Annex D: Energy Efficiency Measures in Homes

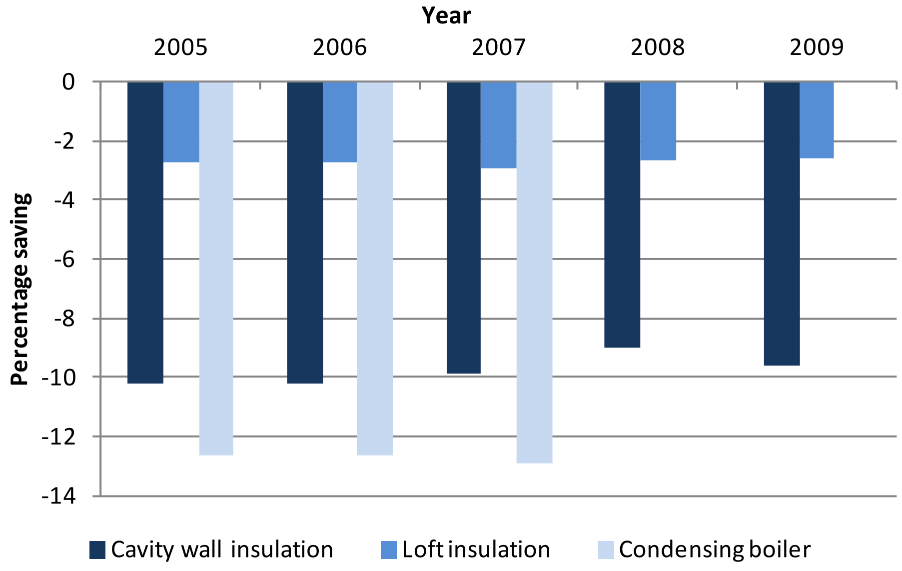
Contents

1. Executive Summary

This annex sets out information on the types of properties which have received energy efficiency measures and the impact of installing these measures on a household's gas consumption.

The analysis shows that considerable savings can be made by installing energy efficiency measures in homes. It also highlights the variation in the observed savings for different types of properties and occupants. Figure 1.1 shows the typical savings for households which use gas as the primary heating fuel for the three main measures considered in this report.

Figure 1.1 Summary of observed savings for energy efficiency measures (median)

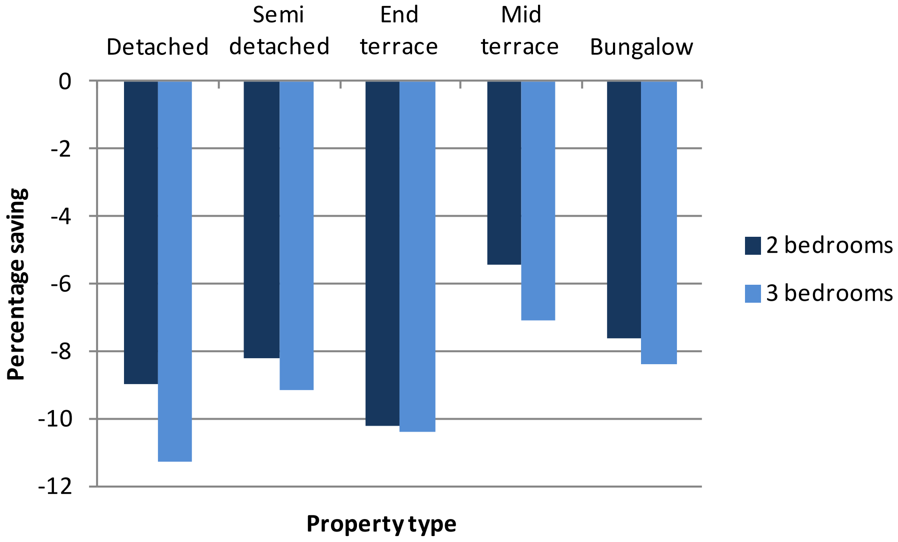


The percentage saving for each of these measures is consistent across all the years considered. However, the typical kWh savings have decreased over time as typical gas consumption has decreased[1]. These estimates of kWh savings are based on average gas consumption for a three bedroom semi detached property[2] which has not had a measure installed. Savings estimates from NEED reflect observed savings, giving the saving after comfort taking[3] and an average for all properties irrespective of whether the measure has been installed fully throughout the property[4]. As a result there will be differences between the savings estimates reported in NEED and more technical physics based estimates. These savings estimates reflect what occurs in practise.

[1] It should be noted that the data used for this analysis are weather corrected. This is important to ensure comparability between years but masks the variation in savings occurring as a result of different temperatures during the heating season. For example, in a year with a cold winter households will experience a greater absolute saving than they would in a warmer year.
[2] A three bedroom semi detached property represents the typical house in England, it is the most common property category making up 18 per cent of the housing stock.
[3] Comfort taking is where some households take the benefit of the insulation measure through increased warmth rather than entirely through energy saving.
[4] For example, cavity wall insulation may not have been installed in all walls due to a garage or conservatory on one or more walls.

Results in this annex also highlight the variation in savings seen in different types of properties and for different households. Figure 1.2 shows the variation in savings for two and three bedroom properties having cavity wall insulation installed by property type. Larger properties tend to see the greatest percentage saving following the installation of energy efficiency measures and this is reflected in the fact that, for all property types, three bedroom properties have greater median savings than two bed properties.

Figure 1.2: Observed savings from cavity wall insulation for two and three bedroom properties, by property type, 2009



Similar robust analysis of solid wall insulation was not possible due to data availability. However, a preliminary assessment reflecting the savings for the types of properties that have received solid wall insulation through Government schemes between 2005 and 2008 is included. Due to the policy under which most of these measures have been installed, a high proportion of these households are in the Priority Group and are therefore not typical of the population as a whole. From these households there are not enough observations to be able to draw reliable conclusions about the typical saving for all solid wall properties. However, it is estimated that for the types of properties which have received solid wall insulation (mainly smaller, council or housing association properties), the typical saving in annual gas consumption was 12.1 per cent. For a number of reasons (described further in Section 5), this is likely to be an underestimate of the typical saving for solid wall properties in the population as a whole.

The analysis from NEED will help support the development of key DECC policies, including the Green Deal, and will be used alongside other evidence to help understand observed savings, and how and why these differ from physics based estimates.

2. Introduction

The uptake of energy efficiency measures has been encouraged over recent years through Government schemes such as the Energy Efficiency Commitments (EEC), the Carbon Emissions Reduction Target[5] (CERT), the Community Energy Saving Programme[6] (CESP) and Warm Front[7]. CERT, for example, places an obligation on energy suppliers to reduce the amount of CO_2 emitted by households. Energy suppliers then meet this target by promoting uptake of low carbon energy solutions to domestic energy consumers.

The current Government schemes are due to end in December 2012. New schemes such as the Green Deal and the Energy Company Obligation (ECO) will replace them, aiming to continue to improve the energy efficiency of the housing stock. It therefore remains important to understand where measures have been installed and how much they save, both to help understand the impact of past policy and help with the effective delivery of future policy.

This annex covers:

- take up rates of energy efficiency measures;
- the impact of having energy efficiency measures installed on gas consumption; and
- an initial assessment of the longer term impact of measures.

The energy efficiency measures included in this analysis are: cavity wall insulation, professionally installed loft insulation, condensing boilers and solid wall insulation. Cavity wall, solid wall and loft insulation all involve the installation of material to reduce heat loss, which in turn can reduce the amount of energy required to heat a home. Condensing boilers are often used to replace older, less efficient boilers. This means that following installation of a condensing boiler it should require less energy to heat a home.

This annex provides more detailed results for the analysis covered in Section 5 of the main report. It also includes a more detailed description of the methodology used for estimating the impact of the installation of energy efficiency measures on the amount of gas required to heat homes.

The analysis is based on observed savings and will therefore take into account factors such as comfort taking (where some households take the benefit of the insulation measure through increased warmth rather than entirely through energy savings), and the fact that not all measures can be installed in every wall of a home. As a result there will be differences between the observed estimates and more technical physics based estimates. However, the savings estimates from NEED are valuable as they are a reflection of what occurs in practise.

As in Section 5 of the main report, the data on measures installed in households are from the Homes Energy Efficiency Database (HEED. HEED picks up many of the measures installed through Government schemes, but cannot pick up measures installed in properties when they

[5] http://www.decc.gov.uk/en/content/cms/funding/funding_ops/cert/cert.aspx
[6] http://www.decc.gov.uk/en/content/cms/funding/funding_ops/cesp/cesp.aspx
[7] http://www.decc.gov.uk/en/content/cms/funding/warm_front/warm_front.aspx

are built or other measures installed outside Government schemes, such as loft insulation installed by the household themselves (DIY loft insulation).

Many of the energy efficiency measures delivered through Government schemes are aimed at poorer homes in order to support DECC's fuel poverty targets while reducing emissions. For example, in CERT, suppliers are required to meet 40 per cent of their total target energy savings by delivering measures to a 'Priority Group' of vulnerable and low-income households, including those in receipt of eligible benefits and pensioners over the age of 70. This means that poorer households are over represented in the measures picked up in HEED. More information on the data in HEED including an assessment of its quality is included in Annex B.

3. Rates of Take Up

NEED can be used to look at the take up of different energy efficiency measures by property attributes and household characteristics, specifically, property age, property type, number of bedrooms, floor area, household income and tenure. The dataset used in this section of analysis covers records in NEED where HEED data could be matched to the Valuations Office Agency (VOA) property attribute data. HEED has good coverage of energy efficiency measures installed under CERT, but progressively less coverage of early policies aimed at improving the energy efficiency of the housing stock. It also has no coverage of measures installed by the home owner themselves and the measures installed in a property when it is built.

Installations of solid wall insulation have been included in the following analysis, however it should be noted that only 13,000 homes included in this section of analysis have had solid wall insulation installed (0.2 per cent of solid wall properties in England[8]). It should also be noted that properties using different types of heating fuel have been included when looking at take up of measures while the savings estimates covered in later parts of this annex only refer to measures installed in properties which use gas as their main heating fuel. Also, flats are included in this section of analysis, however they are not included in the impact of measures analysis. This is because the analysis is carried out at a property level and in a large number of cases insufficient address details were available to identify which flat within a building received the energy efficiency measures and therefore the measure could not be accurately match to the appropriate consumption.

The analysis of the take up of measures is included to provide an understanding of the distributional differences in rates of take up, it is not intended to be an accurate reflection of the total proportion of properties that have had each measure installed. For a more complete picture of the total number of homes in Great Britain with cavity wall, loft and solid wall insulation users should refer to 'Estimates of Home Insulation Levels in Great Britain'[9]. This is based on national housing surveys from April 2008 and measures installed through Government schemes since April 2008, including DIY loft insulation. It also takes into account new builds and other changes to the housing stock such as demolitions and change in building use.

3.1 Property age

Figure 3.1 shows the proportion of properties which have received energy efficiency measures in each property age category. Properties built between 1945 and 1982 were most likely to have received retro-fit cavity wall insulation (CWI), with 29 per cent of properties built between 1945 and 1964 having had CWI installed and 26 per cent of properties built between 1965 and 1982 receiving the measure. Properties built outside this period are much less likely to have had retro-fit cavity wall insulation installed, especially pre 1919 when the majority of properties would have been of solid wall construction and therefore unsuitable for cavity wall insulation, and post 1983 when properties started to have their cavity walls insulated or partially insulated when built. A similar amount of loft insulation has been installed in properties of all ages up to

[8] This is based on the number of solid wall properties reported in the English Housing Survey: Homes Report 2010 http://www.communities.gov.uk/publications/corporate/statistics/ehs2010homesreport.

[9] http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/en_effic_stats/home_ins_est/home_ins_est.aspx

1992. As with cavity wall insulation, properties built more recently have lower take up rates as they will have had loft insulation installed when they were built. Condensing boilers have been installed in less than ten per cent of properties in each age group, with the proportion in each property age group ranging from three to eight per cent. However it should be noted that information on condensing boilers installed is only available up to 2008.

Figure 3.1: Energy efficiency measures installed as a proportion of all properties, by property age

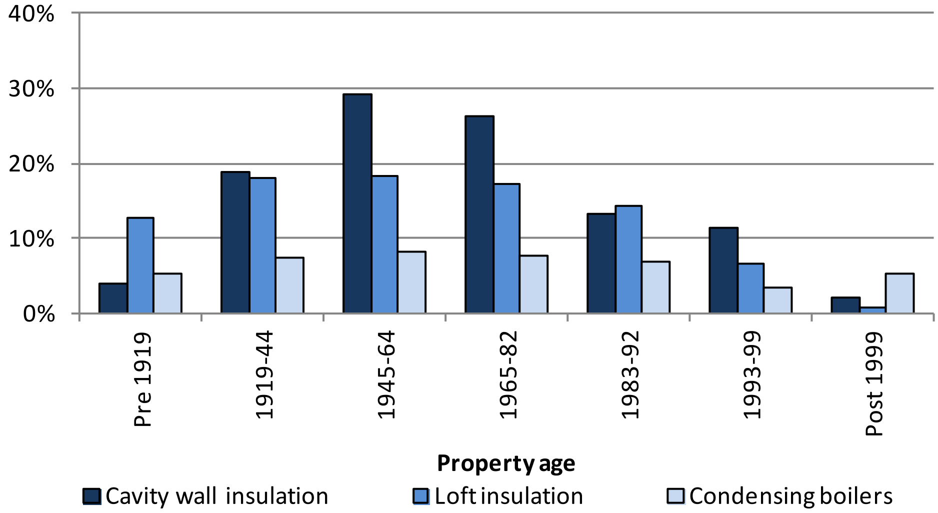
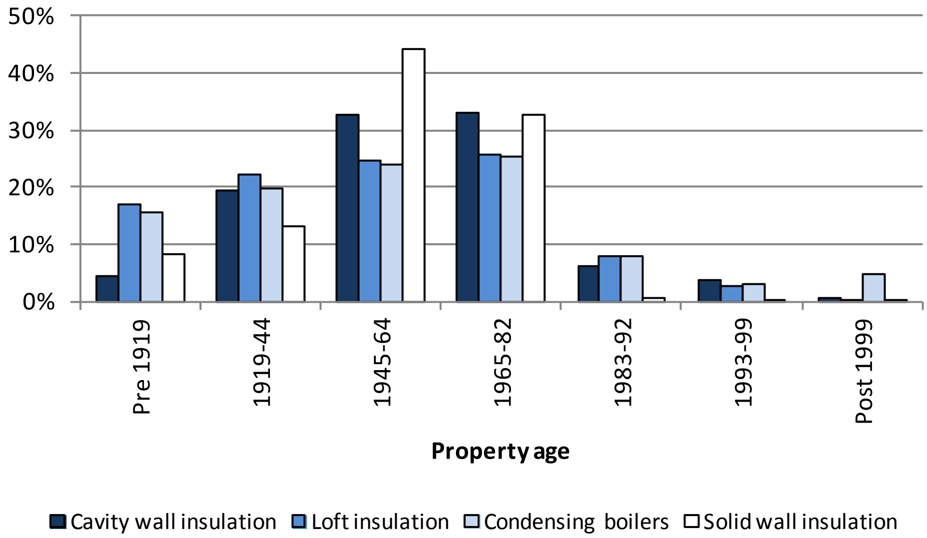


Figure 3.2 shows the distribution of installations of energy efficiency measures by property age. When looking at cavity wall insulation it shows that 90 per cent of installations were carried out on properties built before 1983. The number of installations carried out in post 1983 properties is much lower since most of these properties would have been built with filled cavities in order to comply with building regulations[10] at the time of construction. Similarly 89 per cent of installations of loft insulation were carried out on properties built before 1983. The proportion of condensing boilers installed in properties built before 1983 was slightly lower (84 per cent) – this is due to newer properties having their older boilers replaced with more energy efficient condensing boilers. A boiler typically lasts around 10 years, while other energy efficiency measures such as cavity wall and loft insulation last a lot longer (around 40 years). Nearly all (98 per cent) solid wall insulation installed was in properties built before 1983, reflecting the change in construction of dwellings from solid wall to cavity. However, nearly half (44 per cent) of solid wall insulation has been delivered into properties built between 1945 and 1964, this is likely to be because of the focus on social housing in Government schemes delivering solid wall insulation, and the efficiency in installing solid wall insulation in multiple properties at the same time.

[10] Building Regulations Part L (Conservation of fuel and power) – see Annex G for details.

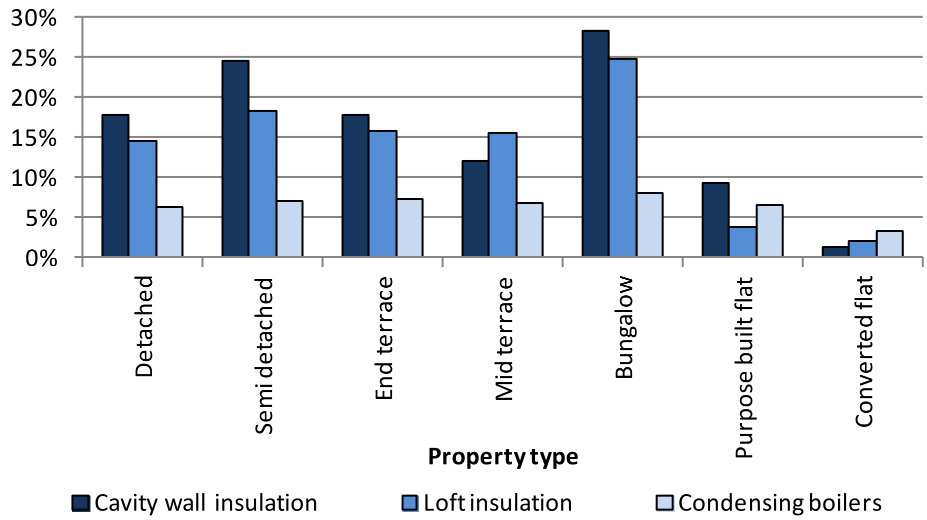
Figure 3.2: Installation of energy efficiency measures, by property age



3.2 Property type

Figure 3.3 shows the percentage of each property type which has received an energy efficiency measure. It shows that bungalows have had the highest proportion of energy efficiency measures installed, with 28 per cent of them having had cavity wall insulation, a quarter having had loft insulation and eight per cent having had a replacement condensing boiler installed. This probably reflects the fact that people in these properties are more likely to be eligible for assistance from energy efficiency schemes. Energy efficiency measures are next most likely in semi detached properties; a quarter have had cavity wall insulation installed and 18 per cent have had loft insulation installed. Flats are least likely to have had an energy efficiency measure installed, with nine per cent of purpose built flats having had cavity wall insulation and four per cent having had loft insulation[11].

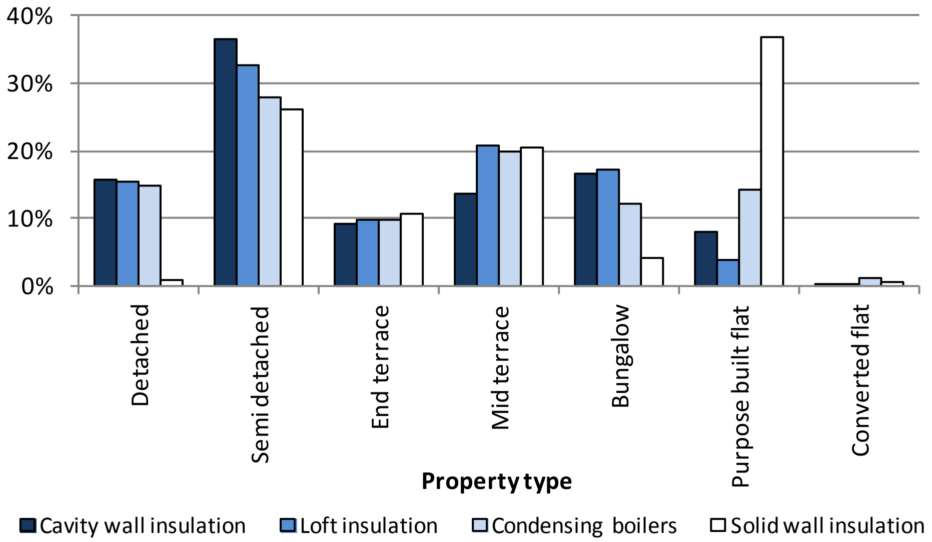
Figure 3.3: Energy efficiency measures installed as a proportion of properties, by property type



[11] Flats are underrepresented in HEED since it is not always possible to identify which flat within a building received the energy efficiency measure. This is particularly problematic in converted flats.

Figure 3.4 shows the distribution of measures installed by property type. It shows that semi detached properties were the most likely to have received cavity wall insulation, loft insulation and condensing boilers. This is consistent with semi detached properties being the most common property type; 27 per cent of properties in the sample are semi detached properties. Just over a third of solid wall insulation (37 per cent) has been installed in purpose built flats, with a further 26 per cent being installed in semi detached properties and very little (one per cent) in detached properties. The high number of occurrences of solid insulation in purpose built flats is due to the efficiency of installing solid wall insulation in multiple properties at the same time and because of the focus on installing energy efficiency measures in homes in the Priority Group.

Figure 3.4: Installations of energy efficiency measures, by property type



3.3 Number of bedrooms

Figure 3.5 shows the percentage of properties with measures installed by number of bedrooms. It shows that three bedroom properties are the most likely to have had cavity wall and loft insulation – 22 and 18 per cent respectively. The installation of condensing boilers shows less differentiation between the different categories, with approximately seven per cent having had a condensing boiler installed in all cases.

Figure 3.5: Energy efficiency measures installed as a proportion of all properties, by number of bedrooms

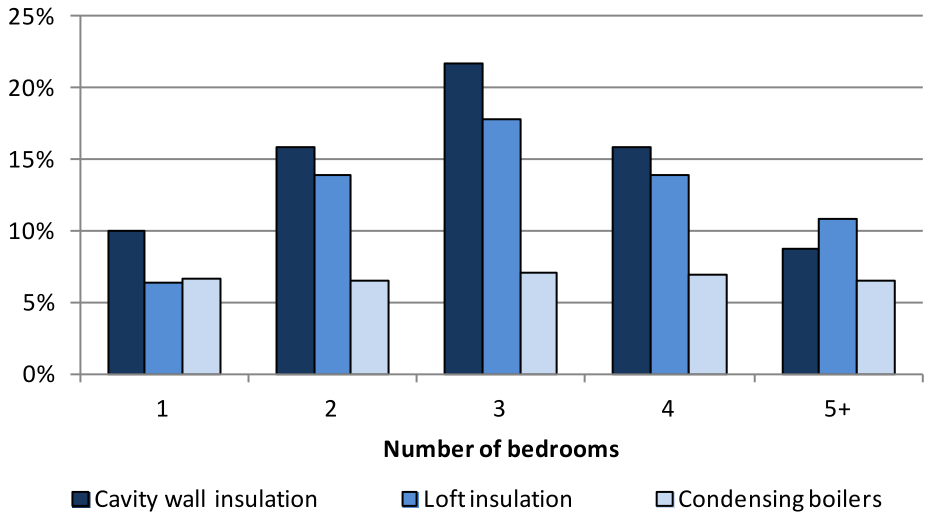
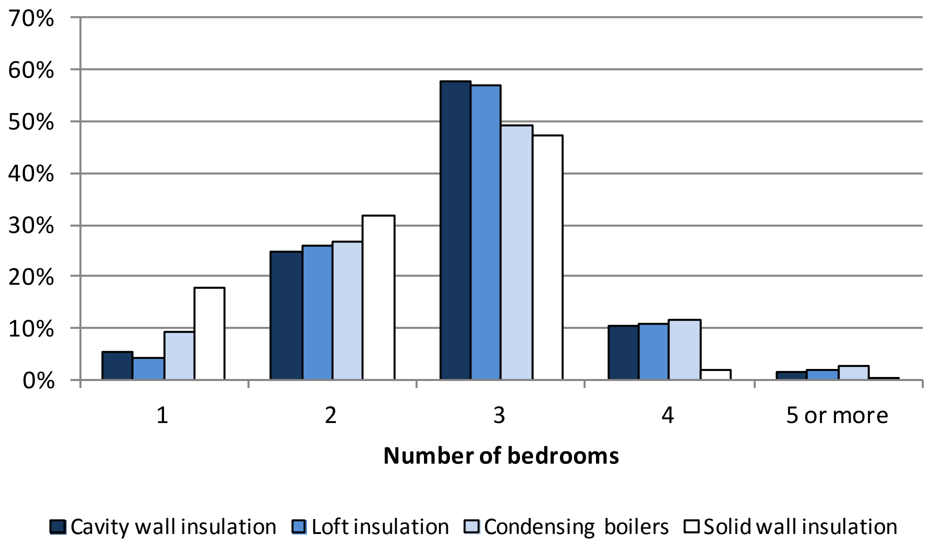


Figure 3.6 shows that around 60 per cent of cavity wall and loft insulation installations have taken place in homes with three bedrooms. This reflects the fact that this is the most common category (48 per cent of properties in the sample had three bedrooms). Similarly around 50 per cent of installations of solid wall insulation and condensing boilers have taken place in homes with three bedrooms. Around a quarter of installations of cavity wall insulation, loft insulation and condensing boilers have taken place in homes with two bedrooms.

Figure 3.6: Installations of energy efficiency measures, by number of bedrooms



3.4 Floor area

Figure 3.7 shows that around 20 per cent of properties with a floor area of between 51 to 100, and 101 to 150 square metres have had cavity wall insulation installed. Similarly, 17 per cent of properties with the same floor areas have had loft insulation installed. Properties with a floor area of between 1 and 50, and greater than 250 square metres are least likely to have had energy efficiency measures installed. The installation of condensing boilers shows little differentiation between the floor area of a property, with approximately seven per cent of properties in each category having had a condensing boiler.

Figure 3.7: Energy efficiency measures installed as a percentage of properties, by floor area

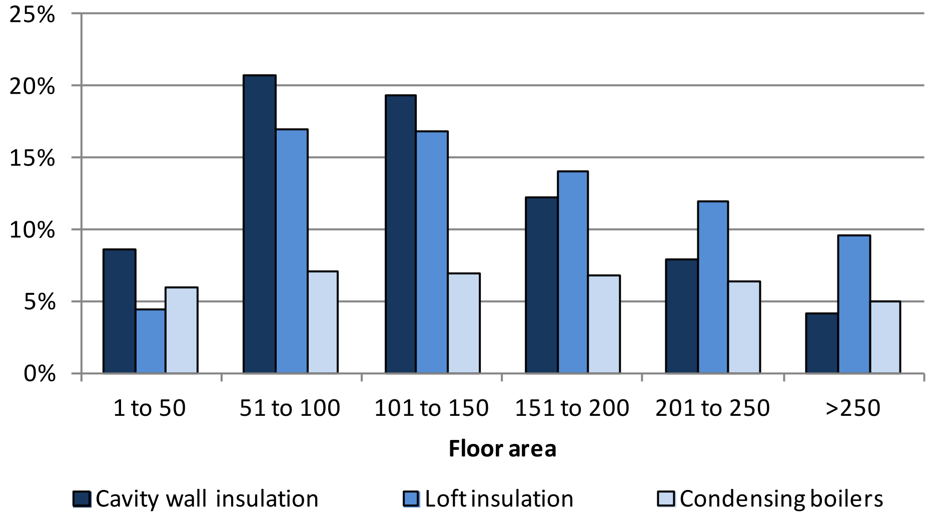
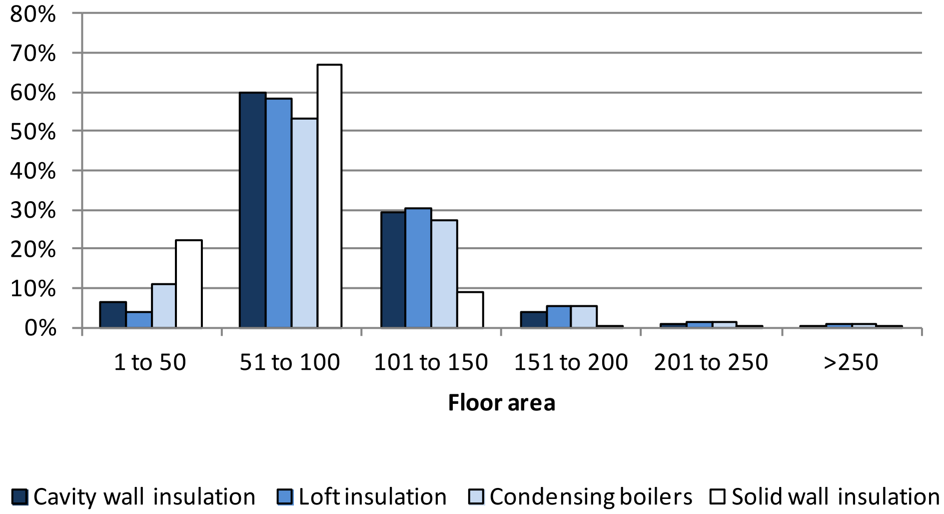


Figure 3.8 shows that around 60 per cent of all cavity wall and loft insulation installations have been installed in properties with a floor area of between 51 and 100 square metres – 51 per cent of properties in the analysis sample had a floor area in this range. A further 30 per cent have been carried out in properties with a floor area of between 101 and 150 square metres. A third of all installations of solid wall insulation have been carried out on properties with a floor area of 51 to 100 square metres.

Figure 3.8: Installations of energy efficiency measures, by floor area



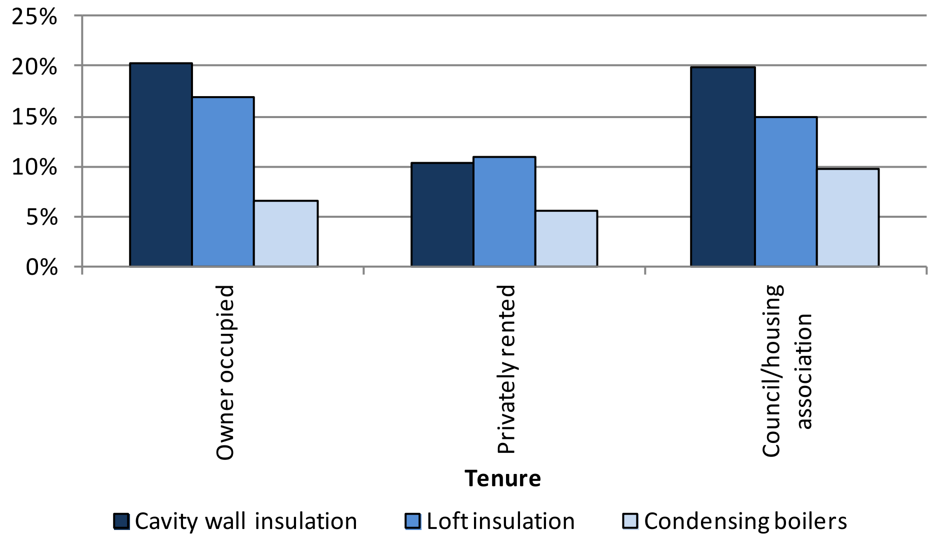
3.5 Tenure[12,13]

Figure 3.9 shows that a similar proportion of owner occupied properties have had cavity wall insulation and loft insulation installed, 20 and 17 per cent respectively. Similarly, 20 per cent of

[12] Breakdowns by tenure are not available for solid wall insulation.
[13] Data on tenure is not available for all properties included in the NEED sample and therefore totals do not sum to 100 per cent.

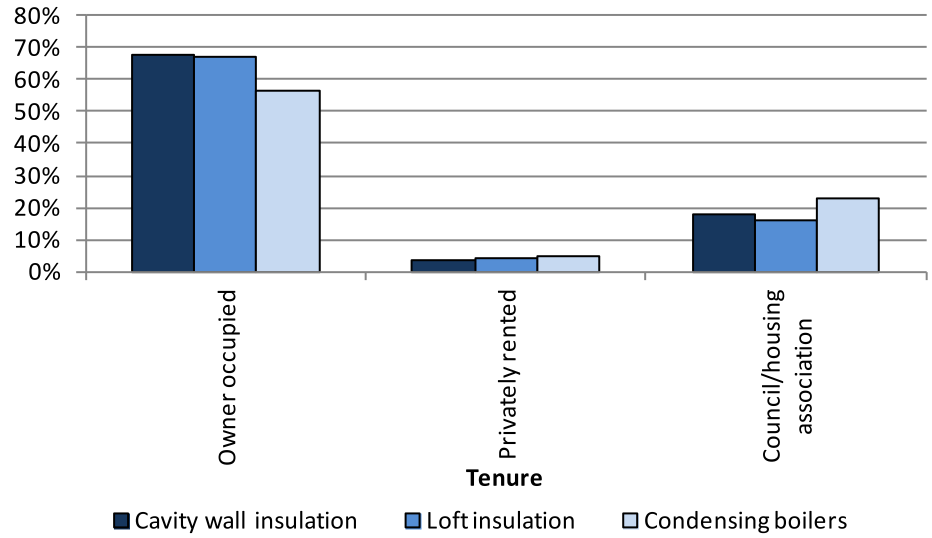
council owned properties have cavity wall insulation, and 15 per cent have loft insulation. Privately rented properties are least likely to have any of the three energy efficiency measures looked at, with ten per cent having cavity wall insulation, 11 per cent with loft insulation and six per cent with a condensing boiler. Privately rented properties could be less likely to have cavity wall and loft insulation because the owner of the property would not see the benefit from having the measure installed as they do not occupy the property themselves.

Figure 3.9: Energy efficiency measures installed as a percentage of properties, by tenure



Two thirds of cavity wall and loft insulation installations have occurred in owner occupied properties (73 per cent of the NEED sample is made up of owner occupied properties). A further 18 per cent of cavity wall insulation and 16 per cent of loft insulation has been installed in council owned properties. Less than five per cent of cavity wall and loft insulation installations have taken place in privately rented properties. When looking at condensing boilers, 57 per cent have been installed in owner occupied properties and just under a quarter have been installed in council owned properties.

Figure 3.10: Installations of energy efficiency measures, by tenure



3.6 Income[14,15]

Figure 3.11 shows that those properties with a household income of between £10,000 and £14,999 are most likely to have had cavity wall and loft insulation installed, with 24 per cent having had cavity wall insulation and 22 per cent having had loft insulation. For cavity and loft insulation the proportion of properties with the measure decreases as household income increases. The installation of condensing boilers shows little differentiation between household income groups, with approximately seven per cent having had a condensing boiler installed in all cases.

Figure 3.11: Energy efficiency measures installed as a percentage of properties, by income

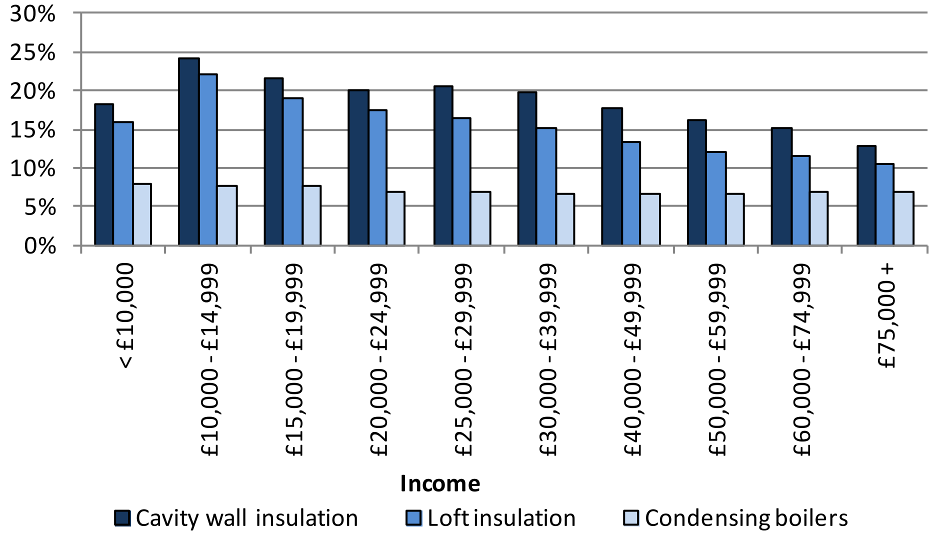
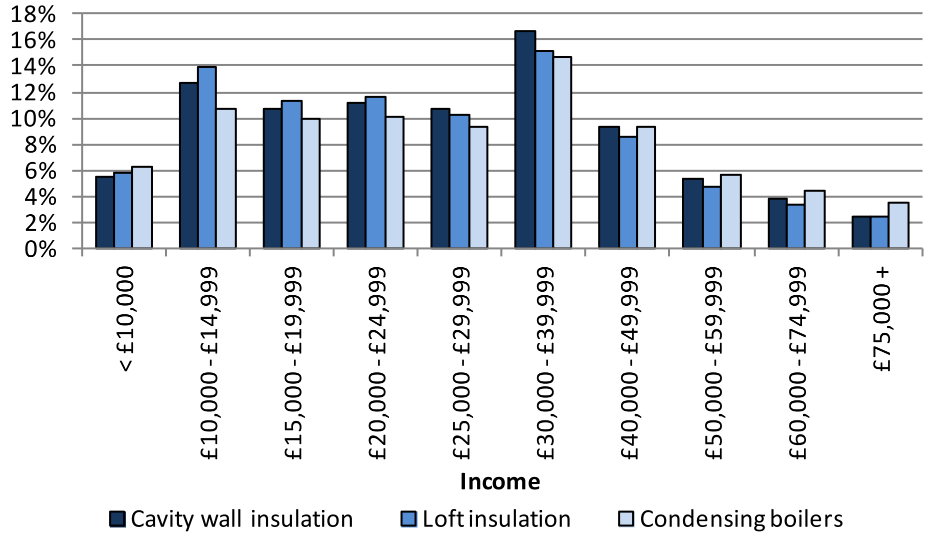


Figure 3.12 shows the distribution of measures by household income band.

Figure 3.12: Installations of energy efficiency measures, by income



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14 Breakdowns by income are not available for solid wall insulation.

15 Household income is not available for all properties included in the NEED sample and therefore totals do not sum to 100 per cent.

The highest proportion of installations of cavity wall insulation, loft insulation and condensing boilers have been installed into properties with a household income of between £30,000 and £39,999. A similar proportion of properties have had each energy efficiency measures installed in the household income groups between £15,000 and £29,000. The proportion of properties having each energy efficiency measure installed decreases when household income reaches £39,999. This is consistent with the fact that the number of households in each band decreases as income increases above £39,999.

4. Methodology – Impact of Energy Efficiency Measures

This section outlines the methodology for estimating the impact of the installation of retro-fit energy efficiency measures on the amount of gas required to heat homes. For the analysis in this report a difference in difference approach has been used to estimate savings. This section summarises this approach and assumptions made in order to produce the estimates.

The impact of installing energy efficiency measures on a household's gas consumption is estimated by comparing the gas consumption of properties before and after installation of a specific energy efficiency measure, with the gas consumption of similar properties which have not had an energy efficiency measure installed. To do this, intervention and comparator groups are created – with the intervention group containing properties which have received the energy efficiency measure being considered (and no other measure), and the comparator group containing similar properties that have not had an energy efficiency measure installed[16]. Headline savings in the report are based on the percentage savings observed. The kWh saving estimates are calculated by applying the percentage saving to the typical gas consumption of a three bedroom semi detached house – except for solid wall insulation which is calculated slightly differently due to the nature of the properties receiving this measure to date (this is explained in more detail in the results section below).

The benefit of the approach used in NEED is that it allows for a better understanding of the observed savings from energy efficiency measures and compliments DECC's understanding of the technical potential of such measures. Savings estimated based on this approach are expected to be lower than the technical potential of a measure because of factors such as comfort taking[17] or incomplete installations (such as not all walls being insulated when a property received cavity or solid wall insulation). It also means the saving estimates are based on the actual gas use of the households receiving the measure rather than the modelled consumption which is assumed when calculating the technical potential[18].

The rest of this section provides details on how the intervention and comparator groups were formed and how the methodology has been developed since the previous publication of results using data from NEED.

4.1 Intervention group

A separate intervention group was created for each of the energy efficiency measures considered and for each year being investigated. To be included in the intervention group properties must have had the measure under consideration installed in the stated year, and meet the following conditions:

[16] This group has no energy efficiency measure recorded as being installed in HEED. These properties may have had a measure installed which has not been recorded in HEED, such as DIY loft insulation.

[17] Comfort taking is a rebound effect where some households take the benefit of the insulation measure through increased warmth rather than entirely through energy saving (or reduced bills).

[18] Some pilot work has been carried out using the EHS to look at the difference between modelled and observed consumption. More information about this work can be found in Section 6.1 of the Annual Report on Fuel Poverty Statistics 2012 here: http://www.decc.gov.uk/assets/decc/11/stats/fuel-poverty/5270-annual-report-fuel-poverty-stats-2012.pdf.

- Properties must have had no other significant energy efficiency measure recorded as being installed in the period.
- Records have to have a valid gas consumption (between 2,500 and 50,000 kWh) in the year the energy efficiency measure was installed, and the year before and after installation – since these are the years gas consumption will be looked at to see how much change there has been.
- Gas consumption values which are suspected to be estimated are excluded – a value is considered to be estimated if it is the same value as the year before, or if it is one of a number of suspected estimated readings, based on the frequency of each gas consumption value in the data.
- In addition, if a property's gas consumption has increased by 50 per cent or more, or decreased by 80 per cent or more then it is excluded, since it is likely something other than the installation of the measure is causing this change, such as a change in occupants or their circumstances.
- Flats are excluded from this analysis because in a large number of cases insufficient address details were available to identify which flat within a building had the energy efficiency measure installed and therefore it was not possible to identify which gas meter related to the flat which received the measure.

To illustrate the above, the table below summarises the conditions that had to be met for a property record to be included in the cavity wall insulation 2009 intervention group.

Table 4.1: Summary of intervention group conditions, cavity wall insulation 2009

Variable	Condition
Date of installation	Cavity wall insulation recorded as being installed between 1st January 2009 and 31st December 2009 (inclusive).
Energy efficiency measures	No record of loft insulation, solid wall insulation, double glazing, draught proofing or heating measures being installed.
Gas consumption	Gas consumption in 2008, 2009 and 2010 between 2,500 kWh and 50,000 kWh. Estimated readings are excluded – this includes where the gas consumption reading is the same as the previous years, or where the reading is one of a number of suspected estimated values used by energy companies.
Change in gas consumption	Properties with an increase in gas consumption between 2008 and 2010 of more than 50 per cent or a decrease in gas consumption of more than 80 per cent are excluded.
Property type	Flats are excluded due to insufficient address details being available to identify which flat in a block received the energy efficiency measure.

Although applying the above conditions to each intervention group does reduce the number of records in each sample they are necessary to make the analysis as robust as possible. For example by excluding other energy efficiency measures known to have the biggest impact on gas consumption gives more confidence that any change in consumption is a result of the energy efficiency measure being considered.

However, the intervention group cannot be analysed in isolation since a reduction in gas consumption could be down to a number of factors such as a change in energy prices, energy efficiency awareness or changes in household size or occupants – as well as the presence of an energy efficiency measure. Comparing the intervention group with a comparator group who have similar characteristics but have not had a measure installed attempts to control for some of this other variation and provide a more accurate estimate of the impact of the energy efficiency measure.

4.2 Comparator group

As the analysis was carried out retrospectively it was not possible to create a control group in advance of measures being installed. Therefore a comparator group was created retrospectively. A separate comparator group was created for each measure for each intervention year – this was made up of properties with no record of ever having had the following energy efficiency measures installed (as recorded in HEED): cavity wall insulation, loft insulation, heating measures, solid wall insulation, double glazing and draught proofing. In addition, as outlined in the intervention group section above, the gas consumption has to be valid and flats were excluded. All the conditions applied to the intervention group were also applied to the comparator group (with the exception of the installation of the energy efficiency measure being considered).

The comparator group was selected using stratified random sampling. The sample was constructed to have the same characteristics as the intervention group, by selecting a sample which has the same proportion of properties with given characteristics[19]. The variables that the comparator group was stratified by were region, gas bands[20], property age, property type and number of bedrooms.

In all cases, except solid wall insulation, the comparator group was selected to be the same size as the intervention group. For solid wall insulation, because of the small number of installations of solid wall insulations observed, the comparator group was ten times bigger than the intervention group. This was intended to reduce some of the variability which would have been observed if a smaller sample had been used.

4.3 Changes to previous methodology

There have been a number of changes to the methodology used to estimate the impact of energy efficiency measures analysis since the last NEED publication[21]. The previous publication created only one comparator group. Each energy efficiency measure was then

[19] Some variables had to be grouped when the sample was created to ensure there were enough properties in each group, for example two and three bed properties were grouped together.
[20] Gas bands were created using gas consumption in the year before the intervention was delivered, the first gas band was 2,500 kWh to 4,000 kWh, they then increased in intervals of 2,000 kWh up to 50,000 kWh.
[21] http://www.decc.gov.uk/media/viewfile.ashx?filetype=4&filepath=11/stats/energy/energy-efficiency/2078-need-data-framework-report.pdf&minwidth=true

compared to this single comparator group. The current methodology involves creating a stratified comparator group which is unique for each intervention and year. This means each comparator group is more representative of the intervention group giving more confidence that any difference in the change in gas consumption is due to the energy efficiency measure installed rather than differences between the two groups.

In the previous NEED publication, where a gas consumption value was the same as the previous years it was excluded as it was likely to be an estimated reading. The current methodology continues to exclude these records, but additionally excludes a small number of specific gas consumption readings which are suspected to be estimated readings, based on the frequency of each gas consumption value in the data.

Previously there was no restriction on the scale of changes in annual gas consumption. The current methodology excludes properties whose gas consumption has increased by 50 per cent or more or decreased by 80 per cent or more, since it is likely something other than the installation of an energy efficiency measure is causing the change in consumption, such as a change of occupants or their circumstances.

Finally, there is no longer an adjustment for measures which are not recorded in HEED[22]. Measures are still being installed which are not picked up by HEED, however the uncertainty surrounding any attempt to quantify these combined with the improvements to the methodology mean that it should be less of an issue and therefore is no longer being reported or applied to the estimates. The improvements to the comparator groups mean these groups should be more similar to the intervention group and it is therefore likely that in the majority of cases measures are being missed equally in both groups. In the circumstances where this is not the case (such as DIY loft insulation for estimates of the saving from professional loft insulation), the impact on the comparator groups consumption over the period is estimated to be so small (less than 100 kWh) that the level of adjustment would be within the uncertainty of the results presented in this report.

[22] A 170 kWh upward adjustment was made to all estimates in the previous publication of results from NEED to account for measures which had been installed in households but not picked up in HEED, such as loft insulation installed by home owners themselves and boilers not registered with Gas Safe (or CORGI).

5. Results – Impact of Energy Efficiency Measures

The impact of measures analysis covers the following energy efficiency measures:

- cavity wall insulation installed in 2005 to 2009;
- loft insulation installed in 2005 to 2009;
- condensing boilers installed in 2005 to 2007; and
- solid wall insulation installed between 2005 and 2008.

Estimates of the saving from the installation of solid wall insulation in 2009 is not included as there were not sufficient records to undertake robust analysis. Information about boilers installed between mid 2008 and the end of 2009 was not available, so there is no assessment of the impact of replacement boilers for 2008 or 2009 in this report.

All analysis looks at the saving in gas consumption for households which use gas as their main heating fuel.

When interpreting the results in this section, it should be noted that there is a degree of uncertainty around all the results presented. While there is no value put on this uncertainty in this report, users should be aware the savings experienced by any specific household are dependent on a number of factors. The median and mean savings provide a headline estimate for typical or average savings for the dwelling stock as a whole while the information on the range of savings and on the savings for specific property types and household characteristics provide a better indication of what a specific household might expect to save.

As described above, these estimates are based on observed savings and therefore show the savings after comfort taking and an average for all properties irrespective of whether the measure has been installed fully throughout the property. This means that individual households have the potential to make a greater saving than the results set out in this report, but there are also circumstances when a household may save less. As seen in the energy consumption section, household behaviours which cannot be measured using data in NEED have a significant impact on a household’s consumption and would therefore also have an impact on the amount of gas a household could expect to save from the installation of a particular energy efficiency measure.

The headline results for each energy efficiency measure for each available year are presented below. Key findings for property attributes and household characteristics for the most recent year available are also included. Further tables for all available property attributes and household characteristics by year have been published alongside this annex[23].

5.1 Cavity wall insulation

Table 5.1 shows the mean saving for properties which had retro-fit cavity wall insulation installed in each year from 2005 to 2009. Properties receiving cavity wall insulation in 2009 had a mean decrease in consumption of 18.9 per cent while the comparator group experienced a mean decrease in consumption of 10.3 per cent. On the assumption that the two groups are the same in all respects except the installation of cavity wall insulation, this suggests that the

[23] http://www.decc.gov.uk/en/content/cms/statistics/energy_stats/en_effic_stats/need/need.aspx

saving from having the cavity wall insulation installed was 8.6 percentage points (the difference between the change in consumption for these two groups). Based on average gas consumption for a three bedroom semi detached property[24] in 2008 (i.e. the year before the intervention), this gives a mean saving of 1,600 kWh for these types of homes having cavity wall insulation installed in 2009. Table 5.2 shows the median saving for properties receiving cavity wall insulation over the same period. The median saving represents the saving for a typical house. The median saving for properties receiving cavity wall insulation was 9.6 percentage points for 2009. Typical gas consumption in 2008 for a three bedroom semi detached property was 17,900 kWh, which gives a typical annual saving of 1,700 kWh for these types of homes having cavity wall insulation installed in 2009.

The percentage difference between properties receiving cavity wall insulation and the comparator group is consistent across all five years, with mean savings ranging from 8.2 to 8.9 per cent, and median savings ranging from 9.0 to 10.2 per cent. However, the kWh typical savings have decreased over time as typical gas consumption for all properties has decreased in all years between 2004 and 2010. It should be noted that the data used for this analysis are weather corrected. This is important to ensure it is possible to compare gas consumption over time, but masks the variation in savings which would be seen as a result of the temperature during the heating season. For example, in a year with a cold winter households will experience a greater kWh saving than they would in a warmer year.

Table 5.1: Summary of observed savings (mean) – cavity wall insulation

	2005	2006	2007	2008	2009
%	-8.9	-8.9	-8.4	-8.2	-8.6
kWh	-1,900	-1,800	-1,700	-1,600	-1,600

Table 5.2: Summary of observed savings (median) – cavity wall insulation

	2005	2006	2007	2008	2009
%	-10.2	-10.2	-9.9	-9.0	-9.6
kWh	-2,100	-2,000	-1,900	-1,700	-1,700

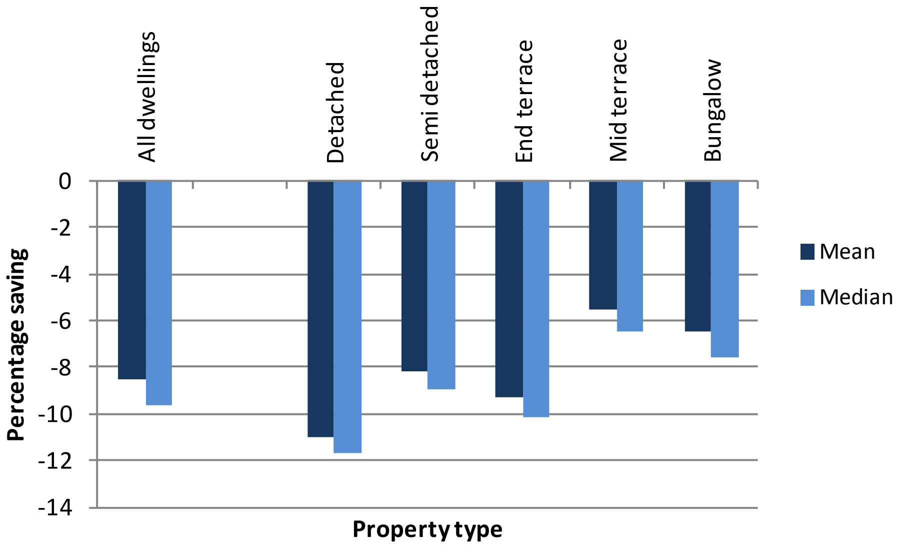
These estimates are based on the savings for the properties recorded as receiving measures in the NEED sample (i.e. in HEED), applied to typical consumption for a three bedroom semi detached house. This means that while the results are representative as far as possible, due to the insulation measures picked up in NEED it is likely that the results are a lower estimate of the typical saving. Although a figure cannot be put on the likely range, looking more closely at the savings for different types of properties provides a better understanding of the likely saving any given household might expect to save. The figures below show further breakdowns of savings for specific property attributes and household characteristics for 2009.

Figure 5.1 below shows the difference in the mean and median savings for properties receiving cavity wall insulation in 2009 by property type. The mean and median difference was largest for detached properties, with a typical detached property saving 11.7 per cent. Semi detached and end of terraced properties, which both have three exterior walls, typically save 8.9 and

[24] A three bedroom semi detached property represents the typical house in England, it is the most common property category making up 18 per cent of the housing stock.

10.2 per cent respectively. The property type which had the smallest percentage saving was mid terraced properties, with a typical mid terraced house saving 6.5 per cent – this smaller saving for mid terraced properties would be expected since they only have two exterior walls which can be insulated.

Figure 5.1: Observed savings from cavity wall insulation, by property type, 2009



The difference in the mean and median savings for properties receiving retro-fit cavity wall insulation by tenure is shown below (Figure 5.2). Owner occupied properties show the largest mean and median difference, with a typical owner occupied home saving ten per cent. Homes which are owned by either the council or a housing association show the least saving, with a typical home saving 7.5 per cent. It is assumed that there is a rebound effect of approximately 15 per cent for homes receiving an energy efficiency measure[25] i.e. householders take some benefit in terms of additional heat in the home rather than saving all the energy and heating homes to the same level as prior to insulation being installed – this is known as comfort taking. The smaller saving for council/housing association properties may be because of the higher level of comfort taking usually observed by this group.

[25] Green Deal Impact Assessment: http://www.decc.gov.uk/assets/decc/11/consultation/green-deal/5533-final-stage-impact-assessment-for-the-green-deal-a.pdf.

Figure 5.2: Observed savings from cavity wall insulation, by tenure, 2009

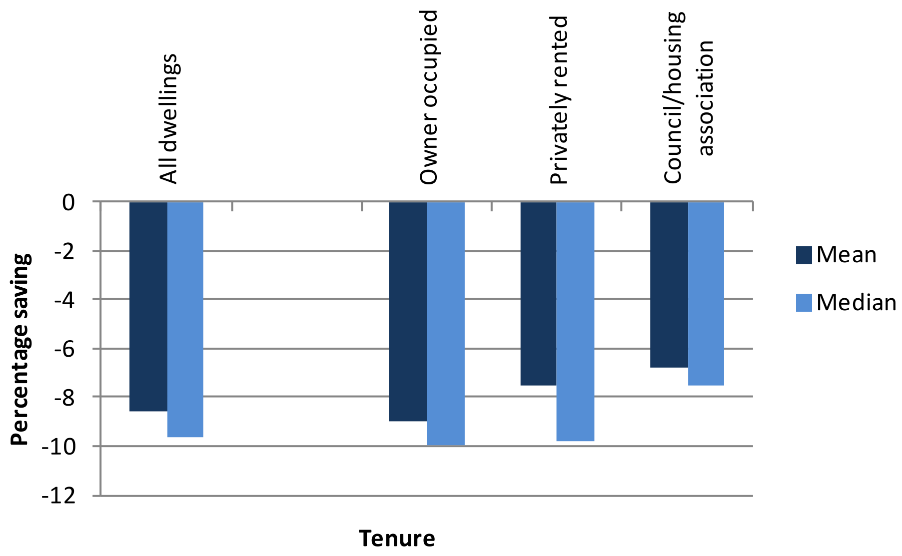


Figure 5.3 shows that for each property type three bedroom properties having cavity wall insulation installed consistently save more than two bedroom properties receiving the same energy efficiency measure.

Figure 5.3: Observed savings from cavity wall insulation for two and three bedroom properties, by property type, 2009

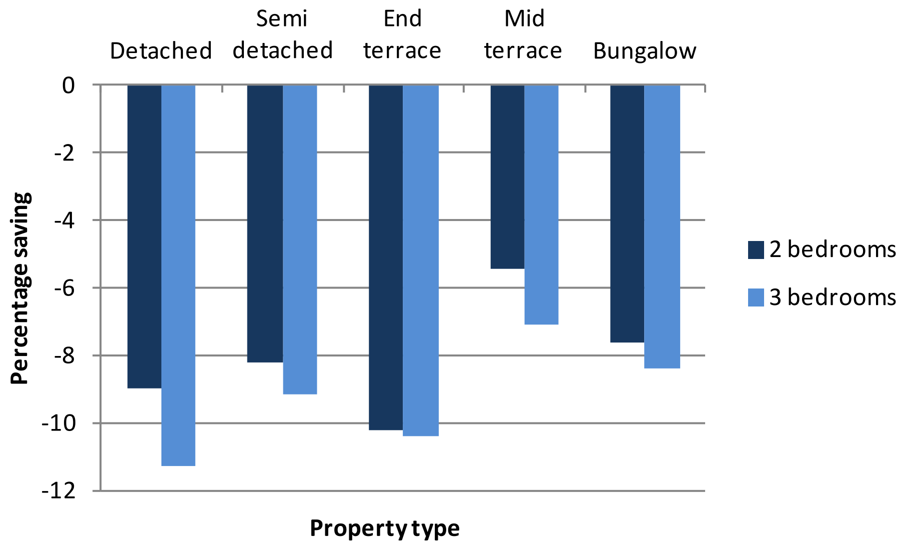
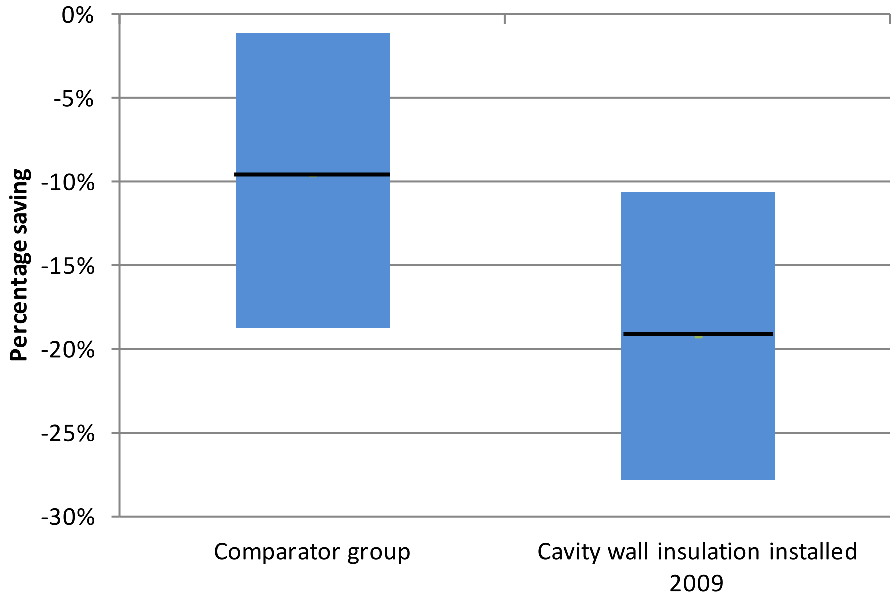


Figure 5.4 shows the median percentage saving for those properties receiving cavity wall insulation in 2009 and the median for the comparator group, along with the upper and lower quartiles. It shows a 9.6 percentage point difference in the medians, and a very similar inter-quartile range for the two groups. It demonstrates that there are a range of changes in consumption over the period considered in both the intervention and comparator groups. For all points in the distribution the intervention group has a larger decrease in consumption than the comparator group.

Figure 5.4: Percentage saving, median and inter-quartile range



5.2 Loft insulation

Data on loft insulation covers professional installations of loft insulation only, as HEED does not capture home owners installing insulation into their own properties (DIY loft insulation) or properties which were insulated when built. HEED covers both installation of insulation into lofts with no insulation and into lofts which already had some insulation, but are not fully insulated. Therefore the estimates from NEED reflect the savings from lofts which are being insulated in any given year, but means that households with very little or no insulation already in lofts can expect to save more than the savings estimates set out below. Properties which already have a reasonable amount of insulation are likely to have smaller savings.

The savings set out are also likely to be an underestimate of the savings a household will experience because some of the properties in the comparator group may have installed DIY loft insulation, but none of those in the intervention group are likely to have done. Therefore they will have experienced some savings as a result of insulation which is not equally experienced in the intervention group. Given the prevalence of DIY insulation in the population, this would lead to an underestimate of the savings of less than 100 kWh. Given the scale of the potential issue and the accuracy of reported estimates no adjustment has been made to the results to account for this, but users should be aware of the issue when interpreting results.

Table 5.3 shows that the difference in the mean saving for properties receiving loft insulation compared to the comparator group was 2.4 percentage points for 2009. Based on average gas consumption of a three bedroom semi detached property in the year before the measure was installed (2008) this gives a typical saving of 500 kWh for these types of properties having loft insulation installed. Table 5.4 shows that the difference in the median saving for properties receiving loft insulation was 2.6 percentage points for 2009, which also gives a typical saving of 500 kWh for three bedroom semi detached properties having loft insulation professionally installed.

The percentage difference between properties receiving loft insulation and the comparator group is consistent across all five years, with savings based on the mean ranging from 2.1 to 2.8 per cent, and median savings between 2.6 and 2.9 per cent.

Table 5.3: Summary of observed savings (mean) – loft insulation

	2005	2006	2007	2008	2009
%	-2.1	-2.5	-2.8	-2.3	-2.4
kWh	-400	-500	-500	-500	-500

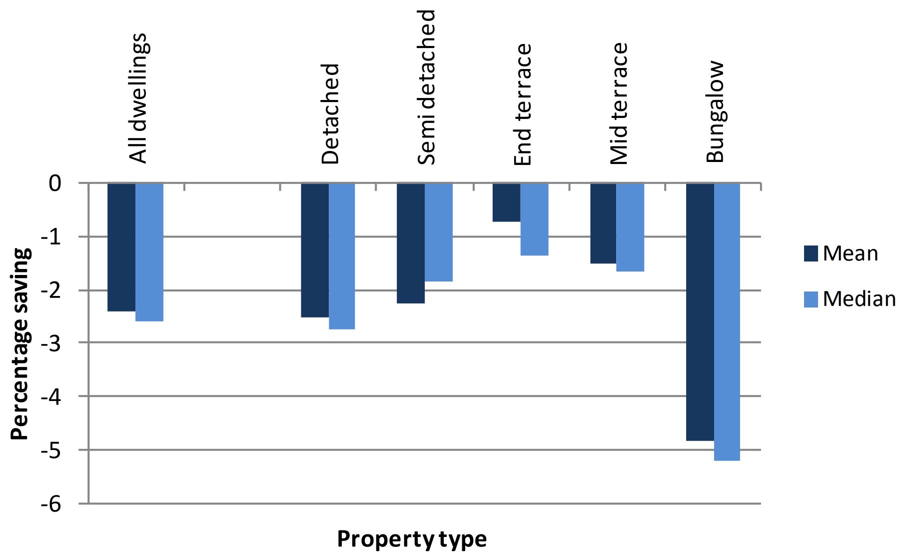
Table 5.4: Summary of observed savings (median) – loft insulation

	2005	2006	2007	2008	2009
%	-2.7	-2.8	-2.9	-2.7	-2.6
kWh	-600	-500	-600	-500	-500

The figures presented below show further breakdowns of savings for specific property attributes and household characteristics for 2009. As described in the cavity wall section of this annex, this provides a better estimate of what a specific property could expect to save from the installation of professional loft insulation.

Figure 5.5 shows that the savings from having loft insulation installed are highest for bungalows, with a typical bungalow saving 5.2 per cent, this is likely to be because bungalows have the largest roof area relative to the size of the property and therefore benefit the most from the measure. Detached properties typically save 2.7 per cent, with semi detached, end of terrace and mid terrace properties saving between 1.4 and 1.9 per cent.

Figure 5.5: Observed savings from loft insulation, by property type, 2009



When looking at savings from loft insulation by the number of bedrooms in the property the highest savings can be seen for properties with one bedroom, who typically save 5.4 per cent. However, this is likely to be due to the dominance of bungalows in this category, as referenced earlier in the report, flats are excluded from this analysis and therefore the majority (64 per cent) of one bedroom properties in the analysis are bungalows. Typical savings then drop for properties with more than one bedroom, with savings ranging from 2.3 per cent for properties with three bedrooms to 2.9 per cent for properties with two bedrooms.

Figure 5.6: Observed savings from loft insulation, by number of bedrooms, 2009

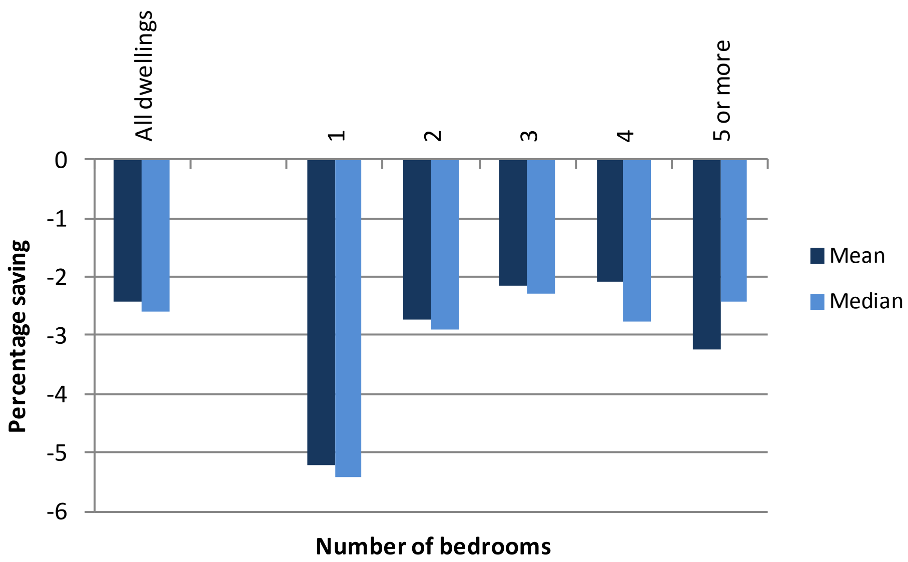
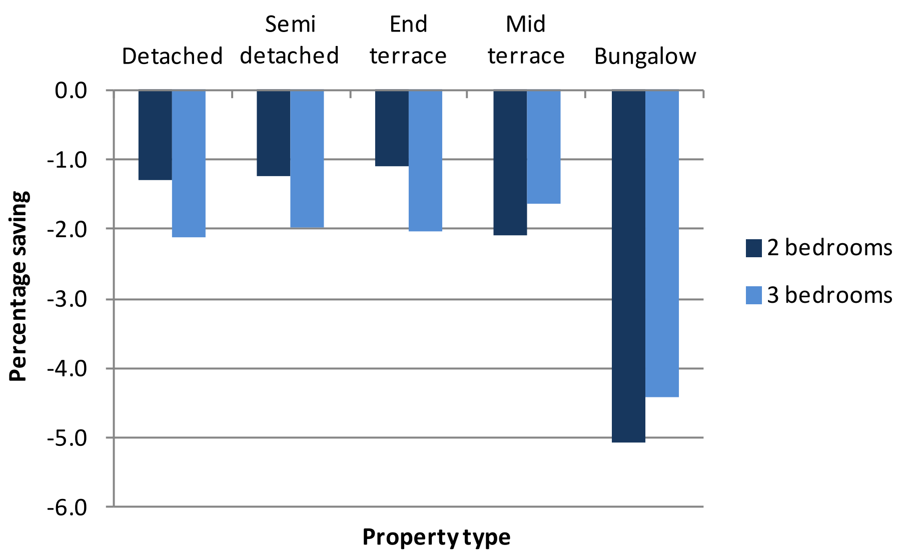


Figure 5.7 shows that three bedroom detached, semi detached and end of terrace properties typically saved more than the two bedroom equivalents. However this trend was reversed for mid terrace properties and bungalows where those properties with two bedrooms saved more than those with three bedrooms, although the differences in the percentage savings were not large. It is not clear why this is the case, but it could be because of sampling or other attributes of the properties in the NEED sample for those categories.

Figure 5.7: Observed savings from loft insulation for two and three bedroom properties, by property type, 2009



Figures 5.8 and 5.9 show the frequency distribution of percentage savings for properties which had loft insulation installed in 2009 and the comparator group respectively. They show that in both cases the distribution of the change in consumption between 2008 and 2010 is very similar. However, the intervention group distribution is shifted slightly to the left compared with the comparator group (i.e. a higher proportion of the properties reduce consumption over the period).

Figure 5.8: Frequency distribution of percentage savings for properties having loft insulation installed in 2009

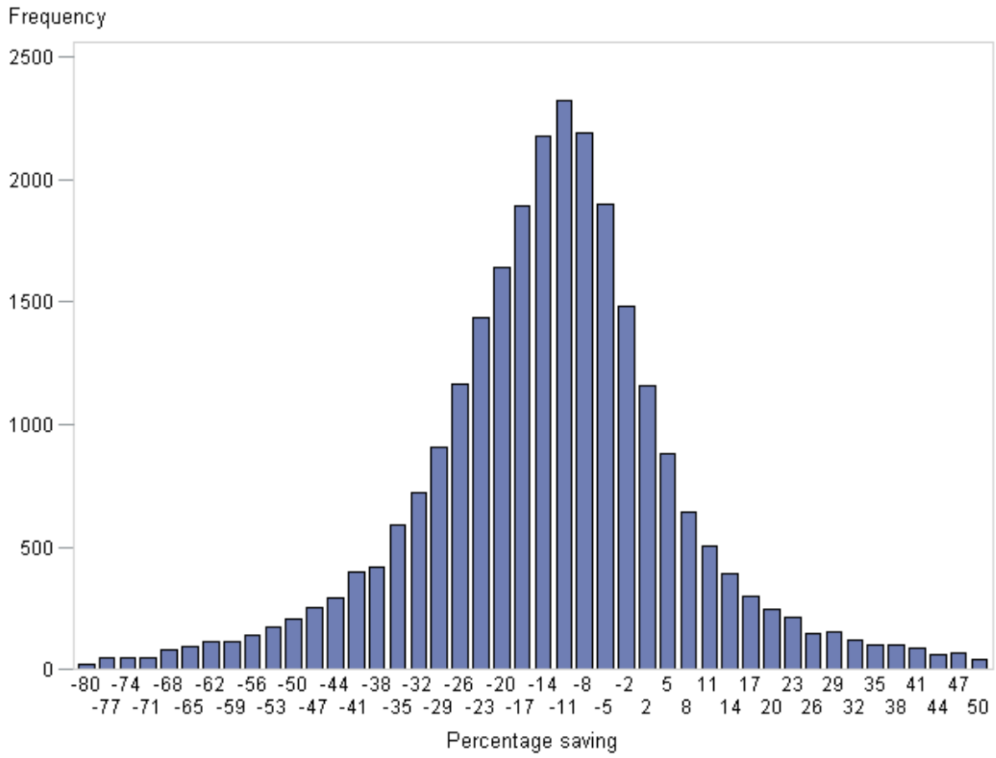
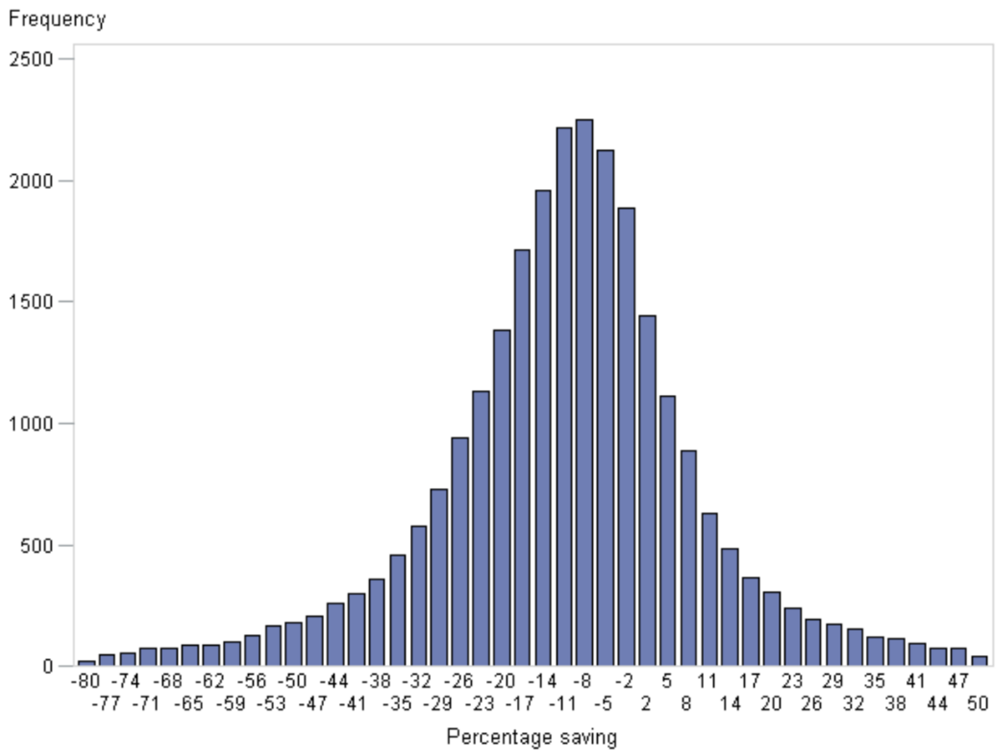


Figure 5.9: Frequency distribution of percentage savings for the comparator group



5.3 Condensing boilers

Data for condensing boilers comes from a variety of sources including Gas Safe, the trade body responsible for registering approved installers. Data for boilers are only available up to mid 2008, and therefore analysis in this section only covers impacts of condensing boilers up to 2007; the last full year for which data are available.

Table 5.5 shows that the difference in the mean saving for homes receiving a condensing boiler was 10.3 percentage points for 2007, this gives a saving of 2,000 kWh for three bedroom semi detached properties having this measure installed. Table 5.6 shows that the difference in the median saving for homes receiving a condensing boiler was 12.9 percentage points for 2007, a typical saving of 2,500 kWh, for three bedroom semi detached properties.

The percentage saving for properties which had a condensing boiler installed is consistent across all three years considered, with mean savings ranging from 9.8 to 10.3 per cent, and median savings ranging from 12.6 to 12.9 per cent.

Table 5.5: Summary of observed savings (mean) – condensing boiler

	2005	2006	2007
%	-9.8	-10.1	-10.3
kWh	-2,100	-2,100	-2,000

Table 5.6: Summary of observed savings (median) – condensing boiler

	2005	2006	2007
%	-12.6	-12.6	-12.9
kWh	-2,500	-2,500	-2,500

The figures presented below show further breakdowns of savings for specific property attributes and household characteristics for 2007.

Figure 5.10 below shows that properties built between 1945 and 1964, and 1965 and 1982 have the highest savings when having a condensing boiler installed, with typical savings of 14.6 and 15.0 per cent respectively. Typical savings for other property ages, up to those built after 1992 are between 11.3 and 12.5 per cent. Results for properties built post 1999 should not be ignored, as the high observed saving is likely to be a result of the peculiarity of consumption for new builds[26].

[26] In some cases, properties have a small annual gas consumption for a period before they are classified as being built (probably covering the time between a property being connected to the gas supply and being occupied or when properties are occupied for a part year before the first full year they are occupied). This then leads to a large increase in consumption over a short period following the property being fully used, which seems to be resulting in a smaller decrease in consumption for these properties meaning the comparator group has a smaller reduction in consumption than would be expected and savings for the properties with the measure being installed will be over estimated.

Figure 5.10: Observed savings from condensing boilers, by property age, 2007

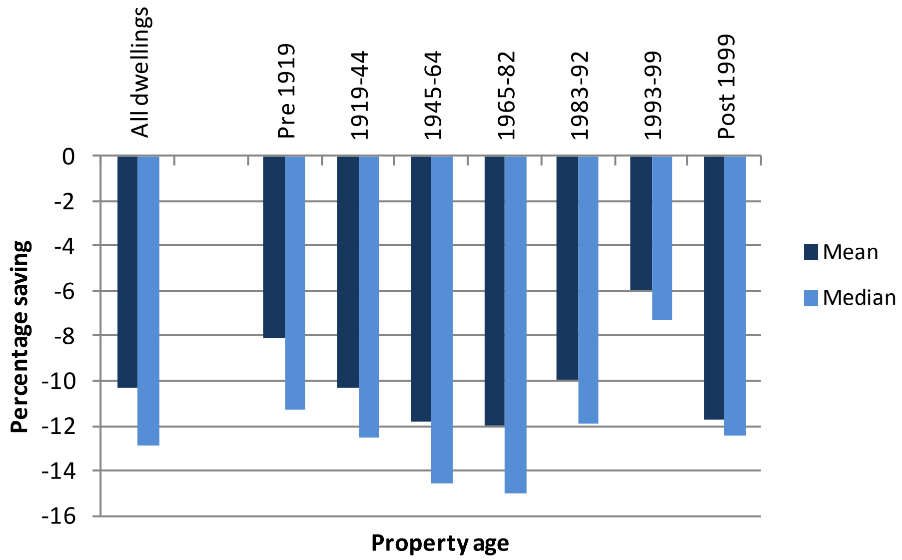


Figure 5.11 shows savings from condensing boilers by household income. The majority of income groups saved between 12.0 and 13.6 per cent, suggesting there is not a great variation in savings by household income. This is a different pattern to that seen for cavity wall insulation, where typically households with higher incomes saved more.

Figure 5.11: Observed savings from condensing boilers, by household income, 2007

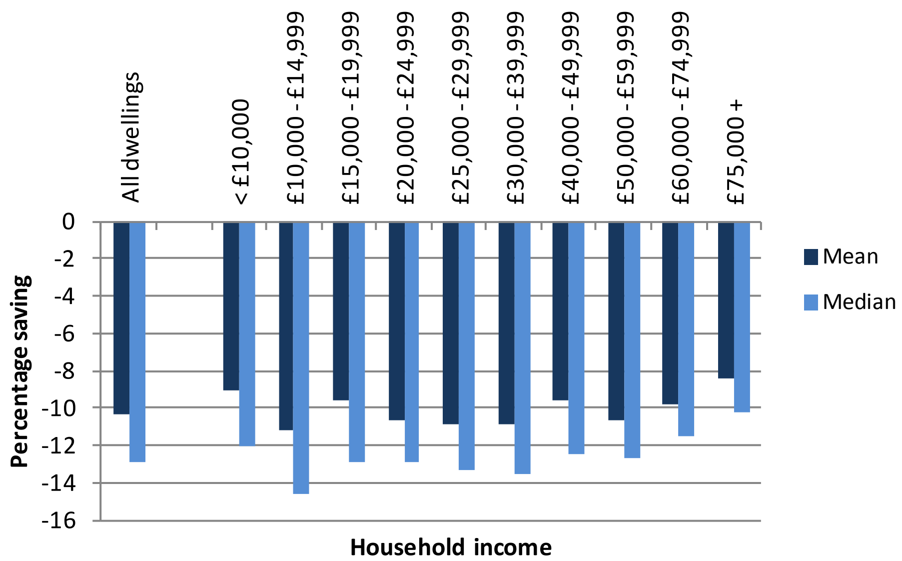
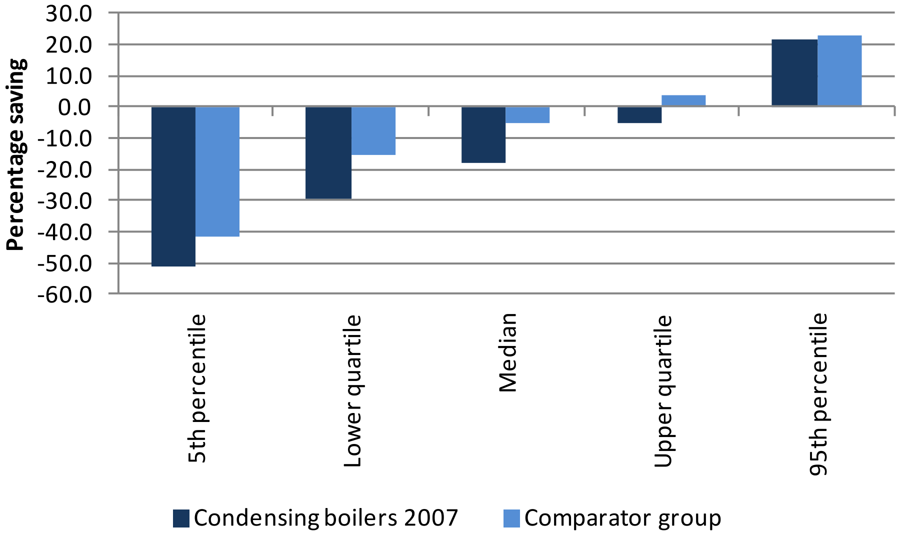


Figure 5.12 shows the distribution of percentage savings for properties having condensing boilers installed in 2007 and the comparator group. It shows that at all points in the distribution the properties that had condensing boilers installed in 2007 had a greater percentage reduction in consumption than the comparator group.

Figure 5.12: Distribution of percentage savings for condensing boilers installed in 2007 and the comparator group



5.4 Solid wall insulation

All figures on solid wall insulation should be treated with caution since they are based on a much smaller number of records than the other energy efficiency measures included in this annex. Because of the unreliable installation dates for solid wall insulation installed between 2005 and 2008 these installations were considered in one group rather than assessing the saving for each year separately as was done for each of the other measures. Analysis for solid wall insulation installed in 2009 (where the date information is more reliable) was undertaken, but due to the very small sample size (260 properties) it is not considered robust enough to include in this report. The small samples are in part due to the high proportion of solid wall insulation installed in flats and in properties which do not have gas as their main heating fuel and therefore could not be included in this analysis. It is intended that further work will be done to look at the savings from solid wall insulation once more data becomes available in HEED. This is expected following the end of CESP when measures installed through this Government scheme will be incorporated into HEED.

One of the benefits of the approach used in NEED is that estimates are observed, rather than theoretical, so for example the estimates should take in to account people's behaviour and any rebound effects – although we cannot assign values to these different components.

The solid wall estimates shown are based on the percentage saving observed in the sample applied to the consumption for a three bedroom semi detached property. However, unlike the other measures considered in this report, the three bedroom semi detached figure is based on the comparator group for this measure, rather than the figure for the whole dwelling stock. This is because, due to the policy under which most of these measures have been installed, a high proportion of these households are in the Priority Group and are therefore properties and households are not typical of the population as a whole. There are not enough observations to be able to draw reliable conclusions about the typical saving for all solid wall properties from these data.

In particular it is estimated[27] that the Super Priority Group have a comfort taking factor of more than two times that of the population as a whole, meaning they are likely to take more benefit of the insulation measure through increased warmth rather than as an energy saving. While the Super Priority Group was only created after the measures in this analysis had been installed, it is likely that the Priority Group (who received the majority of solid wall insulation measures included in HEED) also have a higher comfort taking factor than the typical household. This means that the estimates given are likely to be an under estimate of the saving for a typical house.

The savings are also likely to be lower than average for the population as a whole because of the high proportion of mid terraced properties which have received solid wall insulation in this sample. The majority of properties in this analysis were terraced or semi detached with less than one per cent of properties considered being detached; the property type which showed the largest percentage saving for cavity wall insulation.

These estimates also have increased variability compared with estimates for the other measures considered. This is in part because of the small sample compared with other measures, but also because of the period of time considered, meaning any differences between the comparator group and intervention group would be exacerbated.

Table 5.7 shows that the difference in the mean saving for homes receiving solid wall insulation was 11.0 percentage points for 2005-08. Average consumption in 2004 was 18,800 kWh for three bedroom semi detached properties in the comparator group, this gives a typical saving of 2,100 kWh for these types of properties having solid wall insulation installed. The table also shows the difference in the median saving for homes receiving solid wall insulation which was 12.1 percentage points. Giving a typical saving of 2,200 kWh for these types of properties having solid wall insulation installed.

Table 5.7: Summary of observed savings for solid wall insulation installed between 2005 and 2008

	Mean	Median
%	-11.0	-12.1
kWh	-2,100	-2,200

As with all measures considered in this section, the savings shown are the savings for properties heating their homes with gas. It is more expensive to heat a home with other fuels such as electricity or oil, homes using these fuels as the primary heating fuel would see a greater monetary saving than households heating their homes primarily with gas.

Savings for specific property attributes and household characteristics have not been included in this annex for solid wall insulation due to the small sample sizes and the resulting uncertainty in results.

[27] Green Deal Impact Assessment: http://www.decc.gov.uk/assets/decc/11/consultation/green-deal/5533-final-stage-impact-assessment-for-the-green-deal-a.pdf.

6. Impact of Timing Assumptions

The impact of measures analysis is conducted based on measures installed in the calendar year, however the gas consumption data which is used in the impact of measures analysis uses the gas year which runs from 1st October to 30th September. To look at the potential impact of using the gas year instead of the calendar year and provide assurances about the accuracy of the results the 2006 impact of measures analysis was conducted using installation dates relating to the gas year and compared to results based on the calendar year.

Table 6.1 shows the mean and median percentage change associated with cavity wall insulation, loft insulation and condensing boilers when comparing the calendar year with the gas year[28]. For each measure the mean and median percentage change is smaller when using the gas year compared with the calendar year. The difference is biggest for condensing boilers, where the difference between the mean and median savings when comparing to the estimates based on the calendar year was 1.2 percentage points.

Table 6.1: Mean and median reduction in gas consumption following installation of energy efficiency measures – calendar year compared with the gas year, 2006

Measure		Mean	Median
Cavity wall insulation	Calendar year	-16.2	-16.3
	Gas year	-15.4	-15.4
	Difference	-0.8	-0.9
Loft insulation	Calendar year	-9.4	-8.7
	Gas year	-8.9	-8.1
	Difference	-0.5	-0.6
Condensing boiler	Calendar year	-17.4	-18.8
	Gas year	-16.2	-17.6
	Difference	-1.2	-1.2

Although the results showed a variation in savings when using the gas year over the calendar year it was decided to continue to use the calendar year for analysis in this report. This is due to the accuracy of installation date information recorded in HEED. Currently where exact installation dates are not provided dates are often recorded as the first of the month or the middle of the six month period in which the measure was delivered – therefore if analysis was conducted using the gas year instead of the calendar year measures could be included in the incorrect year.

[28] Note that for this analysis there is no comparison with a comparator group so the changes seen refer only to the reduction in consumption for the intervention group.

7. Comparison of Median Gas Consumption Over Time

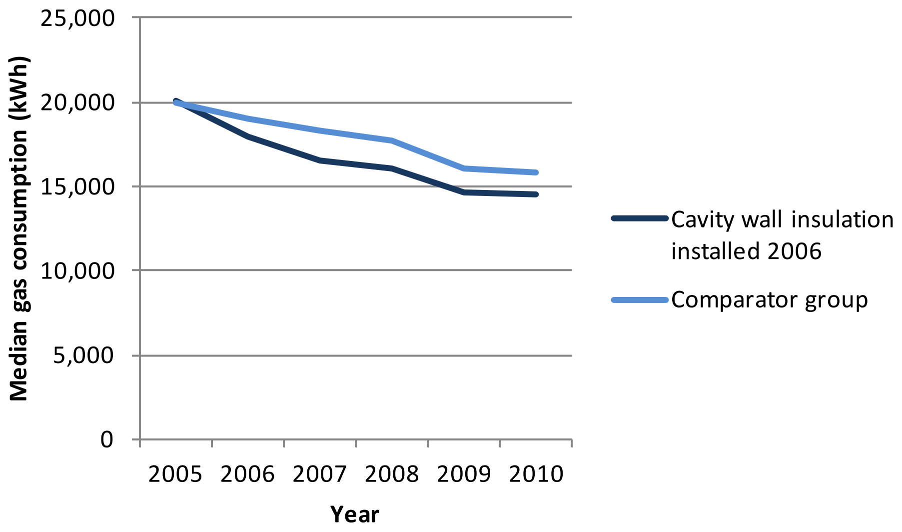
7.1 Post-intervention

The impact of measures analysis presented in early parts of this annex compares gas consumption in the year before and after installation of an energy efficiency measure. Longer term gas consumption can be looked at for cavity wall insulation, loft insulation and condensing boilers installed in 2006 to see whether the savings observed in the year immediately after installation of an energy efficiency measure continue in the longer term. It should be noted that these are presented as initial findings, and will be built on in future analysis. It was not possible to carry out the same analysis for solid wall insulation.

In the following three charts the median gas consumption in the first year (the year prior to the intervention) is very similar for the intervention and comparator group. This is because one of the variables used to select the comparator group was gas consumption in the year before the intervention was installed. The consumption for each group then diverges in 2006 when the measures have been installed in households. For all measures savings continue beyond 2007.

When looking at the installation of cavity wall insulation the biggest difference can be seen between the median gas consumption of the intervention and comparator groups in 2007 – the year after the intervention was installed. In 2007 the intervention group typically used 1,800 kWh less gas. A difference in gas consumption remained, but did reduce slightly and by 2010 the difference in median annual gas consumption was around 1,300 kWh[29].

Figure 7.1: Cavity wall insulation installed in 2006 – long term gas consumption

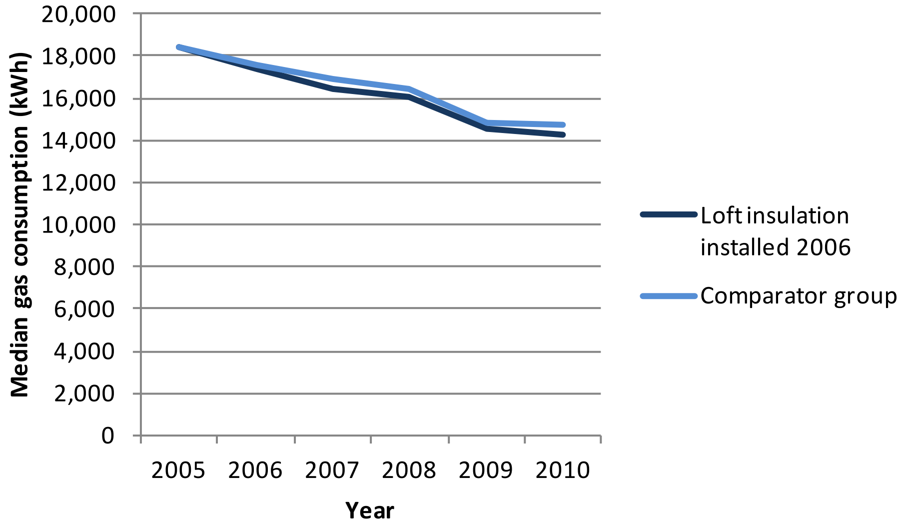


The difference in median gas consumption between properties having loft insulation installed and the comparator group is smaller than cavity wall insulation, however there is still an impact of having loft insulation installed which remains in 2010. In 2007, the year after installation of loft insulation, the intervention group had a gas consumption around 400 kWh lower than the

[29] These differences are a difference in median consumption, they are not estimates of the typical savings which are based on a difference in difference approach used throughout this report.

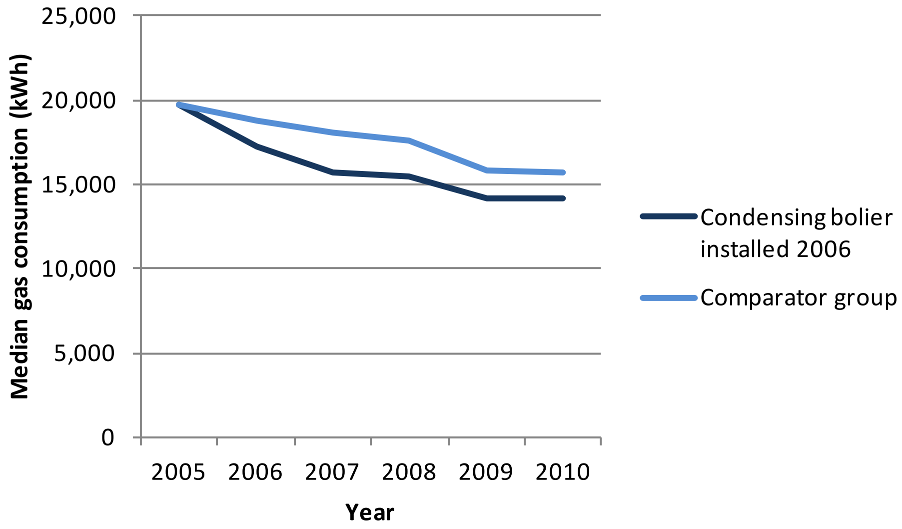
comparator group. This difference decreased slightly in 2008 and 2009, before increasing again to around 500 kWh in 2010.

Figure 7.2: Loft insulation installed in 2006 – long term gas consumption



For properties having condensing boilers installed in 2006 the largest difference in typical gas consumption was seen in the year following installation of the condensing boiler, with the intervention group typically using 2,300 kWh less gas than the comparator group in 2007. The difference in typical gas consumption decreases between 2008 and 2010, but the intervention group still typically use 1,500 kWh less gas than the comparator group in 2010.

Figure 7.3: Condensing boiler installed in 2006 – long term gas consumption



7.2 Pre-intervention

Gas consumption was also looked at before the installation of both cavity wall and loft insulation to ensure that the properties in each group were using a similar amount of gas in the years prior to having a measure installed. This was considered in order to increase confidence in the comparator group. If the two groups had the same gas consumption trend in the years prior to the measure being installed then it increases confidence that any changes following the intervention are a result of the measure installed and not other differences between the two groups. Figure 7.4 shows that properties having cavity wall insulation installed in 2009 had similar gas consumption before the measure was installed. Similarly, Figure 7.5 below shows the same pattern for loft insulation, with an even smaller difference in typical consumption between the two groups before the installation of loft insulation.

Figure 7.4: Cavity wall insulation installed in 2009 – long term gas consumption

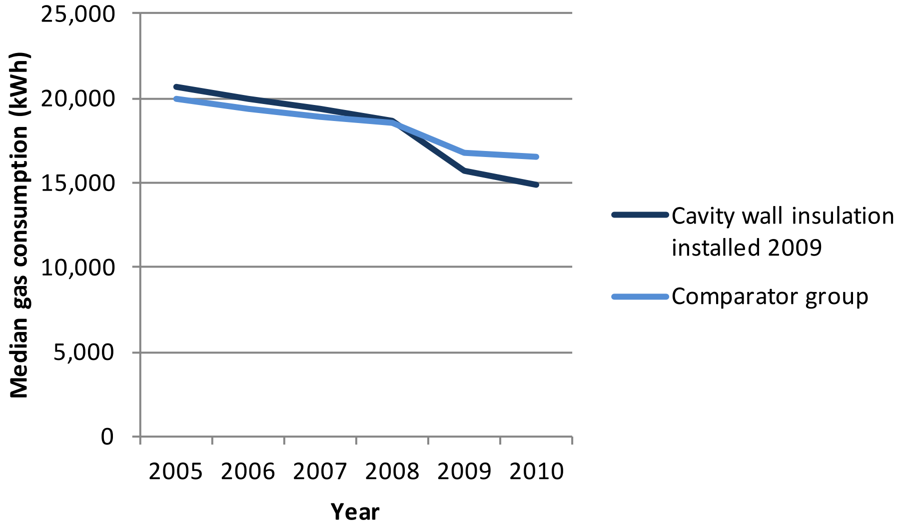
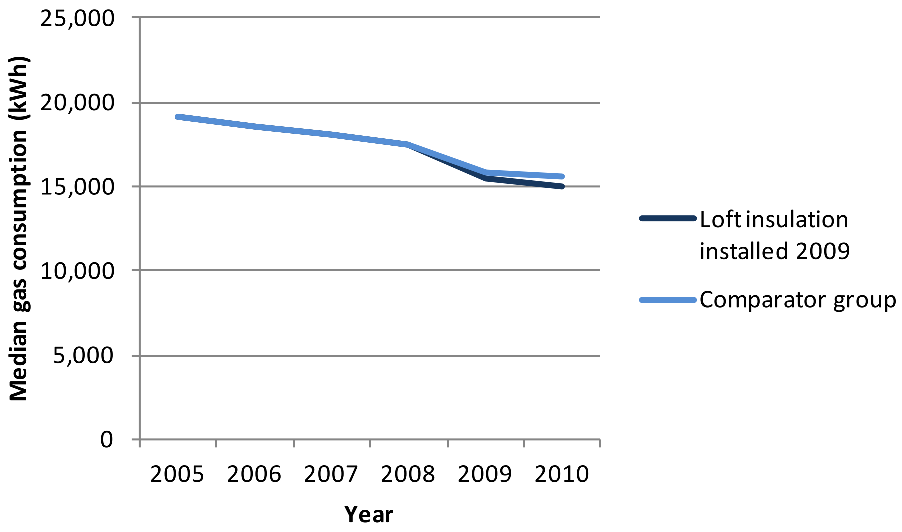


Figure 7.5: Loft insulation installed in 2009 – long term gas consumption



Similar analysis could not be carried out for condensing boilers or solid wall insulation. However the results above confirms that the approach seems to be robust.

8. Conclusion

The take up of measures analysis enables energy efficiency measures to be looked at by property attribute and household characteristics, which means users can see which types and ages of property have received different types of measures. It shows that not all types of properties and households are equally likely to have a had a measures installed. With the exception of replacement condensing boilers which have been installed much more evenly throughout the housing population.

The impact of measures analysis shows that there are significant savings from installation of all the energy efficiency measures considered in this report and provides further support for the value of installing these measures. It is also provides a better understanding of the observed saving for households receiving measures and how this varies for different types of properties and households.