2)	
Large adult household	119	1,007	317	1,444	48.6
	(8.3)	(69.8)	(22.0)	(100.0)	
	(6.1)	(7.0)	(6.7)	(6.9)	
One person under 60	238	1,477	792	2,507	51.0
	(9.5)	(58.9)	(31.6)	(100.0)	
	(12.2)	(10.3)	(16.7)	(11.9)	
One person 60 or over	346	1,836	788	2,970	49.2
	(11.6)	(61.8)	(26.5)	(100.0)	
	(17.7)	(12.8)	(16.6)	(14.1)	
Total	1,950	14,351	4,753	21,055	48.8
	(9.3)	(68.2)	(22.6)	(100.0)	
	(100.0)	(100.0)	(100.0)	(100.0)	

Base: All Dwellings

Table 1.7 Analysis of SAP - by age of household representative

count(000s), (row%), (column%)

	Less than 30	30 - 60	60 or more	Total	Mean SAP
16 - 29	108	1,041	587	1,736	53.1
	(6.2)	(60.0)	(33.8)	(100.0)	
	(5.5)	(7.3)	(12.3)	(8.2)	
30 - 44	430	4,305	1,561	6,296	50.2
	(6.8)	(68.4)	(24.8)	(100.0)	
	(22.1)	(30.0)	(32.8)	(29.9)	
45 - 64	774	5,440	1,495	7,709	47.5
	(10.0)	(70.6)	(19.4)	(100.0)	
	(39.7)	(37.9)	(31.5)	(36.6)	
65 or over	638	3,566	1,110	5,314	47.5
	(12.0)	(67.1)	(20.9)	(100.0)	
	(32.7)	(24.8)	(23.4)	(25.2)	
Total	1,950	14,351	4,753	21,055	48.8
	(9.3)	(68.2)	(22.6)	(100.0)	
	(100.0)	(100.0)	(100.0)	(100.0)	

Base: All Dwellings

Table 1.8 Analysis of SAP - by household income

count(000s), (row%), (column%)

	Less than 30	30 - 60	60 or more	Total	Mean SAP
Quintile 1: < £10k	431	2,520	1,247	4,198	50.5
	(10.3)	(60.0)	(29.7)	(100.0)	
	(22.1)	(17.6)	(26.2)	(19.9)	
Quintile 2: £10k - £15k	384	2,790	1,032	4,206	49.5
	(9.1)	(66.3)	(24.5)	(100.0)	
	(19.7)	(19.4)	(21.7)	(20.0)	
Quintile 3: £15k - £22k	363	2,986	863	4,211	48.7
	(8.6)	(70.9)	(20.5)	(100.0)	
	(18.6)	(20.8)	(18.2)	(20.0)	
Quintile 4: £22k - £33k	342	3,026	847	4,216	48.4
	(8.1)	(71.8)	(20.1)	(100.0)	
	(17.5)	(21.1)	(17.8)	(20.0)	
Quintile 5: > £33k	430	3,029	764	4,223	46.7
	(10.2)	(71.7)	(18.1)	(100.0)	
	(22.0)	(21.1)	(16.1)	(20.1)	
Total	1,950	14,351	4,753	21,055	48.8
	(9.3)	(68.2)	(22.6)	(100.0)	
	(100.0)	(100.0)	(100.0)	(100.0)	

Base: All Households