



Department
of Energy &
Climate Change

National Energy Efficiency Data-Framework

Part II Impact of Energy Efficiency Measures in
Homes

21st November 2013

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Any enquiries regarding this publication should be sent to us at EnergyEfficiency.Stats@decc.gsi.gov.uk.

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1. Executive summary

The National Energy Efficiency Data-Framework (NEED) was set up by DECC to provide a better understanding of energy use and energy efficiency in domestic and non-domestic buildings in Great Britain. This is the second of two NEED reports published in 2013. It presents analysis of the impact of installing energy efficiency measures on a household's gas consumption. Part I, published in June 2013, presented analysis of domestic gas and electricity consumption by property attribute and household characteristics using data available in NEED¹.

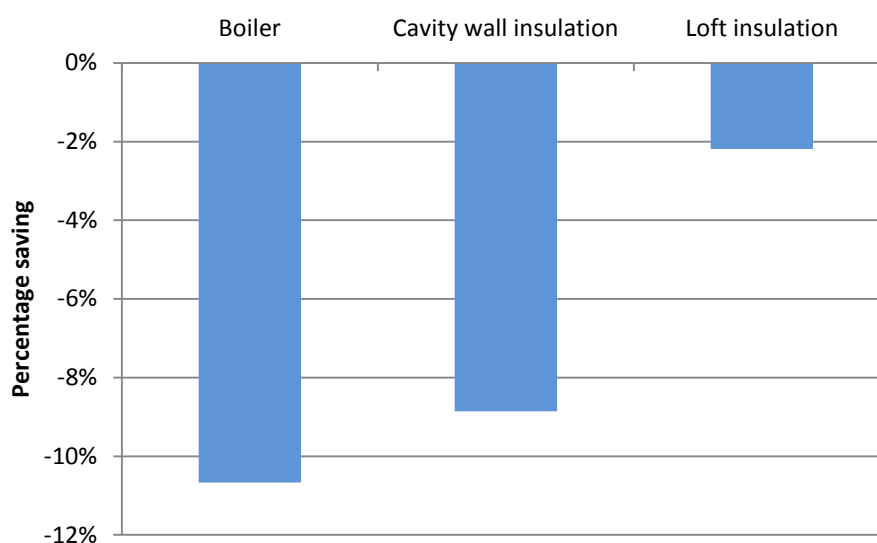
This report builds on the 2012 report by including estimates of the savings households experienced following the installation of cavity wall insulation, loft insulation, gas boilers and solid wall insulation in 2010. As in the 2012 report, results for solid wall insulation are based on a much smaller sample and should be used with care; they are presented as preliminary findings in a separate section of the report. This report also includes estimates of the impact of installing a combination of measures (e.g. cavity wall insulation and a boiler) and assesses the longer term impact of installing measures, for measures installed in 2005. All results produced for this report are based on a representative sample of data for England and Wales and are produced using the methodology outlined in Annex A. Previously published estimates for 2005 to 2009 cover England only².

The saving in gas consumption following installation of energy efficiency measures will differ for different households for a variety of reasons. The savings presented in this report are observed savings and reflect what occurs in practice rather than theoretical estimates. It provides insight into the range of savings experienced and how typical savings vary for different types of properties and households.

Impact of an energy efficiency measure

The analysis shows that households can make considerable savings by installing energy efficiency measures. Figure 1.1 shows the typical percentage saving in gas consumption for each of the main energy efficiency measures considered in this report. The provisional data for solid wall insulation shows a typical saving of 14.7 per cent.

Figure 1.1: Summary of observed savings for energy efficiency measures installed in 2010 (median, weighted)

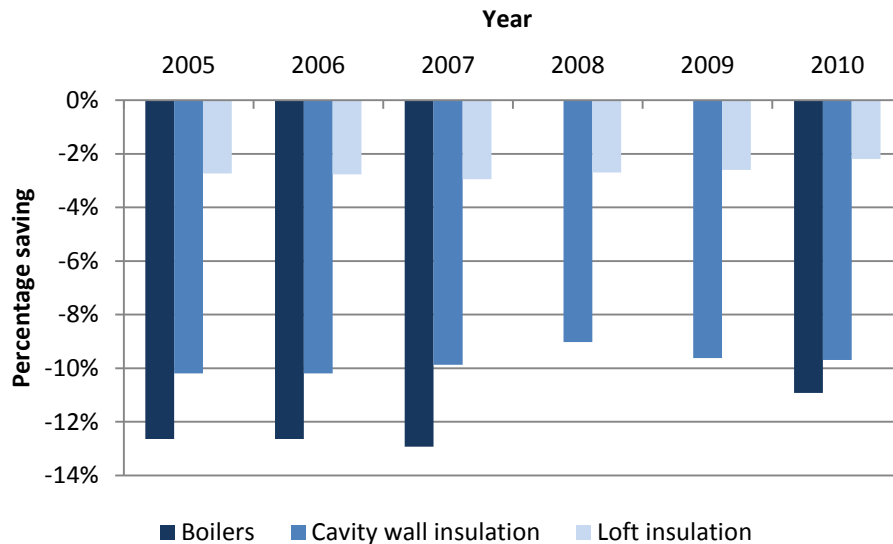


¹ <https://www.gov.uk/government/publications/national-energy-efficiency-data-framework-need-report-summary-of-analysis-2013-part-1>

² The impact of the change in coverage alongside other changes to the methodology since previous results were published can be seen in Annex A: Methodology.

Figure 1.2 summarises the typical percentage savings in annual gas consumption for properties having either cavity wall insulation, loft insulation or a boiler installed in each year from 2005 to 2010. It shows that the percentage saving for cavity wall insulation and loft insulation are consistent in each of the six years presented. The saving presented for boilers in 2010 is two percentage points lower than that for 2007. Due to boiler data being unavailable for 2008 and 2009, it is not possible to see whether this is part of a downward trend.

Figure 1.2: Summary of observed savings for energy efficiency measures (median, not weighted)³

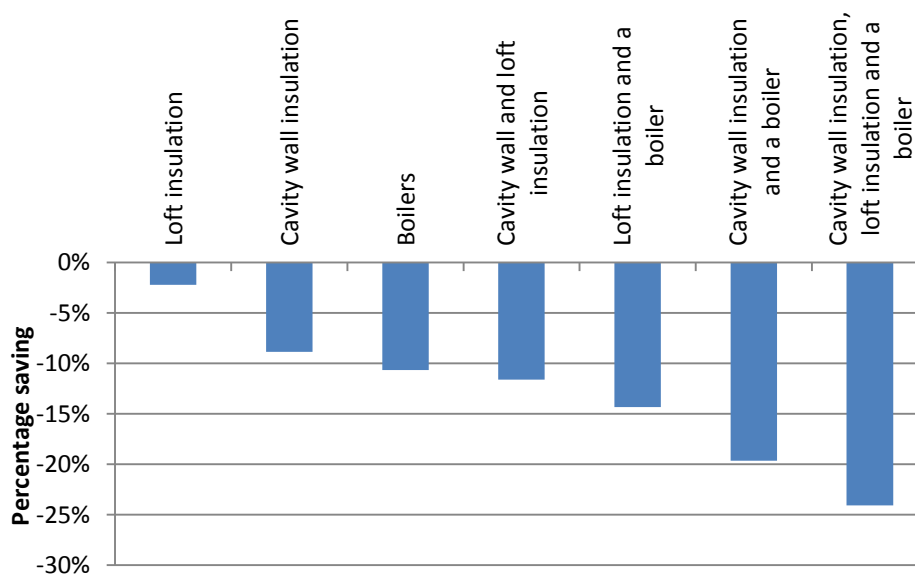


Gas consumption over time was also considered for energy efficiency measures installed in 2005, to see if the initial saving observed in the year after installation continued in the longer term. For all three measures, the data suggests that savings do continue, though not at the same level throughout the period. For example properties which had a boiler installed in 2005 have typically saved 10,000 kWh on their gas consumption over the six years post having the measure installed when compared to similar properties which did not have an energy efficiency measure installed.

Impact of a combination of energy efficiency measures

Figure 1.3 shows estimates of the typical gas consumption saving for a property installing a combination of energy efficiency measures compared to those installing only one measure. It shows that savings from installing a combination of measures in the same year are greater than those experienced from the sum of the savings from the individual measures.

³ Solid wall insulation is not included in this chart since only savings for 2010 have been looked at.

Figure 1.3: Typical savings by combination of energy efficiency measures (weighted)

The results from this work have provided important evidence to enable DECC and a range of other users to better understand the impact of installing energy efficiency measures. It provides useful evidence to inform DECC policies such as the Energy Company Obligation and the Green Deal. DECC will continue to use NEED to understand more about energy consumption and energy efficiency, with results published as analysis is completed. The next publication of results from NEED will be in June 2014 and will include an update to the impact of measures results presented in this report, as well as updated domestic gas and electricity consumption by property attributes and household characteristics as published in Part I in June 2013.

Alongside analysis undertaken internally, DECC is working to make data more accessible to a range of users. This has included publishing more detailed and varied outputs, such as the inclusion of Wales in analysis, and publication of the NEED Table Creator⁴. DECC is also working towards production of an anonymised version of NEED for use by external researchers. Significant progress has been made with this project and a consultation on the proposed content has been published alongside this report⁵. DECC welcomes input into this consultation from any interested parties; the deadline for response is the 21st January 2014.

The development of data included in this report and that published in Part I have allowed DECC to request the UK Statistics Authority (UKSA) carry out an assessment of NEED as a National Statistic. This assessment is currently being undertaken, and it is hoped that it will result in these NEED outputs being awarded full National Statistics accreditation. This will provide assurance of the quality of the outputs and allow users to have increased confidence in results.

⁴ <https://www.gov.uk/government/statistical-data-sets/need-table-creator>

⁵ https://www.gov.uk/government/publications?departments%5B%5D=department-of-energy-climate-change&publication_filter_option=consultations

2. Introduction

The National Energy Efficiency Data-Framework (NEED) project was set up by DECC with support from the Energy Saving Trust (EST) and gas and electricity suppliers. Its purpose is to assist DECC in its business plan priority to “save energy with the Green Deal and support vulnerable consumers”.

It is a key element of DECC’s evidence base supporting DECC to:

- develop, monitor and evaluate key policies (including the Green Deal);
- identify energy efficiency potential which sits outside the current policy framework;
- develop a greater understanding of the drivers of energy consumption; and
- gain a deeper understanding of the impacts of energy efficiency measures for households and businesses.

The data framework provides the largest source of data available for analysis of consumption and the impacts of energy efficiency measures. In June 2013, domestic energy consumption results were updated to include 2011 consumption data, and for the first time included information for Wales and consumption by number of adults in the property.

This report provides updated estimates of the impact of installing energy efficiency measures on a household’s gas consumption for measures installed in 2010. It covers the impact of installing individual measures, for example cavity wall insulation, and the impact of installing a combination of energy efficiency measures, for example a new boiler and loft insulation.

The uptake of energy efficiency measures has been encouraged through Government schemes such as the Carbon Emissions Reduction Target (CERT). In January 2013 previous schemes were replaced by the Green Deal and the Energy Company Obligation (ECO). The Green Deal aims to tackle a number of key barriers to the take-up of energy efficiency measures, whilst ECO focuses on providing energy efficiency measures to low income and vulnerable consumers, and those living in ‘hard to treat’ properties. The continuing emphasis on energy efficiency means it remains important to understand how these measures impact on a household’s gas use, both to help understand the impact of past policy and help with the effective design of new policies.

Headline findings are provided in this report. Detailed data tables including breakdowns by property attributes and household characteristics have been published alongside this report (see Annex C for a list of all published tables).

The remainder of this section gives a brief overview of NEED (see Annex A of the NEED 2013 Part I publication⁶ for more details) and the methodology used to produce estimates (see Annex A of this publication for full details).

For any queries or feedback on this publication please email:

EnergyEfficiency.Stats@decc.gsi.gov.uk

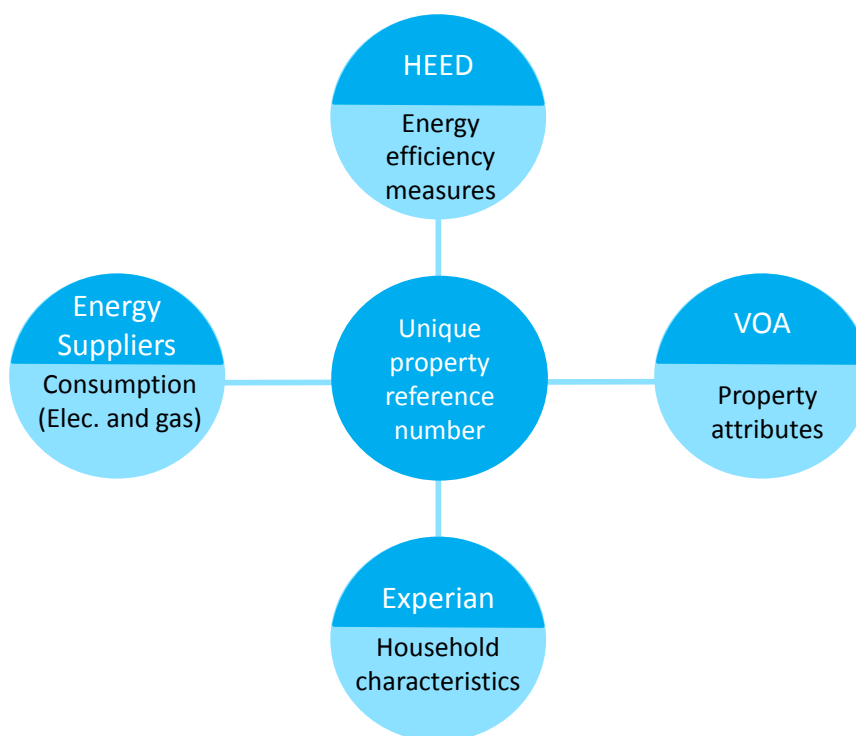
NEED overview

NEED is a framework for combining data from existing sources (administrative and commercial) to provide insights into how energy is used and what the impact of energy efficiency measures are on gas and electricity consumption, for different types of properties and households. The

⁶ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209090/Annex_A_-_What_is_NEED.pdf

address information in each dataset is used to assign a unique property reference number (UPRN) to each record. Data from different sources can then be matched to each other via the UPRN. The principle is the same for both the domestic and non-domestic sector, though different data sources are used.

Figure 2.1: Structure of domestic NEED



Four key data sources have been used to analyse the impact of installing energy efficiency measures on properties gas consumption: meter point weather corrected gas consumption data, Valuation Office Agency (VOA) property attribute data, the Homes Energy Efficiency Database (HEED) containing data on energy efficiency measures installed, and Experian modelled data on household characteristics. The household characteristics data are not used to calculate estimates of the impact of energy efficiency measures, but results are reported by these characteristics (for example savings by tenure).

DECC would like to thank all those who made this analysis possible, including: Energy Suppliers, Gas Safe, the Energy Savings Trust and the Valuations Office Agency.

All analysis of domestic properties presented in this report is based on a representative sample of properties in England and Wales, stratified by local authority, number of bedrooms, property type and property age.

Methodology

A difference in difference approach has been used to estimate the impact of installing energy efficiency measures on the amount of gas required to heat a home. A more detailed explanation of the methodology, including developments since previous publications can be found in Annex A.

The method used compares the gas consumption in properties before and after an energy efficiency measure has been installed with the change in consumption over the same period for similar properties which have not had a 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 installed⁷.

An intervention group is created for each energy efficiency measure considered and for each year being investigated, for example cavity wall insulation installed in 2010. 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.

Comparing the intervention group with a comparator group with similar characteristics but no record of a measure being installed attempts to control for some of this other variation and provide a more accurate estimate of the impact of the energy efficiency measure. As with the intervention group, a comparator group is created for each measure for each intervention year. The comparator group is selected using random stratified sampling and is selected to be the same size and have the same characteristics as the intervention group⁸.

Each individual property in the intervention group is then matched to a similar property in the comparator group creating a matched pair⁹. This allows comparisons of differences (or savings) for each property allowing more understanding of the typical difference (median), the distribution of savings and uncertainty.

Weighting is applied to savings to get an estimate representative of the England and Wales housing stock; rather than just the housing stock which had the measure installed in the period being considered. For example, solid wall insulation installed through government schemes has been targeted at low income homes, which are often smaller than typical homes and newer than typical solid wall properties.

⁷ This group has no energy efficiency measure recorded as being installed in HEED. These properties may have a measure installed which has not been recorded in HEED, for example the homeowner installing their own loft insulation. It should be noted that - with the exception of professional loft insulation - it is equally possible that properties in the intervention group could have installed their own loft insulation, and this will also not be recorded in HEED.

⁸ In a small number of cases there is no property with the same combination of characteristics in the group of properties with no measure installed (i.e. the group which the comparator group is selected from), this results in a small number of properties being excluded from the matched pairs analysis for each energy efficiency measure.

⁹ For a property in the intervention group to be matched to a property in the comparator group it has to have the same: starting gas consumption band; region; property type; property age; and number of bedrooms.

3. Results

Results presented in this report refer to the saving in gas consumption for households using gas as the main heating fuel. Estimates are based on observed savings, so they are savings after comfort taking¹⁰ and do not take into account the quality or coverage of installation. For example, it may include some properties which had cavity wall insulation installed in only two out of three external walls. This means that individual households have the potential to make a greater saving than the results set out in this report. However, there are a number of factors that can impact the amount of gas a household consumes and so there are also circumstances when a household is likely to save less than the estimates set out in this report. The estimates provide insight into the range of savings experienced and how typical savings vary for different types of properties and households.

To help put the results presented in this section of the report into context, the median and mean gas consumption values for 2005 to 2011¹¹ have been presented for the complete NEED sample, as published in Part I of this publication in June 2013 (figure 3.1 and table 3.1 below).

Figure 3.1: Gas consumption, 2005 to 2011, NEED sample

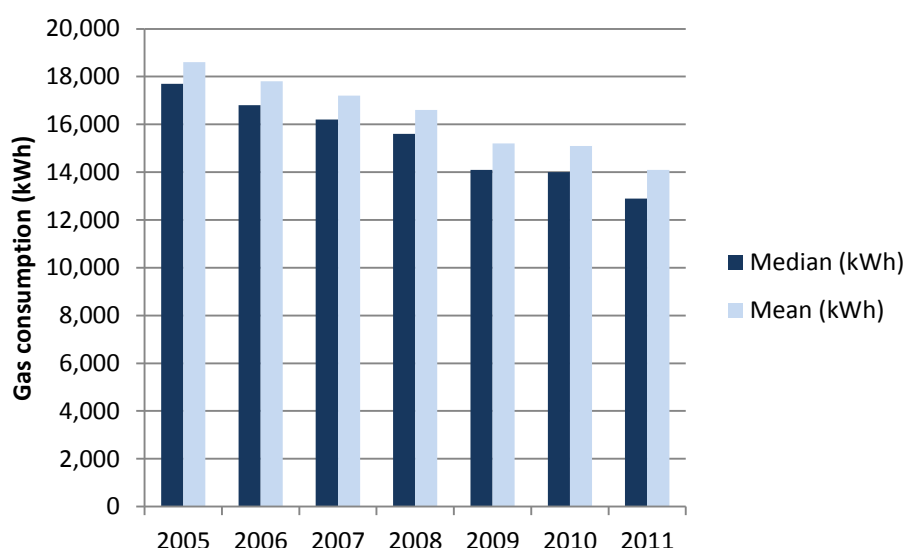


Table 3.1: Gas consumption, 2005 to 2011, NEED sample

	2005	2006	2007	2008	2009	2010	2011
Median (kWh)	17,700	16,800	16,200	15,600	14,100	14,000	12,900
Mean (kWh)	18,600	17,800	17,200	16,600	15,200	15,100	14,100

All headline figures in this report refer to weighted figures, which have been adjusted to be representative of the complete housing stock rather than just properties in the intervention group i.e. properties which have had the measure installed through a Government scheme in

¹⁰ Comfort taking is where some households take the benefit of the insulation measure through increased warmth rather than entirely through energy saving.

¹¹ Figures for 2005 to 2010 cover England, 2011 covers England and Wales. Sample sizes have been rounded to the nearest 10 and consumption to the nearest 100 kWh. Only households with a valid gas consumption between 100 and 50,000 kWh have been included. Estimated consumption readings have been excluded.

the year under consideration. However, breakdowns by property attributes and household characteristics are not weighted, this is so that the breakdown of savings by specific variables can be looked at for the actual properties that had the measures installed.

The headline results are presented below. Detailed data tables including breakdowns by property attributes and household characteristics have been published alongside this report, see Annex C for a list of all published tables.

3.1 Impact of installing energy efficiency measures

This section of the report sets out headline results for the impact of installing a single energy efficiency measure in a household in 2010. It covers the following energy efficiency measures:

- cavity wall insulation;
- loft insulation; and
- boilers.

It also highlights interesting findings by property attributes for each measure. Tables for all available property attributes and household characteristics are published in Excel tables alongside this report (see Annex C for a list of published tables).

Cavity wall insulation

Table 3.2 shows the mean and median annual saving for properties which had retro-fit cavity wall insulation installed in 2010. The typical (median) percentage saving was 8.9 per cent and the mean saving was 7.8 per cent. Both the mean and median percentage savings represent a saving of 1,400 kWh for properties having cavity wall insulation installed in 2010¹².

Table 3.2: Summary of observed savings (weighted) – cavity wall insulation, 2010

	Percentage saving	Saving (kWh)
Median	-8.9%	-1,400
Mean	-7.8%	-1,400

Figure 3.2 below shows the distribution of the estimated percentage saving. It also shows the distribution of the change in annual gas consumption between 2009 and 2011 for properties which had cavity wall insulation installed in 2010, and the change in gas consumption for the comparator group over the same period. It shows that there is a considerable range in savings. When looking at the properties which had cavity wall insulation installed in 2010 in isolation, almost all of these properties experienced a reduction in their annual gas consumption in the year following the installation of cavity wall insulation. However, when comparing these changes to the reductions experienced by similar properties which had not had insulation installed, it suggests the savings experienced following cavity wall insulation were more varied, including showing a larger number of properties which appear to have made no saving.

There are a number of reasons why some properties in the intervention group may not have reduced consumption relative to similar properties in the matched comparator group. For

¹² The kWh saving is calculated by applying the percentage saving in gas consumption for each property to the gas consumption for that property in the intervention group in the year prior to the energy efficiency measure being installed.

example, it could occur because of a change in circumstance for a property in the intervention group which is not experienced by the property it has been matched to in the comparator group, such as a change in property ownership or number of occupants, or a change in employment circumstances. These events should occur equally for properties in the intervention and comparator groups – so overall would be expected to cancel each other out – but in specific cases may make the saving resulting from installing a measure look greater or smaller than the saving actually achieved for an individual property. There will also be variations in savings as a result of differences in building construction, differences in performance of heating systems and appliances, and differences in the behaviours of the individuals within each household which cannot be controlled for.

Figure 3.2: Distribution of percentage saving (weighted) for cavity wall insulation installed in 2010

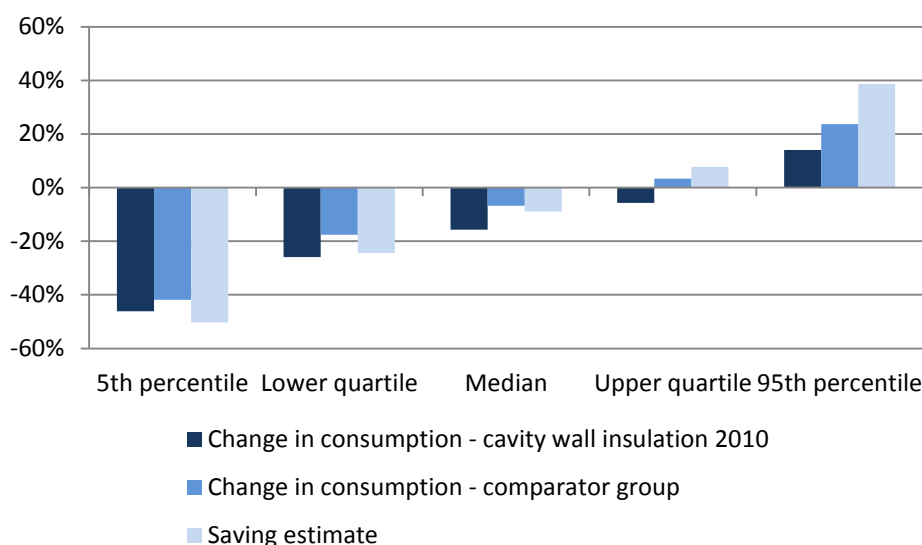
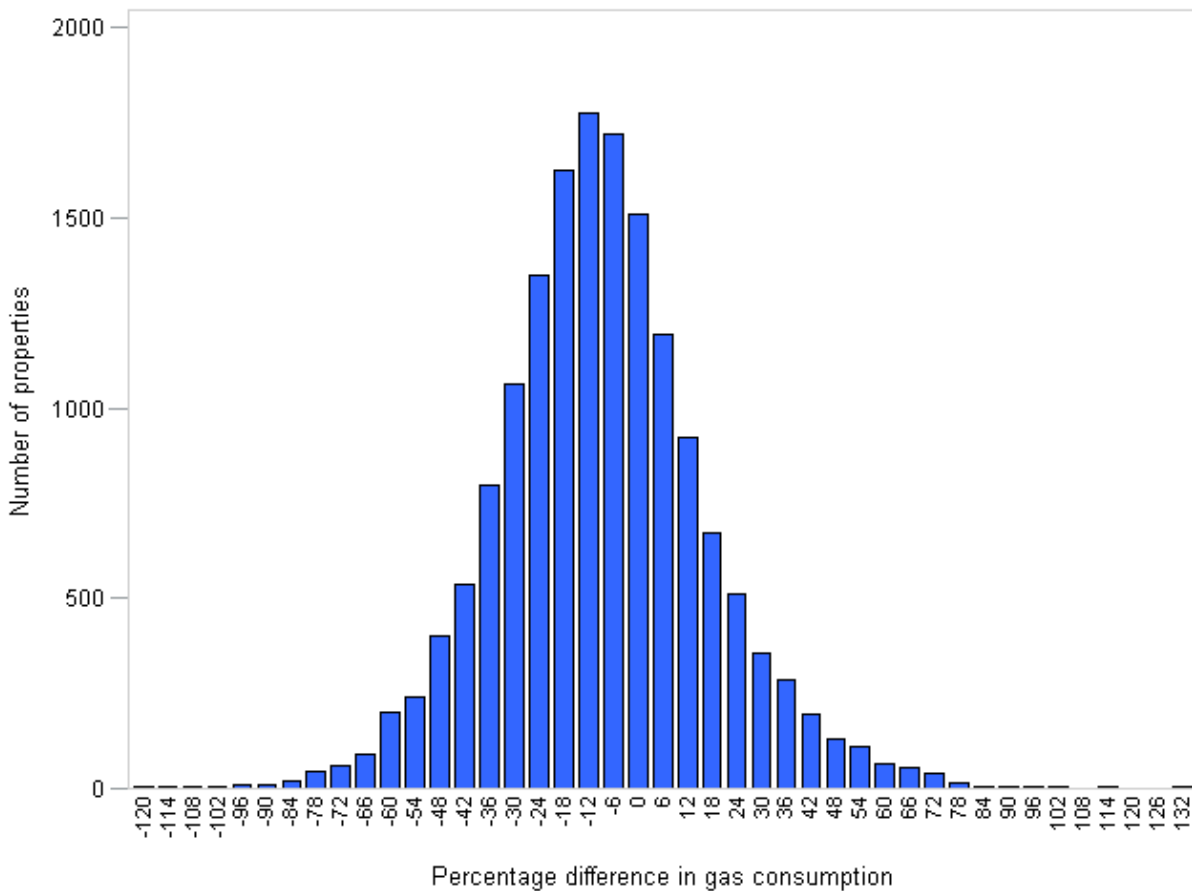


Figure 3.3 further illustrates the spread in savings. It shows that although the typical saving is 8.9 per cent of annual gas consumption there is a lot of variation around this figure.

Figure 3.3: Distribution of savings for properties having cavity wall insulation installed in 2010 (not weighted)



Loft insulation

Estimates of savings from installation of loft insulation are based on professional installations only, as recorded in HEED. It does not cover properties which have had loft insulation installed by the homeowner themselves (DIY loft insulation) or properties which had their loft insulated when built (as built).

It covers both installations of loft insulation into lofts which have no existing insulation (virgin loft insulation), and installations into lofts which are already partially insulated (top-up loft insulation). Therefore, households with very little or no existing insulation can expect to save more than the typical savings presented below. Conversely, properties which already have a reasonable amount of loft insulation, or where the existing insulation is being replaced, are likely to experience smaller savings.

It is also possible that these figures slightly underestimate savings because of the potential for DIY loft insulation to be installed in the comparator group, but not in the intervention group. This will mean the comparator group may have experienced some savings as a result of insulation which is not accounted for in the intervention group. Taking into account 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 this possibility when interpreting results.

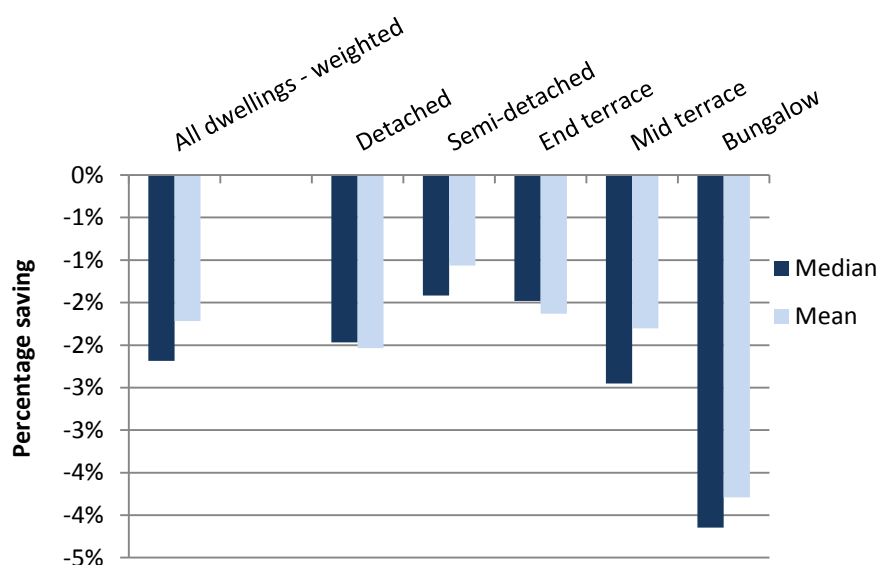
The typical (median) observed saving for properties having loft insulation installed in 2010 was 2.2 per cent, an annual saving of 300 kWh. The mean percentage saving was 1.7 per cent a saving of 400 kWh.

Table 3.3: Summary of observed savings (weighted) – loft insulation, 2010

	Percentage saving	Saving (kWh)
Median	-2.2%	-300
Mean	-1.7%	-400

Figure 3.4 below shows observed percentage savings in gas consumption for properties having their loft professionally insulated in 2010 by property type. It shows that bungalows experienced the greatest saving, a finding consistent with previously published estimates for earlier years. The typical saving for a bungalow was 4.1 per cent of annual gas consumption. It is likely that the relative saving for bungalows is greatest because bungalows generally have the largest roof area relative to the size of the property, which means they benefit most from this particular measure. The typical saving for other property types varied between 1.4 per cent and 2.5 per cent.

Figure 3.4: Observed savings for properties having loft insulation installed in 2010, by property type (not weighted)



Boilers¹³

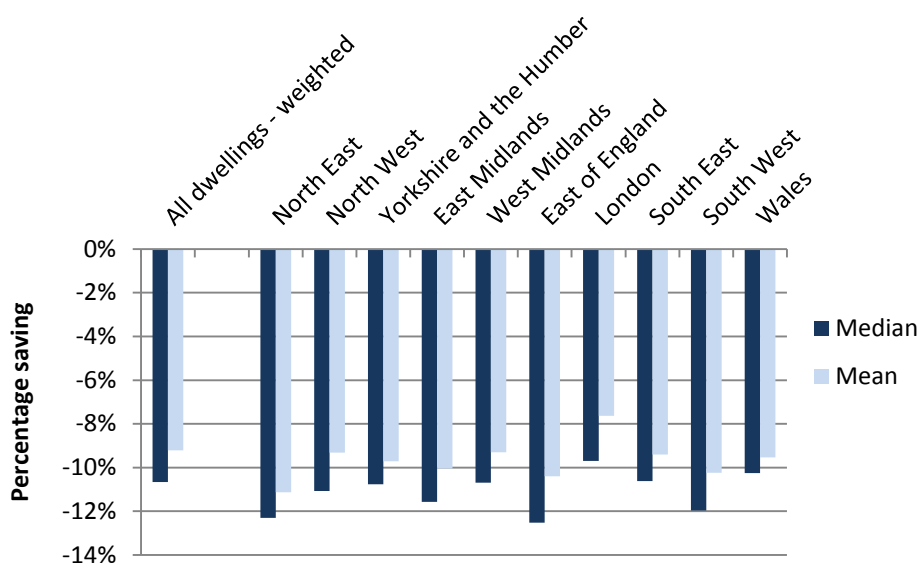
The table below shows that the typical annual saving for properties which had a boiler installed in 2010 was 10.7 per cent, or 1,700 kWh. The mean reduction in annual gas consumption was 9.2 per cent, which represents a saving of 1,800 kWh.

¹³ Data on the installations of boilers in 2010 comes from Gas Safe, the trade body responsible for registering approved installers, rather than HEED – the data source used for other energy efficiency measures included in this report.

Table 3.4: Summary of observed savings (weighted) – boilers, 2010

	Percentage saving	Saving (kWh)
Median	-10.7%	-1,700
Mean	-9.2%	-1,800

The chart below shows estimated annual savings for properties having a boiler installed in 2010 by region. For the first time Wales has been included in the impact of measures analysis, and this chart shows that savings for properties in Wales are similar to savings in others regions. The highest typical percentage saving was for properties in the East of England, which saw a reduction of 12.5 per cent in annual gas consumption. The smallest typical percentage saving was in London, with a reduction of 9.7 per cent. Differences between regions may occur because of differences in the housing stock in different areas. For example, when looking at the NEED sample by region and property size, around a quarter of properties in London have a floor area of 50 square metres or less; in all other regions the equivalent figure is 9 per cent or less. In addition, there are a smaller proportion of detached properties in London when compared with other regions.

Figure 3.5: Observed savings for properties having a boiler installed in 2010, by region (not weighted)

Summary – impact of a single energy efficiency measure

Table 3.5 below shows the typical savings experienced for the measures looked at in this section of the report. It shows that the greatest typical saving is seen for properties installing a replacement boiler. The smallest typical saving is seen for properties installing loft insulation.

Results presented for 2010 are weighted to be representative of the housing stock. This means for some measures results for 2010 appear lower than results presented for previous years. Further information on this can be found in Annex A: Domestic NEED Methodology, accompanying this publication. Both weighted and unweighted headline results have been published in accompanying Excel tables. In addition to headline results now being weighted there are a number of other potential reasons for 2010 savings appearing lower than those

presented for previous years. Energy prices have been increasing which could have led to all consumers trying to become more energy efficient regardless of whether they have had an energy efficiency measure installed. Consumers being more energy efficient would result in there being less potential for energy savings from measures, for example if a household has already adjusted their behaviour or households may be more likely to take some of the potential saving in comfort i.e. heat their home to a higher temperature following installation of a measure. Another potential reason is that boilers which are now being replaced may be more efficient than those being replaced in the past, which would mean the savings experienced from installing a new boiler are lower than previously observed.

Table 3.5: Summary of observed savings for energy efficiency measures installed in 2010 (weighted)

Energy efficiency measure		Percentage saving	Saving (kWh)
Boiler	Median	-10.7%	-1,700
	Mean	-9.2%	-1,800
Cavity wall insulation	Median	-8.9%	-1,400
	Mean	-7.8%	-1,400
Loft insulation	Median	-2.2%	-300
	Mean	-1.7%	-400

The next section of the report looks at the types of savings observed for properties installing more than one energy efficiency measure in 2010.

3.2 Impact of installing solid wall insulation in 2010

All figures on solid wall insulation should be interpreted with care since they are based on a much smaller number of records and a less diverse housing stock than other energy efficiency measures presented in this report.

Results for 2010 are based on approximately 790 measures. This small sample size is down to a number of factors. Most significantly because not as many properties have received solid wall insulation as other measures. According to Ofgem reports, approximately 13,000 properties in Great Britain had solid wall insulation installed through CERT in 2010¹⁴. This compares with around 420,000 properties having cavity wall insulation installed through a Government scheme in the same year.

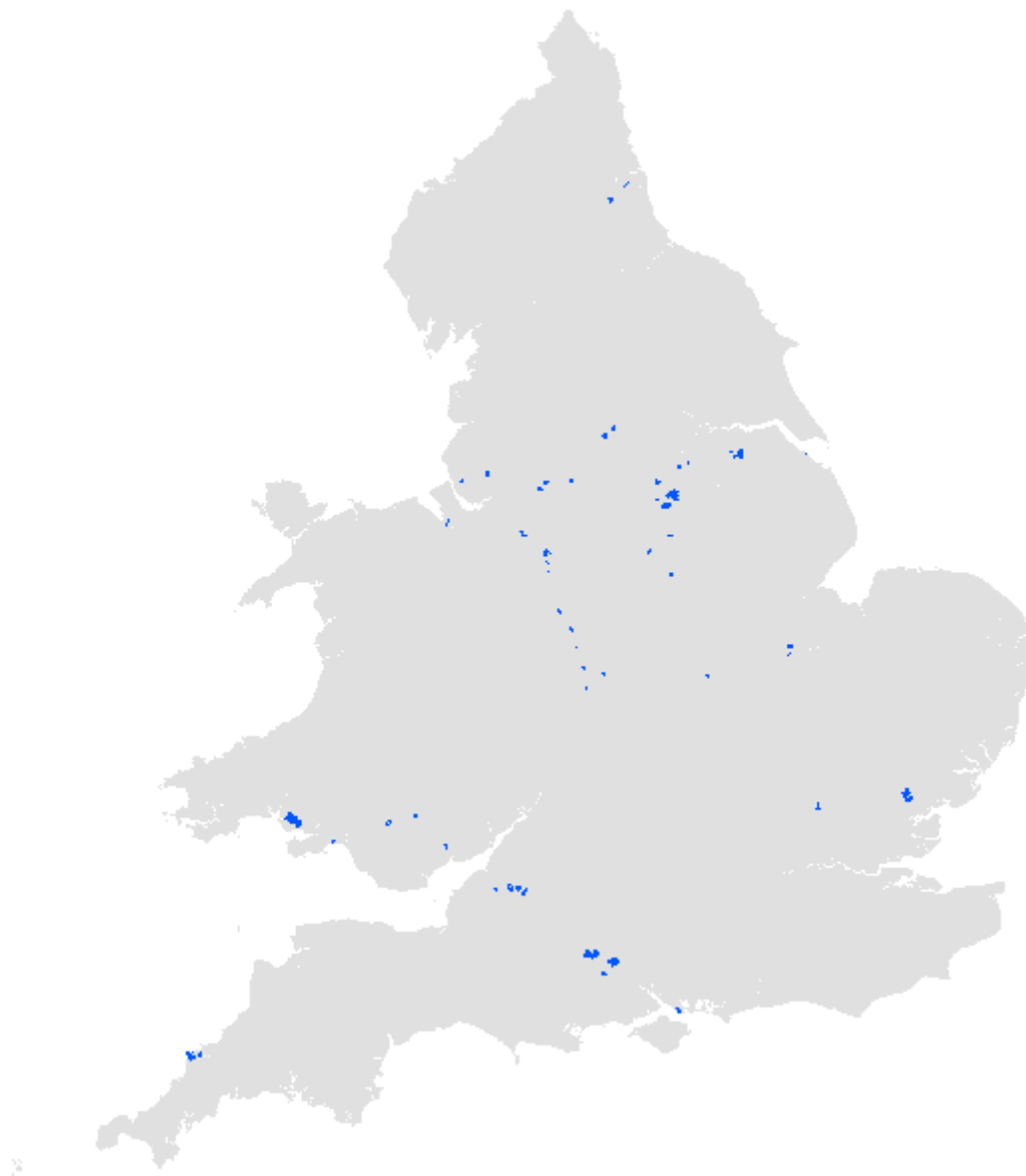
In addition, properties which had solid wall insulation are more likely to be excluded from the analysis in NEED. Firstly, solid wall insulation is often installed in flats which are excluded from the impact of measures analysis due to difficulties with matching information to the correct flat within a building. Secondly because solid wall insulation is often installed in properties which do not have gas as their main heating fuel, and therefore could not be included in this analysis, since it considers savings in gas consumption for properties with gas as the main heating fuel. Finally because solid wall insulation is more likely to be installed in combination with another

¹⁴ Source: DECC Estimates of home insulation levels in Great Britain, <https://www.gov.uk/government/collections/estimates-of-home-insulation-levels-in-great-britain>.

energy efficiency measure, such as a new boiler or loft insulation, this means it would be excluded from this analysis.

It is also often the case that solid wall insulation is installed in a number of properties in close proximity to each other at the same time, due to the cost savings which can be made by using this approach. This is seen in the data analysed for this report. The 790 measures included in the analysis for this report have been installed in 94 lower level super output areas¹⁵ and two thirds of the installations have been in just 16 lower level super output areas. Figure 3.6 below shows the limited geographic areas where solid wall insulation records analysed for 2010 have been installed. It shows all lower level super output areas where there was at least one installation of solid wall insulation in the data analysed for this report. It can be seen that the majority of installations have occurred in clustered areas.

Figure 3.6: Installations of solid wall insulation in 2010 by geographic area

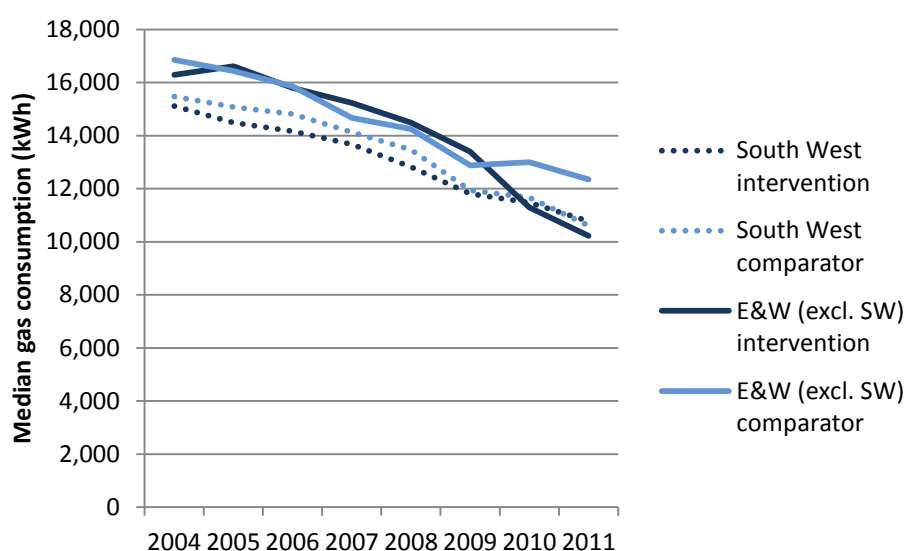


¹⁵ Lower level super output area (LSOA) is a geographic area made up of a number of output areas. Super output areas were designed to improve the reporting of small area statistics. Each LSOA contains between 400 and 1,200 households. There are 32,844 lower level super output areas in England and 1,909 in Wales.

In addition to the limitations to the data more generally, outlined above, it is suspected that there may be some data quality issues with information relating to properties in the South West. These properties are showing a low saving from this measure, which DECC is unable to explain with the data available. The data shows that for the South West, the trend in consumption for those properties which had a measure installed is very similar to the trend for those which did not. This is not what would be expected following the installation of solid wall insulation.

Figure 3.7 below shows the median gas consumption in each year between 2004 and 2011 for the intervention and comparator groups for the South West and separately for all properties in England and Wales excluding the South West. The chart illustrates that properties in the intervention group excluding the South West diverge from the comparator group in 2010 when solid wall insulation was installed, as would be expected. This divergence is not visible for properties in the South West.

Figure 3.7: Median gas consumption, kWh (not weighted): Solid wall insulation installed in 2010, properties in the South West compared to properties in England and Wales (excluding the South West)



Properties in the South West make up 43 per cent of all solid wall properties analysed for 2010. However, due to the weighting of the data, their influence on the estimate of mean and median saving for England and Wales is much less significant. Around ten per cent of the solid wall stock in England and Wales is in the South West.

The headline savings presented below for solid wall insulation have been weighted so that they are representative of the housing stock, rather than just properties which had solid wall insulation installed in 2010. This weighting is especially important for solid wall properties because of the geographic focus of installations and because this measure in particular has been targeted at low income homes, which are often smaller than typical homes and newer than typical solid wall properties.

Table 3.6 shows that the typical annual percentage saving for solid wall insulation installed in 2010, when weighted to be representative of the housing stock, is 14.7 per cent, or 2,100 kWh. The mean savings is 16.1 per cent, or 2,400 kWh.

Table 3.6: Summary of observed savings (weighted) – solid wall insulation, 2010

	Percentage saving	Saving (kWh)
Median	-14.7%	-2,100
Mean	-16.1%	-2,400

Understanding the savings which a property can make as a result of installing solid wall insulation is an area that DECC continues to prioritise. This is being done in a variety of ways including through physical assessments of properties which have received solid wall insulation. In future it should also be possible to analyse more properties through NEED analysis. Nearly 65 per cent more properties received solid wall insulation through CERT or CESP in 2011, compared to CERT in 2010. Work to develop NEED for Scotland and improve matching for flats should also allow a higher proportion of these to be included in future analysis.

3.3 Impact of installing a combination of energy efficiency measures

This section looks at the impact of installing a combination of energy efficiency measures, for measures installed in 2010, covering:

- cavity wall insulation and loft insulation;
- cavity wall insulation and a boiler;
- loft insulation and a boiler; and
- cavity wall insulation, loft insulation and a boiler.

Limitations to data sources as outlined in the impact of a single measure section also apply to data used for the analysis set out in this section. In addition, sample sizes for the combinations of measures analysis are smaller than those presented in the impact of a single measure section, and results should therefore be considered within the context of these smaller sample sizes. Due to the small number of records, it is not possible to include solid wall insulation in any of the analysis presented in this section.

The table below summarises the mean and median percentage and kWh savings for the combinations of energy efficiency measures outlined above, weighted to be representative of the housing stock. As with the impact of a single measure analysis, headline figures refer to weighted figures, which have been adjusted to be representative of the complete housing stock rather than just properties which have had the measure installed through a Government scheme in the year under consideration. Breakdowns by property attributes and household characteristics are not weighted.

The figures presented in this section show that savings from installing a combination of measures in the same year (2010) are greater than the sum of the typical savings experienced from each of the individual measures. Whilst there are a number of possible reasons why this might be the case, this is an area where further work is required. DECC would welcome any input into possible reasons behind these findings, and comments can be sent to:

EnergyEfficiency.Stats@decc.gsi.gov.uk.

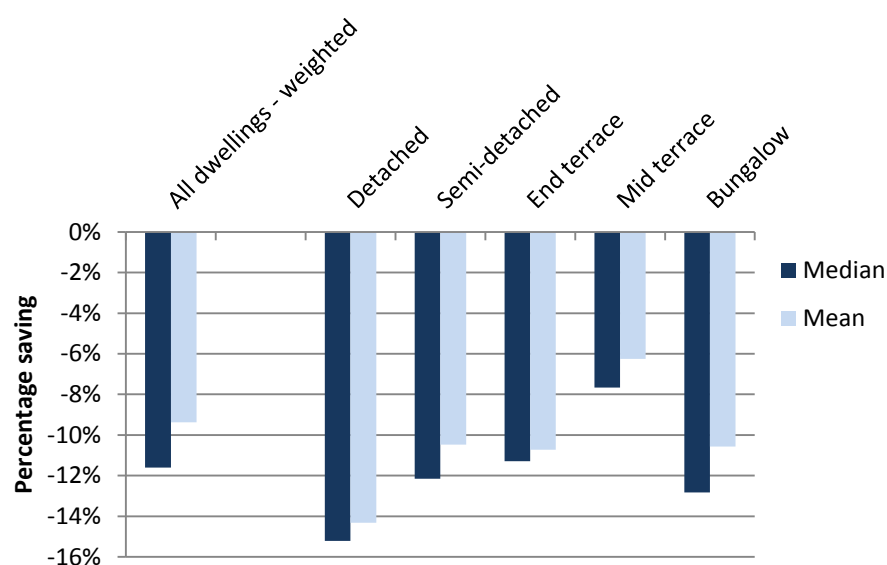
Table 3.7: Summary of observed savings (weighted) – combinations of energy efficiency measures

Combination of measures		Percentage saving	Saving (kWh)
Cavity wall insulation, loft insulation	Median	-11.6%	-1,800
	Mean	-9.4%	-1,800
Cavity wall insulation, boiler	Median	-19.6%	-2,900
	Mean	-15.7%	-3,000
Loft insulation, boiler	Median	-14.3%	-2,200
	Mean	-13.1%	-2,500
Cavity wall insulation, loft insulation, boiler	Median	-24.1%	-3,700
	Mean	-19.0%	-3,600

Cavity wall insulation and loft insulation

Properties having both cavity wall insulation and loft insulation installed in 2010 saw a mean percentage saving of 9.4 per cent, when adjusted to be representative of the housing stock. The typical property saw a percentage saving of 11.6 per cent. This compares to a typical (median) saving of 11.0 per cent when adding the savings together for the two measures individually in 2010.

Figure 3.8 below shows how the mean and median percentage savings vary for different property types. It shows that – consistent with the findings for cavity wall insulation – the mean and median savings are highest for detached properties. When looking at typical (median) savings, bungalows have the second highest annual saving, followed by semi-detached and end terrace properties. Mid terrace properties saved the least as a result of installing these two measures, with the typical annual saving in gas consumption for a mid terrace property being 7.7 per cent.

Figure 3.8: Observed savings for properties having cavity wall insulation and loft insulation installed in 2010, by property type (not weighted)

Cavity wall insulation and a boiler

Table 3.7 above shows that the mean annual percentage saving for properties which had cavity wall insulation and a boiler installed in 2010 was 15.7 per cent, or 3,000 kWh. The typical saving for properties having both of these measures installed in 2010 was 19.6 per cent, a saving of 2,900 kWh. This compares to a typical saving of 8.9 per cent when installing just cavity wall insulation in 2010, and 10.7 per cent for a boiler. The saving for installing these two measures in the same year is therefore very similar to adding the two savings together when looking at the measures individually, 19.6 per cent compared with 19.5 per cent respectively.

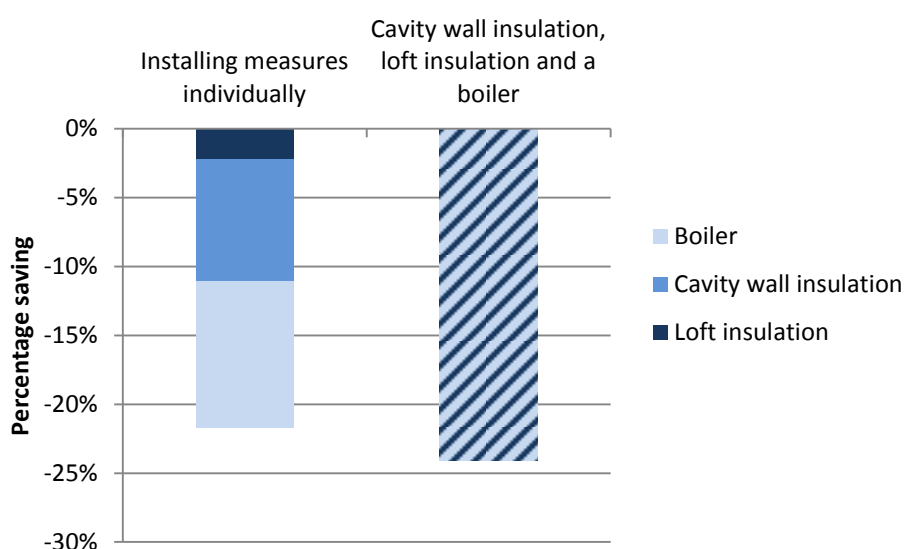
Loft insulation and a boiler

Properties which had loft insulation and a boiler installed in 2010 saw a mean percentage saving of 13.1 per cent, and a typical saving of 14.3 per cent. These represent savings of 2,500 and 2,200 kWh respectively. The typical saving seen when installing this combination of measures in 2010 is higher than that seen by adding together the savings seen for installing these measures individually in 2010, 14.3 per cent compared with 12.9 per cent.

Cavity wall insulation, loft insulation and a boiler

The greatest typical saving observed was for the installation of all three measures considered in 2010; cavity wall insulation, loft insulation and a boiler. The mean saving for properties installing this combination of measures in 2010 was 19.0 per cent, and the typical saving was 24.1 per cent – when adjusted to be representative of the housing stock. Figure 3.9 below shows the typical saving experienced when installing the three measures in 2010 compared with combining the saving experienced when installing each measure on their own. It can be seen that the typical saving experienced is greater when all three measures are installed in the same year.

Figure 3.9: Observed savings from installing cavity wall insulation, loft insulation and a boiler in the same year and separately (weighted), 2010



3.4 Savings over time

All figures presented here are weighted to be representative of the housing stock rather than just properties which had each respective measure installed. The median kWh figures presented in this section will not match those in sections 3.1 and 3.2 since the figures presented

here are for the intervention and comparator groups separately whereas kWh figures presented in the previous two sections are for the matched pairs.

Post-intervention

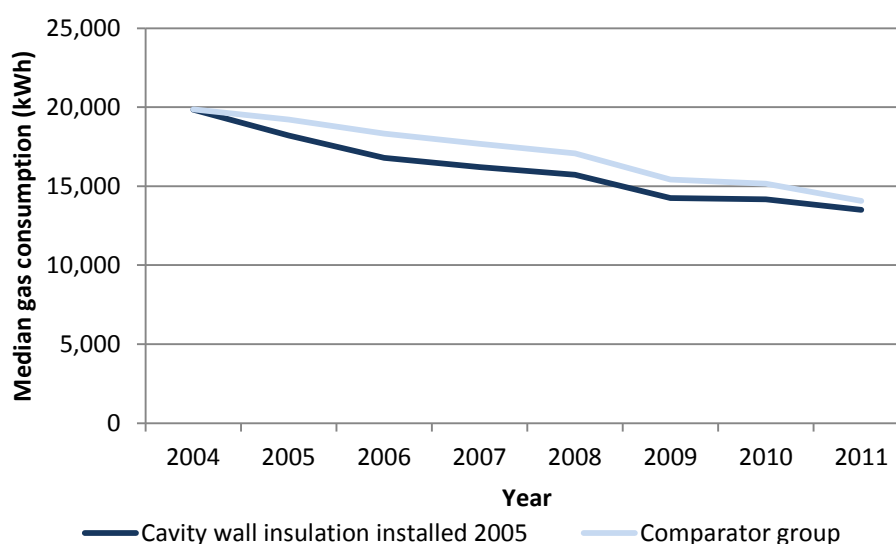
The impact of measures analysis primarily compares gas consumption in the year before and after installation of an energy efficiency measure to get an estimate of the annual saving from installing energy efficiency measures. DECC now has a longer time series of data allowing some analysis of the persistence of savings. The difference in consumption for the intervention and comparator group can be looked at for cavity wall insulation, loft insulation and boilers installed in 2005 to analyse whether the savings observed in the year immediately after installation of an energy efficiency measure continue.

Figure 3.10 shows the median gas consumption between 2004 and 2011 for properties having cavity wall insulation installed in 2005 and a comparator group of similar properties. It shows the comparator and intervention group have similar median gas consumption in 2004 (the year prior to the energy efficiency measure being installed). This is because one of the variables used to select the comparator group was gas consumption in the year before the intervention was installed – to ensure the properties compared were as similar as possible. The consumption for the two groups then diverges in 2005 – the year the measure was installed in the intervention group.

Cavity wall insulation

For cavity wall insulation the biggest difference can be seen between the median gas consumption of the intervention group and comparator groups in 2006 – the year after the intervention was installed. In 2006, properties which had cavity wall insulation installed typically used 1,500 kWh (8.3 per cent) less gas than similar properties which did not have a measure installed. The gap in typical consumption lessens over time, however six years after the installation of cavity wall insulation the intervention group have a typical annual gas consumption of 600 kWh (4.1 per cent) less than the comparator group. Figure 3.10 below shows typical gas consumption between 2004 and 2011 for properties which had cavity wall insulation installed in 2005 and a comparator group of similar properties. Another way of looking at this is that the properties which had cavity wall insulation installed in 2005 have used around 7,100 kWh less gas in the six years following the installation of the measure when compared to similar properties which did not have a measure installed.

Figure 3.10: Cavity wall insulation installed in 2005, long term gas consumption (weighted)



Boilers

Observed differences for boilers follow a similar pattern to cavity wall insulation, the biggest difference in median annual gas consumption is in 2006 – the year after the intervention was installed. In 2006, properties which had a boiler installed in 2005 had a typical consumption 11.9 per cent lower than the comparator group (2,200 kWh). The gap in typical consumption between the two groups lessens over time, however significant savings do continue. Six years after the installation of a boiler this group of properties still have a typical consumption of 8.6 per cent (1,300 kWh) less than the comparator group of similar properties which did not have a measure installed. Properties which had a boiler installed in 2005 have typically saved 10,000 kWh on their gas consumption over the six years post having the measure installed when compared to similar properties which did not have an energy efficiency measure installed.

Loft insulation

The trend for properties having loft insulation installed in 2005 was slightly different to that of properties having cavity wall insulation or a boiler installed. The biggest difference in median gas consumption between the two groups was not in 2006 (the year immediately after the insulation was installed), but in 2007 and 2008, with a typical difference of around 800 kWh (4.5 per cent and 4.7 per cent lower than the comparator group respectively). The next biggest difference was seen in 2006, the year immediately after the intervention was installed, with a typical difference of 600 kWh. A difference did remain throughout the period considered. In 2011, properties which had loft insulation installed in 2005 had a typical consumption 2.9 per cent (400 kWh) below the typical consumption for the comparator group.

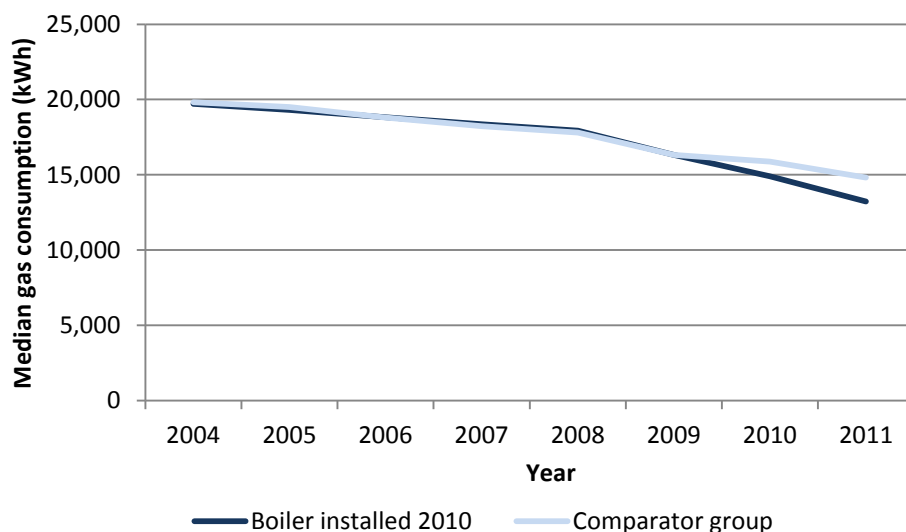
For all three measures savings do continue beyond the first year after a measure is installed, though not at the same level throughout the period. One potential reason for this is the increase in energy prices which could be leading to all consumers trying to become more energy efficient, this may have a greater impact on the comparator group because properties in this group are not benefiting from reduced bills as a result of having a more energy efficient property. It is also possible that some properties in the comparator group may have insulated their own loft (a measure which cannot be controlled for since it is not recorded in HEED) and are therefore seeing a reduction in consumption due to the installation of this measure, however this would not account for all of the observed difference.

3.5 Comparison of consumption pre-intervention

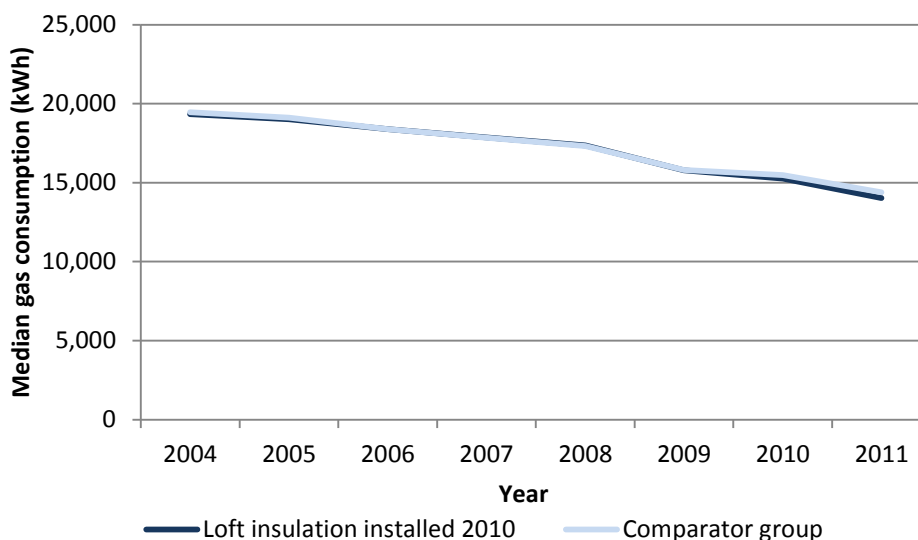
Gas

For measures installed in 2010, annual gas consumption for 2004 to 2009 for the comparator group and intervention group were compared to provide assurance that the comparator groups selected had similar behaviour to the relevant intervention group. As one of the variables used to select the comparator group was gas consumption in the year prior to the intervention (2009) it would be expected that median consumption would be similar in 2009. However, if median consumption is also similar in the years preceding this (2004 – 2008) then it gives greater confidence that any divergence seen following installation of the measure is a result of the measure itself rather than other differences between households in the two groups.

Figure 3.11 below shows the trend in median gas consumption between 2004 and 2011 for properties which had a boiler installed in 2010 and the matched comparator group. It shows that both groups had a similar median annual gas consumption in the years 2004 to 2009. The biggest difference between the median gas consumption of the intervention and comparator group between the years 2004 to 2009 was 200 kWh in 2005. This gives confidence that the divergence seen after 2009 is due to the installation of a new replacement boiler.

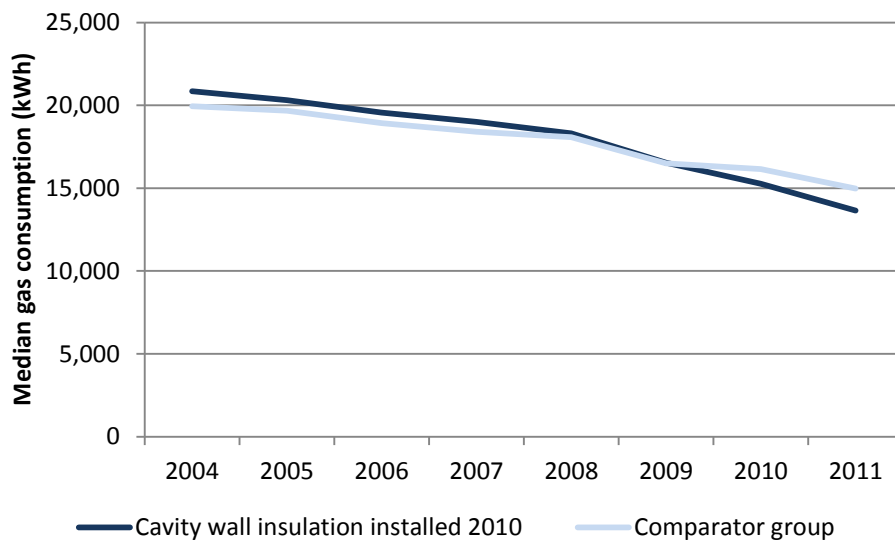
Figure 3.11: Replacement boiler installed in 2010, long term gas consumption (weighted)

The trend for loft insulation is similar to those properties having a boiler installed, with the biggest difference in annual median gas consumption between 2004 and 2009 being 100 kWh. This is shown in figure 3.12 below.

Figure 3.12: Loft insulation installed in 2010, long term gas consumption (weighted)

When looking at cavity wall insulation, the differences in median gas consumption over time were greater (see figure 3.13 below). The largest difference was in 2004, with a difference of 900 kWh. The difference between the median consumption of the intervention and comparator group did reduce over time, and in 2008 the median difference in gas consumption was 200 kWh. Although there were larger differences in median gas consumption, the trend shown over time for the two groups was similar.

Figure 3.13: Cavity wall insulation installed in 2010, long term gas consumption (weighted)

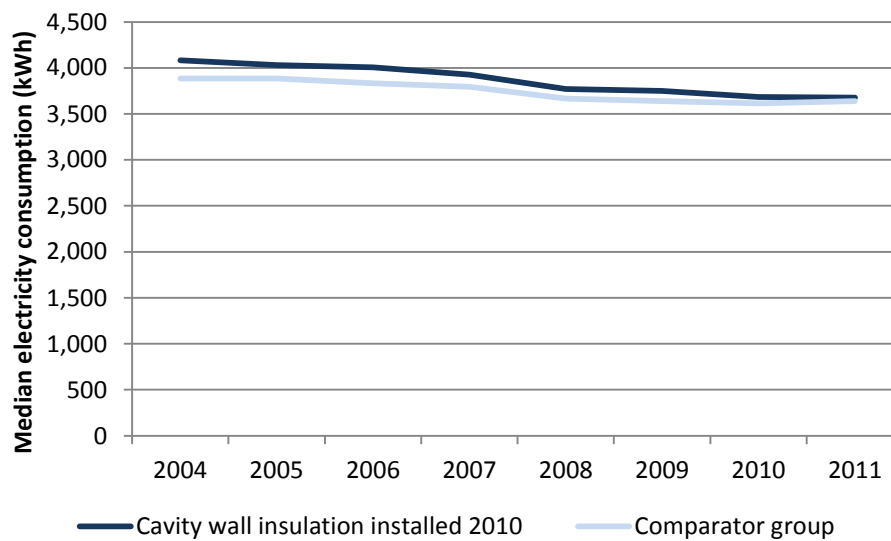


Electricity

In addition to looking at the trend in gas consumption in the years preceding installation of an energy efficiency measure, further assurance that the comparator group selected behaves in a similar way to the intervention group before installation of a measure can be gained by looking at electricity consumption for the two groups. This is more independent than the consideration of gas consumption, as electricity consumption did not form part of the comparator group selection criteria. For measures installed in 2010, annual electricity consumption for the comparator group and intervention group has been compared for 2004 to 2011. The difference in median electricity consumption between the intervention and comparator groups was greatest for properties having loft insulation installed in 2010. In the six years prior to the measure being installed, the median electricity consumption of the comparator group was around 10 per cent higher than the intervention group. For cavity wall insulation and boilers the difference was not more than five per cent in any year.

It is also reassuring that the trends in electricity consumption were similar for the comparator and intervention group in each case, see figure 3.14 for cavity wall insulation – the changes seen in the intervention group are mirrored by the comparator group. For all three measures, median consumption between 2004 and 2009 followed a similar trend in both intervention and comparator groups. There were small differences in trends for the two groups between 2009 and 2011. However, in all cases the intervention group had a greater reduction in median electricity consumption than the comparator group. This is likely to be because of the impact of the energy efficiency measure installed. Some properties with gas as the main heating fuel are likely to have been using electricity as a secondary heating fuel and therefore experienced a small reduction in electricity consumption as a result of installing the energy efficiency measure. DECC hopes to be able to investigate the impact of this in more detail in future.

Figure 3.14: Cavity wall insulation installed in 2010, long term electricity consumption (weighted)



The above results suggest that the approach taken for selecting the comparator group is good and that the comparator group is providing a valid comparison for the intervention group. This gives further confidence in the results presented in this report. However, when interpreting all the results in this report, it should be noted that there is a degree of uncertainty around results presented. While there is no value put on this uncertainty in the 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 has been included to provide a better indication of what a specific household might expect to save.

4. Non-domestic NEED

Update on the Non-domestic National Energy Efficiency Data-Framework

The concept of non-domestic NEED is similar to the domestic sector. It is structured around address matching of energy consumption data and building attributes. However, the use and construction of non-domestic premises is far more varied, leading to greater variation in energy consumption. Analysis of non-domestic properties is therefore much more complex than the equivalent for the domestic sector.

A key purpose of non-domestic NEED is to understand energy consumption across different business sectors, different sizes of organisation and over time. The data used in non-domestic NEED are constructed from a variety of sources including the Valuation Office Agency's Non-Domestic Rating List (NDR), meter point electricity and gas consumption data, business data from Experian and Display Energy Certificates (DEC).

Current work

Since the previous NEED report was published in November 2012, work on the non-domestic side has focused on improving the coverage and matching of data, developing a structured quality assurance process, and identifying potential uses of the data which it has been possible to match. It has also been used to support DECC analysis on the impact of Display Energy

Certificates¹⁶, to estimate energy use of large companies and form the basis for sampling a major research project collecting energy end use estimates for the non-domestic sector.

2014 publication

Early in 2014¹⁷, DECC plans to publish a report focusing on three key aspects of non-domestic NEED:

- Firstly, a detailed quality assurance chapter, highlighting the current strengths, weaknesses and biases within the data. This chapter will also discuss where improvements could be made and possible applications for non-domestic NEED both in its current state and with potential developments.
- Secondly, a review of key findings from analysis thus far on the non-domestic data. This would include experimental analysis of energy consumption and energy intensity (consumption per square metre) across different sector types, building and business characteristics. Trends in the data will also be shown with changes in energy intensity between 2006 and 2011.
- Finally, a proposal of how the model data can be weighted. The weighting of data can remove the biases present in the dataset. This can be done by grossing the achieved matched sample up to the total number of buildings and meters. This chapter will be presented to provide users with an opportunity to feedback on the appropriateness of the methodology prior to implementation.

Future work

The current aims are to increase coverage and representation through improved address matching and the use of weighted data to provide more representative analysis. Following feedback regarding potential uses and the weighting methodology and the implementation of new data matching techniques, we plan to produce an improved version of non-domestic NEED with clear guidance on the potential uses and limitations by the end of 2014.

5. Conclusion

The impact of measures analysis shows that there are significant savings from installations of all the energy efficiency measures considered in this report and provides further support for the value of installing each of these measures individually or in combination. For the first time, headline results have been presented which are representative of the housing stock in England and Wales, rather than just the properties which have had the given energy efficiency measure installed. In addition, the report looked at installations in Wales, and the impact of installing a combination of measures in 2010. Results by property attributes and household characteristics, along with distributions of savings published, also provide an insight into the variation in savings that different properties are likely to experience.

Finally, the longer term savings associated with installing measures have been explored for cavity wall insulation, loft insulation and boilers. These findings show that properties continue to experience savings in the years after installation of a measure.

¹⁶ Energy Trends, June, 2013:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/208560/et_june_2013.PDF.

¹⁷ The date will be pre-announced on the NEED page of the DECC statistics website.

The value of NEED has been demonstrated by the impact of analysis produced using NEED to date. NEED provides valuable insights and also helps the department identify areas where additional research is required. For example, understanding savings from the installation of solid wall insulation and understanding how behaviour affects the savings estimates produced from physics based models.

DECC will continue to develop NEED to meet the future requirements of users inside and outside the department. There are a number of developments planned for NEED in the medium term:

- Working towards publishing an anonymised dataset: DECC continues to work towards making an anonymised version of NEED available. A Privacy Impact Assessment was published¹⁸ in July which sets out how DECC is addressing privacy issues related to NEED. A consultation outlining proposals for the anonymised dataset is being published alongside this report. The final dataset will balance the priorities of ensuring the dataset meets users' needs while maintaining data confidentiality. The consultation can be found on the DECC consultations page¹⁹.
- Conversion to use of AddressBase for the address spine: Work has started on matching address information using AddressBase; initial results suggest this internal matching work will help with some of the harder to match properties, such as domestic flats and non-domestic properties, enabling more of these to be included in NEED in future.
- Inclusion of 2012 consumption data: Consumption data for 2012 will be available for use in NEED in spring 2014. It will be used to produce analysis for an update to both the impact of measures analysis and domestic gas and electricity consumption by property attributes and household characteristics. This next report is planned for publication in June 2014.
- DECC policy evaluation: NEED is a core part of DECC's evidence base and will contribute to the development, monitoring and evaluation of Government schemes including the Green Deal and Smart Meters.
- Energy Performance Certificate (EPC) data: it is intended that EPC data will be linked with NEED over the next six months. This will provide further valuable information such as a property's Energy Efficiency Band and information on main heating fuel. It will increase the scope of analysis possible using NEED and lead to potential further improvements to the selection of the comparator group to estimate the impact of installing energy efficiency measures.
- Non-domestic NEED: As outlined in section 4 of this report, work to develop robust approaches to analysis of non-domestic properties using NEED continues. DECC plans to publish a report on non-domestic NEED in early 2014.

Outputs using NEED are produced and published in line with the National Statistics Code of Practice, NEED is currently undergoing assessment to gain National Statistics accreditation by the UK Statistics Authority.

¹⁸ <https://www.gov.uk/government/publications/national-energy-efficiency-data-framework-privacy-impact-assessment>

¹⁹ https://www.gov.uk/government/publications?departments%5B%5D=department-of-energy-climate-change&publication_filter_option=consultations

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Department of Energy & Climate Change
3 Whitehall Place
London SW1A 2AW
www.gov.uk/decc
URN 13D/297