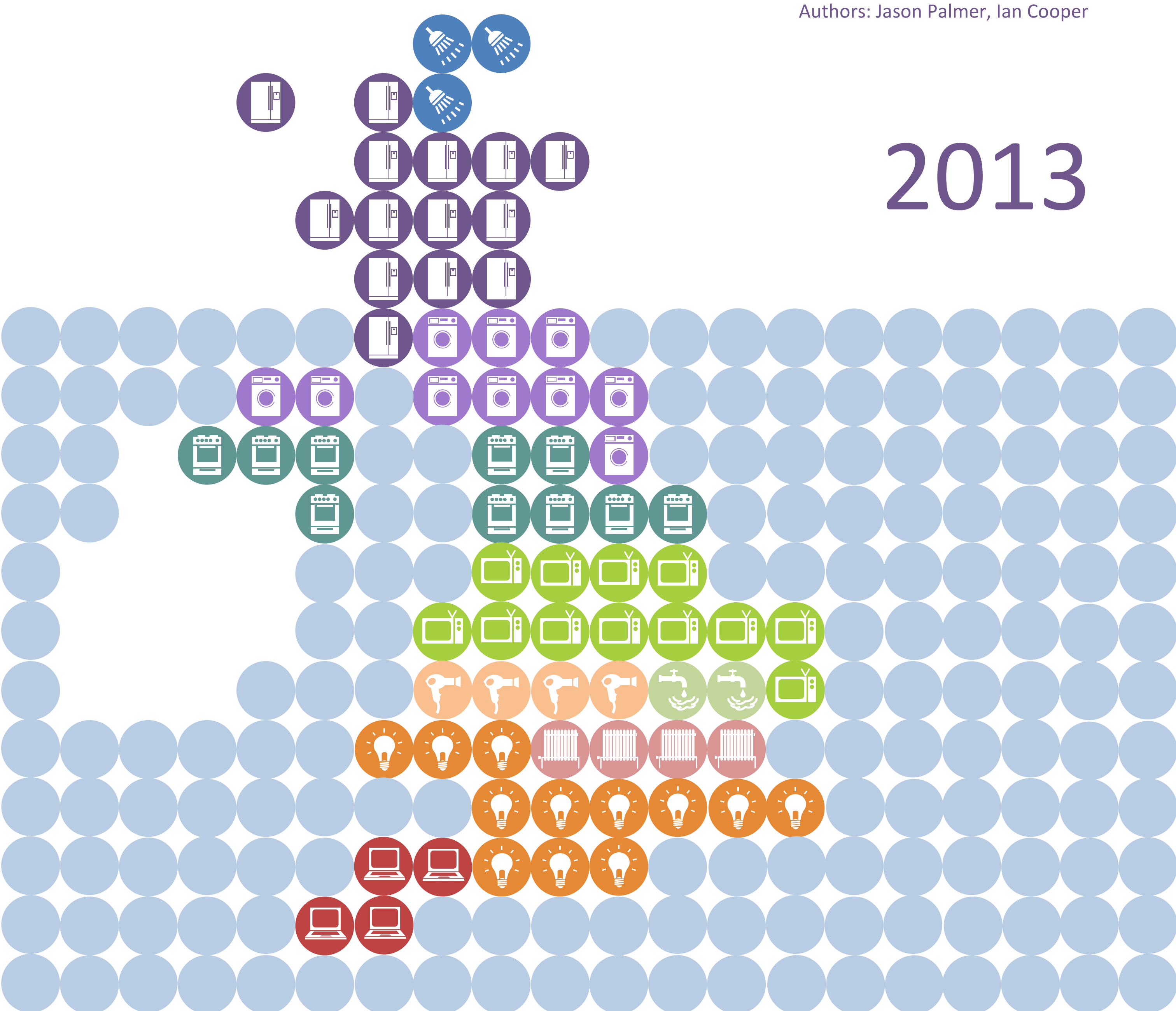
Department of Energy & Climate Change

United Kingdom housing energy fact file

Authors: Jason Palmer, Ian Cooper



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Cambridge Architectural Research Limited

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Cambridge Energy

bre

UCL

eclipse research consultants

United Kingdom housing energy fact file 2013

Authors: Jason Palmer (CAR), Ian Cooper (Eclipse)
Researchers: Amy-Alys Tillson, Peter Pope,
Peter Armitage, Martin Hughes,
Daniel Godoy-Shimizu (CAR)

The Housing Energy Fact File aims to draw together most of the important data about energy use in homes in the United Kingdom since 1970. It is intended for policy-makers, researchers, and interested members of the public.

Prepared under contract to DECC by Cambridge Architectural Research, Eclipse Research Consultants and Cambridge Energy. The views expressed are not necessarily DECC's. December 2013.

With thanks to those who commented on drafts of this report: Matt Lipson (ETI), Kevin Lomas, Steven Firth and David Allinson (Loughborough University), Tadj Oreszczyn and David Shipworth (UCL), Erica Rankin (AEA), Rachel Beaven (Cambridge Econometrics), Sebastian Macmillan (University of Cambridge), Les Shorrock (BRE), Ganka Mueller (Scottish Government).

This is the final edition of the Fact File in this form. DECC will review the situation in the future and may bring back the Fact File in a more condensed form. If this affects you please contact energy.analysis@decc.gsi.gov.uk

Cover illustration: Fionna Catlin. Icons show proportions of electricity use in UK homes, based on the Household Electricity Survey.

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Contents

1. Introduction and policy context

Introduction

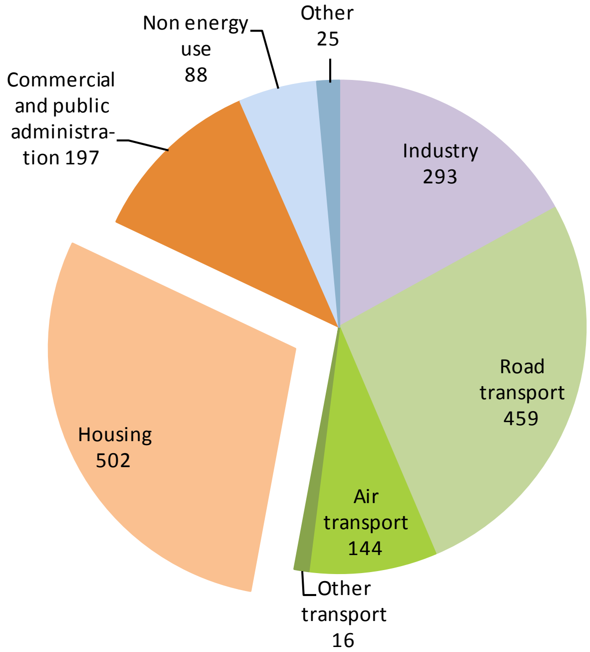
The energy used in homes accounts for more than a quarter of energy use and carbon dioxide emissions in the United Kingdom. More energy is used in housing than either road transport or industry (Graph 1a), and housing represents a major opportunity to cut energy use and CO_2 emissions.

The UK's homes, and how they are used, has changed enormously since 1970.

Much of the UK's housing was built before the links between energy use and climate change were understood. Much of it was also built when there were very different expectations of thermal comfort.

To put it simply, most families in 1970 lived in homes that would be cold by modern standards in winter – as cool as 12°C on average (see Table 6o, Appendix 1). There may have been ice on the insides of the windows, and nearly everyone accepted the need to wear thick clothes at home in winter.

Few homes had central heating, and many families used coal for heating. Added to this, few families owned the household appliances everyone takes for granted today.



Graph 1a: Final energy consumption by sector 2012 (UK, TWh, Total 1,724 TWh)

The way energy is used in homes today is very different. Most homes have central heating, usually fuelled by natural gas, and most households have fridges, freezers and washing machines. Many households also own dishwashers, tumble dryers, PCs and games consoles.

The *Housing Energy Fact File* aims to draw together most of the important data about energy use in homes in the UK since 1970. As well as describing the current situation, it also shows changes over the last 40 years. It is intended for policy-makers, researchers, and interested members of the public. (More detailed information about homes in England is available on DECC's website, in the *Cambridge Housing Energy Tool,* see http://tinyurl.com/HousingFactFile.)

The Fact File is one in a series of reports stretching back to the early 1970s, previously prepared for the Government by the Building Research Establishment.

This report is a collaborative endeavour, prepared by Cambridge Architectural Research and Eclipse Research Consultants, with input from Loughborough University and UCL.

A significant change in this year's Fact File is a new chapter on Household Behaviour, from page 63. This examines how energy use in the home is affected by different patterns of behaviour by householders. It draws on new, more detailed sources of evidence about energy use in UK homes.

This report supports informed decisions about how to reduce energy use and CO_2 emissions from homes. These decisions are not only the territory of governments and policy-makers, but all of us, in day-to-day decisions about how homes are used and improved.

Policy context

Households are responsible for a quarter of the UK's greenhouse gas emissions. The 2008 Climate Change Act requires:

- a 34% cut in 1990 greenhouse gas emissions* by 2020, and
- at least an 80% cut in emissions by 2050.

**CO_2 is the most important greenhouse gas from housing and the one most closely related to energy use in homes.*

It will be impossible to meet the 2050 objective without changing emissions from homes.

The Energy Act 2011[1] paved the way for the Green Deal[2], which was designed to improve energy efficiency in the nation's homes at no upfront cost to householders, at the same time as cutting carbon emissions and helping the vulnerable.

The Green Deal allows householders to pay for energy efficiency improvements through savings on their energy bills. Advisors and approved companies are tasked with identifying improvements where savings are likely to be greater than the costs.

The Green Deal works in tandem with the new Energy Company Obligation[3] (ECO), which is funded by energy suppliers, and replaces the old Carbon Emissions Reduction Target (CERT) and Community Energy Saving Programme (CESP). The ECO provides extra assistance for properties that are harder to treat, including solid wall insulation and hard to treat cavity wall insulation, and for low income, vulnerable households in need of assistance.

The Green Deal is a market-led initiative operating within a new government framework, with an estimated £1.3 billion a year of supplier investment through the ECO, and £200 million a year in private sector investment to fund energy efficiency measures.

The Green Deal is a twenty-year programme and it is very early days, but the statistics show that the market is starting to build and the supply chain is gearing up.

David Thomas. Deputy Director, Green Deal, DECC, June 2013

The ECO was launched throughout Great Britain at the start of January 2013. By the end of July 2013 over 194,000 measures had been installed under ECO – mainly loft insulation, cavity wall insulation and boiler upgrades.

The Green Deal was launched at the end of January 2013 in England and Wales, and a month later in Scotland. By the end of August 2013, more than 71,000 homes had been assessed for the Green Deal[4], and 81% of people who received Green Deal Advice Reports said they had installed or intended to install energy saving measures[5] and 72% of people would recommend a Green Deal assessment to a friend.

By the end of August, nearly 270 organisations and more than 2,300 people had been accredited as Green Deal Assessors.

Uncertainty and sampling errors

Much of the data reported here comes from the English Housing Survey and other work based on samples. As for all work relying on samples, some inaccuracy is unavoidable in the figures presented. The most significant source of inaccuracy is known as ‘sampling error’ – where the characteristics of a sample do not exactly match the characteristics of the whole population.

Sampling errors in the English Housing Survey are relatively small because the sample size is over 14,000 homes. These errors are described and quantified in some detail elsewhere, see *English Housing Survey: Homes 2011*.[6]

There is also a chance of inaccuracy from characteristics of dwellings that are hard to record. For example, where difficulties accessing a loft or the inside of a cavity wall mean it is hard or impossible to assess insulation thickness, or when it is not obvious whether an installed boiler is an efficient condensing boiler or a less efficient non-condensing boiler.

Some of the data included in the Fact File also comes from modelling, which is subject to even greater uncertainty. We have examined this uncertainty in considerable detail, and our findings are summarised in Appendix 4. We will come back to this issue in the next chapter. Throughout the Fact File, *modelled* data is clearly marked in the text, and graphs have a coloured border.

2. Energy use trends 1970-2011

Total energy use in housing gives some clues about energy efficiency, but it is only part of the story. For one thing, it says nothing about how the housing stock has grown, or how energy is used in homes.

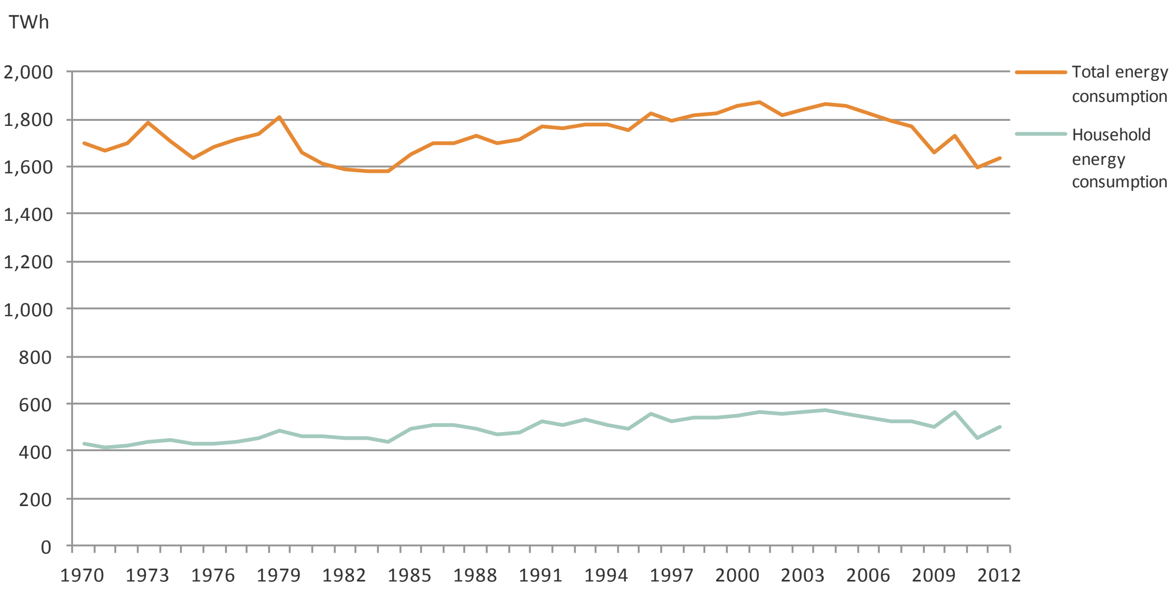
Similarly, the total use of energy hides variations in carbon emissions, because different fuels lead to higher, or lower, levels of CO_2 emissions. Nor does this aggregate information say anything about energy spending – because each fuel has a different price, which can vary independently.

Nevertheless, total fuel use is a simple barometer of whether more, or less, energy is used in all UK homes over time. It is a good place to start to get an overview of housing energy.

Housing energy is nearly a third of total energy use, and its share is rising over time.

Energy use in homes amounts to just under a third of total energy use in the UK, up from a quarter in 1970. The headline graph below shows that housing energy (the blue line) crept up gradually until 2004, fell by nearly a tenth to 2009, and then became more erratic. A big rise in 2010 was followed by an even bigger fall in 2011, and then another 11% rise in 2012 – all largely because of alternating cold and mild winters.

The orange line on the graph shows all energy used: transport, industry, public sector use and housing. (All of the sources and references for the graphs in the Fact File are in Appendix 1, and the data is available here: www.carltd.com/FactFile.)



Graph 2a: Final energy use for housing and all sectors (UK, gross calorific TWh)

Total energy use in the UK rose and fell during the 43 years covered in the graph. However, it finished the period at below the level of use in 1970: 1,635 terawatt hours, TWh. (A terawatt hour is a million million watt hours, 10^{12} Wh – equivalent to leaving on a small hairdryer in every home in Britain, continually, for 1.6 days. These figures are lower than those on page 5 because they exclude 'non energy use' of fuels for chemicals and lubricants.)

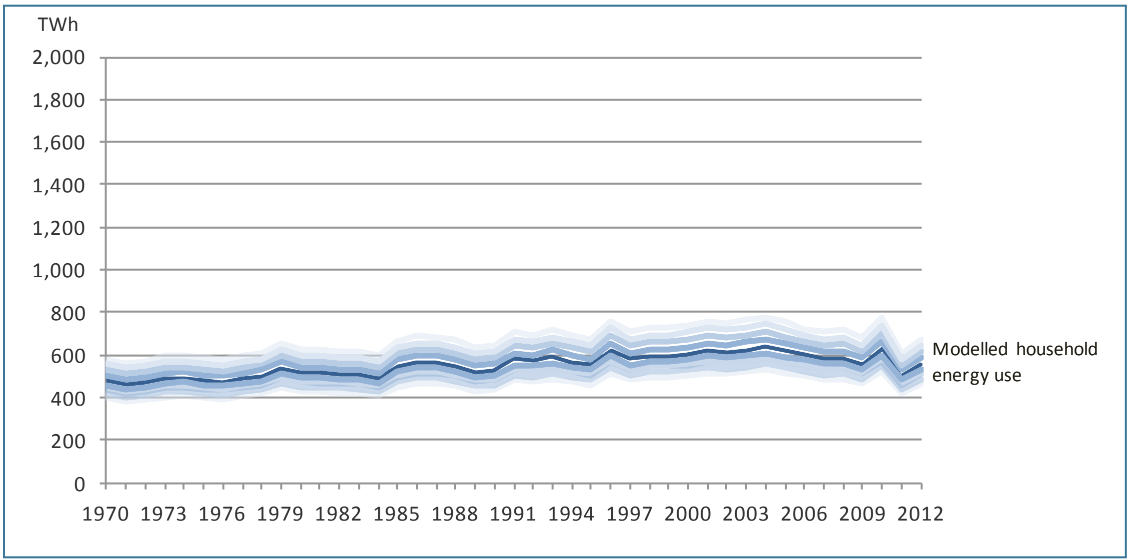
Energy use in housing rose by 16% from 1970 to 2012 – an average increase of 0.4% per year. However, the number of homes also increased by more than two-fifths, and average household size has fallen (see Chapter 4). Taken together, this means average energy use per home has fallen – from 23,800 to 18,600 kWh – although the harsh winters in 2010 meant that energy use per home was higher that year.

Overall energy use in homes has risen since 1970, but use per household has fallen more than a fifth.

Uncertainty in total housing energy

The energy use graphs above use data from the Digest of UK Energy Statistics, DUKES. However, to illustrate the uncertainty inherent in our modelling (principally in Chapter 5), the graph below shows our estimates of total household energy use from 2009 to 2012. By considering uncertainty in modelling we move away from a single point estimate to a range of estimated values, which more accurately captures model findings.

The dark blue line is our central estimate, and the lighter blue lines are indicative, intended to show how the likelihood that the 'true' value is different falls as you move away from the central estimate. This is based on the uncertainty work we describe in more detail in Appendix 4.



Graph 2b: Modelled energy use for housing 1970-2012 (UK, TWh)

3. Carbon emissions and energy generation trends

Carbon dioxide emissions and energy use are inextricable. Nearly all use of energy results in increased CO_2 emissions somewhere – even nuclear electricity and renewable power require energy (and emit CO_2) to build generating capacity and, for nuclear, in extracting and refining uranium.

However, the carbon-efficiency of electricity generation has improved since 1970 – largely through switching from coal to gas in power stations. (This chapter focuses purely on CO_2 and excludes other greenhouse gases.)

This section of the Fact File charts how CO_2 emissions and energy prices have changed over time. There are three key points raised:

- Carbon dioxide emissions from housing have fallen more than a fifth since 1990. This was despite increases in the number of homes and changing expectations about energy use in the home.
- The cost per unit of electricity, solid fuel and oil has increased in real terms, while gas costs per unit have barely changed over the last 40 years. Rising costs for electricity hit poorer households with electric heating the hardest.
- Coal-fired power generation increased by nearly a third in 2012, which will increase the UK's CO_2 emissions.

Carbon emissions

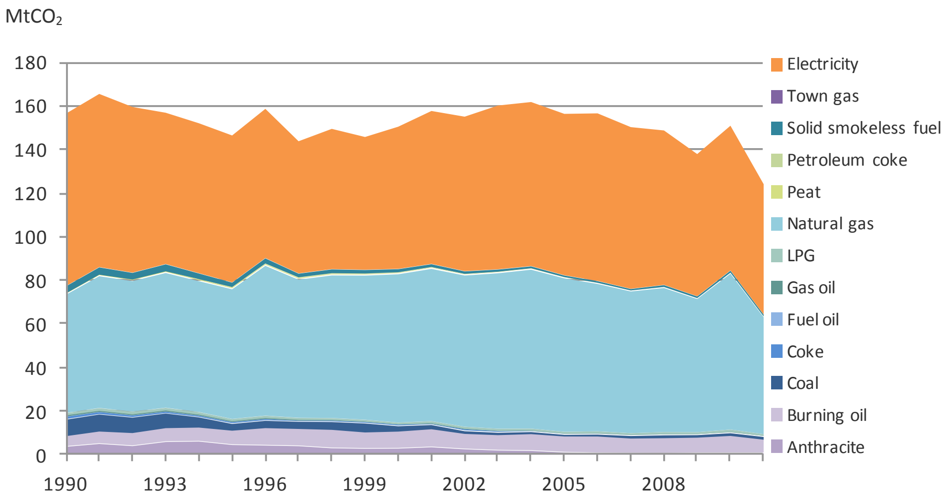
There are many more UK homes now than there were 40 years ago: more than 27 million today, compared to 19 million in 1970, and just over 23 million in 1990. Inevitably, this puts upward pressure on carbon emissions.

Added to this, significant changes in heating systems, comfort expectations, insulation and use of appliances have transformed carbon emissions from housing. However, some changes (like greater use of appliances) have worked against measures aimed at saving energy and CO_2 (like better insulation).

Overall there has been a broad downward trend in CO_2 emissions from housing (see graph below). However, the trajectory has not been straight – and, unsurprisingly, cold and prolonged winters like the harsh winters of 2010 led to higher CO_2 emissions.

Carbon emissions from gas use have fallen marginally since 1990, while emissions from electricity have fallen by a quarter over the period. Emissions from solid fuels used for heating have fallen even more steeply: more than 80% since 1990.

Electricity use still accounts for the lion's share of total household CO_2 emissions – just over half, compared to just over a third of emissions from gas use for heating.



Graph 3a: CO_2 emissions from housing energy (million tonnes)

Surprisingly, perhaps, CO_2 emissions from oil use (shown in mauve, near the bottom) rose by more than a quarter during the period, from 4.9 to 6.2 $MtCO_2$. This may reflect increased demand for heating in homes not served by gas, and particularly the near-doubling in take-up of oil-fired central heating since 1990.

Electricity generation

Electricity generation in Britain has changed considerably since 1970. The changes have come mainly as a result of different prices for the input fuels used in power generation, but also because of the availability of North Sea gas, electricity sector privatisation, growth in nuclear power, and regulations aimed at cutting emissions.

These changes alter the economics and the environmental impact of electricity use – in the home and beyond. Notably, coal has fallen steeply as an input into power generation (see graph on next page, which has an extra year of data compared to the CO_2 graph above).

Coal is a high carbon fuel, which leads to high emissions of CO_2 per unit of electricity from a coal-fired power station. Burning coal also results in relatively high nitrous and sulphurous emissions. Nitrous oxide is a very potent greenhouse gas (300 times more potent than CO_2), while sulphurous emissions have a cooling effect on the climate but they contribute to acid rain.

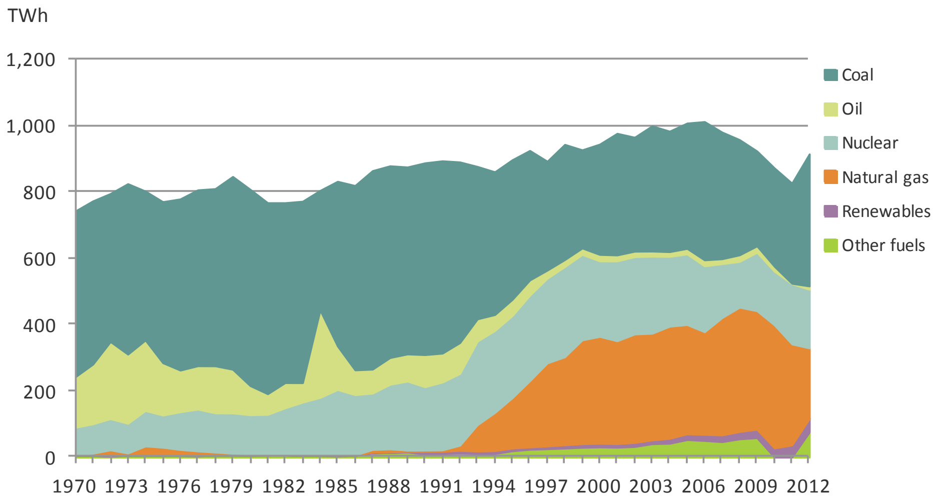
We now use much less coal to generate electricity, which means that CO_2 emissions per unit of electricity have fallen dramatically.

Modern coal-fired power stations are designed to remove most of these emissions from the flue gases before releasing into the atmosphere (except CO_2), and tightening environmental regulations mean that many of the older, less efficient power stations will close over the coming years. However, coal remains a more polluting fuel than gas.

Coal-fired power was being displaced by electricity generated from natural gas and, to a lesser extent, by nuclear power. While two-thirds of the country's power came from coal in 1970, this had fallen to under a third in 2010, but its share is now rising again, and in 2012 it accounted for 44% of electricity generation.

Increased coal use for power pushed up CO_2 emissions for 2012, but the increase does not yet show up in the emissions statistics.

This shift is the result of changing economics for power generation: coal has become cheaper relative to gas on world markets. Using much more shale gas for electricity generation in the US means that the world price of coal has fallen.



Graph 3b: Energy content of fuel input for UK electricity generation (TWh)

Oil's decline in the electricity generating mix is more straightforward: from just over a fifth of UK electricity in 1970 to just 1% now. (There was a big increase in oil use for power generation during the miners' strike in 1984-5.)

The historic switch from coal to gas-fired power generation in the 1990s and 2000s was partly reversed in 2012 because of cheaper coal.

The share of electricity coming from nuclear power almost doubled over the period – from just over 10% in 1970 to 20% today. However, nuclear power peaked in 1998, when it generated towards a third of Britain's power. The decline since then looks set to continue unless the nuclear power stations now reaching the end of their lives are replaced.

Natural gas was used to produce a tiny fraction of power in 1970. But today, mainly as a result of the 'dash for gas' in the 1990s, it generates nearly a quarter of the country's electricity.

The proportion of power coming from other sources (principally gas from coke ovens and blast furnaces, chemical and refuse waste, and renewables) has grown from almost nothing to getting on for 10%.

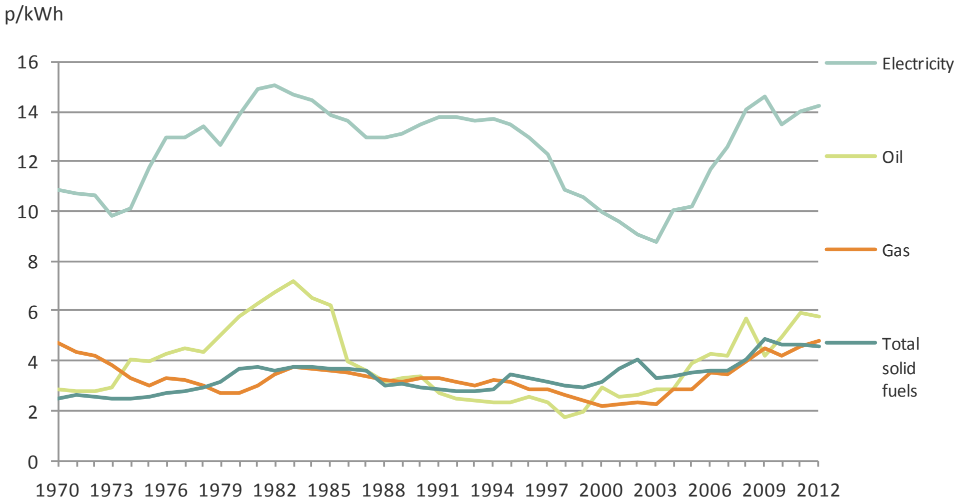
Energy prices

Household spending on energy is directly affected by the price of different fuels. Fuel prices have changed significantly since the 1970s, even when inflation is removed from price figures, as shown in the graph on the next page.

The real price of electricity has increased by almost a third since 1970, although this masks a more complex evolution. There was a steep price rise during the 1970s and early 80s, followed by a sustained downward trend until 2003, and then another steep rise from 2003 to 2009. A fall in prices in 2010 was followed by more modest increases in 2011 and 2012.

The pattern is linked to the prices of input fuels, and particularly the price of oil on international markets. It is no coincidence that the trend of electricity prices is similar to the trend for heating oil shown on the graph, although other factors also play a part.

The jump in real electricity prices from 2003 to 2009 is significant because electricity is three or four times more expensive per kWh than other forms of energy. The price of gas has also fluctuated over time in real terms, although less than heating oil and solid fuels.



Graph 3c: Average UK household fuel prices (p/kWh, 2012 prices)

Heating oil closed the period more than double the cost in real terms than it was in 1970. However, oil prices were volatile in the 1970s and 80s – when the price increased by more than 150%, and then slipped back to the original cost in real terms – and have also been volatile since 2007.

Gas prices were comparatively stable in real terms throughout the four decades in the graph. They finished the period almost the same price in real terms as they were at the beginning.

The price of solid fuels, including coal, coke and breeze (small fragments of coke), rose gradually during the period, finishing 80% more expensive in real

Low-income households spend proportionately more on energy, and lack resources to improve energy efficiency. They are forced to use less energy if prices rise.

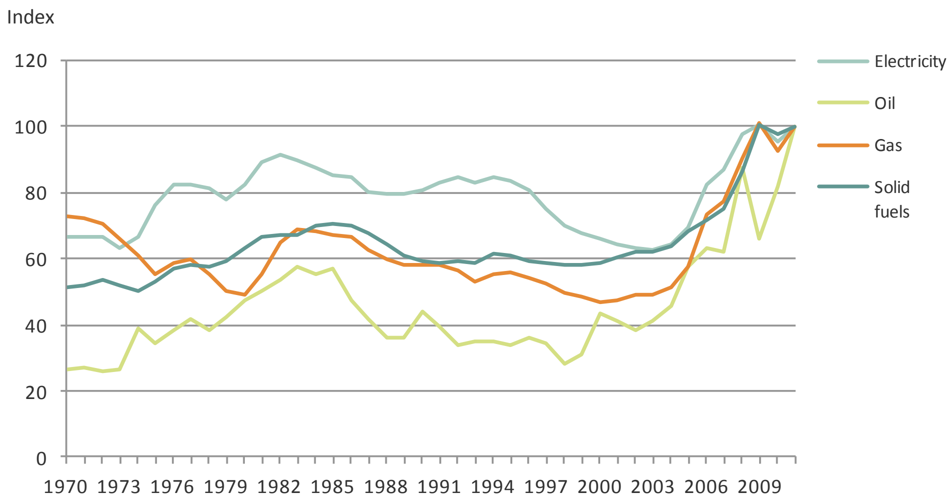
terms. (This is probably less significant than price changes for electricity and gas because far fewer homes now use solid fuel heating.)

The demand for energy is usually reckoned to be 'inelastic' in the short term (i.e. energy use doesn't change much straight away when prices go up) but 'elastic' in the long term (i.e. a few years after price rises households are able to make changes to save energy).

However, low-income households, who spend proportionately more of their incomes on energy, are hit much harder by energy cost rises. Their demand for energy tends to be more elastic than wealthier households, meaning that they tend to use less if prices rise (see also[7,8]).

In the long term, all households may act to reduce electricity use as a result of higher real costs of power. Savings could come from low energy lights and appliances, and possibly reduced use of conventional (resistance) electric heating.

Savings in electricity use may also come from EU policies, such as the EU's regulation on standby on appliances being limited to 1 watt[9], which came into force in December 2012, and the phase-out of ordinary incandescent bulbs.[10]



Graph 3d: Average deflated UK household fuel price indices (2011 = 100)

Indexed energy prices, with all fuels adjusted to a base of 100 for 2011, show similar trends (see graph above). Generally, the prices of fuels rose from 1970 to the early 1980s, then the price of all fuels fell until around 2000, when they rose relatively steeply until 2010, levelling off more recently.

Fuel poverty

The official definition of fuel poverty has changed. In the past, a household was defined as fuel poor if it needed to spend more than 10% of its income on fuel to maintain comfortable conditions[11] (usually 21°C in the living room and 18°C in other rooms). However, this definition was criticised as being over-sensitive to price changes and technicalities in the calculation, and the Hills Review[12] resulted in a more sophisticated definition of fuel poverty, based on households having both:

- higher than average required fuel costs, and
- if spending this amount on fuel would push residual income below the official poverty line.

This is known as the 'Low Income High Costs' indicator (LIHC). Both indicators put an emphasis on heating, but the cost of hot water, lights, appliances and cooking are also included.

The new way of estimating fuel poverty reflects both the extent and depth of the problem: by reporting not only how many households are in fuel poverty, but also the 'fuel poverty gap' (defined as the difference between modelled fuel bills and a reasonable cost threshold for each household).

The graph below shows how these indicators for fuel poverty have changed since 2003. The pale blue bars show that the proportion of fuel poor households has fallen – from 2.44 million households (11.8%) in 2003 to 2.39 million households (10.9%) in 2011.

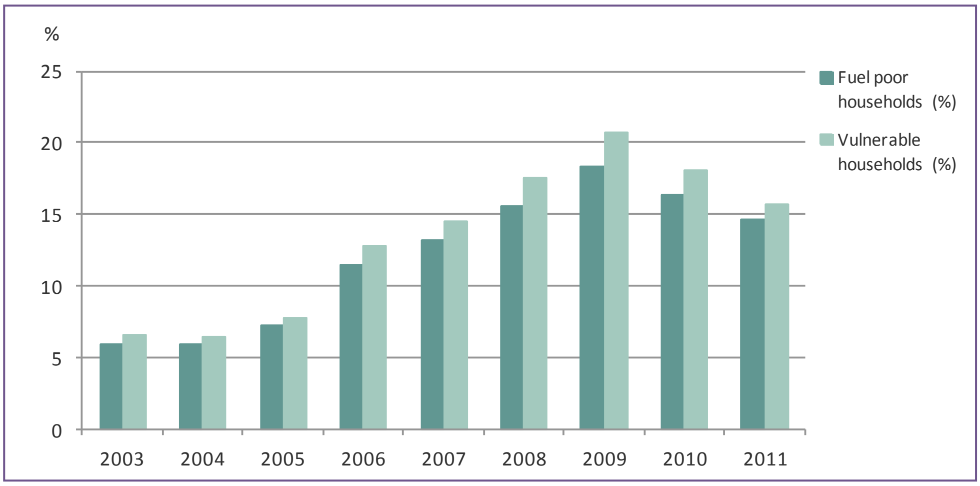
The 'Low Income High Cost' fuel poverty indicators show that although slightly fewer house-holds in England now suffer fuel poverty than in 2010, the depth of fuel poverty has increased.

However, the fuel poverty gap (the red line) shows that the depth of fuel poverty has increased significantly for these households. While they would have needed to spend an average of £248 more on fuel to bring them up to the modelled 'standard' energy use in 2003, this figure increased by three-quarters to £438 in 2011. (This change is mainly due to increasing energy prices over this period.)

The graph is modelled, based on fuel costs, modelled energy use, and incomes. The modelling uses average weather data rather than the actual year's weather. Modelled data is shown in Fact File graphs using a coloured border.

Graph 3e: Fuel poverty in England (%) and the fuel poverty gap, using new indicators

To see how the new indicators compare to the old way of reporting fuel poverty, the graph below shows fuel poverty using the old '10% of income' indicator. (This too is modelled.) Notice that the old indicators identified the number of 'vulnerable households' among those suffering fuel poverty (also possible with the new indicators). These are households with elderly people, children and people with disabilities or long-term illness, and they make up about 70% of households.



Graph 3f: Fuel poverty in England (%) using the old '10% of income' indicator

The old fuel poverty indicators were heavily influenced by energy prices, and the trend appears very different from the new indicator. The 10% measure suggested that fuel poverty rose significantly from 2003 to 2009 – from 1.2 to 4.0 million households – but then fell back to 3.2 million households in 2011.

The number of vulnerable households in fuel poverty followed a similar trend over the last nine years – more than tripling from 2003 to 2009, then declining by 22% by 2011.

The proportion of fuel poor households that are vulnerable stayed relatively stable: between 77% and 80% over the period.

4. The housing stock, households and bills

The UK's housing stock changes very slowly. There are now 27.6 million dwellings in England, Scotland, Wales and Northern Ireland[13], but only around 160,000 new homes are built each year, and far fewer homes are demolished.

(The Department of Communities and Local Government defines a dwelling as 'a self-contained unit of accommodation'. A household is defined as 'one person or a group of people who have the accommodation as their only or main residence and either share at least one meal a day, or share the living room'.[14])

The total number of dwellings changes very slowly over time: the average growth in numbers of dwellings from 2001 to 2011 was only 180,000 per year – less than 1%. Some of these new dwellings are converted from non-domestic uses, and others are existing dwellings that are sub-divided.

Existing homes undergo improvements over time, but historically – like the growth in dwelling numbers – the rate of improvement has been very slow. From 2002 to 2012, CERT accelerated the rate of energy efficiency upgrades, and especially of cavity wall insulation, and loft insulation – see Graph 6j in Chapter 6.

Historically the UK's housing stock has changed very slowly, but now unparalleled improvements to energy-efficiency are needed to meet climate change objectives.

The UK has now embarked on an ambitious strategy to accelerate the rate of housing energy-efficiency improvements. This, coupled with work to decarbonise energy supply, will allow progress towards climate change objectives in the housing sector.

This section of the Fact File explains the current situation in terms of different types and ages of homes, who owns them, and how they are spread around the country. It also provides information about household spending on energy and how this relates to household incomes.

In summary, there are five main trends emerging from the data:

- the number of households is increasing at a rate of 0.86% a year, and average household size is falling
- the concentration of households is shifting – slowly – away from the North, towards the South West, Midlands and South
- flats and detached homes are now more common, and together these make up more than a third of the stock
- there has been a significant change in home ownership since 1970 – nearly nine million more homes now belong to the household living

there, and local authorities now own four million fewer homes than they did in 1970

- energy bills have fallen in relation to total household spending[15] (expenditure on all goods) – from 6% in 1970 to 4.4% today.

Population and households

Energy use in homes is driven by householders' need for energy services, such as light, comfort and hot water. The amount of energy required to meet these energy services is shaped by the level of service required and the type of home, heating systems, lighting and appliances in place. However, people do not actually want to use energy – it is services like light and comfort they really seek.

Nevertheless, it comes as no surprise that total energy use in homes across the UK is strongly affected by both the size of the population and the number of households. Hot water use and the use of some appliances (kettles, hairdryers, washing machines) increase in proportion to household size.

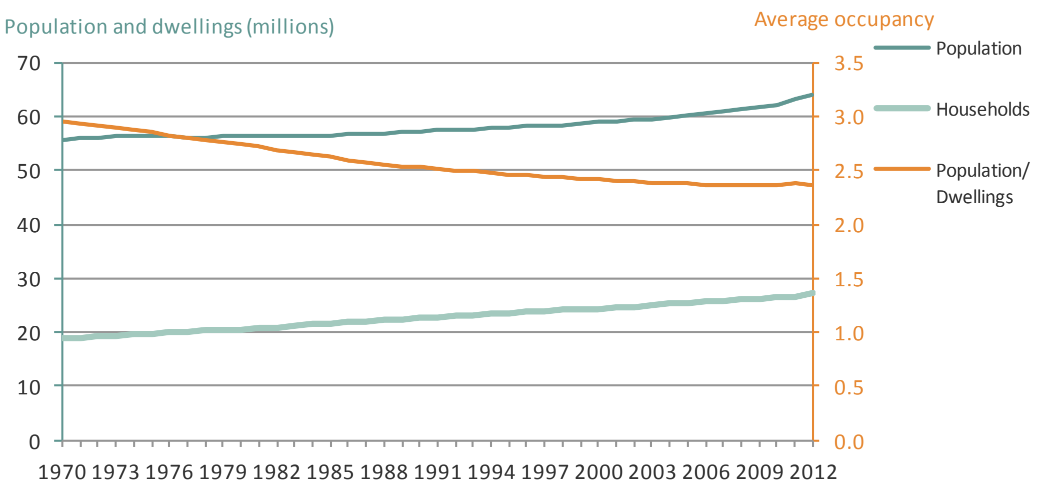
However, heating energy (which is the biggest slice of energy use in homes) usually correlates more strongly to the size of dwellings, and household size makes little difference to heating. (See *Sensitivity Analysis*, Appendix 4, and reference [16].)

There also seems to be a minimum level of energy use in homes, which applies regardless of the household size. For example, households nearly always run a fridge or fridge-freezer, some electronic appliances, minimum heating and hot water whether they live alone or in large families.

The graph below shows how the UK's population, and the number of households, have changed since 1970. (As before, all of the sources and references for these graphs are in Appendix 1.)

The number of people in a home, and the home's floor area, both influence energy use. However, dwellings seem to have a minimum annual energy use that is not related to the number of occupants or floor area.

How people use energy in their homes is usually more significant in shaping consumption than either household size or the size of the dwelling.



Graph 4a: Population and households

The population rose from 55.6 million in 1970 to 64.1 million in 2012 – an average 0.34% increase every year. However, the number of households grew more rapidly over the period, from 18.8 million in 1970 to 27.1 million in 2012. The average yearly increase in household numbers was 0.88%, and was higher than this in 2012.

The rising number of households reflects a trend for smaller households, with more people living alone and in small families. This has implications both for the provision of appropriate housing and for energy use in homes.

Demographic trends – particularly increasing numbers of pensioners – and changing working patterns may affect energy use.

Without improving the energy-efficiency of homes, or the ways people use energy at home, growth in household numbers and smaller average household size would lead to higher per capita energy use.

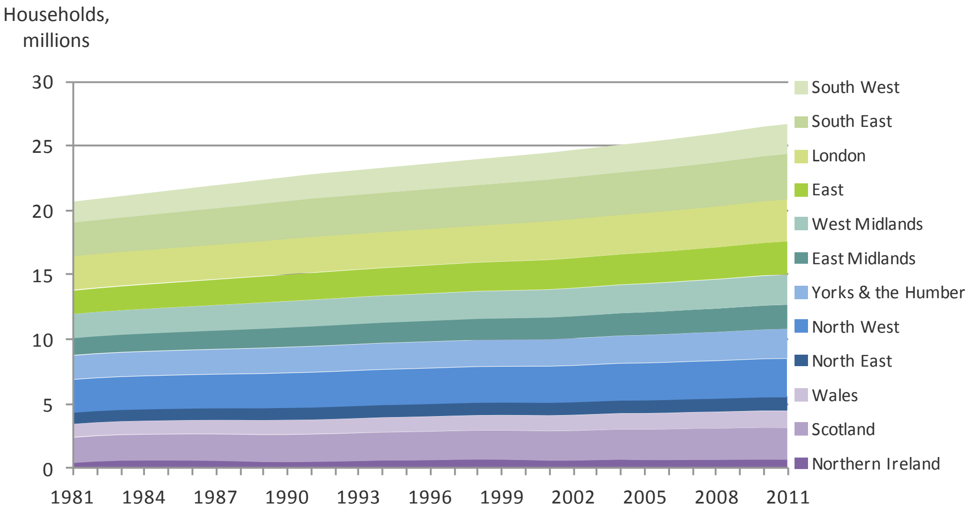
There are also demographic trends affecting how energy is used, and how much. An ageing population with more pensioners, and more flexible working practices – which make people more likely to work from home – mean an increased proportion of dwellings are heated between 9am and 5pm on weekdays. This also affects electricity use.

Geographical profile of homes

Some parts of the UK have much harsher winters than others. There is also higher rainfall and stronger wind in some parts of the country.

Typically, Scotland and the North of England are colder in winter, while the South and especially the South West are usually milder. Wales and the west coast and upland areas see most of the rain, while it is significantly drier in the East.

This all translates into different heating requirements for homes in different regions. We have divided households into nine regions in England, and one each for Scotland, Wales and Northern Ireland, in the graph below.



Graph 4b: Number of households by region (millions)

The number of households has risen in all regions since 1981 (the first year data is available). On average for the UK as a whole, there are now over a quarter more homes than there were in 1981.

However, the expansion was not shared evenly throughout the country. The fastest-growing region in terms of new households was Northern Ireland (54% growth since 1981), despite declines in population due to outward migration in some years. The South West and the East also grew considerably (both more than 35%).

The North East and North West grew much more slowly – just 16% and 17%, respectively. Scotland's households grew by more than a quarter, while Wales's grew by 30%. Overall the concentration of households is shifting – slowly – away from the North, towards Northern Ireland, the South West, Midlands and South.

The concentration of housing is shifting – very slowly – towards the South West, Midlands and South, where it is milder.

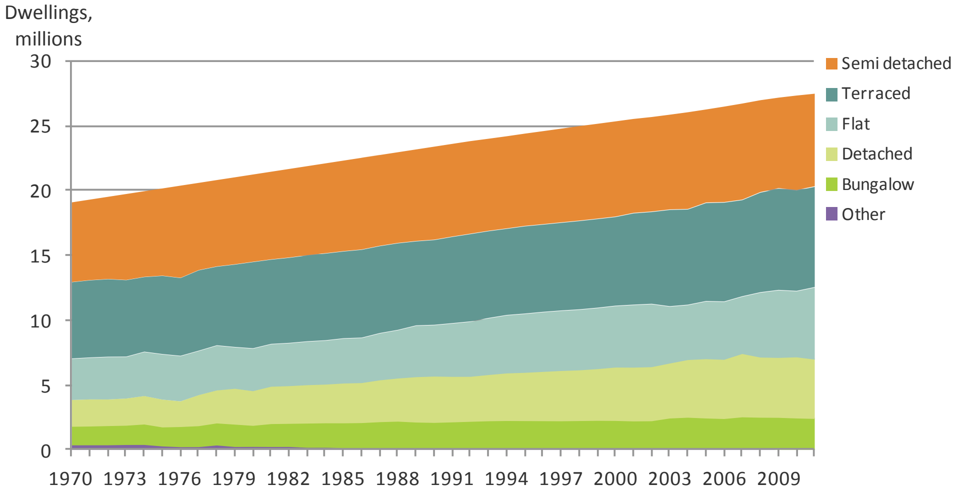
Type profile of homes

'House type' refers to whether dwellings are semi-detached houses, terraced houses, detached houses, flats or bungalows. Unsurprisingly, the housing mix changes slowly over time – due to new house building and some demolition of dwellings.

However, over 40 years the change is quite pronounced (see graph below*). While semi-detached and terraced houses have always been the most common house types (each representing just under a third of the housing stock throughout the period), flats and detached houses have become more common. (Flats are now 20% of the housing stock, and detached houses are 17%.)

** We should note here that there were significant changes in data collection methods between 2002 and 2003, when the English House Condition survey replaced surveys carried out by GfK. This means that there are inevitably some discontinuities within the data series. The changes are described in more detail in Appendix 2.*

This is significant in energy terms because heating energy is related to external wall area and window area. Flats tend to have less external wall area compared to their floor area (so have less heat loss in winter), while detached houses typically have more external wall and more windows than equivalent homes of other types.



Graph 4c: Housing stock distribution by type (millions)

A bias towards higher glazing ratios (larger windows compared to walls) in many modern flats may undermine some of the benefit of lower wall-to-floor ratios, but this is balanced by higher-performance glazing.

Some house types also tend to be larger (e.g., detached houses) or smaller (e.g. flats) than an average home. Since heating energy is correlated to floor area, this means that the doubling in the number of detached homes would increase heating energy unless other factors affecting heating changed.

Different house types also imply differences in lighting energy use – linked to window areas and how 'deep' the homes are.

The age of a dwelling usually affects its energy efficiency, and older homes typically have poorer insulation than modern homes.

Age profile of homes

Two of the most important determinants of heating energy use are insulation and the efficiency of heating systems. Both are related to a home's age. Broadly, older homes have inferior insulation and if they have solid walls they are more difficult to bring up to modern standards of insulation.

(Even if they have been improved over time and added insulation in the loft and double-glazing, older homes tend to have poorer thermal performance than new homes overall. First, because it is unusual to retrofit underfloor insulation and to insulate solid walls, and second because even older homes with cavity wall insulation added do not match current standards for new homes in the Building Regulations.)

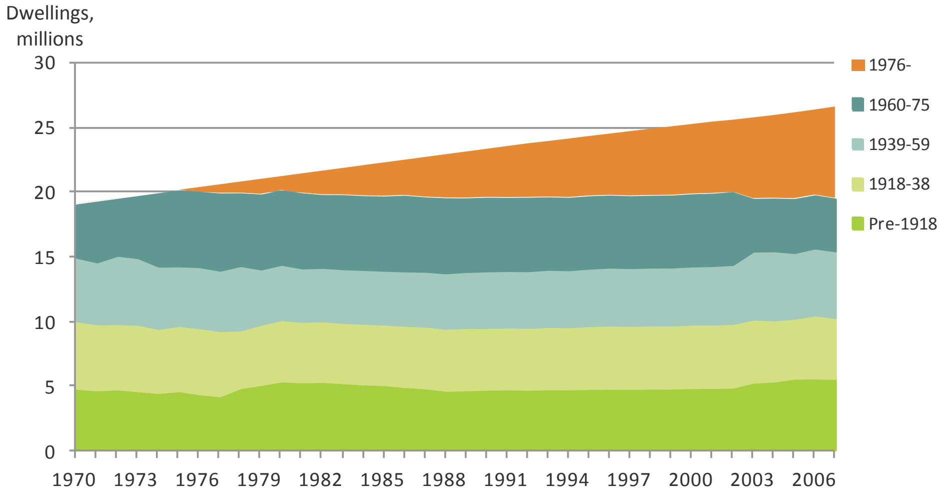
Heating systems are usually much easier to change than wall or floor insulation, and they nearly always have much shorter service lives than the homes they heat. This means that although a home's original heating depends on when it was built (along with other factors, like access to a gas main), the current heating system in most homes is not the original one.

(This does not mean that older homes tend to have heating systems as efficient as those in new homes, and there is a time lag in heating upgrades.)

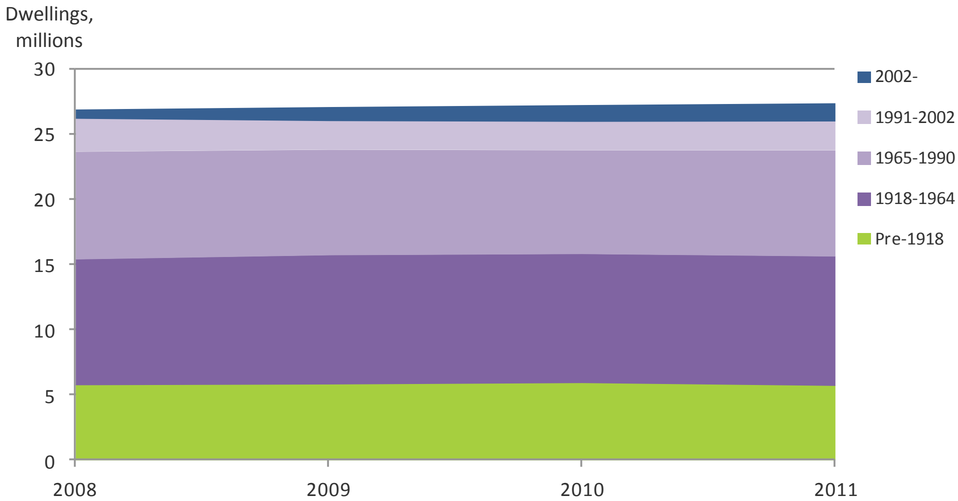
Because the demolition rate for housing is so low, the number of existing homes for all periods stays almost the same (see graphs below, which are split in 2008 because of changes to the housing surveys). The real change in the age profile of housing is, unsurprisingly, the increasing number of more recent homes dating from 1976.

In 1970, homes were divided fairly evenly between the four age bands (broadly, pre-war, inter-war, post-war and 1960s). Around 180,000 new homes were built each year on average from 2001 to 2011 (141,000 in England[17], 22,000 in Scotland[18], 13,000 in Northern Ireland[19], and 8,000 in Wales[20]).

The graph below is split in 2007 because the English Housing Survey changed the age categories recorded for homes in 2008.



Graph 4d(i): Housing stock distribution by age to 2007 (millions)



Graph 4d (ii): Housing stock distribution by age 2008-2010 (millions)

This means that the pre-1976 age bands now each represent a smaller share of total housing: about a fifth each. 'Modern' homes built since 1991 now make up 13% of the stock.

The dip in the number of 1960s-70s homes shown in Graph 4d(i) in 2003, and the spike in the 1940s-50s homes, is probably due to the change in housing survey that took place that year, and not a spate of demolitions and sub-divisions of the earlier homes.

The Building Regulations addressed energy conservation from 1965, and the controls on energy became ever stricter in every revision of Part L of the Regulations. This means that, in theory, modern homes should be more energy-efficient than older ones.

Nearly all modern homes have better energy efficiency than older ones – largely because the Building Regulations require developers to make the homes they build more efficient.

Almost all 21st Century homes have better insulation and more efficient heating systems than homes from earlier periods. This means that the increased proportion of modern homes in the stock should, by itself, lead to better average energy efficiency and lower carbon emissions per home.

This path is likely to continue in future – as the Building Regulations continue to get stricter, and as modern homes make up an ever-larger share of the stock. However, electricity use is not included in the Building Regulations (this would be very difficult because electricity use depends on what appliances people use and how). And electricity use is growing, see next chapter.

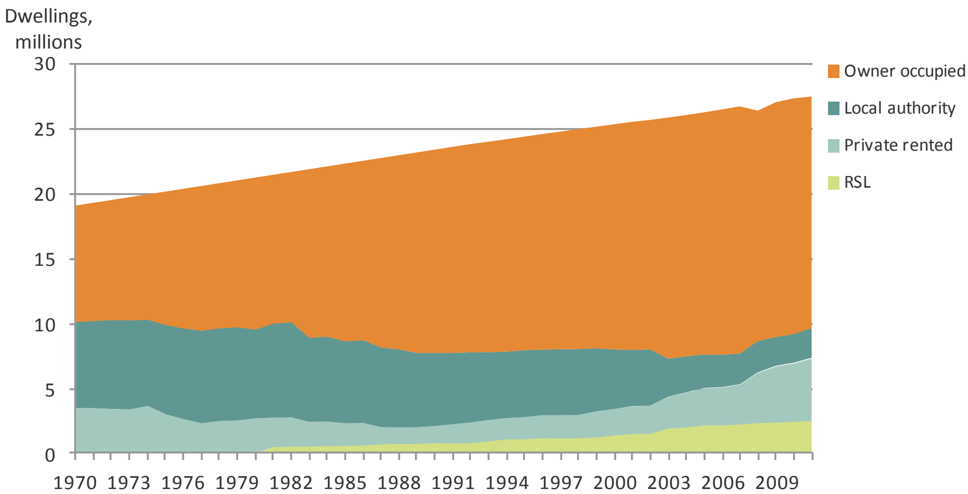
Home ownership

It is not immediately obvious why home ownership should affect energy use. However, historically housing belonging to some groups (e.g. local authorities or Registered Social Landlords – RSLs) has been much more likely to get energy-efficiency improvements.[21]

Conversely, private rented homes are less well insulated. (In part this is because the landlords who would pay for improvements do not get the benefits in improved comfort or lower bills.)

This means that, overall, you would expect housing belonging to local authorities and RSLs to have above-average energy performance, followed by owner-occupied homes, followed by below-average energy performance for privately rented homes.

Changes in the ownership structure of British homes have been quite pronounced in the past 40 years – a more dramatic change than the changes in housing type or age (see Graph 4e). There are now many more owner-occupied homes, and far fewer local authority-owned homes.



Graph 4e: Housing stock distribution by tenure (millions)

In 1970, less than half of all homes were owned by their occupants, whereas by 2011 two-thirds belonged to the people living there. There was an even starker change in local authority ownership, and while councils owned more than a third of homes in 1970, this had fallen to just 8% by 2011.

Some responsibility for providing social housing switched to RSLs from the early 1980s, and their share of British housing rose from nothing in 1980 to 9% of the stock by 2011.

The impact of these changes on energy efficiency is complex, with some changes pushing in one direction and others pushing in another. The rise in home ownership means that many households have more of a stake in their homes, so they are more likely to maintain them.

If window seals fail, or a door gets damaged, homeowners may be more likely to replace them quickly.

However, energy-efficiency improvements have historically come second to concerns about the quality of homeowners' accommodation: people who own their own homes are probably more likely to invest in better kitchens or bathrooms than in wall insulation or a more efficient boiler. Further, poorer people who own their own homes may find it much harder to raise the money for energy-efficiency improvements than local authorities or RSLs.

Fewer homes owned by local authorities (and the smaller share of social housing generally) make it more difficult to carry out wholesale improvements to a whole street or estate – because ownership is fragmented, and a single big project may need the agreement of many different owners.

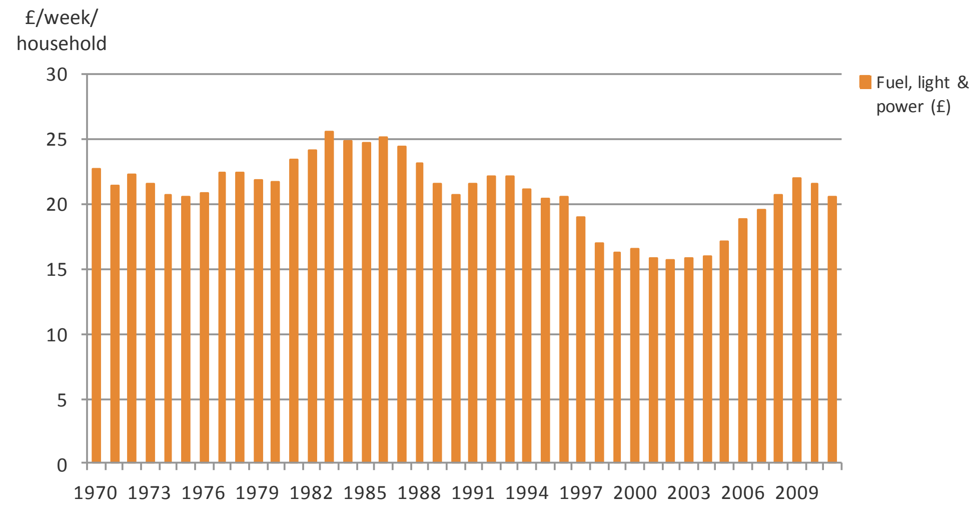
Fewer council-owned properties make it harder to carry out wholesale improvements to a whole street or estate, because of fragmented ownership.

The number of private rented homes fell markedly from 1970 to 1988, but it recovered more recently, and there are now towards 40% more private rented homes than there were in 1970. This is probably due partly to the huge growth in 'buy-to-let' investments and mortgages.

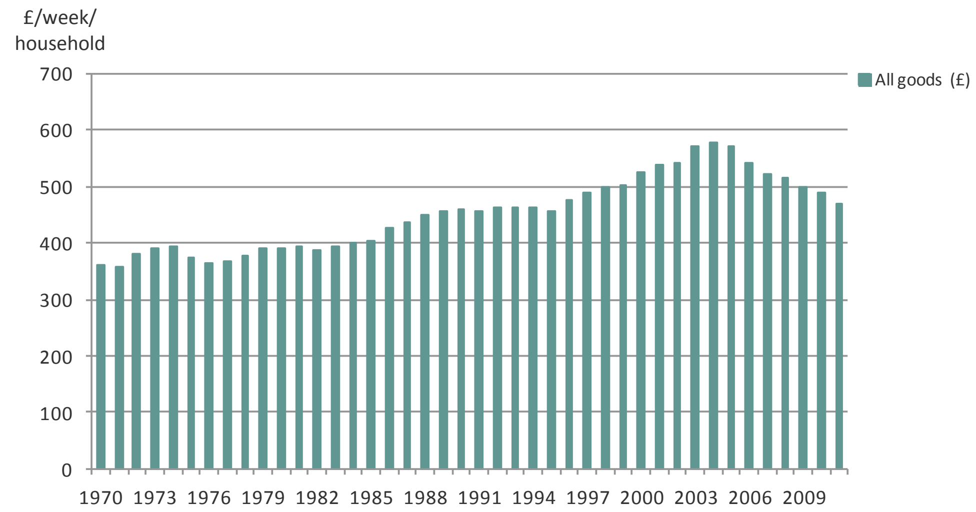
Household spending on energy

Spending per household on energy has varied markedly since 1970, but average weekly spending on heating, lighting and power reported in the Living Costs and Food Survey [22] was 9% lower in 2011 than in 1970 (normalised to 2011 prices, see graph below).

Further, the second graph below shows that total weekly spending by households has also risen over the period – by a third. This means that energy costs have fallen as a proportion of total household spending: from more than 6% on average in 1970 to nearly 4.4% in 2011. From 2001 to 2004 (a period of low energy cost) it was even lower: less than 3% of total expenditure.



Graph 4f: Average weekly expenditure on fuel, light and power (2011 prices)



Graph 4g: Average weekly expenditure on all goods (2011 prices)

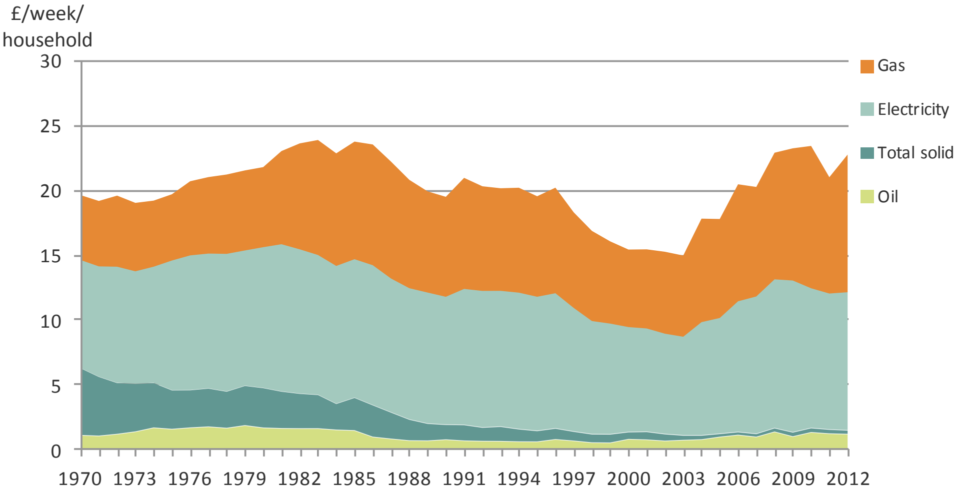
Energy costs per household are inevitably affected by household size. As average household size has fallen, the burden of paying for energy bills falls on fewer people – so the energy cost per head increases even as energy cost per household falls.

For example, in 1970 total household spending on energy was £363 million per week, averaged over the year, in 2011 prices (see Appendix 1, Tables 4a and 4h). This cost was borne by a population of 56 million – i.e. an average energy cost per person of £6.79 a week.

In 2012, however, total household spending on energy was £643 million per week. The population in 2012 had grown to 64 million, so the average energy cost per person was £10.06 a week. (This increase incorporates both an increase in the use of heating/appliances – see below – and the effect of smaller households.)

Energy costs have fallen in relation to total household spending – from 6.3% in 1970 to 4.4% in 2010.

Household energy costs are also affected by the proportion of energy coming from different fuels. Spending on gas per household has more than doubled since 1970, while spending on electricity has gone up by more than a quarter – see graph below. Conversely, expenditure on coal is less than a twentieth of its level in 1970.



Graph 4h: UK Weekly energy expenditure by fuel (£/household, 2011 prices)

(Note that these figures, from the Digest of UK Energy Statistics, do not exactly match total energy spend figures from the Living Costs and Food Survey reported above, although the trends are consistent.)

Part of the change in energy spending is a result of changes to the housing stock and how homes are used, and part of it is due to changing energy prices (in pence per unit). Energy prices are probably more significant in short-term changes, and these are described in the next sections.

Gas bills have increased since 2003 – even excluding the effect of inflation.

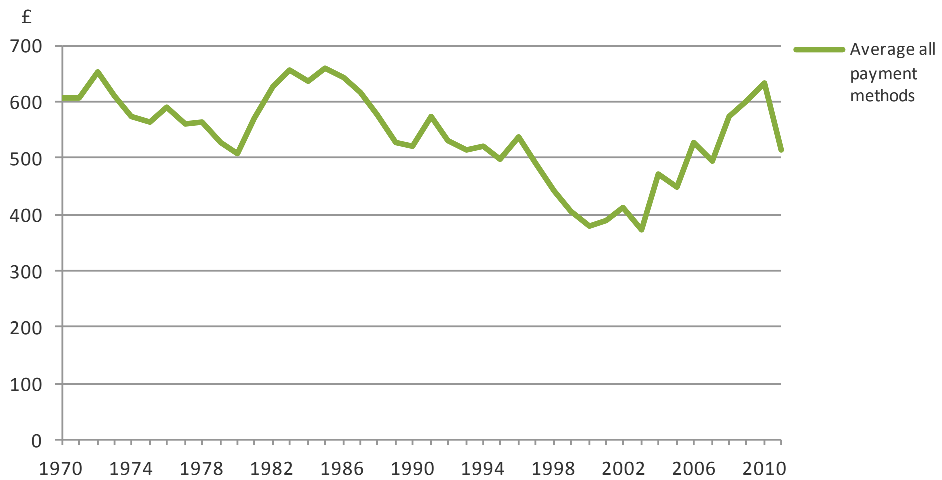
Gas bills

Gas is now the main fuel used for heating British homes. Its price is therefore important – both in charting energy costs relative to incomes and total household spending, and particularly in questions about fuel poverty.

Precise prices for gas vary according to the tariff and method of payment, and discounts are offered to households that pay for their gas using direct debit. Typically, it is around 8% cheaper than average (mean) for households to pay by direct debit and about 7.5% more expensive for households using prepayment meters. Households that switch supplier also get a better deal for gas, and on average they save getting on for 10%.[23]

Overall average gas bills per home with gas have fallen and risen again in real terms since 1970 (see Graph 4i below, which runs to 2011 because 2012 data is not yet available). They closed the period 19% lower than they were 40 years ago. However, this is deceptive because now many more households have a gas connection and use gas central heating, replacing coal and other fuels. The English Housing Survey[6] suggests that the number of homes with a gas connection has risen from around 7.7 million in 1970 to around 23.3 million in 2011.

Increased use of gas displaced household spending on solid fuels – now a fraction of what it was in 1970. The number of rooms usually heated in homes has also increased, along with the average number of hours of heating. The graph shows all prices adjusted to 2011 values, so removing the effect of inflation.



Graph 4i: Average annual gas bill (2011 prices, not weather-corrected)

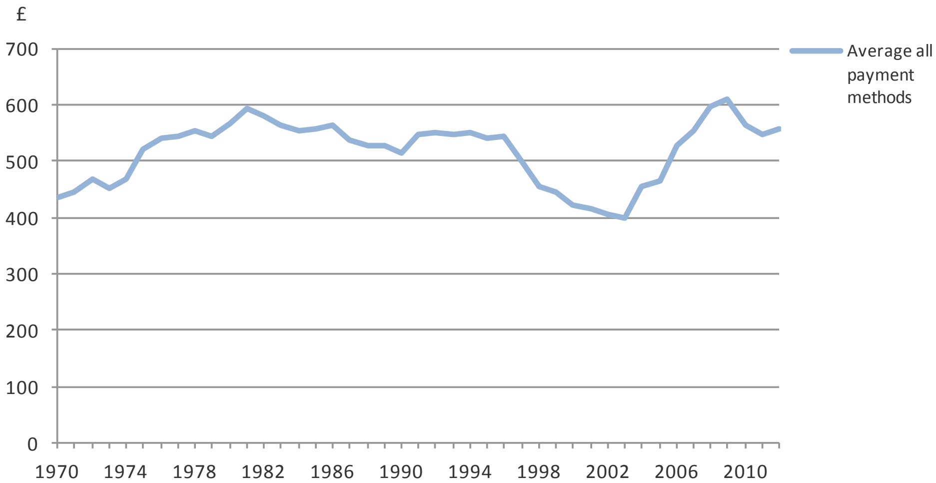
Excluding inflation, then, gas bills have increased 33% since 2003, although they rose dramatically during the very cold winters in 2010, and bills have actually fallen since the mid-1980s (a quarter lower now than in 1985). The average gas bill in 2011 was £493 per year – although 2011 was milder-than-average, so less heating was needed.

Electricity bills

Again, discounts are offered to electricity customers who pay using direct debit (typically about 6%), while households using prepayment meters pay a little more for their electricity. As for gas, customers that have changed supplier or tariff get more favourable rates, and households that have switched save an average of 6% on their electricity bills.

As for gas, there was a downward trend in average prices until 2003, but then electricity prices rose until 2009. By 2012 the average electricity bill was nearly two-fifths higher than in 2003 – £556 per year, see graph below. (Households with electric heating face bills that are much higher than this, on average.) Part of this rise was driven by rising gas prices because a significant proportion of power was generated from gas, see Table 3b in Appendix 1.

Electricity bills have also risen significantly since 2003, but costs per unit fell in 2010 and 2011.



Graph 4j: Average annual electricity bill (2011 prices)

Household incomes

Intuitively, you might expect energy spending to be loosely related to income, with wealthier households living in larger, warmer homes, with more appliances, and spending more money on energy. Is it true, though, that the richer you are the more you spend on energy?

Wealthier families spend more on energy than poorer ones, but a smaller fraction of their income.

The graph below shows how much different households spent on energy each week in 2011. Households are divided into ten 'deciles', with the poorest 10% on the left and the richest 10% on the right.

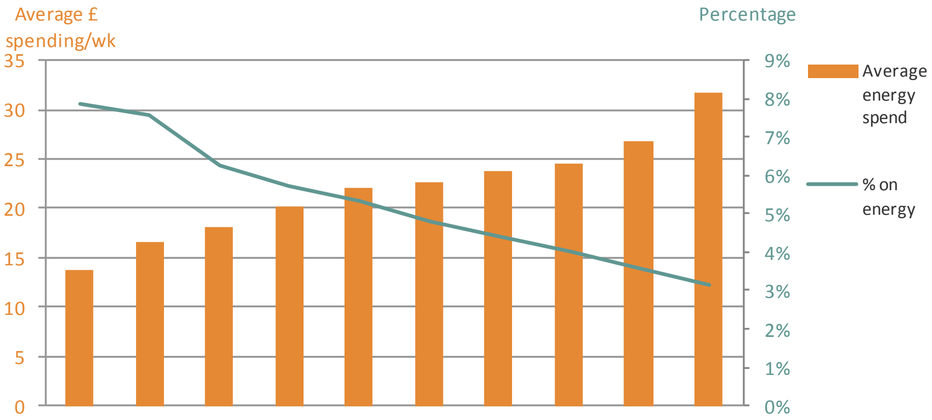
You can see that it is true that wealthier households do spend more on energy each week than poorer ones. Each successive band of income spends more than the one before it on energy, on average, in pounds per week. (The wealthiest 10% also spend significantly more on average – an extra £4.90 a week – than the next 10% of incomes.)

However, as a fraction of income, every successive band of income spends a smaller proportion of earnings on energy. On average, while the poorest 10% spend 7.8% on energy*, the wealthiest 10% of households devote just 3.1% of their spending to energy in the home.

** Averaging in the data means that the graph suggests no-one spends more than 10% of their income on energy. This is not true – in fact around 5 million people do, see Chapter 6.*

Again, the explanation for this pattern of spending is complicated. You would expect people on low incomes to be much more careful about their energy use than richer households. However, poorer households are also more likely to live in poorly insulated homes, and less likely to be able to improve their homes' energy efficiency.

Conversely, wealthier households often have larger homes, and may be more prone to ignoring 'avoidable' energy use (like heating unused rooms, or leaving unnecessary lights on). But they probably also have more money to invest in insulation, efficient heating, lights and appliances, and/or renewable energy systems.



Graph 4k: Average UK weekly expenditure on fuel, light and power, and income (£/wk/household) 2011

This data is crude, and the reality is that there is limited understanding of how income and poverty affect energy use in homes. (Indeed, this section illustrates the problems and uncertainties from using standard energy models, which omit income effects, to estimate savings from improved energy efficiency.) More research, along with better survey data would help to unpack the links between income and energy use, and DECC has commissioned a review of the evidence.[24]

5. How much energy is used in homes?

This chapter of the Fact File shows estimates of how energy use in homes breaks down into different so-called 'final uses'. Most of the data has been modelled, although there is also a section presenting actual weather data over the past 43 years. To summarise, there are five important points to draw from the data:

- winters in the UK were a little milder from 1988 to 2007 than they were at the beginning of the period and in 2011, but 2010 was one of the coldest years on record
- energy used for heating homes has increased by two-fifths since 1970, although it fell from 2004 to 2009
- less energy is used now for water heating and cooking in homes than it was 40 years ago
- more energy is now used for lights and appliances in homes than it was in 1970
- average SAP ratings (a standardised way to assess housing energy efficiency from 1-100) have improved every decade, and the average SAP rating for a UK home is 56.7 – compared to just 17.6 in 1970.

Energy use and weather

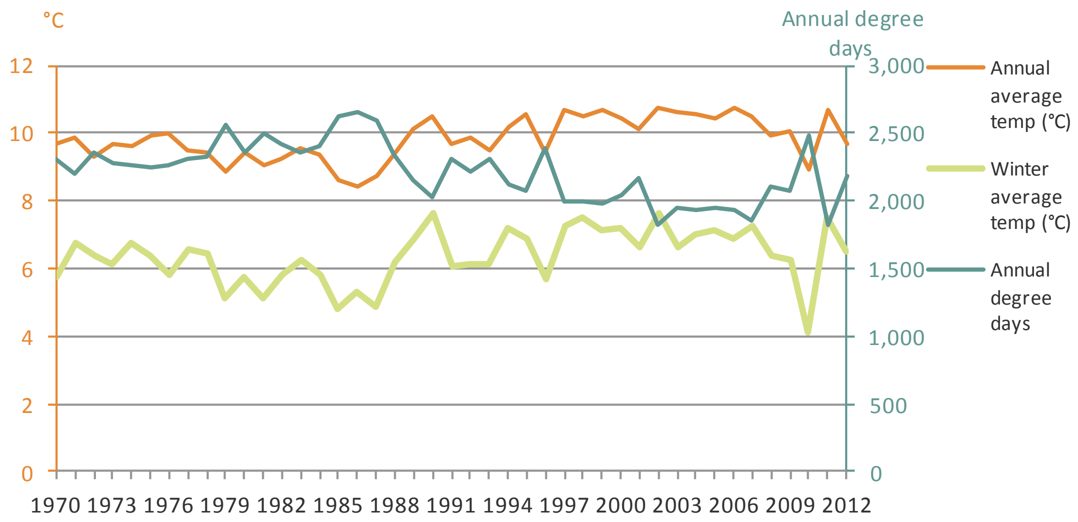
Average winter temperature is one of the most important determinants of energy use in homes.

The difference in temperature between outside and inside homes in winter is the single most important factor shaping energy use at home. If it is very cold outside and a householder chooses to heat their home to 25°C, their home will inevitably use much more heating energy than if it were mild outside and the home were only heated to 18°C. (This example combines weather and behaviour effects, and the Fact File returns to household behaviour in Chapter 7, below.)

The average winter temperature for the year is one of the simpler ways to summarise past weather data. The graph below shows how average winter temperature (the pale green line) varies from year to year. ('Winter' is defined as January to March and October to December.)

On average, winters since 1988 have been milder than those at the start of the period – one or two degrees centigrade milder. The average winter temperature hides some complexity in how external temperature changes over time (for example, it does not show very cold periods in the evening, when people are at home and heating their homes).

Nevertheless, the graph shows particularly cold winters in 1985, 1987 and especially 2010 (the coldest for the last 40 years), and particularly mild ones in 1990, 2002 and 2011. You would expect above-average energy use and CO_2 emissions in 1985, 1987 and 2010, and below-average figures in 1990, 2002 and 2011. Broadly, this is borne out by graphs 2a and 3a above.



Graph 5a: Average UK air temperatures

'Degree days' give another measure of how mild or cold it is in winter. (A degree day is defined here as the number of days mean temperature is below 15.5°C, multiplied by the temperature difference. This figure allows you to normalise space heating energy use or CO_2 emissions between years with different weather.)

You can see from the graph that degree days are almost a mirror image of average winter temperature. Cold winters have many more degree days than mild ones. Again, you would expect years with many degree days to coincide with years of high energy use and CO_2 emissions from housing – and they do.

Energy use for heating has increased by a third in the past 40 years.

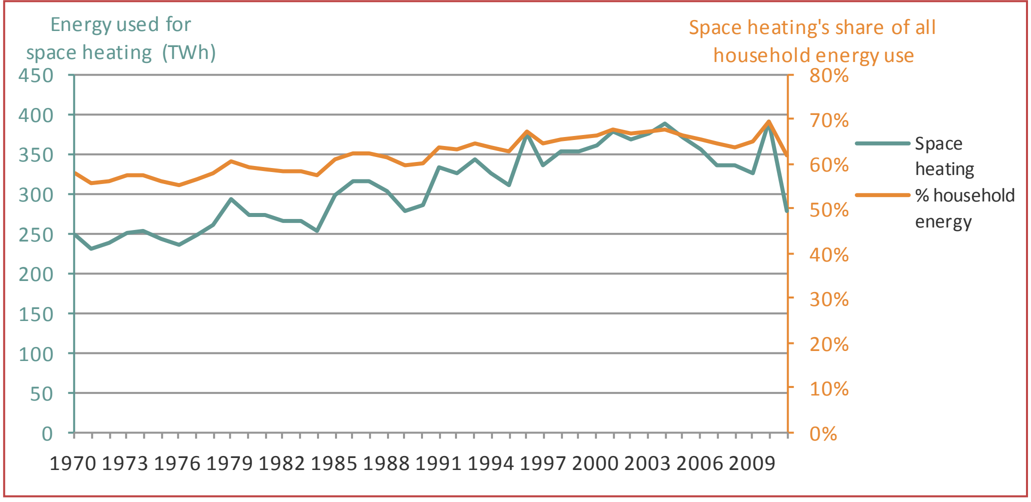
Space heating

Heating energy is by far the biggest slice of UK household energy use. To make serious inroads in cutting CO_2 from housing, reducing heating energy has to be part of any solution.

(This section and the four sections that follow are based on modelling using BREHOMES and the Cambridge Housing Model (CHM). Graphs drawn from modelled data are highlighted with a coloured border. A brief summary of the modelling procedures are included as Appendix 3, and a discussion of uncertainty in modelling is provided in Appendix 4.

The modelling moved from using BREHOMES to the CHM in 2009, so there is a discontinuity in time series data in 2009, see Appendix 3.)

Across all homes, the four-decade story about heating energy is not the direction of travel needed to meet climate change objectives. Modelling suggests heating energy increased just over a tenth (see graph below). This is much less than the increase in the number of households (up from 18.8 to 27.1 million – an increase of 44%). This means that improvements in insulation and heating system efficiency offset the effect of household growth, and the demand for warmer homes, see Chapter 6.



Graph 5b: Household energy use for space heating (TWh)

Given the improvements in thermal comfort (both average temperature and the number of rooms routinely heated), the growth in heating's share of total energy use in homes has been modest – from 58% to 62% – although this proportion has been volatile in the past few years. The volatility reflects the very cold weather in 2010, followed by mild weather in 2011, see previous section.

Part of the long-term increase in energy use for space heating comes from the way homes have been extended over the years, increasing the heated volume, and especially how conservatories have been added and heated – which significantly raises heating energy use[25,26].

However, the good news is that modelling suggests a significant reduction in heating energy used since the cold year of 2010, and a gradual downward trend since 2004. The gradual trend does not appear to be the result of milder winters, and some commentators (for example see reference[27]) have suggested that this is largely due to the increase in energy costs since 2004.

The UK has cut energy use for heating by a fifth since 2004.

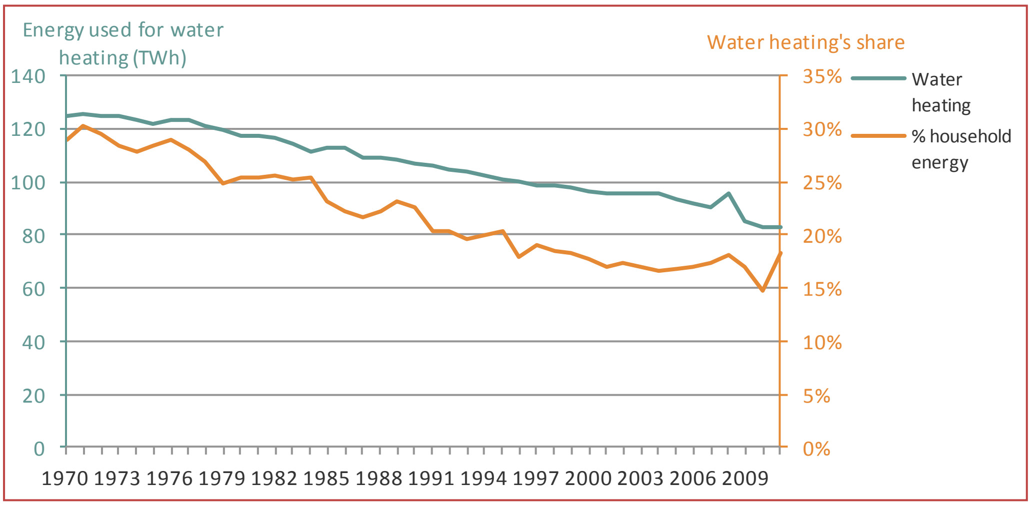
Hot water

The UK's use of energy to provide hot water in homes has fallen dramatically since 1970. This is a quiet success story. Modelling suggested there was a cut of one third in energy used for hot water, in spite of the increase of more than two-fifths in the number of households (see graph below).

Unsurprisingly, this led to a shrinkage in the proportion of household energy used for water heating – down from nearly 30% to just 18%*.

** Evidence from EST Field Trials[28] suggested that less energy is used for hot water than we thought in the past. Figures reported here have been adjusted compared to the old Domestic Energy Fact Files to reflect this, with less energy used for hot water and more for heating.*

This improvement is consistent with the reduced heat loss from stored hot water (through better lagging of tanks and pipes, and eliminating hot water tanks with combi boilers), and more efficient heating systems. Greater use of electric showers and dishwashers – which heat water separately using electricity – also reduces energy use recorded as 'water heating'. However, even allowing for this there have still been significant savings from total energy use for hot water.



Graph 5c: Household energy use for water heating (TWh)

Lights

Energy use for lighting has increased by half since 1970 despite widespread take-up of low energy lights.

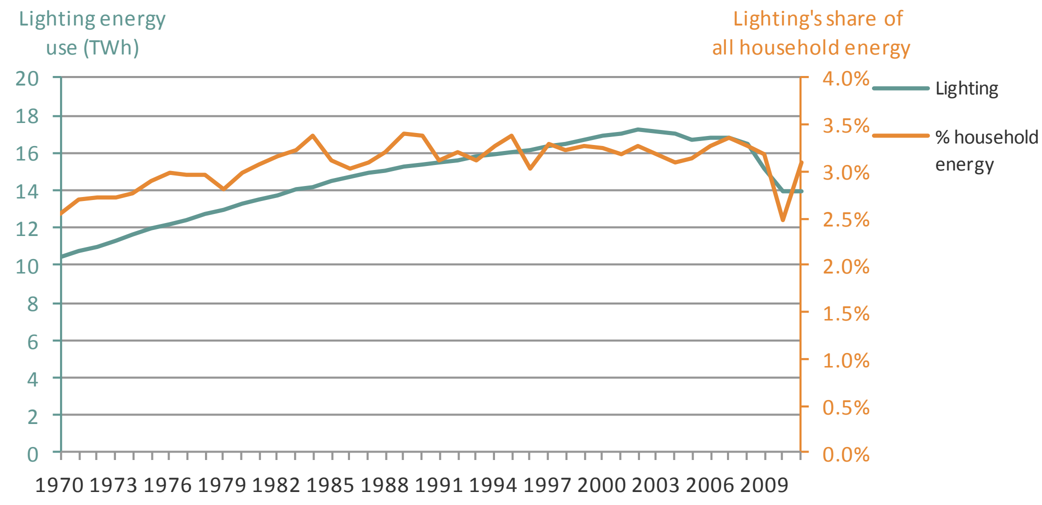
Lighting energy has always been a small proportion of total housing energy (around 3%) and here a very different story emerges. Energy use for lighting increased every year until 2002, and then began to decline – see graph below. Overall it increased by one third from 1970 to 2011.

(As for the other graphs in this section, the Cambridge Housing Model was used to model lighting for 2009, adjusted to match the total electricity use figure in the Digest of UK Energy Statistics. The lighting algorithms are from SAP, the Standard Assessment Procedure[29], and use floor area, number of occupants in the home, number of low energy lights, window areas and rooflight areas.)

As a proportion of all household energy use, there was a parallel rise – from 2.5 to 3.1%. There are opposing forces affecting the figures for lighting energy.

On one hand, most old-fashioned incandescent bulbs have been withdrawn from sale, and the Carbon Emissions Reduction Target (CERT) provided many low energy bulbs for homes, so there are now far more low energy lights being used in homes.

On the other hand, most homes now have more light fittings than they did in 1970 – especially in kitchens and bathrooms. Lighting in kitchens, in particular, tends to be a much higher specification than it was in the past. Many homes have replaced a single fluorescent strip light with many high output spotlights.



Graph 5d: Household energy use for lighting (TWh)

In 2010 DECC, the Department for the Environment, Food and Rural Affairs, and the Energy Saving Trust commissioned a large-scale survey of electricity use in homes, *Powering the Nation*.[30] This has now been published, and provides much more detailed data about patterns of electricity use in the

UK, and we recommend readers with an interest in electricity refer to that report.

The survey provides a rich seam of information about electricity use. On average, it found that 15% or more of the electricity used in homes surveyed was used for lighting. It found that homes in the study had an average of 34 lights: 40% old-fashioned incandescent bulbs, 24% compact fluorescents, 31% halogen lights and 6% fluorescent strip lights.

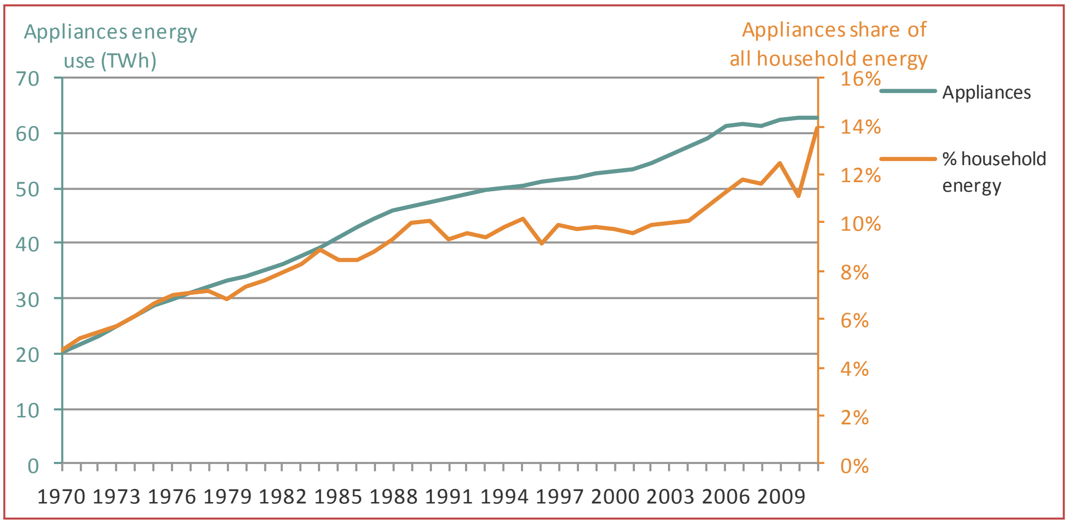
Appliances

The growth in appliances* energy use has been even sharper: it has tripled in 40 years (see graph below). The average annual growth in appliances energy was nearly 3% a year, although the annual rise appears to be slowing.

**Appliances are defined in the Cambridge Housing Model as everything except space and water heating, lighting, the oven and main hob. This means that the energy used in microwaves, sandwich toasters and toasters, for example, is counted here and not in 'Cooking' below.*

Appliances' share of total energy use in homes has followed a similar path, and whereas household appliances used less than 5% of total energy in 1970, they now use nearly 14%.

There are three factors at play in increased appliances energy use – none of them unexpected. First, there are now many more electric gadgets in homes – washing machines, tumble dryers, hairdryers, computers, consoles and chargers.



Graph 5e: Household energy use for appliances (TWh)

Second, the use of these appliances has increased (ownership alone does not raise energy use). These changes point to higher disposable incomes and complex lifestyle changes – automation of jobs previously done by hand, and substituting energy-using appliances like computers and consoles where in the past people would have worked using pen and paper or entertained themselves with board games or books.

Third, much greater use of cold appliances to store food – freezers and large fridges are now commonplace, and likely to increase energy use even though the efficiency of new cold appliances has improved. Further, microwaves are often used to thaw out frozen food. This energy service did not exist in 1970.

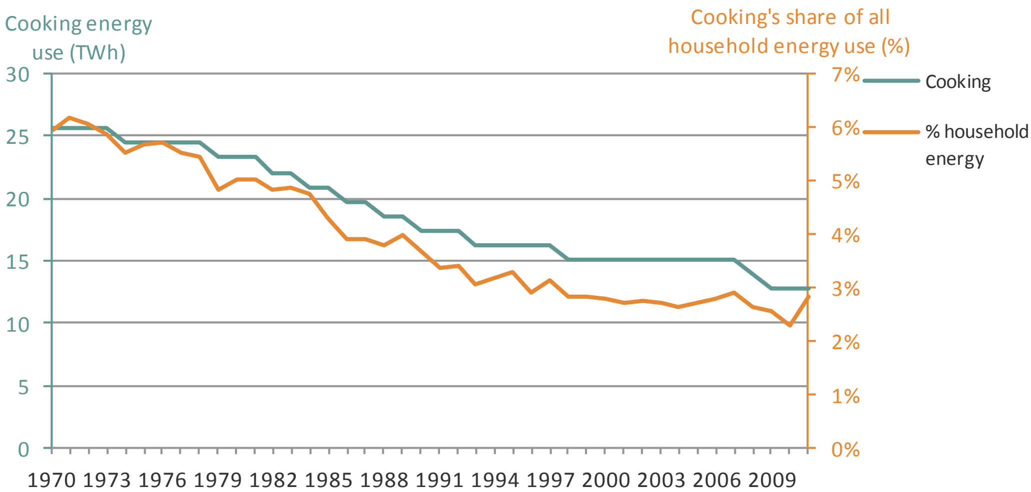
The *Powering the Nation*[30] survey mentioned above found that, on average, 50% or more of the electricity consumption in homes surveyed was used for appliances. The work suggested that 16% of household electricity powers cold appliances (fridges and freezers), 14% is used for wet appliances (washing machines and dishwashers), 14% for consumer electronics, and 6% for information and communication technology.

The UK now uses two-fifths less energy for cooking – partly because of more efficient appliances and more 'ready meals'.

Cooking

A more positive outcome from changes in lifestyles, perhaps, is energy saving from cooking. Energy use for cooking is getting on for half of what it was in 1970 (see graph below). (Note, though, that part of this saving has really just been transferred to appliances energy, as small portable devices like sandwich toasters and bread machines – which are included as 'Appliances' above rather than 'Cooking' – have replaced traditional ovens and hobs.)

As a proportion of all energy use in the home, cooking has more than halved: from 6% to less than 3%. The decline appears to be levelling off, and the rate of change was more rapid in the 1980s and 90s than it has been since 2000.



Graph 5f: Household energy use for cooking (TWh)

Where have the savings come from? In part from more efficient cooking devices: microwaves and fan-assisted ovens have surely helped, and microwaves were found to save 10% of cooking energy.[31] But the huge expansion in 'ready meals' and takeaways is probably a bigger factor in the decline in cooking energy, and it is questionable whether these lifestyle changes have saved energy overall.

It is estimated that one in six meals in the UK are takeaways or 'informal meals' eaten away from home[32], and there is evidence that cooking energy savings have been entirely offset by increased energy use for microwaves, kettles and cold appliances, see[33].

(Again, the graph comes from modelling, and for 2009 the figures come from the Cambridge Housing Model using SAP algorithms for cooking. These are relatively crude, based only on floor area and the number of occupants, because of more limited understanding of energy use for cooking and because cooking energy is not included in the Building Regulations.)

The *Powering the Nation* survey[30] mentioned above found that 14% of household electricity is used for cooking – an average of 460kWh/year. Average energy use for cooking was barely affected by the number of people in a household – so cooking energy per head is much higher in single-person households.

Powering the Nation found that cookers with electric hobs, where present, used most cooking electricity (317 kWh/year), followed by ovens (without hobs) (290 kWh/year), hobs (226 kWh/year), electric kettles (167 kWh/year), and microwaves (56 kWh/year).

Energy efficiency (SAP) ratings

The Standard Assessment Procedure, SAP, is the Government's method of evaluating the energy efficiency of homes. It has been used since 1993.

The figures before this date, shown below, are approximate back-projected estimates. Since 1993, the method for calculating SAP has been reviewed and updated periodically. SAP 2005 has been used for the figures below until 2009. A new version, SAP 2009, was used for 2010 and 2011.

SAP rates homes based on the annual energy costs for space heating, water heating, ventilation and lighting (minus savings from energy generation technologies) under standardised conditions. It uses a scale from 1 to 100 (values of more than 100 are possible for homes that generate sufficient energy from renewable sources).

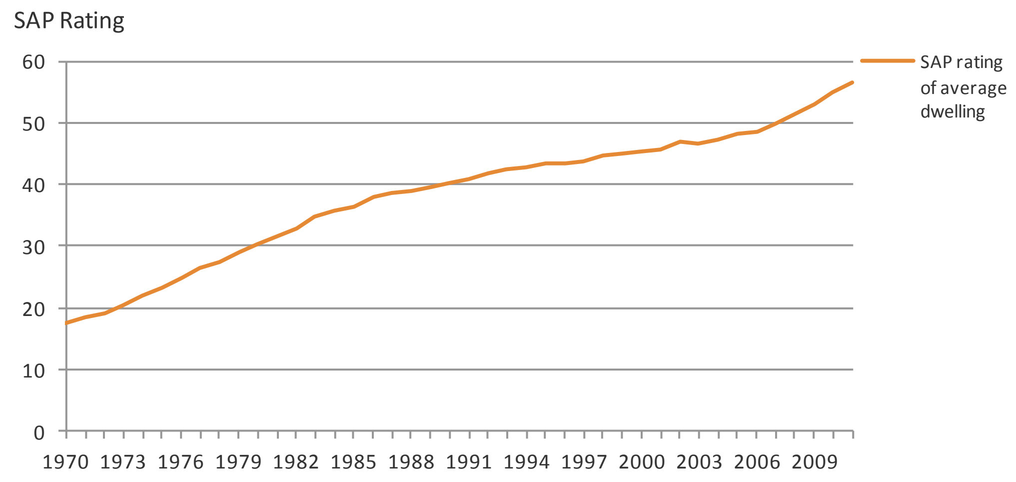
Average SAP ratings are a barometer for how the energy efficiency of the UK's homes has improved.

The higher the rating, the better the energy efficiency and the lower the annual energy costs. However, it is not a linear scale, and a 20% improvement in SAP rating does not imply a 20% saving in energy costs.

SAP also delivers a metric for energy consumption per square metre of floor area and estimates annual CO_2 emissions.

In general, more modern homes have higher SAP ratings, and typical ratings for new homes are around 80. Older homes, conversely, have lower SAP ratings, but there is an upwards trend in the average rating for a British home (see graph below).

The improvement in average SAP rating is due partly to the better efficiency of new homes, but mainly to upgrades to existing homes – either from improved insulation or more efficient heating systems.



Graph 5g: Average SAP ratings by year

There was a marked improvement in SAP ratings in the 1970s and early 1980s, largely due to improvements in insulation and heating system efficiency – notably installing gas central heating. This improvement slowed in the remainder of the 1980s and 1990s, but was re-energised from around 2000. Improvements since 2005 coincided with the Energy Efficiency Commitment (EEC1 and 2) and subsequently the Carbon Emissions Reduction Target (CERT).

Stricter Building Regulations also drove average SAP ratings higher. The energy conservation part of the Building Regulations stipulated at least a D-rated boiler and E-rated windows from 2002, and at least B-rated (i.e. condensing) boilers from 2006.

There is no evidence so far of a ceiling for average SAP ratings.

So far there is no evidence of a plateau in average SAP ratings. These ratings are a good barometer for home energy efficiency, and further improvements in insulation and heating efficiency will inevitably push average SAP ratings higher.

However, electricity use for appliances (beyond its contribution to internal gains, ventilation fans and ceiling-mounted lights) is not reflected in SAP ratings, so it would be a mistake to rely on SAP alone to assess UK homes. Lights and appliances are a significant and rising proportion of total energy use (and an even larger proportion of household CO_2 emissions).

SAP is driven by the Building Regulations, so only 'regulated energy' is currently included in the rating. There may be a case for widening the scope of SAP so it directly incorporates electrical energy use and cost. For instance, energy use by appliances is already estimated in the SAP worksheets but this is not used directly in the main SAP rating. It is currently only used to assess 'zero carbon' homes for the purpose of exemption from stamp duty.

Such widening is problematic in terms of regulations. For instance, specifying low energy appliances throughout a dwelling to comply with regulations would not guarantee that such appliances would continue to be used (unlike a similarly specified heating system or insulation).

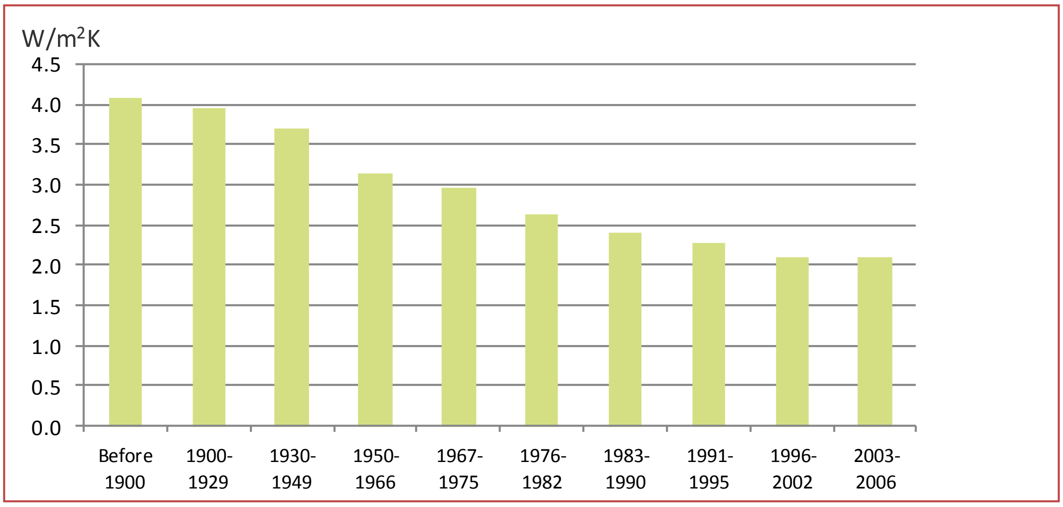
Thermal aspects of energy use in the home are now well understood by developers, and new homes are better insulated and usually have more efficient heating systems than most older homes. However, there is little evidence of parallel savings in electricity use, perhaps because new homes have more light fittings and higher installed lighting loads – especially in kitchens, bathrooms and for external lighting (see also *Powering the Nation: Household electricity-using habits revealed*[30] and *Early Findings: Demand side management*[34]).

Heat loss parameter

The Building Regulations and SAP have a direct effect on insulation and airtightness for new homes. These shape the 'Heat Loss Parameter' of a dwelling: a measure of how well a home retains heat. The Heat Loss Parameter is based on heat transfer through the fabric of a building (e.g. walls and windows), as well as heat loss due to air movement, from both deliberate ventilation and uncontrolled infiltration.

The total heat loss coefficient (measured in W/K) is divided by the total floor area of a home to give a measure of heat loss per unit area (W/m^2K). This allows a fair comparison of the heat loss between dwellings of different size.

The graph below shows how the average heat loss parameter in 2011 varies between homes built in different periods, including the effect of retrofit upgrades (like insulation and more efficient boilers) added after the home was built.



Graph 5h: Heat Loss Parameter by dwelling age (2011)

The normalised heat loss falls for each successive age band of house-building – meaning that for insulation and airtightness (not necessarily heating system efficiency) more modern homes are better, on average, than older ones. This overall trend is unsurprising because of widespread use of cavity wall construction from the 1920s and tougher Building Regulations in recent years.

However, it is more surprising to note that 1950s and 1960s homes (which the accepted wisdom holds to have less energy-efficient fabric than older homes) appear to be better at retaining heat than homes from earlier periods. Part of this may be due to retrofit improvements in insulation, doors and windows.

It is also surprising that the English Housing Survey data suggests there was no improvement in the mean heat loss parameter between 1996-2002 and 2003-6. (An average of 2.1 W/m^2K in both periods.) This was in spite of tougher Building Regulation standards for both loft insulation and wall insulation introduced in 2002.

This may point to a law of diminishing returns from extra insulation: better insulation and airtightness must have the effect of reducing the heat loss parameter, but as insulation gets better the potential for continued cuts in heat loss falls. Even by 2006, other factors seem to offer more scope than insulation alone for reducing household energy use. (See Chapter 7: Household behaviour.)

The Building Regulations also allow developers to trade-off between insulation, glazing, air tightness, and heating system efficiency. An alternative interpretation is that since 2002 developers have complied with the Building Regulations by focusing on better boiler performance, better heating controls, more efficient lights, or other factors rather than insulation alone. These other measures may have less impact on wall thickness and construction or development costs than extra insulation.

The UK has achieved dramatic savings in CO_2 per home since 1970 – down by more than half.

Carbon emissions

We noted above in the section on carbon emissions that CO_2 emissions from housing have fallen since 1970, even in spite of a 50% increase in the number of households, and changing expectations of thermal comfort and appliances use.

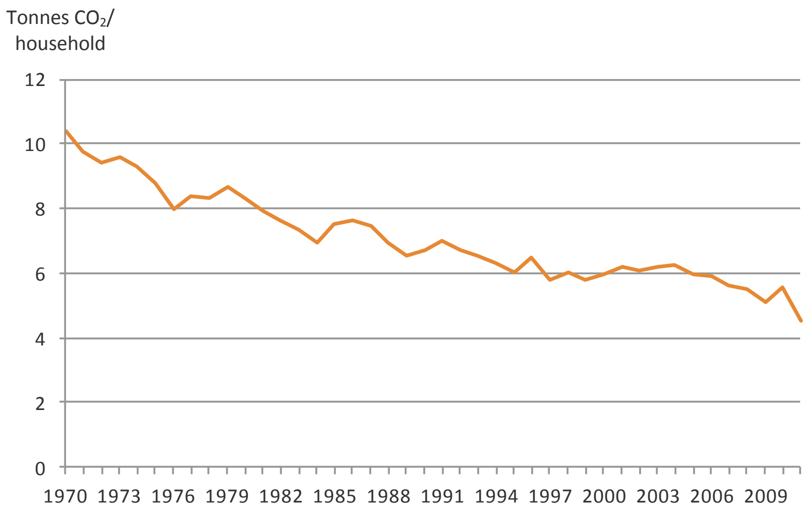
Average CO_2 per home

Carbon dioxide emissions per household have fallen markedly since 1970. This is another quiet success story: CO_2 per home is down by more than half compared to the start of the period (see graph below).

The success is particularly impressive given big improvements in winter comfort for nearly all households – see next chapter, and particularly Graph 6o.

Part of the savings came from electricity itself having a lower carbon footprint, again due to the famous 'dash for gas' in the 1990s, when newly privatised electricity companies developed gas-fired power stations using North Sea gas to replace (more expensive) coal-fired power stations. However, the downward trend started 20 years before, and continued after 2004.

Part of the savings also came from better insulation in homes and more efficient space and water heating systems, reported above.



Graph 5i: CO_2 emissions per household

Again, the trend is 'lumpy', with troughs corresponding to mild winters and peaks corresponding to severe ones, and this lumpiness is likely to continue – sometimes supporting and sometimes acting against carbon savings per home. On average, the reduction in CO_2 per household was 2% a year.

6. What shapes energy use in homes?

Overview

The UK's housing stock may only change gradually but there have been profound changes to its energy efficiency over the past four decades.

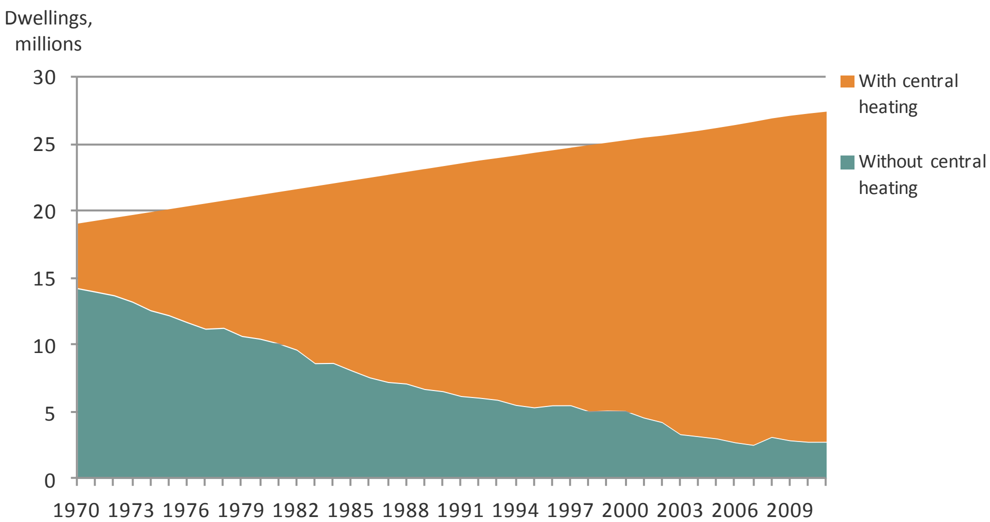
In summary, there are five main trends emerging from the data below:

- people in the UK now run their homes at significantly higher temperatures in the winter than they did forty years ago
- most homes now have central heating – increasing the amount of energy used for heating unless adequate energy efficiency measures are in place
- growth in central heating, predominantly fuelled by gas, has brought great improvements in the carbon efficiency of heating
- the rate homes lose heat during the heating season has, on average, fallen sharply in the last four decades
- in new and existing homes, energy efficiency policies (including the Building Regulations) have helped drive the take-up of efficiency measures such as condensing boilers, double-glazing and loft and cavity wall insulation.

Central heating

More and more central heating has been installed in the housing stock over the last four decades, and now most homes have it. The rise has been steady, and within living memory central heating has changed from a relatively rare luxury to being standard almost everywhere.

In 1970, just a quarter of homes had central heating – see graph below. By 1990, this had risen to nearly three-quarters and, by the turn of the century, to four out of five homes. By 2011, only 10% of the housing stock had yet to install a central heating system. (Here, central heating excludes homes with electric storage heaters, which are sometimes counted as 'centrally heated'.)



Graph 6a: Dwellings with central heating (millions)

This nearly complete penetration of central heating into houses (rather than flats) marks an important turning point. Once people have central heating, their aspirations about how warm they can be at home change significantly, as do their expectations about how to achieve this.

If they have sufficient disposable income, they can heat more of their house and for longer. For most people, gone is huddling around the fire in a household's one heated room: in its place stands the potential for all day heating throughout the home.

This has important implications for energy use and CO_2 emissions. Unless installing central heating is married to improvements in insulation, an average centrally-heated home would require about twice as much energy for space heating as a similar home with heating only in the living room.[35]

A centrally-heated home uses around twice as much energy for heating as an identical home with heating only in the living room.

Even with central heating, those with low incomes – especially the 2.4 to 3.2 million so-called fuel poor households – still struggle.[36] Under the new definition, those classed as fuel poor both have above-average fuel costs, and low incomes, see pages 15-17. (The old definition held that households in fuel poverty would have to spend 10% or more of their income on fuel to maintain a satisfactory heating regime – usually 21°C for the main living area and 18°C for other occupied rooms.) Improving the energy efficiency of low-income homes is an effective way of tackling fuel poverty.

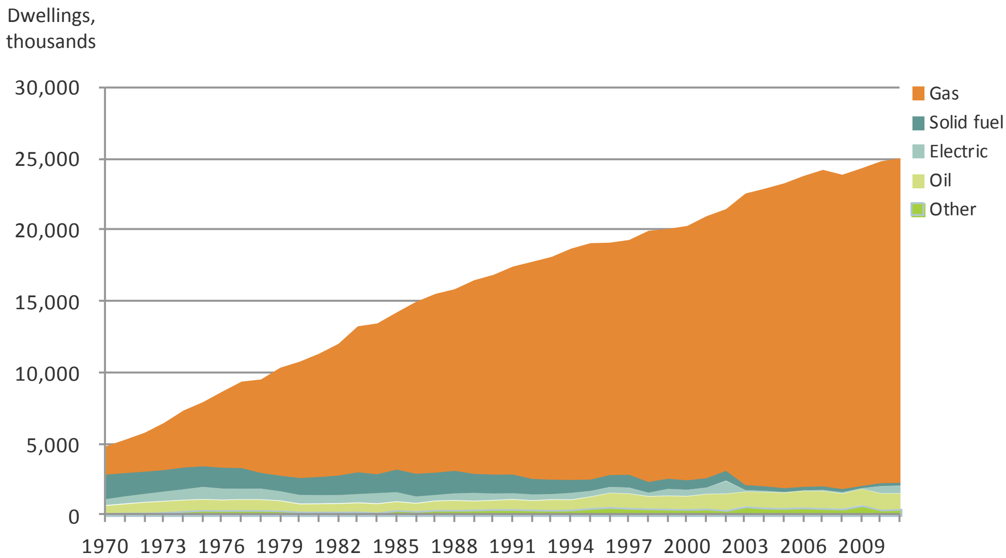
However, energy efficiency improvements are subject to a rebound effect where changes in behaviour – such as demand for warmer rooms – offset energy savings from the improvements. And it is only when indoor temperatures approach some ceiling level of 'comfort' that households are likely to cut heating energy after installing additional energy efficiency measures.[37]

On top of this, research has shown[38] that simply providing controls for central heating systems (thermostats and time clocks) does not necessarily result in homes being heated in ways that reduce energy consumption or carbon emissions.

Fuel use in homes with central heating

The last four decades have seen significant changes in the fuels used to heat homes in the UK. Solid fuel, electricity and oil have been replaced by gas as the main fuel for heating in homes with central heating.

As the graph below shows, in 1970 more than a third of homes with central heating used solid fuel and about a tenth used some form of electric heating or oil, and only two-fifths used gas. In 2011, less than 1% used solid fuel, just 2% used electricity, while the proportion using oil had more than halved to 4%. By then, the proportion of households using gas for their central heating had risen to 91%.



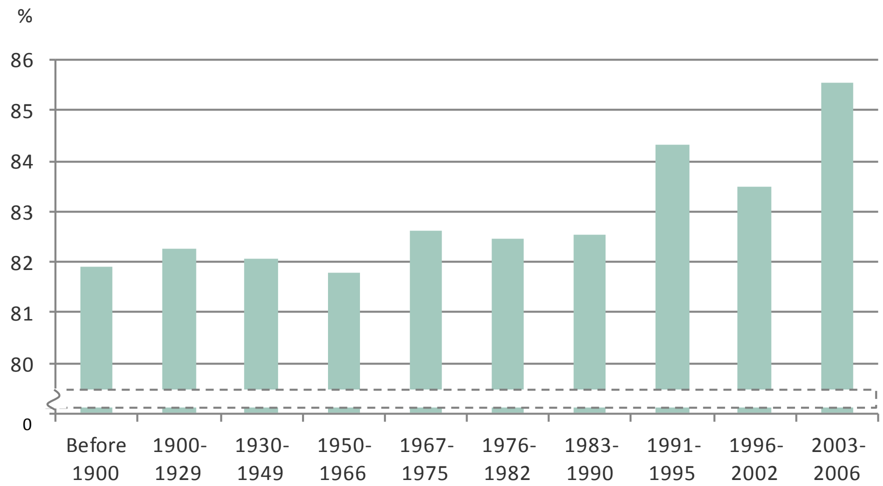
Graph 6b: Main form of heating for centrally heated homes (thousands)

The growth in gas central heating – and especially switching from open fireplaces to condensing gas boilers – made average heating systems much more efficient. Average boiler efficiency (in terms of heating energy output/delivered energy input) has increased from 49%[39] to 82.5% since 1970.

On average, our heating systems are more efficient now – in terms of heating output per unit of delivered energy – than they have ever been.

The graph below shows how average boiler efficiency differs between homes built in different periods. In 2011, the average efficiency of boilers in homes built before 1900 was 81.9%. For homes built since 2003, average efficiency is higher: 85.5%.

There are several factors at play here: first, more modern homes were more likely to have efficient, condensing boilers when first built. Second, many old homes were either built without central heating and boilers, so have had heating systems installed more recently. Third, even homes that had inefficient boilers fitted when first built may now have old boilers in need of replacement. And fourth, modern boilers typically have shorter service lives than old ones, which may explain the dip in boiler efficiency for homes built between 1996 and 2002 (many of which retain their original boilers, whereas many homes built 1991-95 had replaced their boilers by 2011).



Graph 6c: Average boiler efficiency by dwelling age

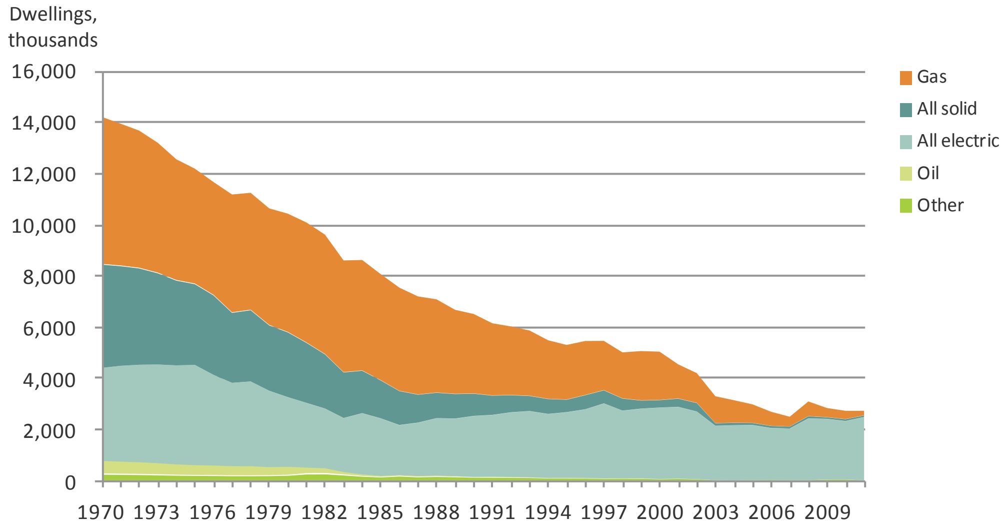
(For comparison, today's standards require new boilers to be at least 86% efficient, see 'Condensing boilers' below.)

There has been an even greater improvement in the carbon-efficiency of heating, because of conversions from high carbon fuels (electricity and coal) to a lower carbon fuel (natural gas).

Fuel use in homes without central heating

The last four decades have also seen significant changes in the fuels used for heating homes without central heating (currently 10% of dwellings). But, as the graph below shows, here solid fuel has been replaced by electricity as well as by gas. In 1970, a quarter of these homes used gas, while nearly a fifth used solid fuel and electric, and just 2% used oil room heaters.

By 2011, gas use had fallen to just 6% of homes without central heating, solid fuel had declined to 1%, while electric heating had risen to 82% of these homes. The majority (four-fifths) of the electric heating was from electric storage heaters.



Graph 6d: Main form of heating for non-centrally heated homes (thousands)

The increase in electric heating in homes without central heating since 2007 is probably due to the rising proportion of flats in the housing stock. Flats are more likely to use electric heating for safety reasons and because of lower installation costs. (The fall shown in electric heating on the graph in 2003 is probably due to the change in survey methods and/or sample sizes around this time.)

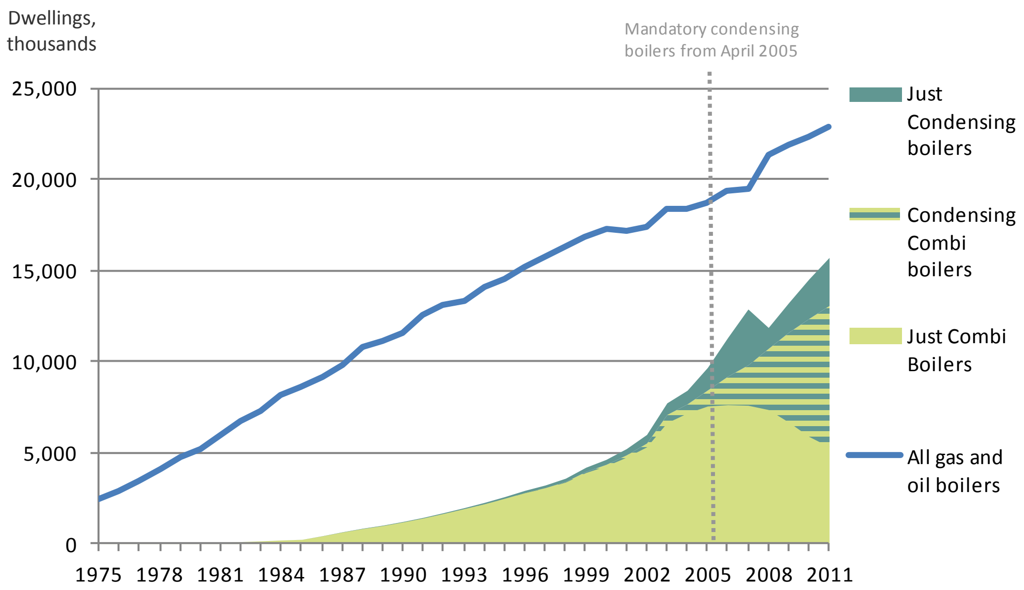
Condensing boilers

Today almost all new boilers installed are energy efficient condensing units.

Since 2005, all new gas central-heating boilers fitted in England and Wales must be high-efficiency condensing boilers, unless there are exceptional circumstances. Since April 2007 the same condition has applied to oil-fired boilers. Similar regulations are in force in Scotland and Northern Ireland. These regulations have had a dramatic impact on the take-up of condensing boilers, see graph below.

(The kink in the graph for condensing boilers in 2007 is due to a change in method when the English Housing Survey replaced the English House Condition Survey.)

Before the 2005 regulation, condensing boilers made up only 7% of the gas and oil boilers in the UK. Six years later, they represented getting on for half of them. This increase translates into a significant improvement in energy efficiency.



Graph 6e: Ownership of condensing and combi boilers (thousands)

A condensing boiler extracts additional heat from its waste gases by condensing this water vapour to liquid, thus recovering its 'latent heat'. A typical increase of efficiency can be as much as 10-12%.

Lab tests show modern condensing boilers can offer efficiencies around 90%, which brings most brands of condensing gas boiler into the highest available categories for energy efficiency[40]. However, field trials show lower efficiencies are achieved in practice[41].

As the graph above also shows, the growth in use of combination (or 'combi') boilers is almost as pronounced, and the growth started earlier. However, standard combi boilers are being replaced with condensing combis, and in 2011 nearly 60% of boilers were combis, of which nearly two-thirds were condensing combis.

Getting on for two-thirds of the boilers in our homes are now 'combi' boilers with no large hot water tank.

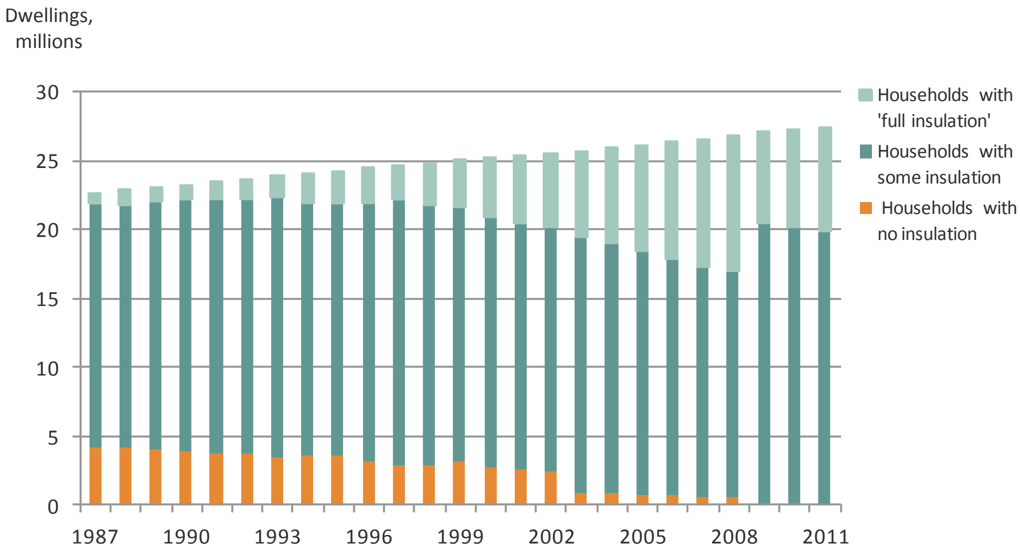
Combi boilers, as their name suggests, combine central heating with domestic hot water heating in one box. These boilers instantly heat water as it flows through the unit, and usually retain little water internally except for what is in the heat exchanger coil.

Until 1982, less than 2% of the gas and oil central heating boilers in the UK were combis. By 2004, more than two-fifths were. The 2005 legislation requiring all combi boilers to be condensing meant that older, non-condensing combis are being replaced, so now condensing-combis (shown with horizontal stripes in the graph) are the fastest-growing segment of UK boilers. In 2011, they made up a third of central heating boilers.

Overview of insulation

Steady but relatively slow progress has been made in introducing insulation into the British housing stock, see graph below.

From 1987 (first figures available) until 2011, the number of households with no insulation fell by more than 99%, from nearly a fifth to just 0.1%. Likewise, over the same period, the number of households with what, in the past, was described as 'full insulation' (defined below) rose eight-fold, from 3% to more than a quarter of households. (Note that there is a discontinuity in the data because of a change in how the figures were compiled in 2008. This resulted in around 3.5 million households being re-categorised from 'full' to 'some' insulation.)



Graph 6f: Households with no, some and 'full' insulation measures (millions)

So now there are hardly any homes with no insulation, but more than two-thirds of the stock still has insufficient insulation by modern standards.

Here 'full insulation' is defined as:

- at least 100mm of loft insulation (where there is a loft)
- cavity wall insulation (where there is a cavity)
- at least 80% of rooms with double-glazing.

DECC estimates that 70% of homes built with cavity walls now have cavity wall insulation.[42]

(This definition is well below modern standards of insulation, especially because solid wall properties with no wall insulation are treated as fully insulated. The Energy Saving Trust now recommends a minimum of 270mm of loft insulation, while DECC uses 125mm as a threshold because this depth saves 85% of the energy of 270mm of loft insulation[42]. However, we have retained the definition, using 100mm as the break-point, to allow for consistency and so readers can see trends.)

'No insulation' is defined as:

- no loft insulation (where there is a loft)

- no cavity wall insulation (where there is a cavity)
- no double-glazing.

Homes without lofts or with solid walls are favoured by this categorisation. So, for example, a house with solid walls, loft insulation of 100mm or better, and full double-glazing, would be categorised as 'fully insulated'. But a house with cavity walls – with the same loft insulation and double-glazing – would not be categorised as 'fully insulated' unless its cavities were also insulated.

The majority of houses built under the 1985 Building Regulations or later are in the 'fully insulated' category. So the proportion of 'fully insulated' homes will continue to rise, especially as the Green Deal and other schemes encourage more retrofitting of existing homes.

Drivers of change

The 2006 Building Regulations were themselves expected to lead to a 25% improvement in energy efficiency (relative to the previous 2002 version). Since 2002 the Regulations have made it compulsory to upgrade energy efficiency in existing homes when extensions or certain other works are carried out, which should help to improve the energy performance even of older homes over time.[43]

Changes to the 2010 Building Regulations increased the levels of insulation (and air tightness) of new homes. Energy efficiency standards for new homes were improved by 25% in 2010[44], and the proposed changes to the 2013 Regulations range from an 8% to a 26% improvement relative to 2010 standards.[45]

Other initiatives, such as the Energy Efficiency Commitments (EEC1 and EEC2) and the Carbon Emissions Reduction Target (CERT), have also contributed to improving insulation in existing homes.[46] Modelling for the Green Deal also estimated that the Green Deal and Energy Company Obligation will lead to around 2.7 million cavity wall insulations, 1.6 million loft insulations, and 1 million solid wall insulations by 2022.[47]

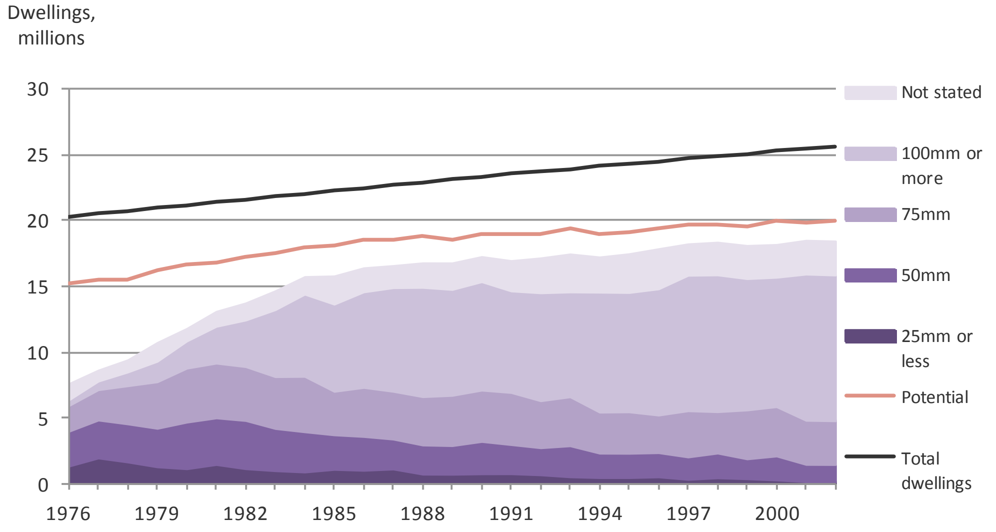
Loft insulation

There has been a dramatic change in the number of homes with some level of loft insulation over the past four decades. As the first graph below shows, about half of Britain's housing stock that could have loft insulation had some in 1976. A quarter of a century later, in 2002, this proportion had increased to more than 90%.[48] But most of these homes still had what would be seen today as inadequate levels of loft insulation (from 25-100mm).

The regulations governing the amount of loft insulation required in new homes, and following 'material alterations' to existing ones, were increased in 2002. Further changes were made when the Building Regulations were revised again in 2006. The impact of these revisions and initiatives such as EEC1 and EEC2 (the Energy Efficiency Commitment programmes – forerunners to CERT) can be seen in the second graph below.

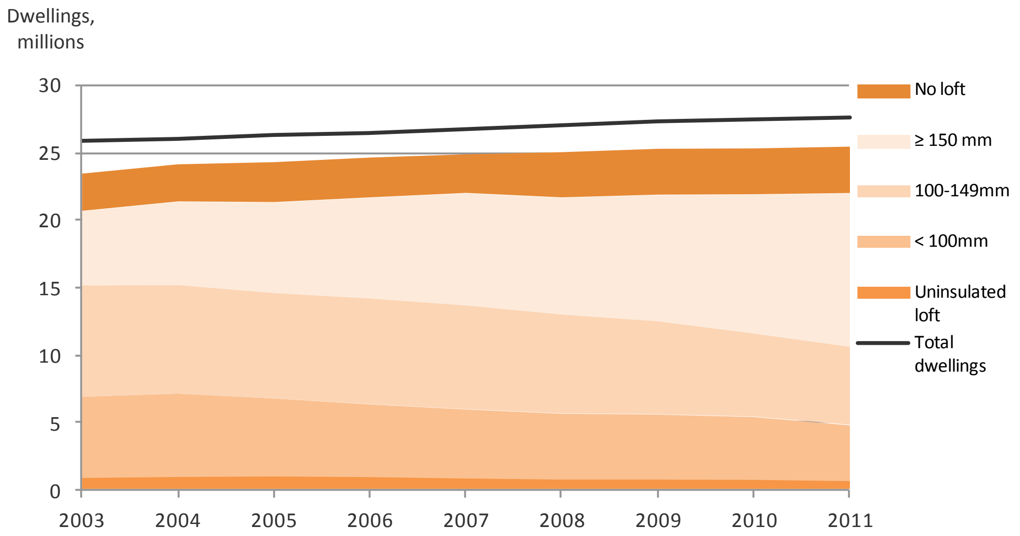
The Building Regulations, EEC and CERT have been effective in raising standards of insulation.

(The graphs have been split in 2002 because of changes to the way data was collected in the English Housing Survey.)



Graph 6g: Depth of loft insulation (UK) – pre EHS

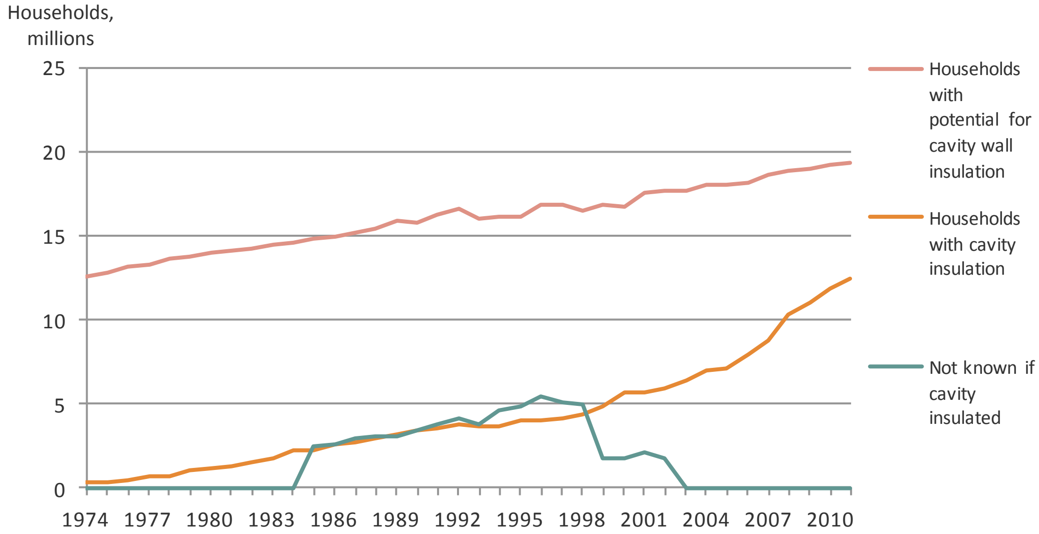
Since 2002, the number of homes with higher levels of insulation has increased notably. By 2011, more than two-fifths had 150mm or more of loft insulation (six inches or more), one fifth had 100-149mm (4-6 inches), just 15% had up to 100mm (4 inches), and 2.5% of homes had no loft insulation.



Graph 6h: Depth of loft insulation (UK) – post EHS

Cavity wall insulation

There has been a stark increase in cavity wall insulation in Britain's housing stock, see graph below. (This graph shows figures for households in Great Britain, rather than the UK like the rest of the Fact File, to match DECC's wall insulation data.)



Graph 6i: Cavity wall insulation (GB)

In 1974, two-thirds of the housing stock was capable of having cavity wall insulation but it had been installed in less than 2% of these homes. By 2011, the proportion of the stock capable of having this form of insulation had grown a little to 71% and nearly two-thirds (64%) had it. This was more than a 40-fold increase.

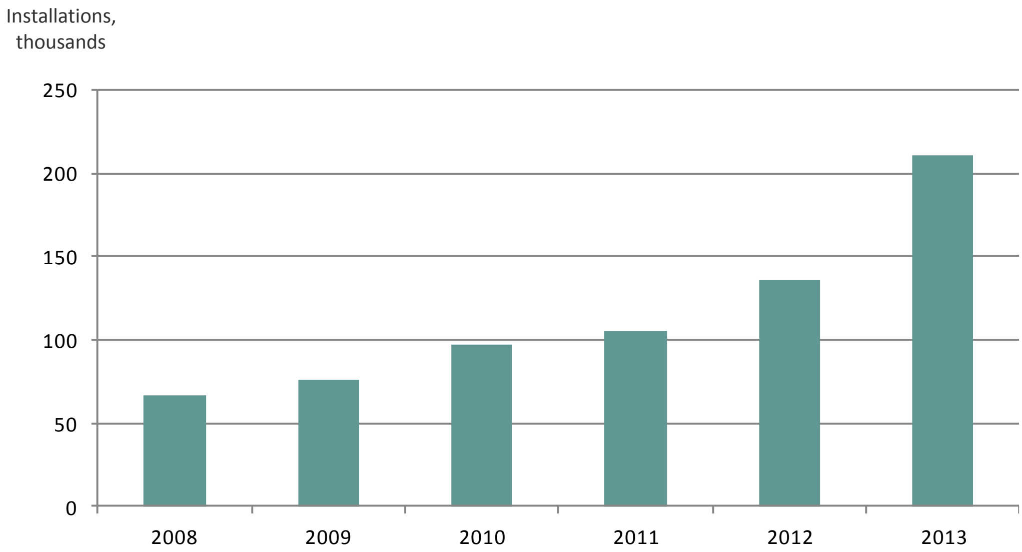
(There were a large number of homes with unknown status from 1985 to 2002 because of difficulty in classifying homes in the old Home Audit survey – a forerunner of the English Housing Survey.)

Solid wall insulation

There is a consensus of opinion that insulating the existing stock of solid wall homes is one of the strategic opportunities for improving energy efficiency.[49] This is one of the priorities for the Green Deal, see page 6, which is expected to have a major impact on the solid wall insulation market.

In 2008, annual installations of solid wall insulation were estimated in the range from 25,000 to 35,000.[50] Of these, an estimated 60% were external wall insulation, 30-40% were internal wall insulation, and 10-20% of these used 'insulated wallpaper'. Around a third of all projects applying solid wall insulation were reckoned to be new homes built with solid walls. However, there is considerable uncertainty over these figures, and they should be treated with caution.

Current estimates of installed solid wall insulation[51] suggest that there were 211,000 homes with this energy efficiency measure by April 2013, see graph below. These more recent estimates imply the installation rate has increased – to around 75,000 a year.



Graph 6j: Solid wall insulation (UK)

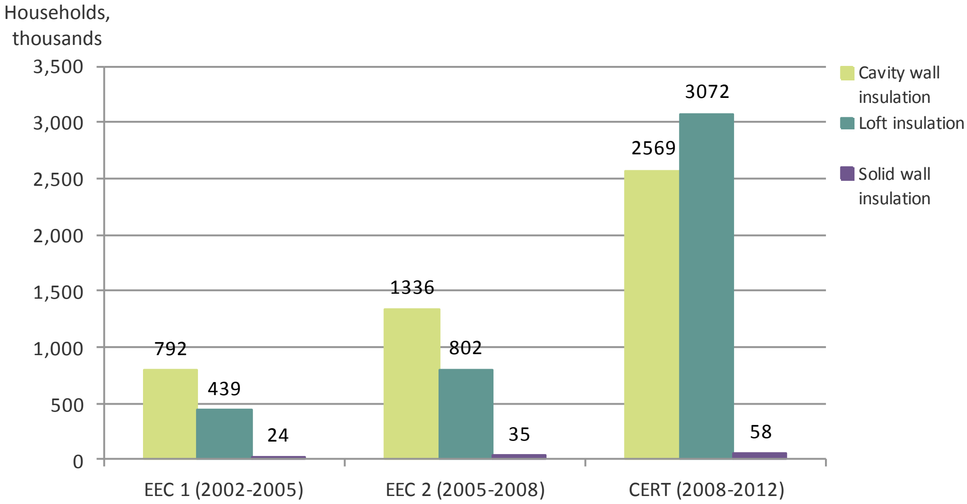
This chapter has looked in some detail at the historic trends affecting physical characteristics of homes, but this has not been linked to Government work aimed at improving energy efficiency. The next section turns to the outcomes of Government efforts to improve the housing stock.

EEC and CERT led to large numbers of improvements to loft and cavity wall insulation. There was less emphasis on promoting solid wall insulation.

Impact of Government initiatives

Between 2002 and 2008 gas and electricity suppliers were required to achieve energy savings in households in Great Britain under the Energy Efficiency Commitments (EEC1 and 2). The EECs were the Government's key energy efficiency instruments for existing households and they were expected to curb carbon emissions from housing by 1% per annum.[52]

The Carbon Emissions Reduction Target (CERT) 2008 followed on from the EEC. It set out the carbon reductions to be achieved by suppliers between 2008 and 2012.[53] The graph below shows the number of insulation measures installed under these two initiatives (up to March 2012).



Graph 6k: Insulation measures installed under EEC and CERT (GB)

As the graph shows, the two initiatives have mainly been successful at installing cavity wall and loft insulation. EECs resulted primarily in installing cavity wall insulation, with the CERT tilting the balance towards significantly greater uptake of cavity wall and loft insulation.

However, both initiatives have led to much smaller numbers of solid walls being insulated. Just 2% of the measures shown in the graph as implemented under the initiatives have involved solid wall insulation. This is in line with policy aims, which were to promote the most cost-effective measures first.

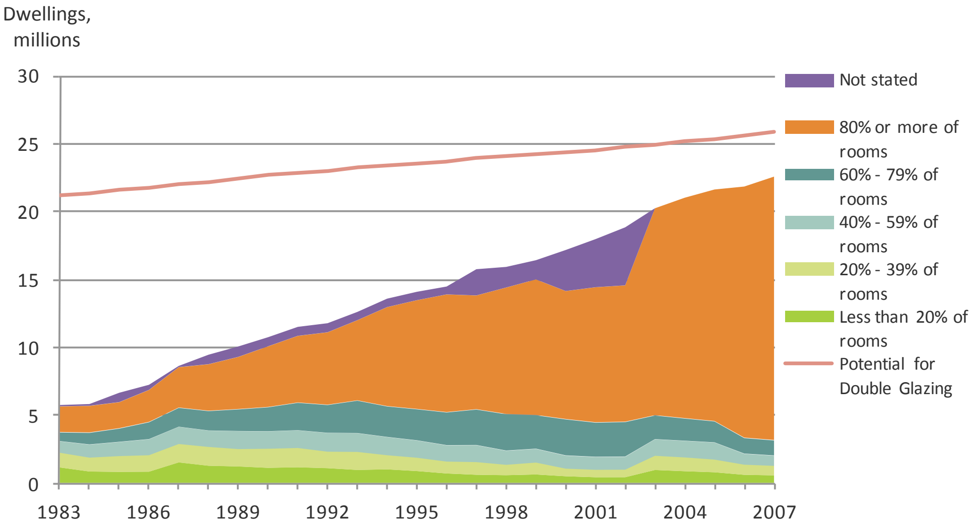
Glazing

The last four decades have seen significant increases in the number of homes with double-glazing. Since 1970, the proportion of homes with some level of double-glazing has grown 12-fold, from just under 8% to 93% in 2011, see graphs below*.

**Changing from the English House Condition Survey to the English Housing Survey in 2008 meant that double-glazing data was collected differently. This means the graphs had to be split in 2008.*

Since 1983 (the first time figures for double-glazing penetration became available), the proportion of homes with 80% or more of their rooms double-glazed has increased nine-fold, from 9% to 83% in 2011.

Some form of whole-house double-glazing is close to becoming a near universal standard.

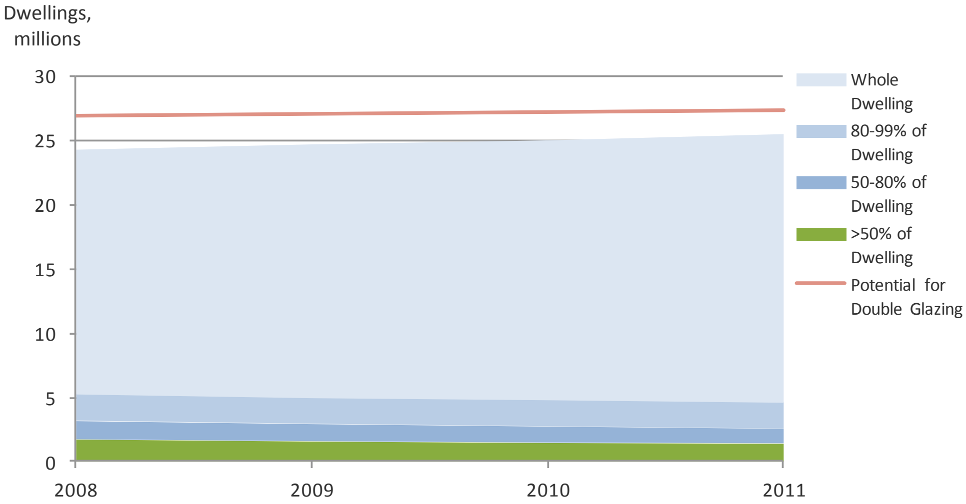


Graph 6l: Double-glazing 1970-2007 (UK)

In this section, 'double-glazing' refers to sealed units rather than windows with secondary glazing. Homes built now must have double-glazing to meet the Building Regulations. Since 2002, most existing homes where windows are replaced also need to be double-glazed.

The graphs show that upgrades were very common from 1983-2007, but there has been almost no change in the number of homes with double-glazing since 2007. In spite of this, the UK has still managed to reduce energy use for space heating (see Graph 5b), which suggests that other upgrades are now more important than double glazing for improved energy efficiency.

Double-glazed units have a limited life-span. Eventually their seals fail, the units mist up internally and their capacity for saving energy declines. Units can perform well for up to 35 years. However, they often fail long before this. Failed units cannot be repaired and have to be replaced [54,55], although it is now possible to replace just the glass.



Graph 6m: Double-glazing 2008-2011 (UK)

Glazing units are available now to a significantly higher standard than previously. And a window rating system, similar to that for boilers, is in place so that consumers can identify the performance of different products[56].

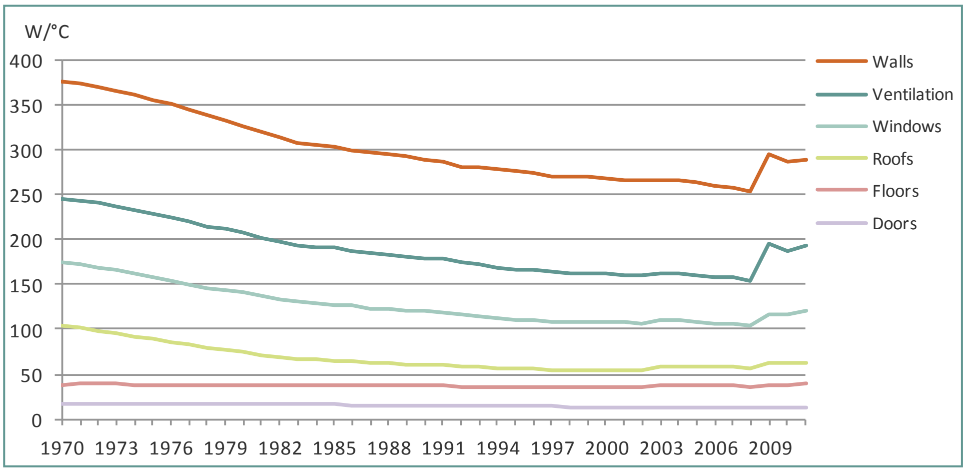
**Heat loss is linked to the difference between internal and external temperature, called the 'temperature difference'. This measure of heat loss says that for an average home, if it is 1℃ cooler outside than inside, you need 376 watts of heating to maintain a stable temperature. The measure is affected by insulation and ventilation losses.*

The heat loss figure for 2010, 287W/℃, implies that for a typical cold winter's day with an external temperature of 0℃ and an internal temperature of 20℃, an average house would need six kilowatts of heat to maintain a stable temperature. This is equivalent to six small electric fan heaters.

Heat loss

The rate at which homes in the UK lose heat during the heating season has fallen significantly in the last four decades. (This reflects the improvements described in the three previous sections.)

In 1970, the overall rate of heat loss from a home was, on average, 376W/°C*. Forty years later, it had fallen by almost a quarter to 290W/°C, see graph below.



Graph 6n: Average heat loss per dwelling (UK)

(Data for this graph was modelled, see Appendix 3. Figures are not drawn from the monitored performance of homes, and like the previous chapter we have signalled modelled data using a coloured border. The big increase shown in ventilation heat loss in 2009 comes from a change in modelling.)

On average, excluding the spike in ventilation heat loss that is an artifact of modelling changes, the rate of heat loss has reduced for all elements that make up the external envelope of a home – walls, windows, roof and doors – bar one, the floor. It has also reduced for the ventilation through those elements.

The improvement (reduction) has been most pronounced for roofs – a 65% decrease in heat loss. This reflects the dramatic improvement in loft insulation in new and existing homes. Walls, windows and doors have seen similar reductions of 17-25%.

According to these figures, heat loss through floors appears to have increased by a fifth, but this may be due to changes in data collection, or to more accurate judgements about whether floors lack insulation. There is also an increase in ventilation losses in 2011, due to higher average wind speeds[57], which pushed up total heat loss a little.

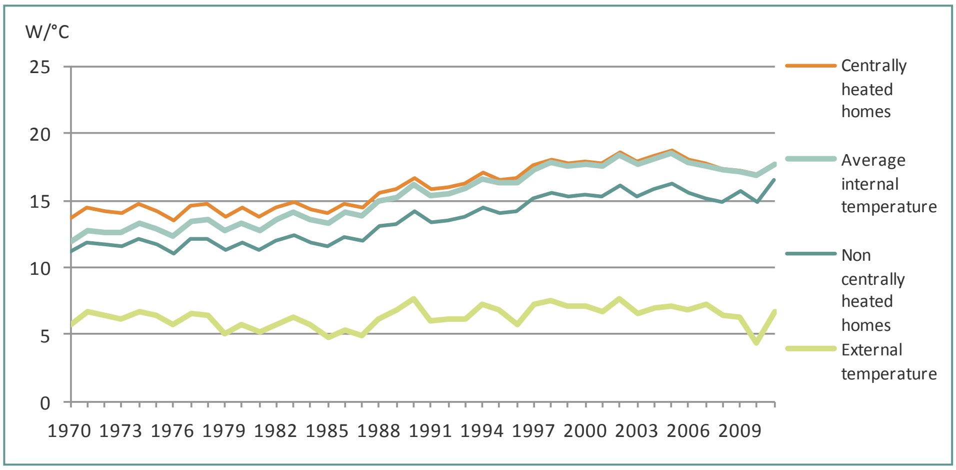
Again, according to the figures, there have been significant improvements over the four decades per average dwelling (i.e. the average across dwelling types, weighted according to the actual number of dwellings in each type). But, overall, the total heat loss for the stock as a whole (i.e. average heat loss multiplied by the number of homes) has actually increased dramatically since 1970, largely because many more homes have been added to the stock.

Internal temperature

Modelling suggests that UK homes are run at significantly higher average temperatures in the winter now than they were forty years ago – whether or not they have central heating. As the graph below shows, winter temperatures in homes, with and without central heating, have increased considerably over the past four decades.

Like the previous graph, internal temperatures shown in the graph are the result of energy balance calculations that have been modelled using building physics data and DUKES energy consumption figures. They are not drawn from the monitored performance of homes, which is unavailable.

In 1970, during the winter, the average internal temperature in homes with central heating was estimated at 13.7°C. Forty-one years later, this estimate had risen by 4°C to 17.7°C. (Note that the average temperature is for the whole house, and the duration and extent of heating is at least as significant here as the temperature of the living room. As others have noted[58], there is limited evidence of changed thermostat settings over the period. The unusually cold winter of 2010 means that average internal temperatures were lower in the second-to-last year of the graph than usual – the fall does not signal a reduction in living temperatures.)



Graph 6o: Average winter internal and external temperatures (°C)

The average internal temperature of UK homes in winter seems to have gone up by 4℃ since 1970.

We have achieved this mainly by installing central heating and burning more fossil fuels.

Over the same period, a similar rise is estimated in average winter internal temperatures in homes without central heating, from 11.2°C to 16.5°C – a rise of 5.3°C. However, the modelling suggests that households without central heating were hit harder by the severe winter of 2010 than other households. While homes with central heating were 0.3°C cooler in winter than in 2009, homes without central heating were 0.8°C cooler.

During these four decades, the proportion of homes with central heating rose to 90%, see ‘Central heating’, at the beginning of the chapter. Over this period, the average internal temperature in *all* homes (both with and without central heating) appears to have risen. Because of the dominance of central heating, the average for all homes now stands very close to the average internal temperature for dwellings with central heating).

In the first decade shown in the graph above, the average external temperature in the heating season was 6.2°C. However, the general trend since then has been for milder winters, and the last decade displayed had an average winter temperature of 6.6°C – a rise of 0.4°C.

There was an exceptionally cold winter in 2010, but we have returned to milder temperatures since, and but for this unusually severe winter, the rise in average temperature would be more pronounced.

If the average internal temperatures of homes had not increased in winter, generally milder winters ought to have decreased the amount of fuel used to heat UK homes (although this would have been offset, to some degree, by the increase in the number of households). This has not happened, even excluding the fluctuations in 2010-11, see Graph 5b (Household energy use for space heating) which shows that energy use for heating had an upward trend until 2004, and then fell from 2005 to 2009.

Instead, the average internal temperature of homes in winter seems to have risen significantly more than the external temperature. As Graph 5b shows, the gap between the lines for external and internal temperatures has widened.

The gap between these lines is proportional to the amount of heating used to lift homes from the temperature outside to the indoor temperature that is now demanded in winter. This elevation in temperature has been achieved largely by burning fossil fuels, nowadays mainly by consuming gas.

Hot water tank insulation

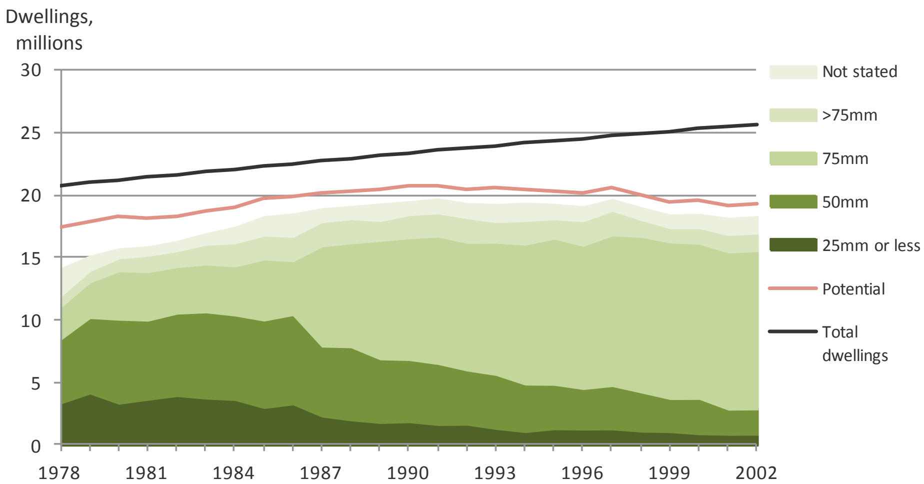
Installing adequate insulation on hot water tanks is an easy way to raise energy efficiency. It is cheap, fast, and does not require specialist skills.

In 1978, more than 3 million homes had 25mm or less insulation around their hot water tanks. Thirty years later, in 2008, 3 million homes had this same thickness of insulation installed, see graph below, but they were factory-insulated tanks, which have much better performance. (The insulation thicknesses before 2002 are ‘loose jacket’ equivalents, whereas those afterwards are factory-insulated tanks. These modern tanks with 25-50mm of insulation are equivalent to home-fitted jackets of 75mm or more.)

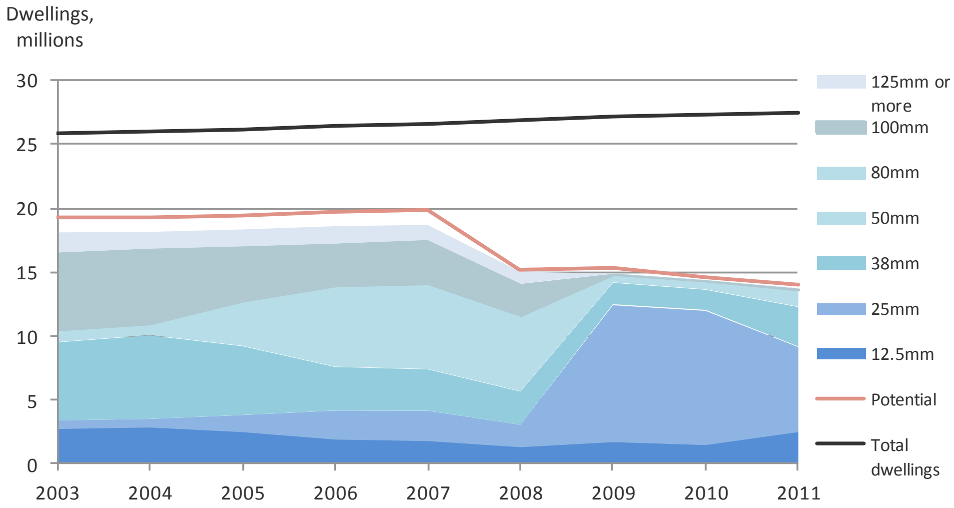
By 2002, only 5% of homes had more than 75mm of hot water tank insulation (however, by then 9% more homes had replaced their hot water tanks, using combi boilers instead, Graph 6e above).

The regulations affecting hot water tanks were changed in 2002. In the past, it was possible to purchase a bare tank without any insulation, but now all new tanks have to be supplied already insulated to comply with the appropriate British Standard.

These new regulations have led to a significant growth in hot water tanks with higher levels of insulation, as the second graph shows.



Graph 6p: Hot water tank insulation – GfK survey



Graph 6q: Hot water tank insulation – post GfK survey

By 2011, nearly all homes with hot water tanks had some insulation on them, and the majority had 12.5 to 50mm. The number of homes with 38 or 50mm of tank insulation almost doubled from 2010 to 2011. (There are discontinuities in the time series data for 2003 to 2010, but 2009 to 2011 appear to be more reliable estimates.)

However, as the graph also shows, the potential for improving tank insulation is in decline. As more and more combi boilers are installed (which have no tanks), there are inevitably fewer tanks to insulate.

As for loft insulation, there are also diminishing returns from progressively thicker insulation around hot water tanks. This too means potential savings from insulating tanks in the whole stock will fall over time.

7. Household behaviour

Introduction

Household behaviour affects energy use in four ways: through investment decisions, infrequent actions, repeated actions, and spontaneous reactions to events.

How members of a household behave has a significant effect on their home's consumption of energy. Such behaviours are highly complex and take many different forms.[59] They include relatively infrequent *investment decisions* that lead to long-term locked-in consequences, such as:

- whether to extend or upgrade a home
- what types of energy consuming equipment (e.g. heating, lighting, ventilation and cooling systems) people choose to install, and
- how many and what types of appliances (e.g. cookers, fridges, TVs and computers) they bring into their home.

They include *infrequent actions* that have persistent effects, such as:

- the times people want their heating systems to go on and off
- the temperatures at which they set their room and water heating thermostats
- the settings at which they run their fridges and freezers, and
- windows being kept open.

They include frequently *repeated actions* (habits and routines) with recurring or accumulating effects, such as:

- whether people have a bath or take a shower (and how full or long they run them)
- the temperature and programme length they select on their washing machines and tumble dryers, and
- whether they regularly turn appliances off or leave them on or on standby when not in use.

And they also include individuals' *spontaneous reactions* to prevailing conditions with one-off effects, such as whether:

- to hang out washing to dry on sunny days rather than tumble dry it
- to put on more/heavier clothes or turn the heating on/up when cold
- to take off clothes, open windows or turn the heating down/off when hot, and
- to turn lights on/off when entering or leaving an empty room.

The actions listed vary both in their frequency and in the size of their impact on energy consumption. In addition, even within a single household, different members can behave in counteracting ways, particularly in terms of their frequently repeated actions and spontaneous responses. And so their behaviours can have opposing effects on energy consumption – for instance, by turning heating up or down, lights and appliances on or off, and by opening or shutting windows and doors.

As a result of these varied actions – and their multiple interactions – similarly sized households in similar properties consume widely ranging amounts of energy.[60] And, as homes become more energy efficient, the behaviour of their occupants can play an increasingly important role in their energy consumption.[61] The UK government is interested in understanding and influencing how people's behaviour affects domestic energy consumption, particularly as a means of reducing carbon emissions:

> "Behaviourally based changes that reduce emissions have major advantages. First, the benefits can be very fast, unlike major infrastructure changes that can take years, or even decades – a 1% gain today is worth more than a 1% gain tomorrow. Second, they can be highly cost-effective. Third, they can provide savings and other benefits directly to citizens."[62]

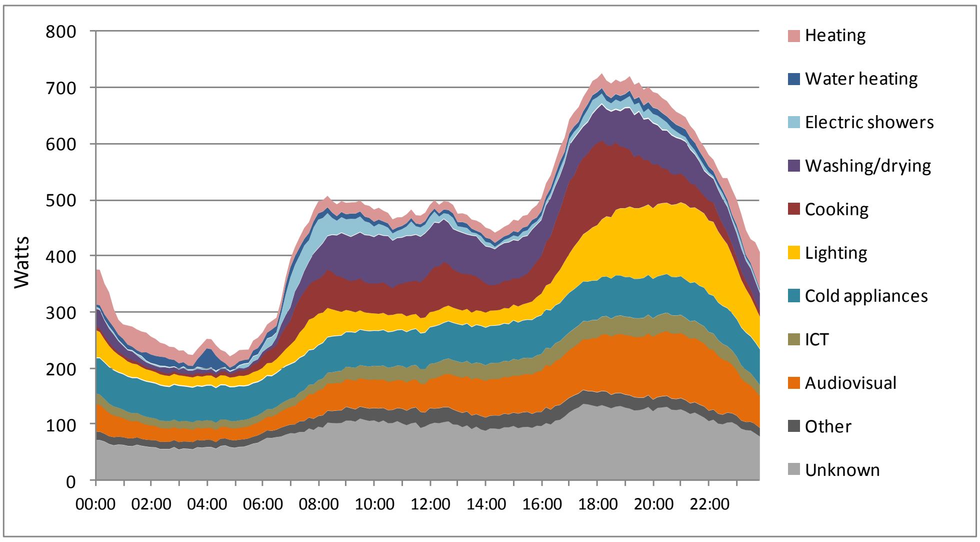
Surveys of behaviour

This chapter draws on recent studies undertaken for Defra and DECC that employed household surveys to understand the effects that people's behaviour has on their domestic gas[63] and electricity[64] consumption. Summaries of the findings of these surveys, including subsequent re-analyses of the Household Electricity Survey data, are presented below.

The chapter also draws on the Carbon Reduction in Buildings (CaRB)[65] project and on the Energy Follow Up Survey (2010-11).[66] These are supplemented by the EST's study on the impact of home electrical products on energy use[67] and its analysis of the effect of water use in the home on energy consumption.[68] Jointly this material offers rich insights into how people interact with their heating systems and the electrical products that power their lives.

For example, the Household Electricity Survey[69] shows not only how electricity is used in different ways by different households, but also how the profile of electricity use varies through the day (see graph below). The shape of this profile is clearly affected by all four forms of behaviour described above, and the profile is critical to questions about the peak electrical load, and how households could alter their behaviour to reduce their electricity demand at busy times of day.

(Heating in the graph is only electric heating, but includes primary and secondary heating for homes with electric heating. Averaging in the data means that the share of electricity used for heating appears much lower than it does for homes with primary electric heating.)



Graph 7a: HES average 24-hour electricity use profile for owner-occupied homes, England 2010-11

Gas use varies enormously from household to household, and the variation has more to do with behaviour than how dwellings are built.

Gas consumption

The amount of gas consumed in the UK varies dramatically between households. The top 10% of households consume at least four times as much gas as the bottom 10%.[60] Modelling to predict households' energy consumption – based on the property, household income and tenure – has so far been able to explain less than 40% of this variation.

Households with especially high or low consumption do not have *particular* behaviours that make them easy to identify. Instead they tend to have a cluster of very ordinary behaviours that *happen* to culminate in high or low gas use. There are, it seems, many different ways to be a high or low gas user. The behaviours in question can be clustered under three broad headings:

- physical properties of the home – the particular physical environment in which people live
- temperature management – how people manage the temperature in their homes and their awareness of the energy implications of their actions
- people in the home – who is in the home, and when, and what they are doing. [60]

Physical properties of the home

Many UK homes have been modified by extensions, conservatories, conversions and/or open plan spaces. These modifications have the potential to affect the thermal properties of a home. But, typically, these have not been included in existing quantitative modelling of domestic energy consumption.

Insulation and double-glazing are now considered 'normal' parts of home improvement. When households have extensions built, or lofts converted, they consider double-glazed windows and efficient insulation to be normal features of this work. However, home improvements that consist solely of insulation or the installation of double-glazing are, by contrast, rare. [60]

Households with high gas consumption tend to live in properties with lower energy efficiency ratings.[70] Such physical differences are enough to explain, on the basis of estimates from Energy Performance Certificates, an average of £250 variation in bills between high and low consumption households (at 2012 prices). However, the difference in average gas bills between the high and low households surveyed in 2012 was £860. So modelling based on the physical characteristics of properties is therefore able to explain less than a third of the actual difference observed.[60]

Temperature management

Some households, with high consumption, prefer to live in warmer homes, with peak temperatures an average of 2 to 4°C higher than those with low consumption. Although households report being able to make their homes *feel* comfortable, few fully understand their heating systems and have distinct and different ways of achieving comfort. Many rarely, if ever, touch their heating controls, while others tinker endlessly with their settings.[60]

Often households do not have a precise sense of the temperature setting of their thermostats. When adjusted, their thermostats are often set within temperature *ranges* rather than to specific temperatures. They are also typically in the hall which reduces the connection between the thermostat and how people subjectively experience warmth or cold in their living room.[60]

Many households have a limited understanding of their heating controls and their energy use.

Central heating system controls seem to live incognito in many homes. Many people may not recognise or understand their central heating control system.[62] Many households do not realise that they have room thermostats even when these have been installed. Even where thermostatic controls have been fitted on central heating systems, no statistically significant difference exists in average maximum living room temperatures between homes with or without them.[62]

Households that use central heating system controls have no lower demand temperatures or durations than households that do not use controls. DECC has commissioned research to understand more about how people use heating controls.

Households are not typically aware of how much gas they use, either in absolute terms or in relation to others. Paying by direct debit, fluctuating energy prices, variations in how cold the winter is, and changing household circumstances – all of these appear to cloud people's understanding of how much energy they use.

Most households underestimate the amount of energy used by their space heating, relative to other uses. While energy efficiency is almost unanimously seen as a good idea, particularly to save money, few people seem to be attempting to reduce gas consumption and are far more focused on saving electricity.[60]

Household composition

The composition of a household influences how heat is used. The presence of young children leads to particular consideration of house temperatures and people taking relatively unusual steps to manage the temperature. Likewise, occupants with health issues (including chronic conditions such as back pain, or whilst recovering from injury or surgery) or with elderly occupants or visitors keep their homes warmer to alleviate stiff joints or because older people feel the cold.[60]

How people use their houses is reflected in winter heating hours. Homes that stand empty during the working day are likely to be heated for fewer hours a day. Households with high gas consumption tend to be empty on fewer occasions. Showering and bathing habits vary considerably between individuals and households, with high consumption households taking more and longer showers than low consumption ones.[60]

Households with high gas consumption tend to have lived in their homes for longer. Those who have been in their homes for longer tend to have undertaken large-scale modifications in the early years of their residency, including energy efficiency measures. As a result, households that have been in their homes for longer tend to have older and potentially less effective energy efficiency measures in place.[60]

Electricity consumption

The observed, average annual electricity bill for all households monitored in the Household Electricity Survey (2010-11) was around £530 (at 2012 prices). This was 10% higher than the UK national average, costing on average an extra £50. Intriguingly, these higher figures were from a group of householders whose stated attitudes regarding being careful of energy use in the home were, on average, a whole ten per cent higher than the national average.[69]

Regardless of the size of their electricity bill, householders are not particularly good at judging how big their own bill is in comparison to other households in similar circumstances. They frequently express surprise when confronted by an accurate comparison of the size of their own bill with similar households. They are also relatively poor at providing reasons for the size of their bills and are equally poor at identifying which of their appliances give rise to the largest part of their bills.[71]

Standby consumption

On average, households spend between £50 and £86 a year on their appliances in a standby, or 'non-active', state. Consequently total standby consumption can amount to 9 to 16% of a household's power demand. This is significantly higher than the current 5 to 10% estimated/modelled for domestic standby power.[69]

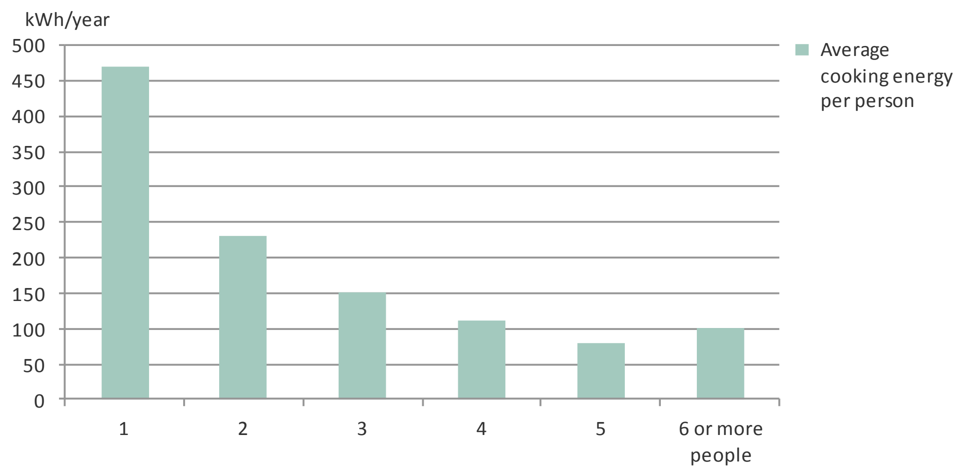
Modems and routers have highest 'standby' power use among ICT equipment – around double the next-highest device. Households often run them continually, so there may be opportunities for using timers on these devices.[69]

There is some evidence that newer appliances use less power in standby modes, but not all appliances have been successful in cutting standby electricity use. New hi-fi equipment, TVs, ovens and monitors appear to use less power in standby modes, but other new appliances – like combined fax/printers– may actually use more electricity in standby.[69]

Empirical research shows that households spend a considerable amount of money powering appliances they are not using – in 'standby' modes. Different behaviour may reduce this, without any loss of benefit.

Single-person households

The old adage 'two can live as cheaply as one' appears to be particularly true when it comes to electricity use. In the monitored homes, one-person households used as much, and sometimes more, energy than typical families on particular appliances. In particular, the cooking of lone dwellers matched or sometimes exceeded those of average family units (see graph below).[64]

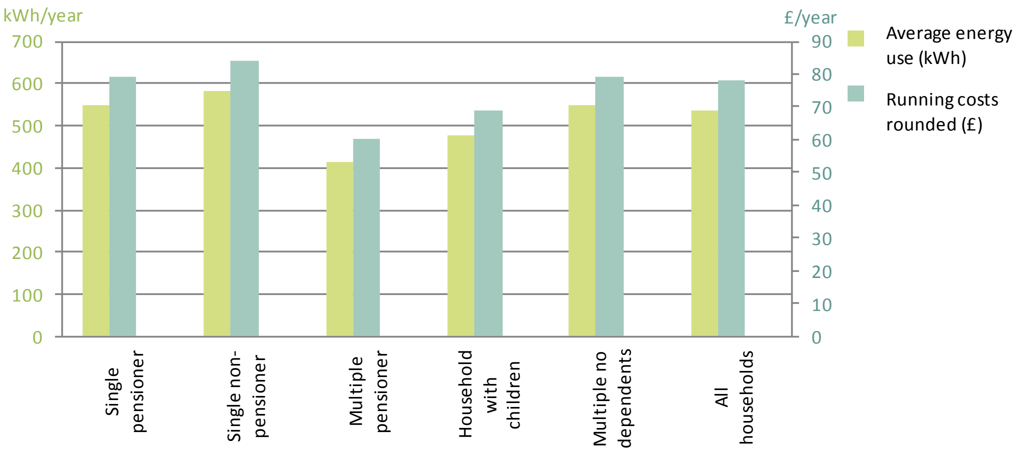


Graph 7b: HES Annual Energy Use for Cooking, England 2010-11

The implications of this finding are troubling from a future energy demand perspective, particularly if the trend towards increasing numbers of lone households continues. Over 29% of all UK households were single-person by 2011, an increase of less than 1% since 2001.[72]

Lighting

On average, homes in the study had 34 installed light bulbs. Unsurprisingly, kitchens and living rooms have the highest installed lighting loads – each responsible for close to a quarter of the installed lighting capacity. Again, on average, lighting used 537 kWh a year, at a cost of around £77 (see graph below). However, single people and pensioners used more energy for lights than households with children.[64]



Graph 7c: HES Annual Energy Use for Lighting, England 2010-11

Televisions

The UK really is a nation of television watchers. Instead of the previously assumed figure of almost five hours of typical daily TV viewing, the HES found this was more likely to top six hours a day.[64] The prevalence of background TV activity while household members are performing other tasks suggested that the TV may be receiving limited attention for at least part of this time.

Research suggests that households leave the TV on for more than six hours a day, on average. But they may not actually watch the TV for part of this time.

There are strong associations, for instance, between TV use while households are also employing cooking devices, ICT equipment, washing appliances and even the shower.[73] Nevertheless, however actively watched, this is an additional 400 hours of TV viewing per household a year to add to previous assumptions. This equates to over 10 billion extra hours nationwide. This costs the nation, on average, an extra £205 million a year in total.[64]

Purchasing TVs appears to be different from other appliances, which are usually replaced when they break. It appears to be more common to retain old TVs and continue using them after buying a new one, which means the 'replacement rate' for new energy efficient TVs is lower than sales data suggests.[74]

Washing machines and tumble dryers

Households also love to keep clothes clean. On average, HES households ran 5.5 washes a week[64] but only about a quarter selected a 30°C wash.[69] Households with a tumble dryer dried 81% of their wash cycles using dryers rather than using outdoor washing lines or other non-powered forms of drying. If households owned a washing machine and a tumble dryer, then the energy for laundering their clothes typically cost them £80 per year.[64]

Washing up

Hot water use for baths, showers, washing up and water-using electrical appliances contributed £228 to the average annual combined energy bill and emitted 875kg of CO_2 per household per year.[69] Households used much more energy for keeping crockery, glasses and cutlery clean than they did for clothes. Those with dishwashers used on average nearly double the amount of electricity for this appliance than they did for washing machines.[64] Most people (77%) filled their dishwasher to capacity before turning it on.[69]

Fridges

Historically, fridges, fridge-freezers, upright and chest freezers have been the largest single consumers of electricity in the home.[64] The most commonly owned appliance in the kitchen was the fridge-freezer, which was owned by 57 per cent of households in the HES study. Ten per cent of the total sample owned three separate cold appliances, and 3.5 per cent owned four types. The average number of cold appliances per household was 1.7 units.

The HES study estimated that an average household bill for keeping food and drink cold was around £79 per year.[64] A fridge bought 15 years ago uses on average around 50% more electricity than a comparable model bought today. The danger is that some of these energy (and emissions) savings are being eroded by two trends: from the consumer side, in a recent fashion for larger, American-style fridge-freezers; and from the industry side, in adding on new features, which consume more energy.[69]

Peak demand and power shifting

If cold appliances had controls that enabled households to avoid electricity use in the evening peak (6-7pm), it would be possible to suspend up to 10% of peak power for half-an-hour, i.e. up to 70 W for each household that replaced its cold appliances. However, given current replacement cycles for white goods it would take more than 20 years for UK households to replace all their cold appliances.[74]

Small behaviour changes and smart controls could reduce peak electricity demand by as much as 18%.

If householders switched their use of washing machines, tumble dryers and dishwashers from the evening peak to non-peak periods, this would transfer at least 8% of the peak demand for the monitored households, i.e. an average of 57 W per home.

If households replaced their inefficient appliances with the most efficient appliances, this would have the potential to reduce peak power demand by at least as much as demand shifting *per se*.[69]

Conservatories

One in seven households in England has a conservatory that they heat at least some of the time. This can increase energy use by at least 13%.

About 18% of households in England have conservatories.[75] Around 77% of these have heating, with just over half of them connected to a central heating system. Slightly less than half of them have storage or direct electric heaters. In the winter, more than half of the conservatories – capable of being heated – are heated every day. Only a fifth of conservatories (with heating fitted) are never heated. Most households heat their conservatory to the same or a cooler temperature than their home.[74]

Most conservatories open on to a living room, kitchen or dining room. In 9 out of 10 cases, there is a separating door. Most households keep the separating door shut in the winter, mainly to keep heat in or for security. Where the door is left open, this is mainly for convenience or to make the adjoining room feel more spacious.[74]

If heated, conservatories can result in significant additional space heating, particularly if they have a poor thermal performance, for example, if they are single glazed. (Modelling using the Cambridge Housing Model shows that households can use at least 13% more energy for space heating if they heat their conservatories.) In addition, leaving a door open between a home and its conservatory in winter results in extra heat loss from the house, and so a higher heating bill.[74]

Policy implications

UK householders may have little understanding of how their heating system and its controls operate. They would appear to have little awareness of the relative size of their gas and electricity bills in comparison to similarly situated others. And they may also lack understanding of the extent to which their own disparate behaviours can affect these bills. So studies such as those reported will prove invaluable over the coming years. They can help researchers and policy makers to get under the skin of the nation's energy-using habits.

This will allow government to form new policies to change the way people think of, and use, the energy consumed in their homes. For instance, we need people to use less power, but we also need them to use power differently and at different times, altering their behaviour to reduce the 'peak load' demands on the grid. This will become even more crucial when we have a greater contribution of decentralised and renewable power in the electricity mix in the next decade.[64]

Over recent years, it has become increasingly important for government to develop its understanding of energy-related behaviours in order to be able to develop and implement more effective policies. Attempts to influence behaviour in the past have traditionally tended to rely on either legislative prohibition, or on financial incentives or disincentives, to steer people into desired paths of activity.[76] While both these strategies remain important tools within any policy toolbox, a much broader understanding of behaviour allows:

- the development of 'light touch' policies that do not need to rely on legislation and regulations
- policies that are more effective in areas where prohibitive or fiscal measures have not worked as well as expected
- better use of official and regulatory instruments so that where they are necessary, they are used in the most effective way and are seen to be legitimate[71], and
- potentially, more sophisticated targeting of initiatives to move away from 'one-size-fits-all' towards strategies that are specifically aimed at households with greatest potential for savings.[69]

8. Breaking down energy use by fuel type

The mix of fuels is significant, because each fuel implies different carbon emissions, cost and different implications for fuel security.

The type of fuel used in housing is important for three reasons. First, different fuels have very different carbon emissions (electricity, for example, currently emits towards three times as much CO_2 per kilowatt-hour as a kWh of gas).

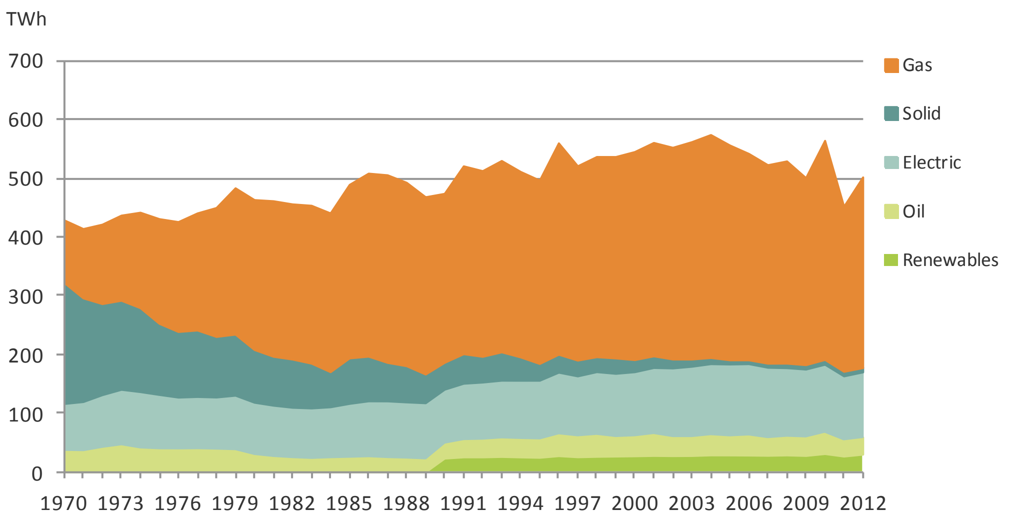
Second, costs vary significantly between different fuels, so the choice of fuel for heating, for example, makes a big difference to energy costs for an individual household – as it does for the UK as a whole.

And third, different fuels have quite different implications for fuel security. For example, theoretically it would be possible for the UK to generate all its electricity from renewables and nuclear generators.

Given the information above about changes to heating technologies in homes, it comes as no surprise to see a big expansion in gas use in homes, with a parallel contraction in solid fuel use (see graph below).

All fuels are measured in terawatt hours in the graph, TWh. (As a reminder, this is a million million Watt hours, 10^{12} Wh – equivalent to leaving on a small hairdryer in every home in Britain, continually, for 1.6 days.)

Today, gas provides two-thirds of household energy (excluding the gas used to generate electricity in power stations). In 1970, gas provided only a quarter of household energy.



Graph 8a: Energy use in housing by fuel type

The demise of solid fuels (for heating) was even more stark: they provided nearly half of the energy used in homes in 1970, but are down to just 2%

today. This is because so few homes now use open fires or coal stoves as their main form of heating. ('Solid fuel' included wood until 2000 because of the way BREHOMES categorised fuels. It is now classified as 'Renewables'.)

Electricity use in homes peaked in 2005 at almost 120 TWh, and has now slipped back to just under 110 TWh. There are pressures in both directions affecting electricity use: more efficient lights and appliances reducing consumption, offset by increased ownership and use of appliances and especially information and communications technologies. Increased energy use for electric heating in cold years (and lower use in mild years) also has a pronounced impact on electricity use. (Note that this is different from electricity's contribution to CO_2 emissions, described in Chapter 3.)

The use of solid fuels for heating has plummeted: from nearly half of heating energy in 1970 to only 2% now.

Heating oil's share of household energy use declined from nearly a tenth in 1970 to just 6% today – partly because of increased gas-fired central heating.

9. Renewables and microgeneration

Renewables meet only a small proportion of the UK's overall demand for energy – just over 4% of total energy use across all sectors of the economy in 2012. However, renewables now account for more than 11% of the UK's electrical supply[77].

Greater use of renewables in electricity generation helps to reduce carbon emissions from all electricity drawn from the national grid. This means that housing benefits from lower carbon emissions along with other sectors of the economy.

**DECC defines microgeneration as low, zero-carbon, or renewable energy generated at a 'micro' scale. It covers energy resources that are decentralised, not centralised.*

Households can also benefit from renewable energy systems that provide heat or electricity directly to the dwelling. In both cases, there can be major advantages in generating energy close to the place it is used, at a smaller scale than traditional power stations. This is known as 'microgeneration'*.

Microgeneration is a newer topic of interest than other aspects of energy use in homes. The data available is growing over time, and this 2013 edition of the Fact File has a more detailed description of renewables and microgeneration than past editions.

UK generation of renewable electricity almost quadrupled from 2003 to 2012, and every kind of renewable technology experienced the growth.

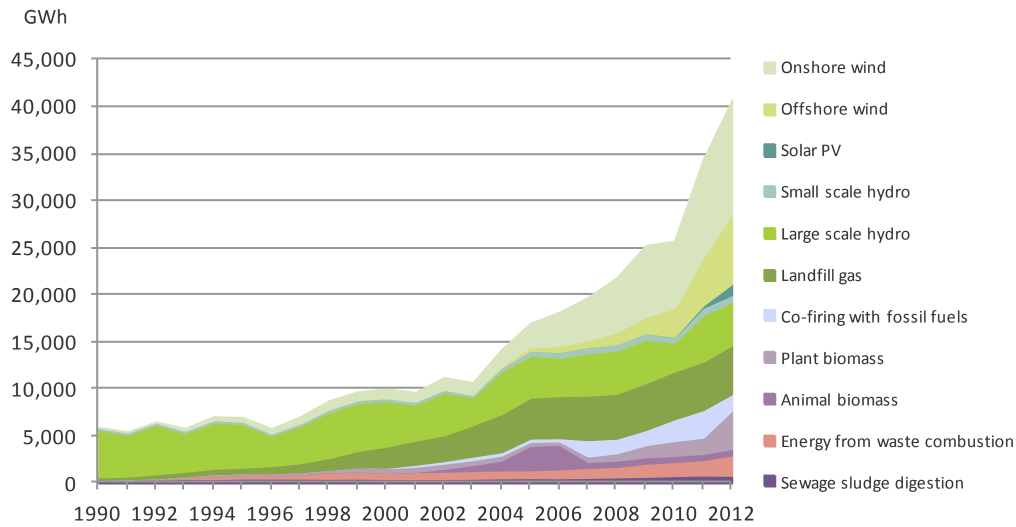
In summary, there are four main trends emerging from the data below:

- renewable energy – as electricity and heat – is growing rapidly in the UK
- onshore and offshore wind are now the largest contributors to renewable power
- landfill gas, large-scale hydro and plant biomass are now all significant contributors to renewable power
- the number of installed photovoltaics systems (solar electric) has increased massively since 2010, but their contribution to total renewable power in 2012 was still small: less than 3%.

Renewable electricity from the grid

The Digest of UK Energy Statistics, DUKES, includes data about renewable energy derived from wood, waste incineration, geothermal and active solar systems and wind. This data has only been collected since 1990, so there is a shorter time frame than most of the other statistics reported here, and not all of the data separates out renewable energy used or generated by households from that used by other sectors.

The largest growth in renewable energy across all sectors was in offshore wind – predominantly power generated on wind farms out to sea – where output increased seven-hundred-fold, from 10 GWh to 7.5 TWh from 2003 to 2012. The UK now gets 60% more energy from offshore wind than it does from large-scale hydroelectric plants.



Graph 9a: Renewable electricity generation by fuel

The DUKES data shows that even in the seven-year period from 2003 to 2012, there was significant growth in total renewable electricity generation – up by more than 290% overall, but from a very low base (see graph above). In fact, every single source of renewable electricity grew in this period.

Output from solar photovoltaics (electric panels) also grew very steeply, especially in 2011-2012, driven partly by the sweetener of Feed-In Tariffs (see below). There was a 400-fold increase from 2003 to 2012, and output rose seven-fold in 2011, and five-fold in 2012. However, total output from solar photovoltaics remains very small compared to wind, at 1,188 GWh in 2012. Photovoltaics contributed less than 3% of all renewable electricity.

Electricity from plant biomass and offshore wind showed the biggest absolute rises in 2012, both jumping more than 2,300 GWh in a single year.

The UK gets many times more electricity from onshore wind, offshore wind, landfill gas and large scale hydro. Wind turbines alone generated more than 16 TWh, or enough electricity for around 4 million homes in 2012.

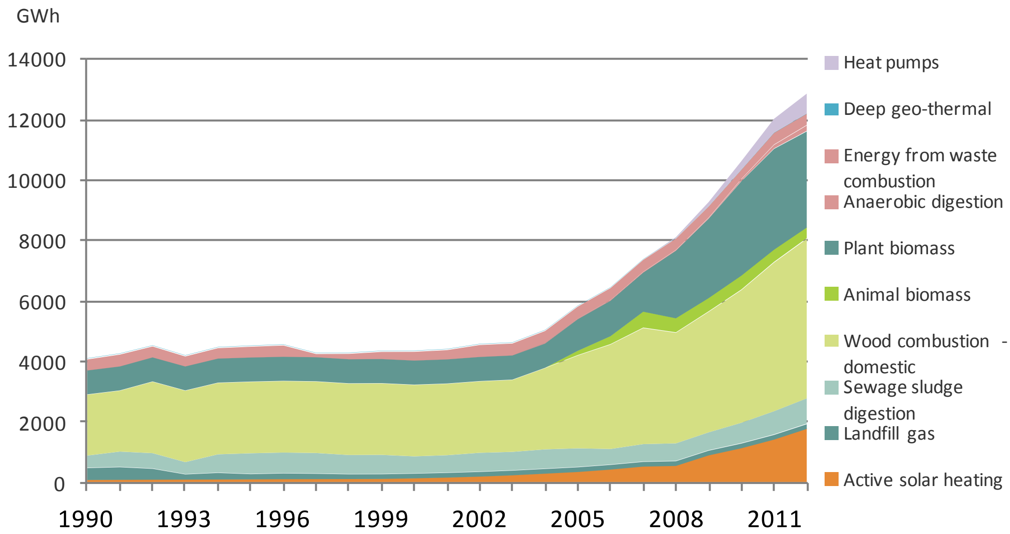
Plant biomass was the largest absolute increase in 2012, and double the output in 2011, because the Tilbury B power station was converted to run on biomass. Tilbury B alone could generate 10% of the UK's renewable power, but Tilbury stopped generating in August 2013 because it was no longer viable. Difficulties in converting to biomass and changes to subsidies for biomass made it uneconomic[78].

Renewable heat

Although renewable electricity has been a focus of attention for some time, and the UK has achieved extraordinary growth in renewable electricity, heating also offers considerable potential for substituting renewable fuels in place of fossil fuels. Heat is not as valuable in terms of price per kWh as electricity, and it is usually more difficult to move around, but renewable heat is still a useful contribution to the UK's energy mix.

The UK's use of renewable heat has quadrupled since 1990, and more than doubled since 2003 (see graph below). The largest share comes from 'bioenergy': all renewable sources except aquifers, heat pumps and solar heating. Wood combustion is the largest contributor to bioenergy, and wood burnt for heating homes accounted for more than half of all renewable heat used in housing in 2012.

However, wood combustion has grown much more slowly than other sources of renewable heat. It grew 160% from 1970 to 2012, while active solar heating (mainly solar water heating) grew by a factor of 24, and plant biomass nearly quadrupled. Solar water heating is now more than an eighth of renewable heat used in housing.



Graph 9b: Renewable heat generation by fuel (not only for housing)

It appears that the decline in heat from landfill gas stems from competition between electricity generation and heat production. Many times more landfill gas is now burnt to generate electricity than heat, which is beneficial for cost reasons and carbon emissions.

Microgeneration in housing

Feed-in Tariffs, introduced in 2010, changed the landscape for generating renewable power in the home. FITs made it much more attractive for householders to add renewable electricity systems – and particularly 'photovoltaics' (solar electric arrays) to their homes.

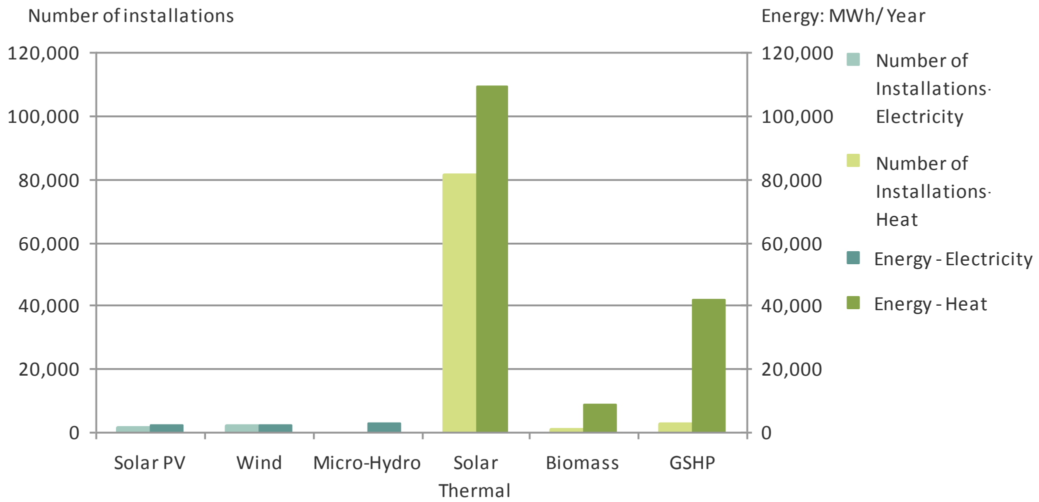
FITs provide a guaranteed payment for electricity generated by renewables – both power that is used, and unused power that is sold into the electricity grid. They encouraged hundreds of thousands of households to install photovoltaics.

There is limited data available about the number of microgeneration installations in homes before FITs started, but there is now very good data about installations that have been supported by FITs.

The pre-FIT graph below separates out *cumulative* electric and heating small-scale renewables installed by 2008 – the only year data was available. The contrast between the high number and larger scale of heating technologies (shown on the right of the graph), and the low number of electric technologies (on the left) is striking.

More than 50 times as many solar thermal systems had been installed, for example, as the most common electric technology – wind power. Biomass heating and ground-source heat pumps ('GSHP') are noteworthy because although relatively few systems had been installed, their *predicted* annual output in MWh (or TWh) was high – at least three times more than any of the electric systems.

However, it is important to draw a distinction between renewable electricity and renewable heat, because electricity is a more versatile form of energy. Moreover, the carbon savings and cost savings per unit generated from renewable electricity are much greater than those from renewable heat.



Graph 9c: Household renewable technologies (cumulative installations and annual energy, 2008)

On the electric side, there were 50% more wind installations than photovoltaics ('PV'). Although a tiny number of micro-hydro systems had been installed – just 56, too few to show up on the graph – their annual output was considerable: nearly 3 GWh. This is more than the output of either PV or wind.

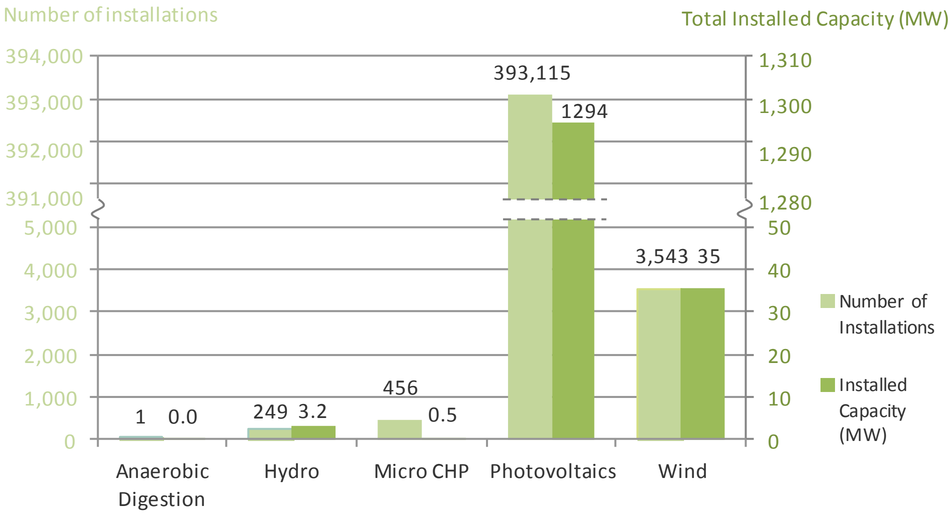
The data from Feed-In Tariffs shows that the number and pattern of installed microgeneration technologies has changed completely since 2008. The graph below shows the huge increase in the number of PV installations

– towards 400,000 in three-and-a-half years, with a peak of nearly 100,000 installations reported for the first quarter of 2012.

The number of PV installations fell back in the second quarter of 2012, and continued to fall at the end of 2012 and early 2013 because of reductions in FIT payments.

There have been 3,543 wind turbine installations supported by FITs, although the number of projects varies significantly from year to year. These remain a tiny proportion of FIT projects, and micro-combined heat and power (specifically oriented towards domestic properties) is even smaller: just 456 installations up to mid-August 2013.

FITs are intended to encourage microgeneration, and although the data in the graph includes industrial and commercial projects, the vast majority of installations (97%) have been in homes[79].



Graph 9d: FIT installations and capacity (April 2010-June 2012)

FITs have been so effective as an incentive for householders to install PV that PV has shifted from a niche upgrade that was dwarfed by solar thermal in 2008 to a mainstream part of home improvements.

10. Summary and conclusions

More energy services, more efficiently than ever

The energy used in housing is more than a quarter of the UK's total energy consumption. It is a larger fraction than the energy used by business, and more than even road transport, see Chapter 1.

Despite widespread uptake of central heating and increased ownership and use of appliances, energy use per household has fallen by 18% since 1970, see tables below. However, the growth in the number of households more than offsets this efficiency improvement, and overall energy use in homes has *increased* by 17%.

Although there has been massive expansion in central heating and appliances use in homes, average energy use per household has fallen nearly a fifth.

Energy use per household has fallen even in spite of increases in energy services – particularly heating. This is largely due to the dramatic improvements in the efficiency of space and water heating. (Average energy use per household for space heating is only four-fifths of what it was in 1970, when most of the energy was lost up chimneys. Even though average internal temperatures have risen by 4°C or more, much better insulation and more efficient heating systems have provided more comfort *at the same time* as cutting energy use per home.)

Energy and CO_2 in homes	1970	2012
Total energy use	429 TWh	502 TWh
Total energy spending (2012 prices)	£20 billion/year	£34 billion/year
CO_2 from housing	182 Mt	137 Mt (estimated)
Number of households	19 million	27 million
UK population	56 million	64 million

Energy and CO_2 per home and per person	1970	2012
Average energy use per household	22,600 kWh	18,600 kWh
Average energy use per person	7,700 kWh	7,800 kWh
Average energy spend per household (2012 £s)	£1,050	£1,250
Average energy spend per person (2012 £s)	£360	£530
Average CO_2 per household	9.6 tonnes	5.0 tonnes
Average CO_2 per person	3.3 tonnes	2.1 tonnes

The fuel mix for generating electricity in Britain has changed radically since 1970 – with coal-fired power displaced by electricity from natural gas and an increasing contribution from renewable electricity. This brought great improvements in the carbon-efficiency of power, which along with more efficient products heralded extraordinary growth in electrical services *at the same time as* big reductions in CO_2 emissions per household.

UK households now have more electric lighting than ever before, and new energy services that would have been unimaginable in 1970 (mobile phones, 40" colour TVs, DVD players, set-top boxes, games consoles, bread machines, yogurt makers, and much more). It is astonishing that households have witnessed this change while simultaneously almost halving CO_2 emissions per home.

Structure of the housing stock

The number of households in Britain is rising at a rate approaching 1% a year, and the average household size is falling. This is due to demographic effects and changing family structures.

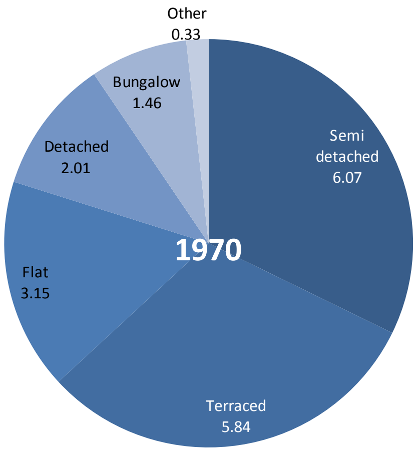
Two trends are apparent in the overall housing stock: an increase in the number of flats, and a parallel increase in the number of detached houses (see pie charts, right). The rise of flats seems like a logical response to the growth in smaller (one-or two-person) households. The increasing proportion of detached houses is harder to explain, but this seems to be linked to the increase in the percentage of incomes spent on housing[80].

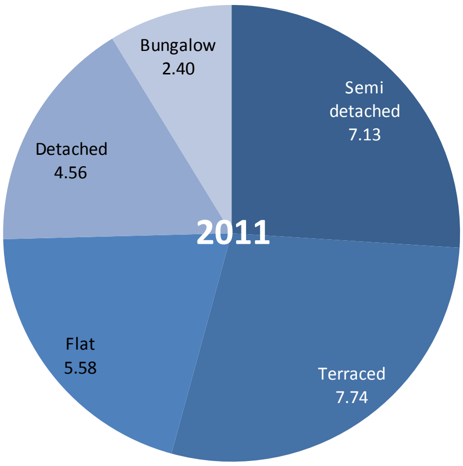
All these trends have important implications for energy use and CO_2 emissions. First, more homes mean more energy use – unless they are offset by energy efficiency improvements to existing homes. Second, although smaller homes tend to use less energy, there seems to be a minimum 'base load' that is not related to household size or floor area.

This means that the trend towards smaller households puts upward pressure on energy use and CO_2 emissions from housing. Further, the growth in detached homes (with proportionately larger external walls) increases heat loss in winter compared to terraced houses or flats. This too puts upward pressure on energy use and CO_2 emissions.

The ownership of UK homes has also changed markedly since the 1970s, with a huge expansion in the number of people owning their own homes. Almost nine million more households now own their homes than in 1970.

There has been a corresponding decline in the number of homes owned by local authorities, and councils now own more than four million fewer homes than they did at the start of the 1970s. Registered Social Landlords have taken on part of the responsibility for social housing, and they now own 9% of homes.





Graph 10a: Housing stock broken down by type, 1970 and 2011 (millions)

In the past, local authorities and RSLs have had a better record for systematically improving the energy efficiency of homes than privately-owned, and particularly private rented housing.

Energy spending and incomes

Energy bills for households have increased overall in real terms since 1970, but the increase is modest – just 17% in 42 years. Energy prices rose steeply from 2003 to 2008, and gas bills were high in the cold year of 2010, but they have fallen again since. Energy spending also fell in relation to total household spending – on average from 6% of weekly expenditure in 1970 to around 4.5% today.

How much households spend on energy is related to their incomes, with wealthier families spending more on energy than poorer ones. However, despite this, wealthier households spend a smaller fraction of their incomes on energy than poorer ones.

This means that initiatives aimed at encouraging people to improve energy efficiency in their homes, and trying to persuade them to cut their energy use, may need to be targeted towards different income groups – as the Energy Company Obligation does with low income and vulnerable households. Varying incentives and barriers apply to different income groups, and how much people spend as a fraction of their incomes and/or expenditure probably affects their reactions to such initiatives.

Initiatives aimed at improving energy efficiency may need to be targeted towards different income groups.

Energy use trends

How energy is used in homes is shaped by many different factors: how homes are heated, how well insulated they are, how draughty they are, what temperature they are heated to, whether air conditioning is used, what and how appliances are used, how homes are lit, how cold it is in winter, and so on.

Many of the most important determinants of energy use are within the control of households – especially if they have the resources available to invest in making their home more energy efficient.

Total energy used for heating has increased by a third since 1970 – in part because of widespread take-up of central heating and higher average internal temperatures, but also because there are over 8 million more households today.

The huge growth in central heating, mainly fuelled by gas, has brought great improvements in carbon efficiency per kWh of heat. However, homes with central heating also tend to use much more energy than homes without – often twice as much – because they allow householders to heat the whole of their home easily instead of just one or two rooms.

This increase in energy used for heating would have been much greater but for improved insulation and boiler efficiency in most existing homes.

Outcomes of Government initiatives

The Building Regulations and other Government initiatives have been successful in driving the installation of better insulation, double-glazing and more efficient heating systems in new and existing homes.

Modelling suggests the energy used to heat water in homes has fallen by a third since 1970 – largely thanks to more efficient water heating systems and much improved insulation of hot water storage tanks.

However, the energy used in lighting across all homes grew rapidly after 1970 – up by more than a third. (It has declined since 2002, presumably due to the shift towards using low energy lights.)

One possible explanation of this large growth is that people now use electric lights for more of the day, or that they light more of their homes – similar to the changed expectations of higher internal temperature. We have witnessed increased use of spotlights for internal lighting (especially in kitchens), and households are more likely to have installed external lighting for security purposes.

The energy used by appliances has increased three-fold since 1970. We now own, and use, more electric appliances than ever before.

Appliances growth was even more dramatic: the energy used in appliances more than tripled in 40 years. This is because householders own a broader range of appliances, and because of a big jump in the use of these appliances.

For televisions and home computing, for example, many households now own multiple TV sets and computers. Hours of use of TVs and computers (virtually non-existent in 1970) have increased significantly over the period.

Energy use in cooking reveals a very different trend: now only half as much energy is used for cooking than it was in 1970. (Although some of this is doubtless offset by increased energy in pre-prepared foods, which were not available in 1970, and by use of microwaves, which are classified as appliances and not cooking.)

This growth in energy used for lighting and appliances has, to a degree, been offset by other changes in the energy efficiency of homes. Modelling and SAP ratings – the standard way to assess thermal and lighting efficiency in homes – indicate that today's homes use energy much more efficiently to provide heating than homes in 1970. But for better insulation and more efficient heating systems in homes, twice as much energy could be used in housing now.

Not all energy-efficiency improvements to homes lead to the same reduction in energy use and CO_2 emissions. For homes that start off below acceptable standards of 'comfort', and for households in fuel poverty, more than half of any efficiency improvement is taken in the form of higher internal temperature.[81, 82]

Carbon emissions

Average CO_2 emissions per household have fallen by nearly half since 1970. This is a result of changes in the fuel mix used to generate grid electricity, as well as greatly increased use of natural gas as a heating fuel in homes instead of (high carbon) solid fuels and oil. One factor that has grown in recent years is renewable electricity supplied to the grid, which expanded dramatically from 2003 to 2012.

Across the whole economy, renewable electricity rose seven-fold from 1990 to 2012. The UK currently gets more than 11% of its power from renewables.

To date there is only limited data about changes in the direct use of renewable energy in homes, whether heat from biomass, hot water from solar panels, or electricity from photovoltaic panels. Electricity generated from photovoltaics has grown dramatically since 2010 when the Feed-In Tariffs were introduced, but heating using wood still makes a bigger contribution to renewable energy in homes.

Looking forward

Most of the Fact File reports what has already happened. However, there are areas where more data is needed. Policy-makers, the research community and even householders would benefit from more robust data about:

- so-called 'unregulated' energy use – aspects of energy use that are not covered in the Building Regulations, and specifically the use of appliances, including IT and entertainment systems, and energy for cooking
- actual installation and energy use data from renewable heating systems – from simple systems like wood combustion to more complex technology like solar water heaters
- why some households behave in ways that use significantly more energy – or significantly less – than other households in identical homes
- how 'smart meters' affect energy use in homes by giving householders immediate feedback about the effect of their behaviour.

Policy-makers and the research community would also benefit from more reliable data about:

- current heating levels in homes – the temperatures achieved when heating is used, and the number of rooms heated
- how different income groups' use of energy is affected by the cost of fuel and power – put technically, how the price elasticity of demand varies between income groups
- the proportion of energy efficiency improvements that are 'taken back' in thermal comfort rather than savings on fuel bills.

There remain many gaps in knowledge about energy use in homes, but more research is under way – notably the English Housing Survey's Energy Follow-up Survey.

DECC is publishing new research into heating levels and other aspects of energy use in homes, as part of the Energy Follow-up Survey[83] to the English Housing Survey[84]. It is also publishing findings from the Household Electricity Survey, which monitored the electricity use of 250 homes in meticulous detail.[85] The Department has also commissioned research examining the behaviour of households in fuel poverty.

What is already clear is that reducing carbon emissions from homes is likely to prove a long and complicated process. It will entail not only increasingly sophisticated technical improvements to housing but also significant (perhaps subtle) changes in how energy is used to deliver the services required from homes in the UK.

Appendices

Appendix 1: Tables

Sheet number	Sheet name	Time period
1	1a - Energy use by sector	2012
2	2a - Domestic energy consumption	1970-2012
3	3a - CO2 emissions	1990-2011
4	3b - Fuel input for electricity generation	1970-2012
5	3c - Energy prices	1996-2012
6	3d - Indexed energy prices	1970-2011
7	3e - Fuel poverty (new method)	2003-2011
8	3f - Fuel poverty (old method)	2003-2011
9	4a - Housing stock - population	1970-2012
10	4b - Housing stock - region	1981-2011
11	4c - Housing stock by type	1970-2011
12	4d - Housing stock - age bands	1970-2011
13	4e - Housing stock - tenure	1970-2011
14	4f & 4g - Household expenditure	1970-2011
15	4h - HH spending on energy	1970-2012
16	4i - HH gas bills	1970-2011
17	4j - HH electricity bills	1970-2012
18	4k - HH expenditure and income	2011
19	5a - Weather	1970-2012
20	5b - Energy consumption-space heating	1970-2012
21	5c - Energy consumption-water heating	1970-2012
22	5d - Energy consumption-lighting	1970-2012
23	5e - Energy consumption-appliances	1970-2012
24	5f - Energy consumption-cooking	1970-2012
25	5g - SAP rating	1970-2012
26	5h - Heat Loss Parameters	2008-2011
27	5i - CO2 emissions per HH	1970-2011
28	6a - Home - heating	1970-2011
29	6b - Heating - central	1970-2011
30	6c - Boiler Efficiency	2008-2011
31	6d - Heating - non-central	1970-2011
32	6e - Condensing and combi boilers	1975-2011
33	6f - Insulation measures	1987-2011
34	6g- Loft insulation (Pre EHS)	1976-2002
35	6h - Loft insulation (Post EHS)	2003-2011
36	6i - Cavity wall insulation	1974-2011
37	6j - Solid Wall Insulation	2008-2013
38	6k - Insulation EEC and CERT	2002-2013
39	6l - Double glazing (pre 2007)	1974-2007
40	6m - Double Glazing (post 2007)	2008-2011
41	6n - Heat loss-building Element	1970-2011
42	6o - Internal temperature	1970-2011
43	6p - Tank insulation (pre-EHS)	1978-2002
44	6q - Tank insulation (post EHS)	2003-2011
45	6r - EEC1 and 2	
46	6s - CERT savings	2008
47	6t - CERT measures	2008-2012
48	6u - Energy Company Obligation	2013
49	7a - HES 24-h profile	2010-2011
50	7b - HES Cooking energy	2010-2011
51	7c - HES Lighting energy	2010-2011
52	8a - Energy demand by fuel	1970-2012
53	9a - Renewable electricity generation	1990-2012
54	9b - Renewable heat generation	1990-2012
55	9c - Renewable technologies	2008
56	9d - Renewable installations and capacity	2010-2013
57	9e - Renewables and waste	2000-2011
58	10a - Stock by type	1970 & 2011

Table 1a: UK Final Energy Consumption by Sector (2012)

Energy users	Final energy consumption (TWh)	Final energy consumption (%)
Industry	293	17.0%
Road transport	459	26.6%
Air transport	144	8.4%
Other transport	16	0.9%
Housing	502	29.1%
Commercial and public administration	197	11.4%
Non energy use	88	5.1%
Other	25	1.4%
Total	1,724	100%

Source:

DECC: DUKES 2012, Table 1.1

https://www.gov.uk/government/publications/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes

Notes:

1) 'Other transport' includes final energy consumption by rail and national navigation.

2) 'Other' includes final energy consumption by agriculture and miscellaneous sectors.

3) Final energy consumption figures were converted from the units in DUKES (thousand toe) to TWh: 1 toe = 11,630 kWh.

4) DUKES tables are revised regularly. For further details on data revisions, please follow the link:

http://www.decc.gov.uk/assets/decc/statistics/publications/trends/articles_issue/1_20090921165618_e_@@_revisionspolicyarticle.pdf.

Table 2a: Final energy use (UK, TWh)

Year	Total energy consumption	Household energy consumption
1970	1,698	429
1971	1,670	414
1972	1,700	422
1973	1,788	437
1974	1,707	442
1975	1,637	431
1976	1,679	426
1977	1,715	441
1978	1,735	450
1979	1,809	483
1980	1,656	463
1981	1,609	461
1982	1,590	456
1983	1,583	454
1984	1,579	441
1985	1,650	489
1986	1,695	508
1987	1,700	505
1988	1,728	493
1989	1,700	468
1990	1,713	474
1991	1,766	521
1992	1,757	512
1993	1,776	530
1994	1,774	511
1995	1,749	496
1996	1,826	560
1997	1,790	521
1998	1,813	536
1999	1,820	536
2000	1,853	545
2001	1,872	560
2002	1,820	552
2003	1,839	562
2004	1,860	574
2005	1,857	556
2006	1,826	542
2007	1,794	523
2008	1,765r	528r
2009	1,656r	500r
2010	1,728r	564r
2011	1,597r	452r
2012	1,635	502

Sources:

DECC: DUKES, Table 1.1.5 - internet only [1970-2012]/ONS: Regional Accounts

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/65747/dukes1_1_5.xls

Notes:

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3) All tables provide data for UK, unless otherwise stated.

4) These figures exclude the 'Non Energy Use' category (e.g. used in chemicals and lubricants), which are included in Table 1a.

Table 3a: CO2 Emissions from Housing Energy (MtCO2)

Year	Anthracite	Burning oil	Coal	Coke	Fuel oil	Gas oil	LPG	Natural gas	Peat	Petroleum coke	Solid smokeless fuel	Town gas	Electricity	UK Total Emissions
1990	3.6	4.9	7.6	1.1	0.1	0.9	1.0	54.5	0.5	0.1	3.3	0.0	79.0	156.5
1991	4.9	5.7	7.8	0.9	0.0	0.8	1.2	60.7	0.5	0.2	3.3	0.0	79.4	165.5
1992	3.9	6.0	7.1	0.8	0.0	0.8	1.2	60.1	0.5	0.2	3.0	0.0	75.9	159.5
1993	5.7	6.4	6.7	0.7	0.0	0.8	1.2	62.0	0.4	0.3	3.2	0.0	69.3	156.9
1994	5.9	6.5	4.7	0.6	0.0	0.8	1.1	60.3	0.4	0.5	2.6	0.0	68.7	152.1
1995	4.4	6.6	3.1	0.5	0.1	0.8	1.0	59.7	0.4	0.6	2.0	0.0	67.3	146.5
1996	4.1	8.0	3.4	0.6	0.0	0.8	1.1	69.0	0.3	0.7	2.3	0.0	68.4	158.7
1997	3.8	7.9	3.3	0.3	0.0	0.7	0.9	63.6	0.3	0.8	1.6	0.0	60.6	143.8
1998	2.9	8.5	3.6	0.4	0.0	0.6	0.9	65.7	0.3	0.7	1.7	0.0	64.3	149.5
1999	2.7	7.5	4.1	0.4	0.0	0.5	0.9	66.4	0.3	0.7	1.6	0.0	60.8	145.8
2000	2.7	7.8	2.5	0.4	0.0	0.5	0.8	68.3	0.2	0.6	1.4	0.0	65.2	150.5
2001	3.3	8.3	1.9	0.2	0.0	0.6	1.0	70.1	0.2	0.6	1.3	0.0	70.1	157.7
2002	2.4	7.1	1.2	0.5	0.0	0.6	0.9	69.6	0.2	0.6	1.1	0.0	70.8	155.1
2003	1.9	7.1	1.1	0.4	0.0	0.5	1.0	71.6	0.2	0.5	1.0	0.0	75.0	160.2
2004	1.7	7.7	1.0	0.1	0.0	0.5	1.0	73.2	0.1	0.5	0.9	0.0	75.2	161.8
2005	0.9	7.4	0.8	0.1	0.0	0.5	0.9	70.7	0.1	0.4	0.7	0.0	74.0	156.4
2006	0.6	7.7	0.9	0.1	0.0	0.5	0.9	67.9	0.1	0.4	0.7	0.0	76.8	156.6
2007	0.6	6.8	1.2	0.0	0.0	0.6	0.7	65.2	0.0	0.4	0.7	0.0	74.1	150.3
2008	0.5	7.0	1.3	0.0	0.0	0.5	1.0	66.4	0.0	0.4	0.8	0.0	70.8	148.8
2009	0.6	7.2	1.2	0.0	0.0	0.4	0.9	61.3	0.0	0.3	0.8	0.0	65.2	138.0
2010	0.6	7.9	1.2	0.0	0.0	0.5	1.2	71.8	0.0	0.4	0.9	0.0	66.3	150.9
2011	0.6	6.2	1.2	0.0	0.0	0.5	0.8	53.8	0.0	0.3	0.8	0.0	59.7	124.1

Sources:

UK Greenhouse Gas Inventory Statistics: https://www.gov.uk/government/publications/final-uk-emissions-estimates

http://www.defra.gov.uk/publications/2012/05/30/pb13773-2012-ghg-conversion/

http://efficient-products.defra.gov.uk/spm/download/document/id/785

Notes:

These figures were based on unpublished data provided by the Climate Change Statistics team at DECC.

Table 3b: Fuel Input for UK Electricity Generation (TWh)

Year	Total all fuels	Coal	Oil	Natural gas	Nuclear	Renewables	Other fuels
1970	742.5	500.9	154.3	1.3	81.4		4.5
1971	772.9	493.3	181.8	7.4	85.7		4.7
1972	795.1	447.4	234.1	18.7	91.5		3.4
1973	824.9	515.2	210.4	7.4	86.8		5.1
1974	802.6	450.2	214.1	28.6	104.3		5.3
1975	770.5	486.7	159.3	24.9	94.4		5.1
1976	778.9	517.4	127.0	18.7	111.2		4.5
1977	806.2	531.6	132.0	14.9	123.7		4.0
1978	809.9	535.6	143.2	10.0	115.8		5.3
1979	846.7	582.7	133.2	6.3	119.0		5.6
1980	807.8	593.2	89.2	4.9	115.3		5.2
1981	767.3	577.3	63.5	2.4	118.4		5.7
1982	767.3	543.7	77.2	2.4	138.2		5.8
1983	771.9	548.5	59.8	2.4	156.7		4.5
1984	804.6	361.3	265.2	4.9	168.6		4.5
1985	832.0	497.9	132.0	6.3	191.9		4.0
1986	819.3	557.2	75.7	2.1	179.6		4.8
1987	864.2	599.9	73.3	10.6	167.9		12.6
1988	878.9	579.5	81.5	11.3	192.7		13.8
1989	875.4	565.1	82.7	6.3	206.3		15.0
1990	887.8	579.6	97.7	6.5	189.1	5.8	9.1
1991	894.0	581.3	87.9	6.6	202.7	5.3	10.1
1992	890.5	545.9	93.9	17.9	214.6	6.4	11.9
1993	876.9	460.7	67.2	81.9	251.0	5.7	10.4
1994	860.7	431.5	47.8	117.5	246.6	7.0	10.5
1995	897.3	422.1	48.3	154.3	247.1	6.9	18.6
1996	925.2	391.5	45.0	202.0	258.0	5.7	23.1
1997	892.7	329.1	23.4	252.8	255.7	6.9	24.8
1998	943.6	348.2	19.7	267.7	272.6	8.6	26.7
1999	927.1	296.7	17.9	315.5	258.4	9.6	29.0
2000	944.4	333.4	18.0	324.6	228.4	9.9	30.1
2001	977.0	367.6	16.5	312.5	241.5	9.5	29.3
2002	965.2	344.6	15.0	329.4	233.8	11.1	31.4
2003	999.6	378.5	13.9	323.9	233.1	10.6	39.6
2004	983.5	364.2	12.8	340.2	211.2	14.1	41.0
2005	1,008.0	378.8	15.2	331.7	213.7	16.9	51.8
2006	1,012.6	418.0	16.7	311.4	199.2	18.1	49.1
2007	980.8	382.9	13.5	355.9	163.3	19.7	45.6
2008	948.4r	348.4	18.4	376.8	138.5	21.9	54.0
2009	912.9r	286.8	17.6	359.3	177.1	25.3	57.5
2010	920.7r	297.3	13.7	373.6	162.0	25.8	60.4r
2011	888.2r	302.7	9.1r	307.3	181.7	34.7r	66.1r
2012	899.8r	399.3	9.1	214.1	176.8	41.3	74.4

Sources:

DECC: DUKES, Table 5.1.1, 6.1.1 - internet only

https://www.gov.uk/government/publications/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes
https://www.gov.uk/government/publications/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes

Notes:

1) There are discontinuities in figures pre- and post-1987. Before 1987 the data are for major power producers, transport undertakings and industrial hydro and nuclear stations only, whereas data for all generating companies are available from 1987 onwards.

2) Up to 1990, 'Other fuels' includes natural flow hydro, wind, coke and breeze and other fuels (which include coke oven gas, blast furnace gas, waste products from chemical processes, refuse derived fuels and other renewable sources).

3) The renewable figures are available separately from 1990 onwards, and are excluded from 'Other fuels' for these years.

4) Fuel input has been calculated on primary energy supplied basis.

5) DUKES tables are revised regularly. ('r' indicates a revision from last year.)

Table 3c: Average UK Household Fuel Prices (p/KWh, 2011 prices)

Year	Coal	Coke, breeze + other solid	Total solid fuels	Gas	Electricity	Oil	Total (weighted average all fuels)	Retail Price Index (2011 = 100)	Fuel Price Index (2011 = 100)
1970	1.92	3.19	2.43	4.60	10.56	2.75	4.47	7.9	5.0
1971	1.97	3.30	2.53	4.24	10.41	2.69	4.58	8.6	5.5
1972	1.96	3.25	2.51	4.06	10.29	2.68	4.63	9.2	5.8
1973	1.87	3.15	2.42	3.68	9.53	2.85	4.38	10.1	6.0
1974	1.88	3.01	2.42	3.20	9.77	3.94	4.41	11.7	7.7
1975	1.89	3.10	2.50	2.95	11.41	3.85	4.68	14.5	10.6
1976	2.01	3.27	2.64	3.17	12.55	4.17	5.02	16.9	12.0
1977	2.06	3.29	2.67	3.09	12.57	4.35	4.97	19.6	13.4
1978	2.16	3.42	2.82	2.94	12.96	4.21	4.95	21.2	13.7
1979	2.30	3.82	3.07	2.63	12.27	4.88	4.72	24.1	16.2
1980	2.70	4.27	3.59	2.59	13.44	5.56	5.02	28.4	20.7
1981	2.83	3.83	3.61	2.93	14.44	6.09	5.37	31.8	24.6
1982	2.68	3.82	3.49	3.38	14.56	6.56	5.63	34.5	27.6
1983	2.80	3.89	3.66	3.64	14.23	6.98	5.78	36.1	29.5
1984	2.68	4.17	3.64	3.58	14.04	6.30	5.76	37.9	30.4
1985	2.64	3.84	3.58	3.45	13.45	6.00	5.45	40.2	32.1
1986	2.65	3.90	3.57	3.40	13.22	3.88	5.24	41.6	30.4
1987	2.42	3.99	3.46	3.24	12.59	3.50	5.03	43.3	30.4
1988	2.05	3.25	2.94	3.10	12.59	3.07	4.88	45.5	30.7
1989	2.14	2.93	3.01	3.02	12.70	3.21	4.96	49.0	32.6
1990	2.10	2.94	2.82	3.17	13.03	3.29	4.84	53.6	35.7
1991	2.04	3.05	2.76	3.19	13.37	2.59	4.78	56.8	38.5
1992	1.99	2.90	2.72	3.06	13.35	2.44	4.74	58.9	39.5
1993	2.19	3.03	2.67	2.94	13.24	2.32	4.59	59.8	40.5
1994	2.05	2.97	2.78	3.12	13.27	2.23	4.80	61.3	42.3
1995	2.52	3.00	3.33	3.05	13.04	2.23	4.81	63.4	43.8
1996	2.48	2.66	3.17	2.80	12.58	2.49	4.45	64.9	44.8
1997			3.05	2.77	11.94	2.22	4.36	67.0	46.1
1998			2.91	2.56	10.51	1.71	3.94	69.3	46.3
1999			2.87	2.34	10.27	1.88	3.78	70.3	48.3
2000			3.03	2.15	9.68	2.82	3.60	72.4	51.7
2001			3.56	2.15	9.30	2.48	3.53	73.7	50.3
2002			3.93	2.26	8.76	2.51	3.56	74.9	50.1
2003			3.23	2.20	8.47	2.78	3.46	77.1	51.5
2004			3.24	2.76	9.70	2.80	4.07	79.4	54.7
2005			3.40	2.76	9.87	3.75	4.23	81.6	60.6
2006			3.50	3.43	11.32	4.15	5.03	84.2	69.1
2007			3.47	3.36	12.16	4.10	5.21	87.8	72.4
2008			3.93	3.85	13.64	5.52	5.88	91.3	84.4
2009			4.75	4.37	14.15	4.10	6.34	90.9	82.9
2010			4.52	4.04	13.07	4.79	5.74	95.1	88.6
2011			4.47	4.40	13.60	5.71	6.46	100.0	100.0
2012			4.43	4.63	13.79	5.62	6.46	103.2	104.8

Sources:

DECC: DUKES 2011 Table 1.1-1.6 and DECC: Quarterly Energy Prices - Table 2.1.1 [1980-2012]

https://www.gov.uk/government/publications/quarterly-energy-prices-march-2013

Notes:

1) Household fuel prices are deflated to 2011 using the Retail Price Index

2) The fuel prices (p/kWh) are implicit annual averages, obtained by dividing the amount spent on energy by total energy consumption for households.

Table 3d: Average Deflated UK Household Fuel Price Indices (2011 = 100)

Year	Solid fuels	Gas	Electricity	Oil
1970	54.45	104.53	77.61	48.12
1971	56.59	96.26	76.51	47.16
1972	56.19	92.14	75.65	46.92
1973	54.12	83.51	70.09	49.90
1974	54.16	72.57	71.84	69.09
1975	55.85	66.90	83.88	67.52
1976	58.97	71.96	92.30	73.01
1977	59.81	70.26	92.41	76.31
1978	63.13	66.72	95.31	73.71
1979	68.57	59.82	90.24	85.44
1980	80.30	58.93	98.79	97.42
1981	80.70	66.61	106.20	106.79
1982	78.13	76.71	107.08	115.01
1983	81.95	82.65	104.65	122.26
1984	81.31	81.30	103.23	110.30
1985	79.99	78.46	98.92	105.07
1986	79.82	77.13	97.19	68.04
1987	77.44	73.55	92.57	61.37
1988	65.79	70.42	92.54	53.77
1989	67.40	68.69	93.37	56.19
1990	63.13	71.88	95.84	57.60
1991	61.68	72.50	98.32	45.30
1992	60.91	69.60	98.13	42.70
1993	59.79	66.72	97.32	40.66
1994	62.17	70.92	97.60	39.04
1995	74.50	69.21	95.85	39.07
1996	70.94	63.51	92.53	43.56
1997	68.26	63.02	87.76	38.97
1998	65.20	58.09	77.25	29.93
1999	64.19	53.03	75.51	33.02
2000	67.85	48.75	71.14	49.49
2001	79.67	48.83	68.37	43.45
2002	87.80	51.41	64.37	44.04
2003	72.21	50.02	62.27	48.75
2004	72.42	62.68	71.29	49.05
2005	76.16	62.74	72.60	65.69
2006	78.31	77.79	83.21	72.70
2007	77.61	76.42	89.40	71.91
2008	87.97	87.49	100.33	96.65
2009	106.16	99.32	104.01	71.84
2010	101.19	91.76	96.11	83.90
2011	100.00	100.00	100.00	100.00
2012	99.18	105.06	101.37	98.43

Sources:

DECC: DUKES 2012/DECC: Quarterly Energy Prices - Table 2.1.1 [1980-2012]
https://www.gov.uk/government/publications/quarterly-energy-prices-march-2013

Notes:

1) Household fuel prices are deflated using Retail Price Index.

2) Each deflated series is indexed to 2011.

Table 3e: England Fuel Poverty (New Low Income High Cost method)

Year	Number of households (thousands)	Proportion of households fuel poor (%)	Aggregate fuel poverty gap (£m): Real Terms	Average fuel poverty gap (£): Real Terms
2003	2,441	11.8	606	248
2004	2,492	11.9	644	259
2005	2,428	11.5	752	310
2006	2,262	10.7	886	391
2007	2,357	11.0	904	384
2008	2,438	11.4	957	393
2009	2,486	11.5	1,060	427
2010	2,474	11.5	1,024	414
2011	2,390	10.9	1,047	438

Source:

DECC: Annual Report on Fuel Poverty Statistics 2012

https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/fuel-poverty-statistics

Notes:

1) This is the new 'Low Income High Cost' indicator of fuel poverty. This defines a household as fuel poor a) if it has above-average required fuel costs, and b) if spending this amount on fuel would push residual income below the official poverty line.

2) The ‘fuel poverty gap’ is defined as the difference between modelled fuel bills and a reasonable cost threshold and gives a measure of the average depth of the problem.

Table 3f: England Fuel Poverty (Old 10% method)

Year	Number of fuel poor households (thousands)	Number of vulnerable households	Households (England)	Fuel poor households (%)	Vulnerable households (%)
2003	1,222	974	20,724	5.90	6.60
2004	1,236	951	20,931	5.90	6.40
2005	1,529	1,194	21,134	7.20	7.80
2006	2,432	1,947	21,221	11.50	12.80
2007	2,819	2,259	21,380	13.20	14.50
2008	3,335	2,650	21,407	15.60	17.50
2009	3,964	3,183	21,535	18.40	20.70
2010	3,536	2,829	21,600	16.40	18.10
2011	3,202	2,498	21,918	14.60	15.70

Source:

DECC: Annual Report on Fuel Poverty Statistics 2012

https://www.gov.uk/government/organisations/department-of-energy-climate-change/series/fuel-poverty-statistics

Notes:

1) Using the old method, a household is called fuel poor if it would spend more than 10% of its income on fuel to maintain a satisfactory heating regime.
2) A vulnerable household is a fuel poor household with an elderly person, child, disabled person or a person with long term illness.

Table 4a: Population and Dwellings (millions)

Year	Population	Households	Dwellings	Population/ Dwellings	Mean Household Size (GB)
1970	55.63	18.79	19.0	2.96	
1971	55.93	19.03	19.3	2.94	2.91
1972	56.10	19.20	19.5	2.92	
1973	56.22	19.37	19.7	2.90	2.83
1974	56.24	19.54	19.9	2.88	
1975	56.23	19.71	20.1	2.85	2.78
1976	56.22	19.88	20.3	2.83	
1977	56.19	20.05	20.5	2.80	2.71
1978	56.18	20.22	20.8	2.78	
1979	56.24	20.39	21.0	2.76	2.67
1980	56.33	20.56	21.2	2.74	
1981	56.36	20.73	21.4	2.72	2.70
1982	56.29	20.94	21.6	2.69	
1983	56.32	21.15	21.8	2.66	2.64
1984	56.41	21.37	22.0	2.64	2.59
1985	56.55	21.58	22.3	2.62	2.56
1986	56.68	21.80	22.5	2.60	2.55
1987	56.80	22.01	22.7	2.58	2.55
1988	56.92	22.22	22.9	2.56	2.48
1989	57.08	22.44	23.1	2.54	2.51
1990	57.24	22.65	23.3	2.53	2.46
1991	57.44	22.86	23.6	2.51	2.48
1992	57.59	23.03	23.8	2.50	2.45
1993	57.71	23.20	23.9	2.49	2.44
1994	57.86	23.37	24.1	2.48	2.44
1995	58.03	23.54	24.3	2.46	2.40
1996	58.16	23.71	24.5	2.45	
1997	58.31	23.88	24.7	2.44	
1998	58.48	24.05	24.9	2.43	2.32
1999	58.68	24.22	25.1	2.42	
2000	58.89	24.39	25.3	2.41	2.30
2001	59.11	24.56	25.5	2.41	2.33
2002	59.32	24.76	25.6	2.40	2.31
2003	59.56	24.97	25.8	2.39	2.32
2004	59.85	25.17	26.0	2.38	2.30
2005	60.24	25.38	26.2	2.37	2.30
2006	60.59	25.58	26.4	2.37	2.34
2007	60.98	25.81	26.7	2.36	2.35
2008	61.38	26.05	26.9	2.36	2.37
2009	61.79	26.19	27.1	2.36	2.35
2010	62.22	26.34	27.3	2.36	2.35
2011	63.18	26.44	27.4	2.39	2.35
2012	64.12	27.14	–	2.36	

Sources:

CLG, Live Table 401/ONS: General Register Office for Scotland, Mid Year Population Estimates, Population Estimates Unit/

General Household Survey (updated November 2012).

https://www.gov.uk/government/statistical-data-sets/live-tables-on-household-projections

Notes:

1) 1972-1980, 2005, and 2009 are interpolated household figures.

2) The 'mean size of households', obtained from the General Household Survey, is for GB and included to allow comparison with the population/households' figures, which are calculated by dividing the UK population figures by the number of UK households.

3) CLG's Table 401 is revised periodically.

4) Population figures are ONS mid-year estimates for 2012.

Table 4b: Number of Households by Region (millions)

Year	South West	South East	London	East	West Midlands	East Midlands	Yorks & the Humber	North West	North East	England	Wales	Scotland	N Ireland	GB total	UK total
1981	1.65	2.66	2.63	1.77	1.87	1.42	1.83	2.56	0.98	17.36	1.03	1.88	0.46	20.27	20.73
1982	1.66	2.69	2.63	1.79	1.88	1.42	1.84	2.56	0.98	17.45	1.03	1.90	0.57	20.38	20.94
1983	1.69	2.72	2.64	1.81	1.89	1.44	1.85	2.57	0.99	17.59	1.03	1.91	0.63	20.53	21.15
1984	1.72	2.76	2.65	1.84	1.91	1.45	1.86	2.58	0.99	17.76	1.04	1.93	0.64	20.73	21.37
1985	1.74	2.80	2.66	1.87	1.93	1.47	1.87	2.60	1.00	17.94	1.05	1.95	0.64	20.94	21.58
1986	1.77	2.84	2.68	1.90	1.94	1.49	1.89	2.61	1.00	18.13	1.07	1.96	0.64	21.16	21.80
1987	1.81	2.88	2.69	1.93	1.97	1.52	1.90	2.63	1.01	18.34	1.08	1.98	0.62	21.39	22.01
1988	1.84	2.93	2.70	1.96	1.99	1.54	1.92	2.65	1.02	18.55	1.10	2.00	0.58	21.64	22.22
1989	1.87	2.96	2.73	1.98	2.01	1.56	1.95	2.68	1.03	18.78	1.11	2.01	0.53	21.91	22.44
1990	1.88	3.00	2.77	2.01	2.03	1.58	1.97	2.70	1.04	18.97	1.12	2.03	0.52	22.13	22.65
1991	1.91	3.03	2.80	2.03	2.05	1.60	1.99	2.72	1.05	19.17	1.11	2.04	0.54	22.32	22.86
1992	1.93	3.05	2.80	2.05	2.06	1.62	2.00	2.73	1.05	19.28	1.12	2.06	0.57	22.47	23.03
1993	1.94	3.07	2.80	2.07	2.07	1.63	2.01	2.75	1.06	19.39	1.13	2.08	0.60	22.60	23.20
1994	1.96	3.10	2.81	2.08	2.08	1.64	2.02	2.75	1.06	19.49	1.14	2.09	0.64	22.73	23.37
1995	1.98	3.13	2.82	2.11	2.09	1.66	2.02	2.77	1.06	19.63	1.15	2.11	0.65	22.90	23.54
1996	1.99	3.15	2.84	2.13	2.10	1.67	2.03	2.77	1.06	19.76	1.16	2.13	0.67	23.04	23.71
1997	2.01	3.18	2.86	2.15	2.11	1.68	2.03	2.78	1.07	19.87	1.17	2.14	0.69	23.19	23.88
1998	2.03	3.21	2.88	2.17	2.12	1.69	2.04	2.79	1.07	20.00	1.18	2.15	0.71	23.34	24.05
1999	2.05	3.24	2.93	2.19	2.13	1.71	2.04	2.80	1.07	20.16	1.19	2.17	0.70	23.51	24.22
2000	2.07	3.27	2.98	2.22	2.14	1.72	2.05	2.81	1.07	20.34	1.20	2.18	0.67	23.71	24.39
2001	2.09	3.29	3.04	2.24	2.15	1.74	2.07	2.83	1.08	20.52	1.21	2.20	0.63	23.93	24.56
2002	2.11	3.31	3.07	2.26	2.17	1.76	2.09	2.84	1.08	20.69	1.22	2.21	0.64	24.13	24.76
2003	2.13	3.34	3.09	2.28	2.18	1.77	2.10	2.86	1.08	20.83	1.24	2.23	0.67	24.30	24.97
2004	2.15	3.35	3.11	2.30	2.19	1.79	2.12	2.88	1.09	20.97	1.25	2.25	0.70	24.47	25.17
2005	2.17	3.38	3.15	2.32	2.20	1.81	2.14	2.89	1.09	21.17	1.26	2.27	0.67	24.70	25.37
2006	2.19	3.41	3.18	2.35	2.21	1.83	2.16	2.91	1.10	21.34	1.27	2.29	0.67	24.91	25.58
2007	2.22	3.44	3.21	2.37	2.23	1.85	2.18	2.92	1.11	21.53	1.28	2.31	0.69	25.13	25.81
2008	2.24	3.48	3.24	2.41	2.24	1.87	2.20	2.94	1.11	21.73	1.30	2.33	0.69	25.36	26.05
2009	2.27	3.52	3.28	2.44	2.26	1.89	2.23	2.96	1.12	21.96	1.31	2.35	0.70	25.62	26.19
2010	2.29	3.56	3.31	2.47	2.28	1.91	2.26	2.98	1.13	22.19	1.32	2.37	0.71	25.89	26.33
2011	2.32	3.59	3.34	2.50	2.29	1.93	2.28	3.00	1.14	22.39	1.33	2.37	0.70	26.09	26.44

Sources:

CLG: live table 403 - Household projections by region, England, 1971-2033 (updated Nov 2012).

http://data.gov.uk/dataset/sub-regional_household_population_projections

Notes:

1) Household figures for Wales are interpolated for the years 2005, 2007-2011 and for Scotland from 2007-2011.

2) Figures for England are extrapolated for 2009-2011.

3) Figures do not always add up to totals due to rounding.

Table 4c: Housing Stock Distribution by Type (millions)

Year	Semi detached	Terraced	Flat	Detached	Bungalow	Other	Total
1970	6.13	5.89	3.18	2.03	1.47	0.34	19.04
1971	6.20	5.96	3.22	2.05	1.49	0.34	19.26
1972	6.33	5.99	3.28	2.01	1.52	0.34	19.47
1973	6.62	5.91	3.21	2.06	1.53	0.36	19.69
1974	6.59	5.77	3.40	2.16	1.62	0.36	19.90
1975	6.72	6.04	3.49	2.10	1.51	0.25	20.12
1976	7.10	6.01	3.49	1.94	1.59	0.20	20.33
1977	6.72	6.21	3.41	2.36	1.65	0.20	20.55
1978	6.65	6.08	3.46	2.51	1.74	0.33	20.76
1979	6.70	6.37	3.20	2.73	1.76	0.21	20.98
1980	6.72	6.66	3.29	2.64	1.66	0.22	21.19
1981	6.75	6.51	3.28	2.85	1.80	0.21	21.41
1982	6.82	6.58	3.31	2.88	1.82	0.22	21.62
1983	6.85	6.64	3.36	2.93	1.90	0.15	21.83
1984	6.92	6.70	3.40	2.95	1.92	0.16	22.05
1985	6.97	6.71	3.47	3.04	1.94	0.13	22.26
1986	7.06	6.79	3.48	3.06	1.96	0.13	22.48
1987	6.99	6.72	3.63	3.20	2.04	0.11	22.69
1988	6.99	6.69	3.73	3.30	2.06	0.14	22.91
1989	7.05	6.49	3.97	3.47	2.04	0.09	23.12
1990	7.16	6.55	3.97	3.55	2.03	0.07	23.34
1991	7.14	6.67	4.12	3.49	2.07	0.07	23.55
1992	7.13	6.75	4.25	3.44	2.11	0.07	23.76
1993	7.09	6.70	4.38	3.54	2.16	0.07	23.95
1994	7.10	6.66	4.49	3.65	2.17	0.07	24.14
1995	7.11	6.74	4.55	3.70	2.17	0.07	24.34
1996	7.16	6.74	4.61	3.78	2.16	0.07	24.53
1997	7.22	6.78	4.65	3.86	2.15	0.08	24.72
1998	7.27	6.83	4.68	3.89	2.17	0.07	24.91
1999	7.30	6.85	4.72	3.97	2.18	0.08	25.10
2000	7.33	6.85	4.75	4.10	2.17	0.08	25.28
2001	7.23	7.06	4.84	4.13	2.14	0.08	25.47
2002	7.28	7.10	4.87	4.15	2.15	0.08	25.62
2003	7.29	7.45	4.40	4.22	2.40	0.04	25.80
2004	7.45	7.36	4.25	4.43	2.45	0.04	25.99
2005	7.16	7.57	4.46	4.56	2.36	0.08	26.20
2006	7.35	7.64	4.48	4.55	2.30	0.10	26.42
2007	7.40	7.43	4.43	4.87	2.44	0.09	26.66
2008	7.07	7.70	5.02	4.63	2.41	0.08	26.91
2009	6.97	7.82	5.22	4.61	2.49	0.00	27.11
2010	7.27	7.76	5.11	4.70	2.44	0.00	27.27
2011	7.13	7.74	5.58	4.56	2.40	0.00	27.42

Sources:

GfK Home Audit/CLG: English House Condition Survey, English Housing Survey, Table 401 (updated April 2013)

https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

https://www.gov.uk/government/statistical-data-sets/live-tables-on-household-projections

Notes:

1) 'Other' category consists of all those types of dwellings that do not fit into any standard dwelling type, such as temporary dwellings.

2) The English House Condition Survey is a national survey of housing in England, commissioned by CLG, and was merged with the Survey of English Housing (another housing survey) to form the English Housing Survey in 2008.

3) Sampling errors in the surveys mean that there can be inexplicable fluctuations in the figures from year to year - like the fall in semi-detached homes in 2008.

Table 4d: Housing Stock Distribution by Age (millions)

Year	Pre-1918	1918-38	1939-59	1960-75	1976-	Total dwellings
1970	4.85	5.18	5.01	4.01		19.04
1971	4.73	5.05	4.89	4.59		19.26
1972	4.80	4.99	5.38	4.29		19.47
1973	4.66	5.08	5.25	4.69		19.69
1974	4.53	4.90	4.92	5.56		19.90
1975	4.67	4.99	4.72	5.75		20.12
1976	4.43	5.05	4.83	5.69	0.33	20.33
1977	4.27	4.99	4.78	5.85	0.66	20.55
1978	4.90	4.41	5.09	5.50	0.86	20.76
1979	5.14	4.60	4.38	5.68	1.17	20.98
1980	5.41	4.69	4.38	5.62	1.08	21.19
1981	5.35	4.62	4.24	5.69	1.50	21.41
1982	5.38	4.63	4.24	5.51	1.86	21.62
1983	5.28	4.61	4.26	5.61	2.08	21.83
1984	5.18	4.63	4.28	5.59	2.37	22.05
1985	5.14	4.62	4.27	5.62	2.61	22.26
1986	4.99	4.68	4.32	5.73	2.76	22.48
1987	4.88	4.72	4.35	5.63	3.11	22.69
1988	4.70	4.74	4.40	5.68	3.39	22.91
1989	4.74	4.76	4.44	5.57	3.61	23.12
1990	4.78	4.71	4.49	5.58	3.77	23.34
1991	4.80	4.73	4.47	5.53	4.00	23.55
1992	4.78	4.73	4.49	5.56	4.20	23.76
1993	4.81	4.77	4.53	5.48	4.36	23.95
1994	4.80	4.75	4.51	5.48	4.58	24.14
1995	4.84	4.80	4.55	5.48	4.67	24.34
1996	4.85	4.83	4.59	5.45	4.81	24.53
1997	4.84	4.82	4.57	5.44	5.04	24.72
1998	4.86	4.83	4.58	5.43	5.21	24.91
1999	4.87	4.82	4.59	5.45	5.37	25.10
2000	4.90	4.86	4.60	5.46	5.46	25.28
2001	4.91	4.84	4.64	5.48	5.60	25.47
2002	4.94	4.87	4.67	5.51	5.63	25.62
2003	5.32	4.83	5.35	3.97	6.33	25.80
2004	5.41	4.67	5.44	3.97	6.49	25.99
2005	5.63	4.58	5.17	4.07	6.74	26.20
2006	5.65	4.81	5.28	4.00	6.68	26.42
2007	5.61	4.65	5.25	3.97	7.16	26.66

	Pre-1918	1918-1964	1965-1990	1991-2002	2002-	Total dwellings
2008	5.76	9.69	8.19	2.52	0.76	26.91
2009	5.82	9.94	8.03	2.18	1.14	27.11
2010	5.93	9.93	7.90	2.16	1.37	27.27
2011	5.71	9.96	8.07	2.20	1.48	27.42

Sources:

GfK: Home Audit. CLG: English House Condition Survey, English Housing Survey. CLG: Table 401.
https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

Notes:

1) The English House Condition Survey is a national survey of housing in England, commissioned by CLG, and was merged with the Survey of English Housing (another housing survey) to form the English Housing Survey in 2008.

2) Sampling errors in the surveys mean that there can be inexplicable fluctuations in the figures from year to year.

3) There is a discontinuity in the data in 2003, when the English House Condition Survey replaced GfK's Home Audit.

4) There is a second discontinuity between 2007 and 2008, due to switching to a different data source.

Table 4e: Housing Stock Distribution by Tenure (millions)

Year	Owner occupied	Local authority	Private rented	RSL	Total dwellings
1970	8.95	6.57	3.52		19.04
1971	9.08	6.67	3.50		19.26
1972	9.24	6.79	3.45		19.47
1973	9.47	6.80	3.41		19.69
1974	9.64	6.59	3.67		19.90
1975	10.26	6.81	3.04		20.12
1976	10.73	6.93	2.67		20.33
1977	11.12	7.06	2.36		20.55
1978	11.15	7.08	2.53		20.76
1979	11.29	7.11	2.58		20.98
1980	11.67	6.78	2.74		21.19
1981	11.43	7.19	2.29	0.50	21.41
1982	11.55	7.26	2.30	0.51	21.62
1983	12.95	6.41	1.93	0.54	21.83
1984	13.08	6.48	1.93	0.56	22.05
1985	13.65	6.25	1.78	0.58	22.26
1986	13.78	6.32	1.78	0.60	22.48
1987	14.55	6.07	1.36	0.70	22.69
1988	14.91	5.96	1.31	0.73	22.91
1989	15.40	5.66	1.32	0.74	23.12
1990	15.61	5.57	1.35	0.79	23.34
1991	15.83	5.44	1.51	0.78	23.55
1992	15.99	5.35	1.64	0.78	23.76
1993	16.16	5.17	1.68	0.93	23.95
1994	16.32	5.07	1.67	1.09	24.14
1995	16.40	5.11	1.73	1.10	24.34
1996	16.56	5.00	1.79	1.18	24.53
1997	16.71	5.04	1.80	1.16	24.72
1998	16.89	5.03	1.82	1.17	24.91
1999	17.01	4.82	2.03	1.23	25.10
2000	17.29	4.55	2.05	1.39	25.28
2001	17.52	4.28	2.17	1.50	25.47
2002	17.62	4.30	2.18	1.51	25.62
2003	18.51	2.91	2.45	1.93	25.80
2004	18.52	2.75	2.71	2.00	25.99
2005	18.59	2.55	2.88	2.17	26.20
2006	18.83	2.47	2.95	2.17	26.42
2007	18.98	2.35	3.08	2.25	26.66
2008	17.69	2.40	3.88	2.36	26.91
2009	18.04	2.20	4.35	2.39	27.11
2010	18.10	2.19	4.51	2.46	27.27
2011	17.79	2.27	4.84	2.52	27.42

Sources:

GfK Home Audit/CLG: English House Condition Survey, English Housing Survey
https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

Notes:

1) Registered Social Landlord (RSL) is the technical name for social landlords that are registered with the Tenant Services Authority (the Housing Corporation until December 2008), and consists of mainly housing associations as well as trusts, co-operatives and companies.
2) English Housing Condition Survey is a national survey of housing in England, commissioned by CLG, and was merged with the Survey of English Housing (another housing survey) to form the English Housing Survey in 2008.

Table 4f: Average Weekly Expenditure on all Goods and on Fuel, Light and Power (£/wk/HH)

	Contemporary prices		2011 prices		% on fuel, light & power
Year	All goods (£)	Fuel, light & power (£)	All goods (£)	Fuel, light & power (£)	
1970	28.57	1.79	362.62	22.72	6.3%
1971	30.99	1.85	359.41	21.46	6.0%
1972	35.06	2.06	379.56	22.30	5.9%
1973	39.43	2.17	391.26	21.53	5.5%
1974	46.13	2.42	394.46	20.69	5.2%
1975	54.58	2.99	375.66	20.58	5.5%
1976	61.70	3.53	364.39	20.85	5.7%
1977	71.84	4.38	366.23	22.33	6.1%
1978	80.26	4.76	377.80	22.41	5.9%
1979	94.17	5.25	390.92	21.79	5.6%
1980	110.60	6.15	389.13	21.64	5.6%
1981	125.41	7.46	394.43	23.46	5.9%
1982	133.92	8.35	387.80	24.18	6.2%
1983	142.59	9.22	394.79	25.53	6.5%
1984	151.92	9.42	400.66	24.84	6.2%
1985	162.50	9.95	403.99	24.74	6.1%
1986	178.10	10.43	428.20	25.08	5.9%
1987	188.62	10.55	435.33	24.35	5.6%
1988	204.41	10.48	449.73	23.06	5.1%
1989	224.32	10.58	457.92	21.60	4.7%
1990	247.16	11.11	460.93	20.72	4.5%
1991	259.04	12.25	456.31	21.58	4.7%
1992	271.83	13.02	461.57	22.11	4.8%
1993	276.68	13.24	462.45	22.13	4.8%
1994	283.58	12.95	462.81	21.13	4.6%
1995	289.86	12.92	457.21	20.38	4.5%
1996	309.07	13.35	476.02	20.56	4.3%
1997	328.78	12.66	490.97	18.91	3.9%
1998	346.58	11.78	500.40	17.01	3.4%
1999	353.47	11.39	502.60	16.20	3.2%
2000	379.61	11.92	524.27	16.46	3.1%
2001	397.20	11.70	539.01	15.88	2.9%
2002	406.20	11.70	542.18	15.62	2.9%
2003	441.25	12.20	572.42	15.83	2.8%
2004	457.90	12.70	576.84	16.00	2.8%
2005	465.43	13.99	570.22	17.14	3.0%
2006	455.90	15.90	541.25	18.88	3.5%
2007	459.20	17.20	522.76	19.58	3.7%
2008	470.99	18.90	515.62	20.69	4.0%
2009	455.00	19.90	500.77	21.90	4.4%
2010	466.50	20.50	490.78	21.57	4.4%
2011	470.70	20.60	470.70	20.60	4.4%

Sources:

Family Expenditure Survey (pre 2001)/ Expenditure and Food Survey (2001- 2007)/ONS: Living Costs and Food Survey (2008 onwards)

http://www.ons.gov.uk/ons/publications/index.html

http://www.ons.gov.uk/ons/rel/family-spending/family-spending/family-spending-2012-edition/rft---table-a35.xls

Notes:

1) UK weekly expenditure figures have been deflated to 2011 prices using the Retail Price Index.

2) Percentage of expenditure on 'Fuel, light and power' has been calculated by dividing 'Fuel, light and power' figures by 'All goods' (£/week).

3) Family Expenditure Survey merged into Expenditure and Food Survey in 2001, and was known as Living Costs and Food Survey from 2008 onwards.

Table 4h: UK Weekly Energy Expenditure by Fuel (£/Household, 2011 prices)

Year	Coal	Coke, breeze & other solid	Total solid	Gas	Electricity	Oil	Total
1970	3.38	1.48	5.13	5.00	8.38	1.10	19.61
1971	2.95	1.34	4.51	5.04	8.56	1.05	19.16
1972	2.53	1.19	3.90	5.48	9.00	1.19	19.58
1973	2.39	1.08	3.65	5.27	8.72	1.38	19.02
1974	2.24	1.00	3.41	5.09	9.01	1.68	19.19
1975	1.92	0.89	2.96	5.10	10.04	1.58	19.68
1976	1.87	0.84	2.86	5.71	10.43	1.69	20.68
1977	1.95	0.81	2.91	5.89	10.44	1.76	21.00
1978	1.87	0.77	2.78	6.11	10.66	1.66	21.20
1979	2.03	0.84	3.02	6.17	10.47	1.86	21.52
1980	2.02	0.86	3.03	6.17	10.89	1.68	21.77
1981	1.98	0.68	2.80	7.18	11.39	1.63	23.01
1982	1.87	0.64	2.65	8.16	11.17	1.62	23.60
1983	1.79	0.63	2.55	8.86	10.82	1.62	23.86
1984	1.39	0.49	1.97	8.68	10.67	1.52	22.83
1985	1.80	0.56	2.48	9.06	10.72	1.47	23.74
1986	1.74	0.54	2.41	9.30	10.83	0.98	23.52
1987	1.33	0.57	2.00	9.00	10.37	0.83	22.19
1988	1.02	0.48	1.58	8.35	10.17	0.69	20.79
1989	0.83	0.38	1.28	7.80	10.15	0.68	19.90
1990	0.69	0.37	1.11	7.70	9.90	0.77	19.48
1991	0.75	0.37	1.18	8.56	10.53	0.68	20.94
1992	0.63	0.33	1.01	8.06	10.58	0.65	20.30
1993	0.68	0.34	1.08	7.90	10.51	0.64	20.14
1994	0.61	0.27	0.92	8.08	10.57	0.61	20.18
1995	0.52	0.23	0.79	7.74	10.39	0.61	19.53
1996	0.51	0.25	0.80	8.13	10.47	0.79	20.19
1997			0.67	7.37	9.58	0.67	18.29
1998			0.61	6.94	8.77	0.54	16.89
1999			0.61	6.33	8.58	0.53	16.10
2000			0.51	5.97	8.14	0.80	15.46
2001			0.57	6.09	8.01	0.76	15.47
2002			0.48	6.31	7.79	0.67	15.29
2003			0.32	6.26	7.65	0.73	14.99
2004			0.27	7.97	8.78	0.77	17.84
2005			0.20	7.63	8.97	0.97	17.82
2006			0.19	9.01	10.12	1.12	20.50
2007			0.20	8.44	10.63	0.98	20.30
2008			0.24	9.76	11.51	1.37	22.93
2009			0.28	10.19	11.75	1.01	23.28
2010			0.29	10.97	10.82	1.33	23.64
2011			0.27	8.96	10.53	1.23	21.24
2012			0.25	10.61	10.69	1.19	22.99

Sources:

DECC: DUKES 2012, Table 1.1.6 - internet only [1970-2012]/CLG, live Table 401 (updated March 2013)

Office for National Statistics CPI And RPI Reference Tables, July 2013

https://www.gov.uk/government/publications/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes

http://www.ons.gov.uk/ons/rel/cpi/consumer-price-indices/july-2013/consumer-price-inflation-reference-tables.xls

Notes:

1) DUKES tables are revised regularly.

2) Total expenditure figures are deflated to 2011 using the Retail Price Index.

3) Expenditure per household is calculated by dividing the expenditure figures by the number of UK households.

4) There is some discrepancy between the DUKES figures and the Living Costs and Food Survey (4f), although trends are consistent.

Table 4i: Average Annual Gas Bill (£, 2011 prices, UK)

Year	Average Annual Gas Bill (£, 2011 prices) Average all payment methods
1970	607
1971	607
1972	653
1973	611
1974	575
1975	565
1976	590
1977	561
1978	565
1979	528
1980	506
1981	570
1982	628
1983	655
1984	636
1985	659
1986	643
1987	618
1988	578
1989	529
1990	520
1991	574
1992	530
1993	516
1994	522
1995	499
1996	537
1997	491
1998	442
1999	405
2000	379
2001	390
2002	411
2003	372
2004	472
2005	448
2006	528
2007	494
2008	575
2009	602
2010	634
2011	493

Sources:

DECC: DUKES 2013, Table 1.1.6 - internet only [1970-2011]/CLG, live Table 401 (updated March 2013)

Office for National Statistics CPI And RPI Reference Tables (published July 2013)

EHS 2011 Homes with gas central heating and non-centrally-heated homes with gas (see Tables 6b and 6c)
https://www.gov.uk/government/publications/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes
www.ons.gov.uk/ons/rel/cpi/consumer-price-indices/june-2012/cpi-and-rpi-detailed-reference-tables.xls
https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

Notes:

1) Gas bills are averages, calculated by dividing expenditure by domestic final users by the number of households with a gas connection.
2) Homes with a gas connection are inferred based on homes with gas central heating and non-centrally heated homes with gas heating.
This may result in a small under-estimate of the number of homes, and so a small over-estimate of gas spending per household.

3) All gas bills include VAT where it is not refundable.

4) Figures from DUKES are not precise, and are revised periodically.

5) Figures are deflated using the Retail Price Index.

Table 4j: Average Annual Electricity Bill
(£, 2011 prices, UK)

	Average Annual Electricity Bill (£, 2011 prices)
Year	Average all payment methods
1970	436
1971	445
1972	468
1973	453
1974	468
1975	522
1976	542
1977	543
1978	554
1979	545
1980	567
1981	593
1982	581
1983	563
1984	555
1985	558
1986	563
1987	539
1988	529
1989	528
1990	515
1991	547
1992	550
1993	547
1994	550
1995	540
1996	544
1997	498
1998	456
1999	446
2000	423
2001	417
2002	405
2003	398
2004	456
2005	467
2006	526
2007	553
2008	599
2009	611
2010	563
2011	548
2012	556

Sources:

DECC: DUKES 2013, Table 1.1.6 - internet only [1970-2012]/CLG, live Table 401 (updated March 2013)
Office for National Statistics CPI And RPI Reference Tables, June 2012 (published 17 July 2012)
https://www.gov.uk/government/publications/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes
www.ons.gov.uk/ons/rel/cpi/consumer-price-indices/june-2012/cpi-and-rpi-detailed-reference-tables.xls
https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

Notes:

1) Electricity bills are averages, calculated by dividing expenditure by domestic final users by the number of households.

2) All electricity bills include VAT where it is not refundable.

3) Figures from DUKES are not precise, and are revised periodically.

4) Figures are deflated using the Retail Price Index.

Table 4k: Average UK Weekly Expenditure on Fuel, Light and Power by Income 2011 (£/wk/hh)

Gross income decile group (per cent)	Lower boundary of income	Average energy spend	Average total spend	% on energy
Poorest 10%	0	13.90	177	7.8%
Second Decile	173	16.60	219	7.6%
Third Decile	256	18.20	292	6.2%
Fourth Decile	341	20.30	356	5.7%
Fifth Decile	436	22.20	415	5.4%
Sixth Decile	556	22.70	475	4.8%
Seventh Decile	680	23.80	538	4.4%
Eighth Decile	834	24.60	609	4.0%
Ninth Decile	1,044	26.80	747	3.6%
Wealthiest 10%	1,405	31.70	1,010	3.1%

Sources:

ONS: Living Costs and Food Survey, Appendix A - Table A6, Family Spending (2012): A report on the 2011 Living Costs and Food Survey, Houndmills: Palgrave Macmillan

Notes:

1) Percentage of UK expenditure on 'Fuel, light and power' has been calculated by dividing 'Average spend on fuel, light and power' figures by 'Average total spend' (£/week).

Table 5a: Average UK Air Temperatures
(°C and Annual Degree Days)

Year	Winter average temp (°C)	Annual average temp (°C)	Annual degree days
1970	5.8	9.7	2,311
1971	6.7	9.9	2,202
1972	6.4	9.3	2,355
1973	6.1	9.7	2,283
1974	6.7	9.6	2,259
1975	6.4	10.0	2,240
1976	5.8	10.0	2,262
1977	6.6	9.5	2,318
1978	6.5	9.5	2,323
1979	5.1	8.8	2,558
1980	5.8	9.4	2,356
1981	5.1	9.1	2,494
1982	5.8	9.2	2,422
1983	6.2	9.6	2,357
1984	5.8	9.4	2,408
1985	4.8	8.6	2,622
1986	5.3	8.4	2,664
1987	4.9	8.7	2,587
1988	6.2	9.4	2,340
1989	6.9	10.1	2,153
1990	7.6	10.5	2,022
1991	6.1	9.7	2,303
1992	6.1	9.9	2,221
1993	6.2	9.5	2,309
1994	7.2	10.2	2,120
1995	6.9	10.6	2,082
1996	5.7	9.4	2,387
1997	7.3	10.7	1,996
1998	7.5	10.5	1,994
1999	7.2	10.7	1,975
2000	7.2	10.4	2,040
2001	6.6	10.1	2,163
2002	7.7	10.8	1,823
2003	6.6	10.6	1,949
2004	7.0	10.6	1,932
2005	7.1	10.5	1,954
2006	6.9	10.8	1,932
2007	7.3	10.5	1,860
2008	6.4	9.9	2,102
2009	6.3	10.1	2,067
2010	4.1	8.9	2,489
2011	7.5	10.7	1,815
2012	6.5	9.7	2,185

Sources:

DECC: DUKES 2011, table 1.1.8 and 1.1.9- internet only (2311-dukes-2011-long-term-trends.pdf) [1970-2012]

https://www.gov.uk/government/statistical-data-sets/dukes-2012-weather-statistics

Notes:

1) Winter temperature is average for October, November, December, January, February, and March.

2) DUKES tables are revised regularly.

3) Annual degree days have been calculated using the Hitchin Formula and normalised to 15.5°C.

Table 5b: Household Energy Use for Space Heating (TWh)

Year	Space heating	% household energy
1970	247.7	57.8%
1971	230.1	55.5%
1972	237.4	56.3%
1973	250.9	57.4%
1974	254.3	57.5%
1975	242.9	56.4%
1976	235.6	55.3%
1977	249.4	56.6%
1978	260.0	57.8%
1979	293.1	60.6%
1980	274.5	59.3%
1981	272.2	59.0%
1982	267.1	58.6%
1983	265.4	58.5%
1984	253.3	57.5%
1985	299.3	61.2%
1986	316.6	62.3%
1987	315.9	62.5%
1988	303.2	61.5%
1989	279.2	59.6%
1990	285.6	60.2%
1991	332.6	63.9%
1992	325.4	63.5%
1993	342.8	64.7%
1994	325.3	63.7%
1995	311.8	62.8%
1996	375.5	67.1%
1997	336.9	64.7%
1998	352.4	65.7%
1999	353.6	65.9%
2000	362.0	66.4%
2001	378.7	67.6%
2002	368.9	66.8%
2003	377.3	67.2%
2004	387.9	67.6%
2005	370.5	66.6%
2006	355.1	65.6%
2007	337.2	64.5%
2008	335.6	63.6%
2009	325.8	65.2%
2010	392.0	69.5%
2011	279.6	61.9%

Sources:

Cambridge Housing Model (2008 onwards)

Building Research Establishment Housing Model for Energy Studies (1970-2008)

Notes:

1) '% household energy' is calculated by dividing 'household energy consumption due to space heating' by 'total household energy consumption'.

Table 5c: Household Energy Use for Water Heating (TWh)

Year	Water heating	% household energy
1970	124.4	29.0%
1971	125.6	30.3%
1972	124.4	29.5%
1973	124.4	28.5%
1974	123.3	27.9%
1975	122.1	28.3%
1976	123.3	28.9%
1977	123.3	28.0%
1978	121.0	26.9%
1979	119.8	24.8%
1980	117.5	25.4%
1981	117.5	25.5%
1982	116.3	25.5%
1983	114.0	25.1%
1984	111.6	25.3%
1985	112.8	23.1%
1986	112.8	22.2%
1987	109.3	21.6%
1988	109.3	22.2%
1989	108.2	23.1%
1990	107.0	22.6%
1991	105.8	20.3%
1992	104.7	20.4%
1993	103.5	19.5%
1994	102.3	20.0%
1995	101.2	20.4%
1996	100.0	17.9%
1997	98.9	19.0%
1998	98.9	18.4%
1999	97.7	18.2%
2000	96.5	17.7%
2001	95.4	17.0%
2002	95.4	17.3%
2003	95.4	17.0%
2004	95.4	16.6%
2005	93.0	16.7%
2006	91.9	17.0%
2007	90.7	17.4%
2008	95.4	18.1%
2009	84.9	17.0%
2010	82.6	14.6%
2011	82.6	18.3%

Sources:

Cambridge Housing Model (2008 onwards)

Building Research Establishment Housing Model for Energy Studies (1970-2008)

Notes:

1) '% household energy' is calculated by dividing 'household energy consumption due to water heating' by 'total household energy consumption'.

Table 5d: Household Energy Use for Lighting (TWh)

Year	Lighting	% household energy
1970	10.4	2.5%
1971	10.7	2.7%
1972	11.0	2.7%
1973	11.3	2.7%
1974	11.6	2.8%
1975	11.9	2.9%
1976	12.2	3.0%
1977	12.5	3.0%
1978	12.7	3.0%
1979	13.0	2.8%
1980	13.3	3.0%
1981	13.5	3.1%
1982	13.8	3.2%
1983	14.0	3.2%
1984	14.2	3.4%
1985	14.5	3.1%
1986	14.7	3.0%
1987	14.9	3.1%
1988	15.1	3.2%
1989	15.2	3.4%
1990	15.3	3.4%
1991	15.5	3.1%
1992	15.6	3.2%
1993	15.8	3.1%
1994	15.9	3.3%
1995	16.0	3.4%
1996	16.2	3.0%
1997	16.4	3.3%
1998	16.5	3.2%
1999	16.7	3.3%
2000	16.9	3.3%
2001	17.1	3.2%
2002	17.3	3.3%
2003	17.1	3.2%
2004	17.0	3.1%
2005	16.7	3.1%
2006	16.9	3.3%
2007	16.8	3.4%
2008	16.5	3.3%
2009	15.2	3.2%
2010	14.0	2.5%
2011	14.0	3.1%

Sources:

Cambridge Housing Model (2008 onwards)

Building Research Establishment Housing Model for Energy Studies (1970-2008)

Notes:

1) '% household energy' is calculated by dividing 'household energy consumption due to lighting' by 'total household energy consumption'.

Table 5e: Household Energy Use for Appliances (TWh)

Year	Appliances	% household energy
1970	20.1	4.7%
1971	21.5	5.2%
1972	23.1	5.5%
1973	25.0	5.7%
1974	27.0	6.1%
1975	28.6	6.6%
1976	29.9	7.0%
1977	31.0	7.0%
1978	32.1	7.1%
1979	33.1	6.9%
1980	34.1	7.4%
1981	35.2	7.6%
1982	36.4	8.0%
1983	37.7	8.3%
1984	39.2	8.9%
1985	41.2	8.4%
1986	42.9	8.4%
1987	44.6	8.8%
1988	45.8	9.3%
1989	46.9	10.0%
1990	47.6	10.0%
1991	48.3	9.3%
1992	49.0	9.6%
1993	49.7	9.4%
1994	50.2	9.8%
1995	50.5	10.2%
1996	51.0	9.1%
1997	51.5	9.9%
1998	52.1	9.7%
1999	52.6	9.8%
2000	53.0	9.7%
2001	53.5	9.6%
2002	54.7	9.9%
2003	56.0	10.0%
2004	57.7	10.0%
2005	59.2	10.6%
2006	61.1	11.3%
2007	61.7	11.8%
2008	61.3	11.6%
2009	62.5	12.5%
2010	62.8	11.1%
2011	62.8	13.9%

Sources:

Cambridge Housing Model (2008 onwards)

Building Research Establishment Housing Model for Energy Studies (1970-2008)

Notes:

1) '% household energy' is calculated by dividing 'household energy consumption due to appliances' by 'total household energy consumption'.
2) Household energy consumption estimates from appliances build on data from the Environment Change Institute's (Oxford University) DECADE project.
3) Appliances include all items not attributed to Cooking, Space Heating, Water Heating or Lighting.

Table 5f: Household Energy Consumption by End Use (TWh) - Cooking

Year	Cooking	% household energy
1970	25.6	6.0%
1971	25.6	6.2%
1972	25.6	6.1%
1973	25.6	5.9%
1974	24.4	5.5%
1975	24.4	5.7%
1976	24.4	5.7%
1977	24.4	5.5%
1978	24.4	5.4%
1979	23.3	4.8%
1980	23.3	5.0%
1981	23.3	5.0%
1982	22.1	4.8%
1983	22.1	4.9%
1984	20.9	4.7%
1985	20.9	4.3%
1986	19.8	3.9%
1987	19.8	3.9%
1988	18.6	3.8%
1989	18.6	4.0%
1990	17.4	3.7%
1991	17.4	3.4%
1992	17.4	3.4%
1993	16.3	3.1%
1994	16.3	3.2%
1995	16.3	3.3%
1996	16.3	2.9%
1997	16.3	3.1%
1998	15.1	2.8%
1999	15.1	2.8%
2000	15.1	2.8%
2001	15.1	2.7%
2002	15.1	2.7%
2003	15.1	2.7%
2004	15.1	2.6%
2005	15.1	2.7%
2006	15.1	2.8%
2007	15.1	2.9%
2008	14.0	2.6%
2009	12.8	2.6%
2010	12.8	2.3%
2011	12.8	2.8%

Source:

Cambridge Housing Model (2008 onwards)

Building Research Establishment Housing Model for Energy Studies (1970-2008)

Notes:

1) '% household energy' is calculated by dividing 'household energy consumption due to cooking' by 'total household energy consumption'.

2) Household energy consumption estimates from cooking build on data from the Environment Change Institute's (Oxford University) DECADE project.

3) Cooking appliances consist of ovens and hobs. Microwaves, toasters and kettles, etc, are classified as appliances.

Table 5g: Average SAP Rating by Year (GB)

Year	SAP rating of average dwelling
1970	17.6
1971	18.4
1972	19.2
1973	20.5
1974	22.0
1975	23.1
1976	24.7
1977	26.6
1978	27.3
1979	29.0
1980	30.3
1981	31.6
1982	33.0
1983	34.9
1984	35.7
1985	36.5
1986	37.9
1987	38.7
1988	39.0
1989	39.7
1990	40.2
1991	41.0
1992	41.9
1993	42.4
1994	42.7
1995	43.4
1996	43.4
1997	43.7
1998	44.6
1999	44.9
2000	45.5
2001	45.8
2002	47.1
2003	46.6
2004	47.4
2005	48.1
2006	48.7
2007	49.8
2008	51.4
2009	53.1
2010	55.0
2011	56.7

Sources:

Building Research Establishment Housing Model for Energy Studies (1970-2002)/ CLG: English Housing Condition Survey, English Housing Survey (2003-2011)

https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

Notes:

1) Standard Assessment Procedure (SAP) ratings prior to 2003 are for GB obtained from BREHOMES.

Standard Assessment Procedure ratings from 2003 onwards are for England from the EHCS/EHS survey.

The change in source means there is a discontinuity in the data.

2) The English House Condition Survey was a national survey of housing in England, commissioned by CLG, and was merged with the Survey of English Housing (another housing survey) to form the English Housing Survey in 2008.

3) The SAP rating in 2010 was calculated using SAP 2009, introducing a discontinuity in the figures. The equivalent mean SAP 2005 rating in 2010 was calculated as 54.7.

Table 5h: Heat Loss Parameter (W/m^{2}K)

Year	Date of Construction Before 1900	1900- 1929	1930- 1949	1950- 1966	1967- 1975	1976- 1982	1983- 1990	1991- 1995	1996- 2002	2003- 2006	Average Heat Loss Parameter
2008	4.1	3.9	3.8	3.3	3.0	2.7	2.4	2.4	2.1	2.1	3.3
2009	3.9	3.8	3.7	3.2	3.0	2.8	2.5	2.4	2.1	2.0	3.2
2010	4.1	3.9	3.7	3.1	2.9	2.6	2.4	2.3	2.1	2.1	3.2
2011	4.1	4.0	3.7	3.1	3.0	2.6	2.4	2.3	2.1	2.1	3.2

Source:
CLG: English House Condition Survey, English Housing Survey
Analysis of EHS data by Cambridge Architectural Research

Notes

1) The Heat Loss Parameter (HLP) of a dwelling is a measure of how well a dwelling retains heat. It is based on heat transfer through the fabric of a building (e.g. walls and windows), which depends on the insulating properties of each building element, as well as heat loss due to air movement, from both deliberate ventilation and uncontrolled infiltration. The total heat loss coefficient (units: W/K) is divided by the total dwelling floorspace to give a measure of heat loss per unit area (W/m2K), to allow a fair comparison of the heat loss between dwellings of different size.

2)The 2011 heat loss parameter figures are affected by slightly higher mean wind speeds in 2011 (5.2 m/s against 4.5 m/s in 2010), and improvements to the Cambridge Housing Model, including better modelling of conservatories.

Table 5i: Carbon Dioxide Emissions per Household (Tonnes of CO_2)

Year	Tonnes CO_2 per household
1970	10.4
1971	9.8
1972	9.4
1973	9.6
1974	9.3
1975	8.8
1976	8.0
1977	8.4
1978	8.3
1979	8.7
1980	8.3
1981	7.9
1982	7.6
1983	7.3
1984	6.9
1985	7.5
1986	7.6
1987	7.5
1988	6.9
1989	6.6
1990	6.7
1991	7.0
1992	6.7
1993	6.6
1994	6.3
1995	6.0
1996	6.5
1997	5.8
1998	6.0
1999	5.8
2000	6.0
2001	6.2
2002	6.1
2003	6.2
2004	6.2
2005	6.0
2006	5.9
2007	5.6
2008	5.5
2009	5.1
2010	5.5
2011	4.5

Sources:

DECC: DUKES, Table 1.1.5 [1970-1989]/ Market Transformation Programme - developing evidence for government and business on energy using products, table A1 [1970-2009], BNXS01: Carbon Dioxide Emission Factors for UK Energy Use/ private BRE communication

UK Greenhouse Gas Inventory Statistics: https://www.gov.uk/government/publications/final-uk-emissions-estimates

http://www.defra.gov.uk/publications/2012/05/30/pb13773-2012-ghg-conversion/

http://efficient-products.defra.gov.uk/spm/download/document/id/785

Notes:

1) CO_2 per household is calculated by dividing total carbon emissions by number of households.

2) The DEFRA 2008 emission factors for gas = 0.185, solid = 0.296, and oil = 0.268 ($kgCO_2/kWh$).

3) The emission factors for electricity are obtained from the Market Transformation Programme.

4) DUKES tables are revised regularly.

5) The domestic energy consumption figures are obtained from Table 7a.

6) These figures are for UK and as a result of this and using constant emissions factors for all fuels except electricity the data differs from the National Air Emissions Inventory (NAEI) data.

7) A different source of data was used before 1990.

Table 6a: Dwellings with Central Heating (millions)

Year	With central heating	Without central heating	Total Dwellings
1970	4.83	14.22	19.04
1971	5.30	13.96	19.26
1972	5.79	13.69	19.47
1973	6.48	13.21	19.69
1974	7.34	12.56	19.90
1975	7.92	12.19	20.12
1976	8.66	11.67	20.33
1977	9.36	11.18	20.55
1978	9.51	11.25	20.76
1979	10.34	10.64	20.98
1980	10.76	10.43	21.19
1981	11.32	10.09	21.41
1982	12.01	9.61	21.62
1983	13.23	8.60	21.83
1984	13.43	8.62	22.05
1985	14.20	8.06	22.26
1986	14.94	7.53	22.48
1987	15.50	7.19	22.69
1988	15.83	7.08	22.91
1989	16.45	6.67	23.12
1990	16.83	6.50	23.34
1991	17.41	6.14	23.55
1992	17.75	6.02	23.76
1993	18.09	5.86	23.95
1994	18.66	5.47	24.14
1995	19.05	5.29	24.34
1996	19.08	5.45	24.53
1997	19.27	5.45	24.72
1998	19.91	5.00	24.91
1999	20.04	5.05	25.10
2000	20.25	5.03	25.28
2001	20.94	4.53	25.47
2002	21.43	4.19	25.62
2003	22.52	3.28	25.80
2004	22.86	3.13	25.99
2005	23.23	2.96	26.20
2006	23.74	2.67	26.42
2007	24.18	2.48	26.66
2008	23.83	3.08	26.91
2009	24.29	2.82	27.11
2010	24.78	2.50	27.27
2011	24.98	2.43	27.42

Sources:

GfK Home Audit/ CLG: English House Condition Survey, English Housing Survey

https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

Notes:

1) The English House Condition Survey is a national survey of housing in England, commissioned by CLG, and was merged with the Survey of English Housing (another housing survey) to form the English Housing Survey in 2008.

2) Households with electric storage heaters are not included in 'With central heating'.

Table 6b: Main Form of Heating for Centrally Heated Dwellings (thousands)

Year	Solid fuel	Electric	Gas	Oil	Other
1970	1,725	465	1,983	492	178
1971	1,639	541	2,338	589	195
1972	1,575	599	2,722	690	201
1973	1,525	681	3,306	728	239
1974	1,556	748	3,989	733	314
1975	1,484	854	4,484	719	383
1976	1,495	794	5,317	688	366
1977	1,483	741	6,050	712	379
1978	1,138	759	6,534	706	376
1979	1,117	665	7,554	653	348
1980	1,206	637	8,136	508	271
1981	1,288	617	8,626	519	268
1982	1,384	606	9,213	536	269
1983	1,543	619	10,214	577	281
1984	1,345	748	10,543	583	211
1985	1,604	666	10,992	557	382
1986	1,605	491	12,024	516	306
1987	1,579	426	12,505	595	395
1988	1,598	500	12,706	633	392
1989	1,356	576	13,544	566	414
1990	1,349	480	13,970	589	444
1991	1,332	436	14,545	654	444
1992	1,103	442	15,190	599	412
1993	1,030	395	15,582	692	389
1994	929	489	16,175	654	415
1995	819	412	16,536	751	529
1996	875	406	16,252	952	596
1997	931	416	16,424	968	530
1998	768	266	17,571	810	499
1999	747	482	17,470	872	472
2000	691	451	17,792	870	450
2001	695	446	18,327	987	486
2002	737	896	18,309	1,110	377
2003	377	116	20,391	978	655
2004	338	96	20,819	1,054	552
2005	295	45	21,324	1,040	529
2006	272	45	21,741	1,115	572
2007	278	79	22,138	1,163	518
2008	237	102	21,986	1,028	479
2009	190	47	22,221	1,095	733
2010	245	503	22,514	1,105	408
2011	235	529	22,704	1,053	463

Sources:

GfK Home Audit/ CLG: English House Condition Survey, English Housing Survey
https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

Notes:

1) 'Electric' excludes electric storage heaters, which are shown in Table 6c.

2) The English House Condition Survey was a national survey of housing in England, commissioned by CLG, and was merged with the Survey of English Housing (another housing survey) to form the English Housing Survey in 2008.

Table 6c: Average Boiler Efficiency by Dwelling Age

Year	Date of Construction Before 1900	1900-1929	1930-1949	1950-1966	1967-1975	1976-1982	1983-1990	1991-1995	1996-2002	2003-2006	Average Boiler Efficiency
2008	79.2	79.5	78.6	78.3	79.4	80.0	81.1	81.8	82.5	84.5	79.6
2009	80.2	80.5	79.5	79.1	80.3	80.5	81.5	83.9	82.9	85.9	80.5
2010	81.9	81.6	81.7	81.4	82.2	82.2	82.5	84.8	82.8	88.9	82.3
2011	81.9	82.3	82.1	81.8	82.6	82.5	82.5	84.3	83.5	85.5	82.5

Source:

CLG: English House Condition Survey, English Housing Survey

Analysis of EHS data by Cambridge Architectural Research

Notes

1) Boiler efficiency determines how much fuel is required for a given heat output from a boiler and depends on a variety of factors, including the age and quality of the installed boiler, and whether or not it is condensing.

Table 6d: Main Form of Heating for Non-Centrally Heated Homes (thousands)

Year	Solid fuel fire	Solid fuel stove	All solid	Electric storage	Electric other	All electric	Gas	Oil	Other
1970	3,403	654	4,056	1,164	2,484	3,648	5,754	496	265
1971	3,284	631	3,915	1,359	2,397	3,756	5,551	478	255
1972	3,175	611	3,786	1,505	2,317	3,822	5,368	462	247
1973	3,006	578	3,584	1,677	2,194	3,871	5,083	438	234
1974	2,793	537	3,330	1,845	2,039	3,883	4,725	407	217
1975	2,660	512	3,171	1,989	1,942	3,931	4,496	388	207
1976	2,618	504	3,121	1,848	1,707	3,555	4,414	379	202
1977	2,306	443	2,749	1,725	1,541	3,266	4,611	362	193
1978	2,347	451	2,799	1,766	1,554	3,320	4,574	362	193
1979	1,923	644	2,567	1,548	1,444	2,992	4,561	320	198
1980	1,828	717	2,545	1,483	1,245	2,728	4,628	317	214
1981	1,720	638	2,358	1,298	1,238	2,536	4,694	223	275
1982	1,474	655	2,129	1,131	1,208	2,339	4,672	190	282
1983	1,124	667	1,791	1,003	1,108	2,112	4,370	98	229
1984	1,059	606	1,665	1,394	1,005	2,399	4,323	61	170
1985	958	530	1,488	1,385	870	2,255	4,149	34	136
1986	866	466	1,332	1,216	748	1,964	4,039	23	177
1987	714	383	1,097	1,334	756	2,091	3,837	27	141
1988	648	349	997	1,459	791	2,251	3,648	24	158
1989	625	336	961	1,598	660	2,258	3,286	17	144
1990	567	305	872	1,734	655	2,389	3,110	7	126
1991	491	264	756	1,901	523	2,423	2,822	16	123
1992	435	234	669	1,982	552	2,534	2,683	11	120
1993	384	207	591	2,089	509	2,598	2,554	6	109
1994	379	204	583	1,995	513	2,508	2,291	4	89
1995	317	171	488	2,077	498	2,575	2,135	8	87
1996	359	193	552	2,200	492	2,692	2,112	4	86
1997	331	178	509	2,338	603	2,941	1,926	4	70
1998	306	165	471	2,185	468	2,653	1,799	2	75
1999	205	110	315	2,250	483	2,733	1,927	5	71
2000	189	102	291	2,214	582	2,796	1,888	3	51
2001	207	112	319	2,030	781	2,812	1,333	0	66
2002	216	116	332	1,701	946	2,647	1,162	0	47
2003	65	35	99	1,857	269	2,126	1,049	0	7
2004	62	33	96	1,914	240	2,154	876	0	0
2005	52	28	80	1,919	234	2,153	722	0	9
2006	52	28	81	1,823	209	2,032	549	0	13
2007	47	25	72	1,829	194	2,023	380	0	7
2008	54	29	84	1,947	469	2,416	572	0	7
2009	29	31	61	1,863	511	2,375	357	0	31
2010	42	23	65	1,639	465	2,104	295	0	33
2011	32	21	52	1,720	505	2,224	157	0	0

Sources:

GfK Home Audit/ CLG: English House Condition Survey, English Housing Survey

https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

Notes:

1) 'All solid' includes 'Solid fuel fire' and 'Solid fuel stove'.

2) The English House Condition Survey is a national survey of housing in England, commissioned by CLG, and was merged with the Survey of English Housing (another housing survey) to form the English Housing Survey in 2008.

3) The sample size for non-centrally heated homes falls dramatically over time (see Chart 5d). As a result the main form of heating becomes more volatile towards the end of the period.

4) There is a discontinuity in the data in 2003 because of changes to the housing surveys.

Table 6e: Gas and Oil Condensing Boilers and Combi Boilers (thousands)

Year	Condensing boilers	Condensing (%)	Combi boilers	Condensing Combi boilers	Combi (%)	All gas and oil boilers
1975			1		0.0	2,474
1976			7		0.2	2,927
1977			12		0.3	3,412
1978			18		0.4	4,034
1979			23		0.5	4,722
1980			29		0.6	5,203
1981			71		1.2	6,005
1982	1	0.0	110		1.6	6,762
1983	1	0.0	150		2.1	7,240
1984	1	0.0	198		2.4	8,208
1985	2	0.0	233		2.7	8,645
1986	7	0.1	426		4.7	9,145
1987	12	0.1	639		6.6	9,750
1988	18	0.2	832		7.7	10,791
1989	23	0.2	996		9.0	11,126
1990	27	0.2	1,195		10.3	11,549
1991	35	0.3	1,414	1	11.3	12,540
1992	44	0.3	1,663	1	12.7	13,099
1993	56	0.4	1,923	3	14.4	13,339
1994	78	0.6	2,193	5	15.5	14,109
1995	98	0.7	2,491	7	17.1	14,559
1996	130	0.9	2,809	12	18.5	15,199
1997	163	1.0	3,075	19	19.5	15,789
1998	213	1.3	3,413	34	21.0	16,274
1999	289	1.7	3,963	59	23.5	16,829
2000	358	2.1	4,351	85	25.2	17,287
2001	471	2.7	4,871	127	28.3	17,205
2002	680	3.9	5,520	209	31.7	17,393
2003	1,088	5.9	7,089	451	38.6	18,381
2004	1,251	6.8	7,670	504	41.8	18,343
2005	2,118	11.4	8,431	878	45.2	18,662
2006	3,690	19.1	9,193	1,567	47.6	19,313
2007	5,281	27.2	9,813	2,219	50.5	19,419
2008	4,503	21.1	10,715	3,356	50.1	21,369
2009	6,545	29.9	11,603	4,930	53.0	21,873
2010	8,637	38.6	12,358	6,473	55.3	22,364
2011	10,386	45.4	13,071	7,751	57.2	22,856

Sources:

ECUK Table 3.17

CLG: English House Condition Survey, English Housing Survey

https://www.gov.uk/government/publications/energy-consumption-in-the-uk

Notes:

1) The Market Transformation Programme model was used for this data up to 2002. From 2003 onwards the EHCS, and then the EHS survey data, was used, scaled to UK. This introduces a discontinuity in 2003. A methodology change in 2008 led to a further discontinuity.

2) Figures for 1976 to 1979, 1981 to 1984, and 1986 to 1989 are interpolations.

3) All figures are expressed to the nearest thousand households.

4) Condensing and combi boilers are expressed as a percentage of all gas and oil boilers.

Table 6f: Households with No, Some and 'Full' Insulation Measures (millions)

Year	Households with no insulation	Households with some insulation	Households with 'full insulation'	Total households
1987	4.19	17.73	0.76	22.69
1988	4.28	17.60	1.02	22.91
1989	4.07	17.97	1.07	23.12
1990	3.90	18.32	1.11	23.34
1991	3.83	18.49	1.24	23.55
1992	3.78	18.54	1.44	23.76
1993	3.55	18.90	1.50	23.95
1994	3.70	18.31	2.13	24.14
1995	3.62	18.27	2.44	24.34
1996	3.25	18.78	2.49	24.53
1997	2.87	19.38	2.47	24.72
1998	2.88	18.99	3.04	24.91
1999	3.16	18.59	3.35	25.10
2000	2.76	18.23	4.29	25.28
2001	2.65	17.84	4.98	25.47
2002	2.48	17.75	5.38	25.62
2003	0.93	18.59	6.28	25.80
2004	0.84	18.16	6.99	25.99
2005	0.82	17.68	7.69	26.20
2006	0.80	17.10	8.52	26.42
2007	0.67	16.73	9.25	26.66
2008	0.61	16.45	9.85	26.91
2009	0.07	20.47	6.57	27.11
2010	0.05	20.20	7.02	27.27
2011	0.03	19.85	7.54	27.42

Sources:

CLG: English House Condition Survey, English Housing Survey

https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

Notes:

1) English House Condition Survey is a national survey of housing in England, commissioned by CLG, and was merged with the Survey of English Housing (another housing survey) to form English Housing Survey in 2008. There is a discontinuity in the data between 2008 and 2009, due to a change in methodology.

2) Households with 'full insulation' are defined as those households that have at least 100mm of loft insulation (where there is a loft), cavity wall insulation (where there is a cavity), and at least 80% of rooms with double glazing.

3) Households with no insulation are defined as those households that have no loft insulation (where there is a loft), no cavity wall insulation (where there is a cavity) and no double glazing.

4) Households with some insulation include all those that are not included in 'full' and 'no' insulation household figures.

Table 6g: Depth of Loft Insulation (millions) - pre EHS

Year	25mm or less	50mm	75mm	100mm or more	Not stated	Potential	Total with	Total dwellings
1976	1.38	2.59	2.02	0.45	1.23	15.16	7.67	20.33
1977	2.00	2.82	2.38	0.66	0.83	15.45	8.69	20.55
1978	1.69	2.83	2.97	1.05	0.92	15.45	9.47	20.76
1979	1.32	2.87	3.61	1.56	1.42	16.15	10.79	20.98
1980	1.18	3.48	4.18	2.06	0.96	16.68	11.85	21.19
1981	1.50	3.48	4.24	2.79	1.14	16.82	13.14	21.40
1982	1.18	3.60	4.17	3.53	1.30	17.22	13.78	21.62
1983	1.03	3.15	4.01	5.08	1.43	17.52	14.70	21.83
1984	0.93	3.00	4.28	6.23	1.33	17.93	15.77	22.05
1985	1.13	2.57	3.38	6.61	2.14	18.15	15.82	22.26
1986	1.06	2.52	3.79	7.25	1.82	18.51	16.44	22.48
1987	1.16	2.22	3.70	7.86	1.68	18.51	16.61	22.69
1988	0.76	2.16	3.74	8.29	1.86	18.81	16.82	22.91
1989	0.76	2.13	3.88	8.03	2.01	18.57	16.81	23.12
1990	0.79	2.41	3.97	8.22	1.90	19.03	17.29	23.34
1991	0.80	2.16	4.02	7.70	2.30	18.94	16.98	23.55
1992	0.71	2.01	3.64	8.19	2.65	18.96	17.19	23.76
1993	0.56	2.31	3.79	7.95	2.88	19.35	17.49	23.95
1994	0.50	1.81	3.18	9.10	2.67	18.99	17.26	24.14
1995	0.50	1.80	3.21	9.05	2.94	19.14	17.50	24.34
1996	0.56	1.79	2.92	9.58	3.04	19.44	17.89	24.53
1997	0.37	1.66	3.57	10.28	2.38	19.68	18.25	24.72
1998	0.48	1.83	3.21	10.38	2.48	19.66	18.38	24.91
1999	0.41	1.47	3.78	9.96	2.51	19.59	18.13	25.10
2000	0.32	1.78	3.81	9.82	2.48	19.94	18.21	25.28
2001	0.19	1.27	3.41	11.09	2.56	19.81	18.52	25.47
2002	0.20	1.26	3.38	11.06	2.58	19.96	18.47	25.64

Sources:

GfK Home Audit

https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

Notes:

1) Two separate graphs for pre and post 2003 were drawn due to discontinuities in figures, resulting from a change in data source.

2) The number of Great Britain households that have undertaken loft insulation measure of depth '25mm or less' were obtained by adding households figures for 25mm and less than 25mm.

3) The number of Great Britain households with loft insulation of depth '100mm or more' were obtained by adding household figures for all the categories with 100mm, and greater than 100mm (that is 125, 150, 200, 250, 300 or more).

4) "25mm or less" excludes homes with uninsulated lofts, which can be calculated from the difference between "Total with" and "Potential".

Table 6h: Depth of Loft Insulation (millions) - post EHS

Year	No loft	Uninsulated loft	< 100mm	100-149mm	≥ 150 mm	≥ 125 mm (DECC Insulation Statistics)	Total with	Potential	Total dwellings
2003	2.76	0.92	5.93	8.31	5.53	-	19.77	23.07	25.84
2004	2.75	0.99	6.09	8.11	6.20	-	20.40	23.29	26.04
2005	2.96	1.03	5.70	7.87	6.74	-	20.31	23.31	26.28
2006	2.95	0.98	5.31	7.90	7.50	-	20.71	23.57	26.52
2007	2.86	0.88	5.04	7.76	8.34	-	21.14	23.91	26.77
2008	3.35	0.80	4.81	7.39	8.69	10.43	20.89	23.70	27.05
2009	3.40	0.80	4.75	6.95	9.39	11.23	21.09	23.87	27.27
2010	3.40	0.78	4.59	6.22	10.33	11.23	21.14	24.01	27.45
2011	3.44	0.69	4.07	5.84	11.41	12.81	21.32	24.14	27.61

Sources:

ECUK Table 3.19; CLG: English House Condition Survey, English Housing Survey

https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

https://www.gov.uk/government/publications/energy-consumption-in-the-uk

Notes:

1) Two separate graphs for pre- and post-2003 were drawn due to discontinuities in data as a result of a change in data source.

2) The English House Condition Survey was a national survey of housing in England, commissioned by CLG, and was merged with the Survey of English Housing (another housing survey) to form English Housing Survey in 2008.

3) "25mm or less" excludes homes with uninsulated lofts, which can be calculated from the difference between "Total with" and "Potential".

Table 6i: Cavity Wall Insulation (millions, UK)

Year	Households with cavity insulation	Not known if cavity insulated	Households with potential for cavity wall insulation	Total dwellings
1974	0.30		12.64	19.90
1975	0.38		12.77	20.12
1976	0.50		13.19	20.33
1977	0.65		13.34	20.55
1978	0.69		13.60	20.76
1979	1.06		13.81	20.98
1980	1.14		13.98	21.19
1981	1.31		14.15	21.41
1982	1.50		14.29	21.62
1983	1.81		14.45	21.83
1984	2.20		14.62	22.05
1985	2.27	2.45	14.79	22.26
1986	2.55	2.61	14.97	22.48
1987	2.72	2.92	15.24	22.69
1988	2.95	3.06	15.46	22.91
1989	3.22	3.08	15.87	23.12
1990	3.45	3.45	15.83	23.34
1991	3.55	3.74	16.23	23.55
1992	3.83	4.18	16.61	23.76
1993	3.71	3.74	16.01	23.95
1994	3.71	4.61	16.15	24.14
1995	4.00	4.84	16.20	24.34
1996	4.04	5.44	16.84	24.53
1997	4.21	5.15	16.88	24.72
1998	4.43	4.93	16.54	24.91
1999	4.87	1.78	16.91	25.10
2000	5.68	1.81	16.79	25.28
2001	5.68	2.09	17.59	25.47
2002	5.96	1.75	17.75	25.62
2003	6.41		17.64	25.80
2004	7.00		18.07	25.99
2005	7.18		18.10	26.20
2006	7.98		18.19	26.42
2007	8.73		18.65	26.66
2008	10.31		18.84	26.91
2009	11.06		19.06	27.11
2010	11.82		19.24	27.27
2011	12.43		19.40	27.42

Sources:

CLG: English House Condition Survey, English Housing Survey. GfK: Home Audit.

https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

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

Notes:

1) The English House Condition Survey is a national survey of housing in England, commissioned by CLG, and was merged with the Survey of English Housing (another housing survey) to form English Housing Survey in 2008.

2) The EHCS replaced GfK's Home Audit in 2003, which introduced a discontinuity in this data.

3) Data from 2008 onwards is taken from the DECC Insulation Statistics publication.

Table 6j: Solid Wall Insulation (thousands)

Year	Solid Wall Insulation
2008	67
2009	76
2010	97
2011	105
2012	136
2013	211

Source:

DECC (2013) STATISTICAL RELEASE: EXPERIMENTAL STATISTICS. Estimates of Home Insulation Levels in Great Britain:April 2013
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/209029/Statistical_release_-_Estimates_of_home_ insulation_levels_in_Great_Britain_April_13.pdf

Table 6k: Insulation Measures installed under EEC and CERT obligations (thousands of households)

	Cavity wall insulation	Loft insulation	Solid wall insulation
EEC 1 (2002-2005)	792	439	24
EEC 2 (2005-2008)	1,336	802	35
CERT (2008-2012)	2,569	3,072	58

Sources:

Ofgem E - Serve

http://www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/Documents1/11254-18105.pdf

http://www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/Documents1/Annual%20Report%202008%20Final.pdf

https://www.ofgem.gov.uk/ofgem-publications/58425/certfinalreport2013300413.pdf

Notes:

1) The table shows the number of households with the three insulation measures (cavity, loft and solid wall) installed by the obligated suppliers.

2) Loft insulation figures include professional and DIY (do it yourself) installations.

3) The number of installations for loft is estimated using CAR's estimate of an average house loft space of 38 m^2.

4) Solid Wall insulation figures include both internal and external wall insulation.

5) CERT (2008-2011) figures consist of the approved supplier schemes in the first two years.

Table 6l: Double Glazing (millions)

Year	Less than 20% of rooms	20% - 39% of rooms	40% - 59% of rooms	60% - 79% of rooms	80% or more of rooms	Not stated	Total with double glazing	Potential for Double Glazing
1974						1.50	1.50	19.54
1975						1.79	1.79	19.71
1976						1.88	1.88	19.88
1977						2.43	2.43	20.05
1978						3.00	3.00	20.22
1979						3.36	3.36	20.39
1980						3.95	3.95	20.56
1981						4.24	4.24	20.73
1982						4.71	4.71	20.94
1983	1.13	1.10	0.84	0.63	1.88	0.10	5.67	21.15
1984	0.83	1.04	0.95	0.85	1.95	0.13	5.75	21.37
1985	0.80	1.18	1.03	0.97	1.91	0.69	6.58	21.58
1986	0.82	1.23	1.16	1.23	2.35	0.38	7.17	21.80
1987	1.49	1.37	1.25	1.38	2.97	0.09	8.56	22.01
1988	1.25	1.40	1.19	1.42	3.43	0.70	9.39	22.22
1989	1.20	1.30	1.31	1.59	3.84	0.77	10.00	22.44
1990	1.10	1.42	1.27	1.76	4.47	0.67	10.68	22.65
1991	1.14	1.44	1.29	2.01	4.91	0.66	11.45	22.86
1992	1.07	1.23	1.37	2.04	5.33	0.67	11.72	23.03
1993	0.94	1.34	1.37	2.38	5.91	0.61	12.55	23.20
1994	0.99	1.06	1.32	2.24	7.30	0.62	13.53	23.37
1995	0.86	1.00	1.26	2.28	8.02	0.62	14.04	23.54
1996	0.69	0.89	1.18	2.40	8.68	0.58	14.42	23.71
1997	0.59	0.95	1.23	2.60	8.39	1.94	15.70	23.88
1998	0.56	0.79	1.02	2.66	9.32	1.52	15.87	24.05
1999	0.61	0.89	1.00	2.45	10.00	1.42	16.37	24.22
2000	0.48	0.58	0.95	2.64	9.44	3.03	17.12	24.39
2001	0.41	0.57	0.93	2.51	9.96	3.55	17.92	24.56
2002	0.41	0.58	0.94	2.53	10.06	4.28	18.80	24.76
2003	0.94	1.06	1.20	1.73	15.27		20.21	24.97
2004	0.85	1.03	1.21	1.63	16.27		20.99	25.17
2005	0.77	0.95	1.24	1.54	17.08		21.59	25.37
2006	0.59	0.77	0.79	1.14	18.53		21.81	25.58
2007	0.55	0.72	0.74	1.10	19.43		22.54	25.81

Sources:

CLG: English House Condition Survey, English Housing Survey. GfK: Home Audit.

www.communities.gov.uk/englishhousingsurvey

Notes:

1) The English House Condition Survey was a national survey of housing in England, commissioned by CLG, and was merged with the Survey of English Housing (another housing survey) to form English Housing Survey in 2008.

2) The EHCS replaced GfK's Home Audit in 2003, which introduced a discontinuity in this data.

Table 6m: Double Glazing (millions)

Year	No Double Glazing	>50% of Dwelling	50-80% of Dwelling	80-99% of Dwelling	Whole Dwelling	Total with double glazing	Potential for Double Glazing
2008	2.60	1.69	1.47	2.10	19.05	24.31	26.91
2009	2.39	1.53	1.38	2.05	19.76	24.72	27.11
2010	2.23	1.42	1.29	2.09	20.24	25.04	27.27
2011	2.25	1.35	1.15	2.04	20.63	25.17	27.42

Sources:

CLG: English House Condition Survey, English Housing Survey. GfK: Home Audit.

www.communities.gov.uk/englishhousingsurvey

Notes:

1) The English House Condition Survey was a national survey of housing in England, commissioned by CLG, and was merged with the Survey of English Housing (another housing survey) to form English Housing Survey in 2008.

2) A change in methodology changed the categories of glazing shown in the EHS in 2009.

3) This breakdown is more detailed than similar data published in ECUK - based on the EHS.

Table 6n: Heat Loss of the Average Dwelling and the Whole Stock

Year	Average dwelling heat loss by building element (W/°C)							
	Walls	Ventilation	Windows	Roofs	Floors	Doors	Average dwelling heat loss W/°C	Stock loss GW/°C
1970	129.9	72.1	70.1	65.4	21.0	17.5	376.0	6.76
1971	129.8	72.3	70.4	62.8	21.1	17.6	374.0	6.97
1972	129.6	72.2	70.5	59.9	21.1	17.6	371.0	6.98
1973	129.2	71.9	70.4	56.8	21.1	17.6	367.0	6.96
1974	128.4	71.4	70.1	53.6	21.1	17.5	362.0	6.92
1975	127.7	70.8	69.7	50.4	21.0	17.4	357.0	6.89
1976	126.7	70.1	69.1	47.2	20.9	17.3	351.2	6.83
1977	124.9	69.1	68.3	44.7	20.9	17.1	345.0	6.77
1978	123.9	68.7	67.9	40.8	20.7	17.0	339.0	6.71
1979	121.8	67.9	67.4	38.7	21.4	16.8	334.0	6.66
1980	119.7	66.6	66.1	36.4	21.6	16.5	327.0	6.58
1981	118.2	65.7	65.3	34.0	21.5	16.3	321.0	6.51
1982	116.4	64.5	64.3	31.9	21.6	16.1	314.7	6.41
1983	114.8	63.8	63.2	29.7	21.7	15.9	309.0	6.34
1984	113.6	63.3	63.1	28.3	22.1	15.8	306.1	6.34
1985	113.6	62.8	62.7	27.2	22.2	15.7	304.3	6.37
1986	112.3	61.9	62.0	26.3	22.4	15.5	300.4	6.36
1987	111.6	61.4	61.4	24.9	22.2	15.4	296.9	6.35
1988	111.3	61.0	60.8	23.9	22.5	15.3	294.7	6.38
1989	110.7	60.8	60.7	23.1	22.2	15.2	292.6	6.41
1990	110.2	59.8	59.7	23.1	22.5	15.0	290.2	6.42
1991	109.6	59.3	59.3	22.5	22.2	14.9	287.8	6.43
1992	107.1	58.1	58.4	21.9	21.8	14.5	281.8	6.34
1993	108.7	56.9	57.1	21.7	21.9	14.2	280.6	6.35
1994	109.9	56.9	56.5	20.3	21.5	14.2	279.5	6.36
1995	108.9	55.9	55.6	20.1	21.4	14.0	276.0	6.32
1996	107.6	55.5	55.3	20.2	21.6	13.9	274.0	6.31
1997	107.3	54.8	54.2	19.8	21.7	13.7	271.4	6.29
1998	108.1	54.1	53.8	19.9	21.5	13.5	270.8	6.32
1999	107.5	54.1	54.1	19.7	21.4	13.5	270.2	6.35
2000	106.6	53.6	53.5	20.1	21.7	13.3	268.9	6.37
2001	106.2	53.7	53.3	19.4	21.6	13.3	267.5	6.40
2002	105.7	53.2	52.8	19.4	21.6	13.2	265.8	6.42
2003	105.5	52.0	51.1	21.1	24.6	12.9	267.1	6.51
2004	104.4	52.0	50.8	21.1	24.9	12.9	266.1	6.54
2005	104.6	51.5	50.3	20.6	24.6	12.7	264.4	6.56
2006	102.8	51.0	49.7	20.2	24.6	12.6	260.8	6.54
2007	101.1	50.9	49.5	20.1	24.8	12.5	258.9	6.57
2008	99.6	49.9	48.4	19.4	24.1	12.2	253.7	6.50
2009	99.6	78.0	53.8	25.1	25.0	13.3	294.7	18.21
2010	99.6	70.7	53.5	24.3	25.1	13.3	286.6	17.83
2011	96.7	73.0	58.6	23.0	25.7	13.4	290.4	18.35

Source:

Building Research Establishment Housing Model for Energy Studies [1970-2008], Cambridge Housing Model [2009-2011]

Notes:

1) Figures for 1970 to 1975, 1977 to 1981, 1983 and 2000 are interpolations. Full heat loss calculations have been performed for all other years.

2) Average dwelling heat loss was taken from BREHOMES for 1970-2008. In these years values of individual elements were estimated and then normalised to the total.

3) Changing from BREHOMES to the CHM to calculate heat losses causes a discontinuity between 2008 and 2009. The CHM calculates average heat losses separately for each element.

4) The estimate of ventilation heat loss uses actual wind speed data (regional and monthly) for each year from 2009.

Table 6o: Average Winter External Temperature and Internal Temperatures in °C

Year	Centrally heated homes	Non centrally heated homes	Average internal temperature	External temperature
1970	13.7	11.2	12.0	5.8
1971	14.4	11.9	12.8	6.7
1972	14.2	11.7	12.6	6.4
1973	14.0	11.5	12.6	6.1
1974	14.7	12.2	13.3	6.7
1975	14.2	11.7	13.0	6.4
1976	13.6	11.1	12.4	5.8
1977	14.6	12.1	13.4	6.6
1978	14.7	12.2	13.6	6.5
1979	13.9	11.4	12.8	5.1
1980	14.4	11.9	13.4	5.8
1981	13.8	11.3	12.8	5.1
1982	14.5	12.0	13.6	5.8
1983	14.9	12.4	14.1	6.2
1984	14.4	11.9	13.6	5.8
1985	14.1	11.6	13.3	4.8
1986	14.8	12.3	14.1	5.3
1987	14.5	12.0	13.8	4.9
1988	15.5	13.0	14.9	6.2
1989	15.8	13.3	15.2	6.9
1990	16.7	14.2	16.1	7.6
1991	15.9	13.4	15.4	6.1
1992	16.0	13.5	15.6	6.1
1993	16.3	13.8	15.9	6.2
1994	17.0	14.5	16.7	7.2
1995	16.6	14.1	16.3	6.9
1996	16.6	14.1	16.3	5.7
1997	17.6	15.1	17.3	7.3
1998	18.1	15.6	17.8	7.5
1999	17.8	15.3	17.5	7.2
2000	18.0	15.5	17.7	7.2
2001	17.8	15.3	17.5	6.6
2002	18.6	16.1	18.4	7.7
2003	17.9	15.4	17.7	6.6
2004	18.4	15.9	18.1	7.0
2005	18.8	16.3	18.5	7.1
2006	18.1	15.6	17.9	6.9
2007	17.7	15.2	17.5	7.3
2008	17.3	14.8	17.3	6.4
2009	17.2	15.7	17.2	6.3
2010	16.9	14.9	16.9	4.3
2011	17.7	16.5	17.6	6.7

Sources:

Building Research Establishment Housing Model for Energy Studies [1970-2008], Cambridge Housing Model [2009-2011]

DECC: DUKES 2013, Table 1.1.8 [1970-2011]

http://www.decc.gov.uk/en/content/cms/statistics/source/temperatures/temperatures.aspx

Notes:

1) External temperature is average for October, November, December, January, February and March.

2) DUKES tables are revised regularly.

3) For this table homes with electric storage heaters are classified as 'Centrally heated'.

Table 6p: Hot Water Tank Insulation (millions) - pre EHS

Year	25mm or less	50mm	75mm	>75mm	Not stated	Total with insulation	Potential	Total dwellings
1978	3.32	5.20	2.59	0.78	2.20	14.07	17.35	20.76
1979	4.12	6.10	2.85	0.84	1.17	15.07	17.91	20.98
1980	3.30	6.79	3.88	0.95	0.74	15.66	18.21	21.19
1981	3.61	6.40	3.88	1.22	0.70	15.81	18.13	21.41
1982	3.92	6.65	3.72	1.19	0.77	16.25	18.25	21.62
1983	3.71	6.96	3.83	1.51	0.87	16.87	18.70	21.83
1984	3.60	6.82	3.93	1.77	1.26	17.38	19.04	22.05
1985	2.95	7.07	4.87	1.84	1.50	18.23	19.67	22.26
1986	3.24	7.21	4.31	1.87	1.80	18.44	19.82	22.48
1987	2.26	5.69	8.01	1.86	1.05	18.87	20.10	22.69
1988	1.95	5.94	8.30	1.86	0.99	19.04	20.35	22.91
1989	1.74	5.19	9.45	1.52	1.35	19.25	20.48	23.12
1990	1.80	5.07	9.72	1.78	1.05	19.43	20.65	23.34
1991	1.58	4.98	10.17	1.78	1.14	19.65	20.76	23.55
1992	1.60	4.44	10.19	1.90	1.15	19.28	20.49	23.76
1993	1.25	4.43	10.55	1.57	1.40	19.21	20.52	23.95
1994	1.00	3.91	11.17	1.82	1.40	19.31	20.47	24.14
1995	1.23	3.66	11.66	1.48	1.18	19.21	20.34	24.34
1996	1.20	3.36	11.43	1.89	1.13	19.02	20.09	24.53
1997	1.22	3.58	12.03	1.89	0.89	19.61	20.51	24.72
1998	1.04	3.24	12.42	1.28	0.96	18.95	20.05	24.91
1999	1.00	2.76	12.50	1.07	1.03	18.36	19.42	25.10
2000	0.83	2.94	12.38	1.17	1.09	18.42	19.61	25.28
2001	0.78	2.14	12.54	1.32	1.31	18.09	19.09	25.47
2002	0.79	2.15	12.63	1.33	1.34	18.23	19.26	25.62

Sources:

GfK Home Audit [1978 - 2002]

Notes:

1) The difference between the 'Potential' and 'Total dwellings' is the number of dwellings without hot water tanks.

2) Two separate graphs for pre and post 2003 were drawn due to discontinuities in the data resulting from a change in data source.

3) All tank insulation depths are jacket equivalents. Factory bonded insulation is converted to an equivalent jacket by considering the heat loss.

In the GfK data no information is available for depth of factory bonded insulation and 3" (75mm) is assumed.

Table 6q: Hot Water Tank Insulation (millions) - post EHS

Year	12.5mm	25mm	38mm	50mm	80mm	100mm	125mm or more	Total with	Potential	Total dwellings
2003	2.75	0.67	6.07	0.75	0.30	6.04	1.59	18.18	19.22	25.80
2004	2.87	0.68	6.50	0.71	0.26	5.88	1.32	18.21	19.26	25.99
2005	2.51	1.34	5.35	0.59	3.01	4.27	1.34	18.41	19.47	26.20
2006	1.92	2.28	3.39	0.59	5.82	3.29	1.37	18.66	19.77	26.42
2007	1.80	2.38	3.22	0.56	6.20	3.41	1.20	18.77	19.88	26.66
2008	1.32	1.76	2.59	0.46	5.54	2.46	0.93	15.06	15.24	26.91
2009	1.72	10.75	1.66	0.69	0.06	0.03	0.01	14.93	15.27	27.11
2010	1.49	10.54	1.57	0.72	0.06	0.03	0.02	14.42	14.65	27.27
2011	2.51	6.68	3.06	1.30	0.13	0.08	0.03	13.78	13.96	27.42

Sources:

CLG: English House Condition Survey, English Housing Survey [2003- 2011]

www.communities.gov.uk/englishhousingsurvey

Notes:

1) The difference between the 'Potential' and 'Total households' is the number of households without hot water tanks for insulation.

2) This graph shows figures from 2003 onwards, and was drawn separately due to discontinuities in figures, resulting from a change in data source.

3) The English House Condition Survey was a national survey of housing in England, commissioned by CLG, and was merged with the Survey of English Housing (another housing survey) to form English Housing Survey in 2008.

4) Data for 2009 is taken directly from the EHS and scaled to UK using household numbers. Using data directly from the EHS creates a discontinuity in the figures.

Table 6r: Number of measures installed under EEC1 and EEC2 (thousands of households)

Insulation measures	EEC1		EEC2 (excluding carryover)	
	Priority group (EEC1)	Non priority group (EEC1)	Priority group (EEC2)	Non priority group (EEC2)
Cavity wall insulation	441.2	350.3	658.8	677.6
Loft insulation	65.1	373.4	102.7	695.8
Draught stripping	15.5	7.2	15.8	7.6
Tank insulation	98.7	97.2	65.7	93.2
Solid wall insulation	17.4	6.4	26.4	8.9

Source

Ofgem E - Serve: A review of the energy efficiency commitment

http://www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/Documents1/11254-18105.pdf

http://www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/Documents1/Annual%20Report%202008%20Final.pdf

Notes:

1) Loft insulation figures include professional and DIY (do it yourself) installations.

2) The number of installations for loft insulation is estimated using CAR's estimate of an average house loft space of 38 m^2.

3) Solid Wall insulation figures include both internal and external wall insulation.

4) EEC1 figures include savings by the suppliers achieved in excess of the EEC1 target for priority

and non priority group, and these additional savings are excluded from the EEC2 figures.

Table 6s: Carbon emissions savings achieved under CERT (2008)

Upgrade measures	Percentage of savings in priority groups	Percentage of savings outside priority groups
EEC2 carryover	8.4	16.9
Insulation	23.5	21.4
Lighting	9.4	13.5
Appliances	1.0	2.6
Heating	0.8	2.1
Microgen and CHP	0.1	0.3
Total	43.2	56.8

Source:

Ofgem E - Serve: The CERT annual report 2010 - a review of the second year of the Carbon Emissions Reduction Target

http://www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/Documents1/CERT%20Annual%20report%20second%20year.pdf

Notes:

1) EEC2 carryover represents the savings by the suppliers achieved in excess of the EEC2 target which is then counted towards the CERT targets.

2) The figures are for the first year of CERT.

Table 6t: Number of measures delivered by suppliers in the CERT programme[1]

Year	CERT Phase	Insulation				Heating	Lighting	Microgeneration		
		Cavity wall	Loft insulation (excluding DIY)	Loft insulation (DIY)[2]	Solid wall insulation	Fuel switching	Compact fluorescent lamps (CFLs)	Heat pumps (ground source)	Solar water heating (m²)[3]	Small scale CHP
2008	CERT Q1&Q2	257,010	282,310	-	5,120	4,320	27,662,040	70	..	-
	CERT Q3	144,920	122,870	-	2,040	6,270	93,003,820	370	190	-
2009	CERT Q4	143,500	283,970	-	1,470	5,410	32,011,870	110	30	-
	CERT Q5	172,050	200,420	-	5,430	3,620	17,178,090	140	-	-
	CERT Q6	141,940	169,880	-	2,910	4,210	12,179,090	120	-	-
	CERT Q7	134,170	147,690	697,740	5,650	7,330	42,093,980	210	30	-
2010	CERT Q8	127,730	183,100	147,430	6,730	6,390	8,698,860	1,080	220	-
	CERT Q9	95,290	125,230	39,660	2,410	13,000	11,314,700	700	550	-
	CERT Q10	83,920	103,360	76,300	2,490	4,970	8,479,300	480	-240	-
	CERT Q11	112,000	124,290	231,740	1,580	7,860	23,854,440	1,020	10	-
2011	CERT Q12	170,090	278,460	91,900	1,160	6,930	20,526,850	1,210	1,260	-
	CERT Q13	92,040	152,140	44,900	1,810	3,010	3,636,380	1,060	1,080	-
	CERT Q14	132,570	207,460	74,100	3,290	5,070	5,813,250	10	-40	-
	CERT Q15	126,640	232,530	145,930	3,070	3,410	-2,929,960	-	-	-
2012	CERT Q16	169,280	301,700	84,090	2,260	8,680	32,760	40	-	-
	CERT Q17	179,820	305,270	-	3,790	4,160	-11,000	-	-	-
	CERT Q18	118,880	278,370	-	1,350	2,790	1,091,190	-	-	-
	CERT Q19	167,030	398,290	-	6,370	11,090	-683,070	840	-1,990	-
	Total	2,568,880	3,897,340	1,633,790	58,930	108,520	303,952,590	7,460	1,100	50

Source:

Energy Consumption in the United Kingdom (2012) - Chapter 3: Domestic Sector, Table 3.21 (Updated 26/07/2012)

https://www.gov.uk/government/publications/energy-consumption-in-the-uk

https://www.ofgem.gov.uk/publications-and-updates/final-report-carbon-emissions-reduction-target-cert-2008-2012

Notes:

1) The Carbon Emissions Reduction Target (CERT) replaced the Energy Efficiency Commitment 2005-2008 (EEC2) as the Government's domestic efficiency obligation on energy suppliers from 1st April 2008.

2) DIY activity is reported based on sales of insulation material. These figures assume the average size of loft is 50m2 and a 10 per cent wastage factor. This activity was first reported in Q7 reflecting the high delivery reported in that quarter.

3) Figures are presented as the net change in the amount of cumulative activity reported for the whole programme. Figures for Q10 and Q11 for solar water heating are affected by subsequent revisions to earlier data.

4) Some negative figures appear in the time series. This is because the time series is originally produced using estimated data. At the time of banking for compliance purposes, suppliers receive actual data which is sometimes lower than estimated. In addition, provisional data is subject to change based on more up to date data being submitted by third parties. Ofgem do not revise data from previous quarters when these revisions occur as it is only the latest cumulative total which is published.

5) Final data for Small Scale CHP and DIY Loft insulation was reported in the final CERT report but this does not show in which quarter it was installed.

Table 6u: Energy Company Obligation (ECO) (2013)

Upgrade measures	Total
Soild Wall Insulation	901
Cavity Wall Insulation	4,075
Hard To Heat Cavity Wall Insulation	636
Loft Insulation	23,386
Other Insulation	83
Boiler Replacement	4,854
Boiler Repair	97
Other Heating	0
District Heating System	0
Micro-generation	0
Total	34,032

Source:

Ofgem E-Serve: ECO Compliance Update

https://www.ofgem.gov.uk/ofgem-publications/82600/ecocomplianceupdate16august2013v1.pdf

Notes:

1) Figures are provided to Ofgem by suppliers by the end of June 2013 and approved by Ofgem by the end of July 2013.

Table 7a: HES Average 24-Hour Electricity Use Profile, England 2010-11

Time (hours after midnight)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Cold Appliances	62.1	61.6	61.4	60.9	59.6	59.3	61.3	62.6	62.3	62.6	63.6	65.4	66.1	66.2	67.3	67.8	70.2	70.8	70.3	68.7	67.9	66.7	65.4
Cooking	5.8	5.2	5.3	6.6	11.5	28.6	59.6	65.2	55.4	53.2	62.1	75.9	63.8	48.7	54.4	92.1	135.5	129.3	93.7	63.7	42.3	27.9	14.1
Lighting	24.0	18.6	16.9	16.2	17.8	23.8	45.7	48.9	34.6	29.3	26.6	26.6	25.4	26.5	29.9	50.6	82.0	108.8	125.3	127.9	133.2	121.1	74.0
Audiovisual	30.9	25.2	23.2	22.0	22.6	27.2	38.1	48.7	51.1	51.3	50.8	57.4	64.2	66.0	68.9	79.2	90.0	102.6	108.3	114.7	115.0	100.0	68.6
ICT	14.9	13.8	13.6	13.5	13.4	14.0	16.2	19.7	23.1	25.1	26.1	26.9	27.5	28.5	29.2	31.2	32.2	32.2	33.2	32.8	31.1	27.9	22.2
Washing/drying/dishwasher	12.6	8.2	7.6	5.2	4.9	11.9	34.7	65.0	82.0	85.0	81.4	76.2	70.9	66.9	67.9	63.5	59.7	62.0	73.7	69.0	55.6	44.1	37.1
Water heating	8.7	14.6	11.0	20.2	7.9	11.7	13.8	9.9	8.8	7.1	5.7	6.4	6.7	6.9	7.4	9.4	9.2	9.5	10.2	11.3	12.8	7.2	4.5
Heating	34.3	26.0	20.0	18.9	18.9	14.9	18.0	20.4	20.3	19.5	15.2	15.0	16.3	17.6	20.6	23.9	25.2	25.3	25.9	25.8	20.9	27.7	50.4
Other	13.2	12.8	13.0	12.6	12.9	13.9	18.3	21.4	22.2	23.1	26.6	26.5	24.2	23.7	25.5	26.6	24.8	24.6	22.3	19.7	19.1	17.5	15.4
Unknown	61.7	57.3	56.6	59.5	61.9	76.5	87.0	99.8	107.0	104.5	99.0	102.3	94.9	92.2	95.1	104.6	130.7	131.8	127.7	127.7	119.7	103.6	88.4
Showers	1.9	1.2	1.9	1.3	5.6	16.9	46.0	36.3	26.6	15.4	16.8	15.5	7.9	5.3	7.6	9.1	16.2	17.1	17.0	15.2	7.8	6.0	6.2

Sources:
Palmer et al. (2013) Further Analysis of the Household Electricity Use Survey - Early Findings: Demand side management. London: DECC.
https://www.gov.uk/government/publications/early-findings-demand-side-management

Notes:

1) The Household Electricity Use Survey (HES) monitored a total of 250 owner-occupier households across England from 2010 to 2011. This was the most detailed monitoring of electricity use in homes ever undertaken in the UK.

2) A 24-hour profile 'chooser' is available, which allows users to select households or dwellings of interest, here:
https://www.gov.uk/government/publications/early-findings-demand-side-management

Table 7b: HES Annual Energy Use for Cooking, England 2010-11

Number of occupants	Average energy use (kWh/person/year)
1	470
2	230
3	150
4	110
5	80
6 or more people	100

Sources:

Energy Saving Trust, Defra and DECC (2012) Powering the nation: household electricity-using habits revealed. London: EST.
http://www.energysavingtrust.org.uk/Publications2/Corporate/Research-and-insights/Powering-the-nation-household-electricity-using-habits-revealed

Notes:

1) The Household Electricity Use Survey (HES) monitored a total of 250 owner-occupier households across England from 2010 to 2011. This was the most detailed monitoring of electricity use in homes ever undertaken in the UK.

Table 7c: HES Annual Energy Use for Lighting, England 2010-11

Household type	Average energy use (kWh)	Running costs rounded (£)
Single pensioner	548	79
Single non-pensioner	581	84
Multiple pensioner	413	60
Household with children	477	69
Multiple no dependents	548	79
All households	537	78

Sources:

Energy Saving Trust, Defra and DECC (2012) Powering the nation: household electricity-using habits revealed. London: EST. http://www.energysavingtrust.org.uk/Publications2/Corporate/Research-and-insights/Powering-the-nation-household-electricity-using-habits-revealed

Notes:

1) The Household Electricity Use Survey (HES) monitored a total of 250 owner-occupier households across England from 2010 to 2011. This was the most detailed monitoring of electricity use in homes ever undertaken in the UK.

Table 8a: Energy Use of the Housing Stock by Fuel Type (TWh)

Year	Solid	Gas	Electric	Oil	Renewables	All fuels
1970	205.9	106.2	77.6	39.3		429.0
1971	176.5	117.7	81.4	38.8		414.3
1972	155.2	134.8	87.3	44.5		421.7
1973	151.7	144.4	92.1	48.8		437.0
1974	143.0	161.9	93.6	43.4		442.0
1975	121.3	177.6	90.2	42.0		431.0
1976	112.0	186.4	85.9	41.8		426.1
1977	113.4	198.6	86.6	42.1		440.8
1978	103.4	218.7	86.4	41.4		450.0
1979	104.3	248.2	90.5	40.4		483.4
1980	90.2	254.2	86.7	32.3		463.4
1981	83.7	263.8	85.0	28.9		461.4
1982	82.5	263.2	83.5	26.9		456.1
1983	76.7	267.8	83.7	25.6		453.7
1984	60.2	269.3	84.4	26.8		440.7
1985	77.9	294.3	89.4	27.6		489.2
1986	76.5	310.4	92.9	28.5		508.2
1987	66.0	318.2	94.2	27.0		505.4
1988	62.1	311.1	93.3	26.2		492.7
1989	49.5	300.7	93.2	24.8		468.2
1990	46.3	286.6	89.5	27.5	24.1	474.0
1991	50.8	318.7	93.6	31.3	26.3	520.6
1992	44.3	315.0	94.9	32.1	26.3	512.5
1993	48.8	324.6	95.8	33.5	27.0	529.7
1994	40.2	314.6	96.8	33.3	26.2	511.1
1995	29.1	311.1	97.5	33.3	25.5	496.5
1996	31.1	358.6	102.6	39.0	28.4	559.6
1997	27.4	329.6	99.7	37.6	26.4	520.7
1998	26.0	339.5	104.4	39.3	27.2	536.4
1999	26.8	341.6	105.2	35.1	27.7	536.4
2000	21.2	352.9	106.7	35.9	28.2	544.9
2001	20.4	362.0	110.0	39.1	28.8	560.3
2002	15.8	359.1	114.5	34.3	28.5	552.1
2003	12.9	368.7	117.3	34.0	28.7	561.6
2004	11.1	378.2	118.5	36.2	29.8	573.7
2005	7.7	364.3	119.9	34.3	29.7	556.0
2006	7.1	350.0	119.0	36.1	29.5	541.7
2007	7.5	336.6	117.4	31.9	29.0	522.5
2008	8.4	343.0	114.3	33.6	29.7	528.0
2009	8.1	317.2	113.1	33.4	28.8	500.0
2010	8.7	371.7	113.4	38.0	32.1	564.0
2011	8.4	279.9	106.5	29.6	27.6	452.0
2012	7.9	323.5	109.4	30.0	31.1	501.9

Sources:

Cambridge Architectural Research using the Cambridge Housing Model since 2008.
Building Research Establishment Housing Model for Energy Studies (BREHOMES)/ DECC: DUKES 2012, Table 1.1.5 - internet only [1970-2011]
http://www.decc.gov.uk/en/content/cms/statistics/source/total/total.aspx

Notes:

1) Energy use figures were converted from the units in DUKES (thousand toe) to TWh: 1 toe = 11,630 kWh.

2) DUKES tables are revised regularly.

3) Building Research Establishment estimated figures from DUKES using BREHOMES.

4) Energy from 'Wood' and 'Waste and Tyres' is included in both 'Solid Fuel' and 'Renewables'. 'Renewables' also includes energy from geothermal and active solar heat. For more information on other renewable energy sources please see Table 9a.

5) From 2000 onwards, 'Renewables' are separated from 'Solid Fuels'.

Table 9a: Renewable Electricity Generation (GWh) - UK figures

	Final consumption	Household consumption	Total electricity production	Total electricity supply	Onshore wind	Offshore wind	Wave and tidal	Solar PV	Small scale hydro	Large scale hydro	Landfill gas	Sewage sludge digestion	Energy from waste combustion	Co-firing with fossil fuels	Animal biomass	Plant biomass	Anaerobic digestion	Total bioenergy	Total renewable generation
1990	274,430	93,790	-	-	9	-	-	-	127	5,080	139	316	141	-	-	-	0	596	5,812
1991	281,050	98,100	-	-	9	-	-	-	142	4,482	208	328	150	-	-	1	0	688	5,320
1992	281,470	99,480	-	-	33	-	-	-	149	5,282	377	328	177	-	-	52	1	934	6,398
1993	286,130	100,460	-	-	217	-	-	-	159	4,143	447	378	252	-	-	121	1	1,198	5,717
1994	285,310	101,410	-	-	344	-	-	-	159	4,935	517	361	449	-	-	192	0	1,518	6,956
1995	295,850	102,210	-	-	392	-	-	0	166	4,672	562	410	471	-	-	198	0	1,642	6,872
1996	310,567	107,513	-	-	488	-	-	0	118	3,275	708	410	489	-	-	197	0	1,805	5,685
1997	312,441	104,455	-	-	667	-	-	0	164	4,005	918	408	585	0	-	199	0	2,110	6,946
1998	316,944	109,410	361,078	375,170	877	-	-	0	206	4,911	1,185	386	849	0	-	234	-	2,654	8,649
1999	324,016	110,308	365,250	382,396	850	-	-	1	207	5,128	1,703	410	856	1	-	459	-	3,429	9,616
2000	330,593	111,842	374,374	391,243	945	1	-	1	214	4,871	2,188	367	840	31	-	456	-	3,882	9,914
2001	333,879	115,337	382,356	395,177	960	5	0	2	210	3,845	2,507	363	880	234	-	542	-	4,526	9,549
2002	334,049	120,014	384,594	395,661	1,251	5	0	3	204	4,584	2,679	368	907	272	286	568	-	5,080	11,127
2003	336,865	123,001	395,475	400,369	1,276	10	0	3	150	2,987	3,276	394	965	402	602	525	9	6,174	10,600
2004	339,572	124,200	391,280	401,418	1,736	199	0	4	283	4,561	4,004	440	971	362	1,022	556	9	7,364	14,147
2005	349,349	125,711	395,430	406,681	2,501	403	0	8	444	4,478	4,290	466	964	382	2,533	460	8	9,102	16,936
2006	345,866	124,704	393,429	404,799	3,574	651	0	11	478	4,115	4,424	445	1,083	363	2,528	423	12	9,277	18,106
2007	342,263	123,076	392,971	402,044	4,491	783	0	14	523	4,554	4,677	494	1,189	1,757	585	607	15	9,325	19,690
2008	342,390	119,800	384,783	399,894	5,788	1,305	0	17	555	4,600	4,729	549	1,239	1,575	620	807	16	9,535	21,800
2009	322,352	118,541	373,068	379,614	7,553	1,754	1	20	577	4,664	4,929	604	1,509	1,625	637	1,327	43	10,674	25,243
2010	329,246	118,836	378,608	384,422	7,140	3,044	2	40	483	3,092	5,037	697	1,597	2,332	627	1,594	151	12,037	25,838
2011	318,243	111,603	364,548	373,676	10,384	5,126	1	244	701	4,989	5,092	764	1,739	2,964	615	1,749	278	13,200	34,645
2012	318,070	114,698	360,869	375,880	12,121	7,463	4	1,188	653	4,631	5,154	720	2,279	1,783	643	4,098	523	15,198	41,258

Sources:

DECC: DUKES 2013, Table 5.1, 5.1.2 (internet only), 6.1.1

http://www.decc.gov.uk/en/content/cms/statistics/source/source.aspx

Notes:

1) The drop in Large scale hydro power production in 2010 was due to low rainfall in Scotland, see Energy Trends Dec 2010:

http://webarchive.nationalarchives.gov.uk/20130109092117/http:/www.decc.gov.uk/en/content/cms/statistics/publications/trends/trends.aspx

2) Total electricity supply is made up of energy production, pumped storage, exports minus imports. Final consumption is the energy supplied minus losses and electricity used in the energy industry (see DUKES Table 5.1.2).

Table 9b: Renewable Heat Generation (GWh)

	Household consumption (modelled)	Active solar heating	Landfill gas	Sewage sludge digestion	Wood combustion - domestic	Wood combustion - industrial	Animal biomass[1]	Plant biomass[2]	Anaerobic digestion[3]	Energy from waste combustion	Total bioenergy	Deep geo-thermal	Heat pumps[4]	Total renewable generation
1990	392,881	75	397	402	2,025			833	2	361	4,022	10		4,106
1991	439,088	79	422	506	2,025			833	2	390	4,179	10		4,267
1992	430,387	83	366	506	2,375			833	3	359	4,442	10		4,534
1993	446,675	86	175	395	2,375	2,753		833	3	328	6,863	10		6,959
1994	427,493	90	220	606	2,375	5,293		833	3	343	9,673	10		9,773
1995	412,361	94	175	681	2,375	5,792		833	3	355	10,215	10		10,319
1996	474,930	101	193	681	2,375	5,879		833	3	370	10,335	10		10,445
1997	435,392	103	180	677	2,375	5,886		833	3	105	10,059	10		10,172
1998	450,366	106	158	629	2,375	5,081		834	3	177	9,257	10		9,373
1999	449,596	109	158	631	2,375	4,277		836	3	235	8,514	10		8,633
2000	457,344	129	158	562	2,375	2,956		836	3	287	7,177	10		7,315
2001	471,952	154	158	574	2,375	2,620		836	3	305	6,870	10		7,034
2002	459,025	187	158	621	2,375	2,620		836	3	392	7,005	10		7,202
2003	466,282	230	158	609	2,394	2,620		836	3	392	7,012	10		7,251
2004	476,024	286	158	637	2,703	2,620		836	23	392	7,369	10		7,664
2005	456,664	341	158	615	3,089	1,083	144	1,075	23	392	6,580	10		6,932
2006	441,220	422	158	513	3,475	1,128	266	1,198	23	392	7,154	10		7,585
2007	421,378	522	158	575	3,861	1,177	533	1,313	23	392	8,033	10		8,564
2008	431,828	544	158	579	3,679	2,562	470	2,256	23	370	10,096	10	31	10,681
2009	410,376	896	158	593	4,010	2,599	445	2,645	23	367	10,840	10	131	11,876
2010	474,424	1,134	158	672	4,414	2,974	469	3,140	56	301	12,184	10	275	13,603
2011	362,640	1,424	158	769	4,947	3,278	416	3,355	114	384	13,421	10	455	15,309
2012(P)	412,014	1,781	158	839	5,306	3,527	366	3,199	175	375	13,946	10	652	16,389

Source:

DECC: DUKES 2013, Table 6.1.1

https://www.gov.uk/government/publications/renewable-sources-of-energy-chapter-6-digest-of-united-kingdom-energy-statistics-dukes

Energy Consumption in the United Kingdom (2013) - Domestic Sector, Table 3.05

https://www.gov.uk/government/publications/energy-consumption-in-the-uk

Notes

1) Includes heat from meat and bone combustion and sewage sludge combustion.

2) Includes heat from straw, energy crops and paper and packaging.

3) Includes heat from farm waste digestion and other non-farm AD.

4) Data on heat pumps were included in this table for the first time in 2011. There was a negligible contribution prior to 2008.

5) Minor revisions based on updated DUKES & ECUK data

6) Renewable energy figures were converted from the units in DUKES (thousand toe) to GWh: 1 toe = 11,630 kWh.

Table 9c: Household Renewable Technologies (Cumulative Installations and Annual Energy, 2008)

Technology	Number of installations	Energy (MWh/year)
Solar PV	917	2,624
Wind	1,480	2,438
Micro-hydro	56	2,939
Solar thermal	80,883	109,243
Biomass	376	8,752
GSHP	2,457	42,052

Source:

Element Energy (2008), Number of Microgeneration units installed in England, Wales, Scotland and Northern Ireland, BERR

http://webarchive.nationalarchives.gov.uk/+/http://www.berr.gov.uk/files/file49151.pdf

Notes:

1) Wind data is from December 2007, Photovoltaics and Micro-Hydro data is from August 2008.

2) Solar thermal data is from July 2008. Biomass and Ground Source Heat Pump data from August 2008.

3) The cumulative number of household installation figures (both electricity and heat generating technologies) are the sum of known installations under the following grant streams - Energy Efficiency Commitment 2, Low Carbon Building Programme 1 – households and communities, Scottish Community and Householder Renewables Initiative, Reconnect, Scottish Renewable Heating (Fuel Poverty) pilot.

4) Household energy (electricity and heat generating technologies) is estimated using the ratio of household and non-household installations and the total energy delivered from both household and non-household installations in the Element Energy (2008) study.

Table 9d: FIT Installations and Capacity (domestic sector)

		Domestic Sector												All Sectors (Domestic, Commercial, Industrial, Community)	
		Anaerobic Digestion		Hydro		Micro CHP		Photovoltaics		Wind		Total Domestic		Total	
Year	Month	Number of Installations	Installed Capacity (MW)	Number of Installations	Installed Capacity (MW)	Number of Installations	Installed Capacity (MW)	Number of Installations	Installed Capacity (MW)	Number of Installations	Installed Capacity (MW)	Number of Installations	Installed Capacity (MW)	Number of Installations	Installed Capacity (MW)
2010	Q2 (to end June)	0	0	0	0	0	0	2,678	7	38	0	2,716	7	2,755	15
	Q3 (to end Sept)	0	0	90	1	5	0	7,675	19	565	4	8,335	24	8,473	28
	Q4 (to end Dec)	0	0	30	0	17	0	6,422	17	204	1	6,673	19	7,025	24
2011	Q1 (to end Mar)	0	0	30	0	78	0	11,091	31	199	2	11,398	33	11,785	40
	Q2 (to end June)	0	0	6	0	58	0	14,267	42	133	1	14,464	43	14,775	55
	Q3 (to end Sept)	0	0	9	0	95	0	34,787	104	251	3	35,142	107	35,843	153
	Q4 (to end Dec)	0	0	7	0	67	0	64,228	205	179	2	64,481	207	66,322	342
2012	Q1 (to end Mar)	0	0	9	0	35	0	97,102	313	270	3	97,416	316	100,528	431
	Q2 (to end June)	0	0	18	0	14	0	35,430	124	367	4	35,829	129	37,520	178
	Q3 (to end Sept)	0	0	13	0	30	0	41,683	149	301	3	42,027	152	44,154	217
	Q4 (to end Dec)	0	0	10	0	20	0	26,658	100	560	6	27,248	106	28,750	169
2013	Q1 (to end Mar)	1	0	8	0	18	0	20,017	70	365	4	20,409	75	21,246	138
	Q2 (to end June)	0	0	15	0	13	0	18,114	67	87	1	18,229	69	18,991	127
	Q3 (to 16 Aug)	0	0	4	0	6	0	12,963	47	24	0	12,997	48	13,586	93
Total		1	0	249	3	456	0	393,115	1,294	3,543	35	397,364	1,333	411,753	2,011

Sources:
Ofgem Renewables and CHP Register. FIT Installations Statistical Reports for all technologies, tariff codes and locations
https://www.renewablesandchp.ofgem.gov.uk/

Notes:
1) Gathered from website on 16 August 2013.
2) Slight revisions throughout, compared with 2012 Fact File Table 8d, due to updated figures from the database.
3) Slight discrepancies with the DECC statistics release of 24 July 2013 are due to the dates of accessing the database.

Table 9e: Renewables and Waste: UK Commodity Balances (GWh)

Year	Wood	Waste and Tyres	Geothermal and Active Solar Heat and PV[3]	Heat Pumps[4]	Total renewables
2000	2,373	244	140	n/a	2,756
2001	2,373	267	163	n/a	2,803
2002	2,373	267	198	n/a	2,838
2003	2,373	267	244	n/a	2,884
2004	2,373	267	291	n/a	2,931
2005	3,094	267	337	n/a	3,698
2006	3,477	267	419	n/a	4,164
2007	3,861	267	523	n/a	4,652
2008	4,175	186	651	n/a	5,013
2009r	4,361	186	802	70	5,420
2010	4,559	174	802	140	5,885
2011	4,943	151	802	233	6,594

Sources:

DECC: DUKES 2011, Table 7.1 - 7.3 [2000-2008]

DECC: DUKES 2012, Table 6.1 - 6.3 [2009-2011]

http://www.decc.gov.uk/en/content/cms/statistics/source/renewables/renewables.aspx

Notes:

1) Renewable energy figures were converted from the units in DUKES (thousand toe) to GWh: 1 toe = 11,630 kWh.

2) DUKES tables are revised regularly.

3) PV was included in this data from 2009 onwards.

4) Heat pumps were added to this data from 2009 onwards.

Table 10a: Housing Stock Distribution by Type (millions)

Year	Semi detached	Terraced	Flat	Detached	Bungalow	Other	Total
1970	6.07	5.84	3.15	2.01	1.46	0.33	18.86
2011	7.13	7.74	5.58	4.56	2.40	0.00	27.42

Sources:

GfK Home Audit/CLG: English House Condition Survey, English Housing Survey, Table 401 (updated April 2013)

https://www.gov.uk/government/organisations/department-for-communities-and-local-government/series/english-housing-survey

https://www.gov.uk/government/statistical-data-sets/live-tables-on-household-projections

Notes:

1) 'Other' category consists of all those types of dwellings that do not fit into any standard dwelling type, such as temporary dwellings.

2) The English House Condition Survey is a national survey of housing in England, commissioned by CLG,
and was merged with the Survey of English Housing (another housing survey) to form the English Housing Survey in 2008.

Appendix 2: Changes to methods of data collection

A significant proportion of the data in this report came originally from an annual survey carried out by GfK Marketing Services. However, this data was replaced in 2003 by questions included in the English House Condition Survey (now called the English Housing Survey).

Most of the data underpinning the section, 'How much energy is used in homes?', came from BREHOMES, which itself drew heavily on the GfK data. Until 2003, BREHOMES used annual survey data on household insulation measures and heating systems in England, Wales and Scotland, produced by GfK, as the primary source of input data.

The GfK data was based on questionnaires completed by householders themselves for around 16,000 dwellings per year. However, the quality of this data was perceived to decline following a change of methodology, such that the GfK data was thought to be quite robust up to 2001 but less and less reliable thereafter.

Meanwhile, the English House Condition Survey (EHCS), which was previously a five-yearly survey, became an annual survey – with data available from a rolling annual survey of 8,000 dwellings. The combination of a perceived lack of quality in the GfK data and the availability of an alternative, high-quality annual data source, led to a decision to use EHCS data in place of the GfK data from 2003 onwards.

The EHCS was subsequently merged with the Survey of English Housing (SEH) to become the English Housing Survey (EHS). The EHS is now used as the principal source of annual trend information for a significant part of this report[86].

The EHCS/EHS surveys are carried out not by householders but by trained surveyors. This leads to more accurate data collection, but also to some discontinuities in the data, and readers should be cautious in how they interpret trends from around 2000 to 2004.

Appendix 3: Modelling UK housing energy

Six of the tables and graphs included in Chapter 5 are based on modelled data. From 1970 to 2008, this data was generated using BREHOMES, the Building Research Establishment Housing Model for Energy Studies. However, in 2010 we transferred to the Cambridge Housing Model, developed specifically for DECC in order to produce data for the Fact File and to contribute to National Statistics. This results in a discontinuity in 2009.

This continues the evolution of household energy models, where modelling has improved as understanding of energy use in the home advances. The change in 2009 represents a significant change, where many advances in SAP were incorporated into the model, see below. However, the impact of these changes on the figures published here is reduced because model outputs have been adjusted so total energy use figures match the Digest for UK Energy Statistics.

It is not possible to 'back-cast' the Cambridge Housing Model to 1970, which would be valuable, because there is inadequate input data to use for the 1970s, 80s and 90s.

To help readers interpret the figures, this Appendix summarises both BREHOMES and the CHM and gives signposts to further information.

BREHOMES

BREHOMES was a multiple dwellings model of domestic energy consumption in Britain. BREHOMES was based on a basic version of the single dwelling Building Research Establishment Domestic Energy Model (BREDEM), which calculates annual energy requirements of domestic buildings, and can be used to estimate savings resulting from energy conservation measures.

BREHOMES assumed 1008 different categories of dwelling, based on tenure, house type, age, and the inclusion or exclusion of central heating. For primary data sources BREHOMES used information on household insulation measures and heating systems from the English Housing Survey (EHS), weather data, and estimates of electricity consumption from the Market Transformation Programme (MTP) model. BREHOMES calculated heat losses and energy consumption for each of the 1008 categories of dwelling, and then aggregated to give GB totals, based on the number of dwellings in each category and an extrapolation from the numbers of English to GB dwellings[87].

The Digest of UK Energy Statistics (DUKES) publishes national totals of energy consumption broken down by sector, including totals for domestic energy consumption. While outputs from BREHOMES were estimates, and unlikely to match these actual figures exactly, BREHOMES allowed the user to reconcile calculated outputs with actual domestic energy totals from DUKES. The reconciliation process involved the user modifying assumptions within plausible boundaries and re-running the model. (The main way to ensure that BREHOMES outputs are consistent with DUKES was by altering the internal demand temperature.) This process was repeated iteratively until the model and DUKES totals were in reasonable agreement.

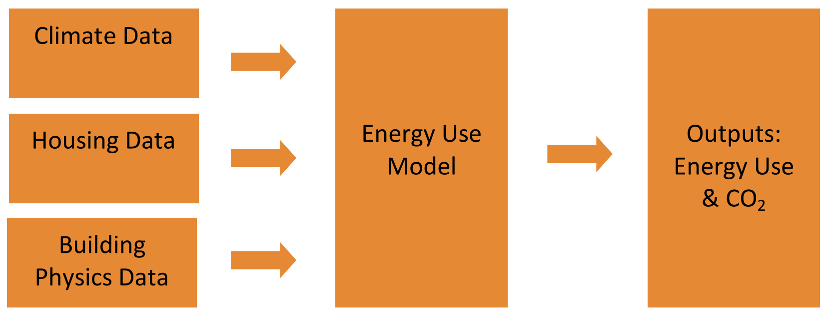
The reconciliation was intended to ensure that modelling assumptions were reasonable. This provided a more reliable basis for predicting future domestic energy consumption and possible savings from energy efficiency measures.

Cambridge Housing Model

Cambridge Architectural Research developed the Cambridge Housing Model to estimate energy use and CO_2 emissions for housing in England, Scotland, Great Britain and the UK. The CHM is a bottom-up building physics model based on SAP 2009[88] and BREDEM[89] calculations. It uses regional climate data at the level of the old Government Office regions. The main source of input data for the CHM is the English Housing Survey (EHS)[90], the national survey of housing in England.

The principle components of the CHM are climate data, housing data, building physics calculations derived from the Standard Assessment Procedure (SAP) plus associated SAP data, and the model outputs. The SAP building physics data comprises information such as SAP parameters used in SAP calculations, for example the thermal bridge parameter y, and SAP values like U-values taken from SAP data tables.

The CHM reads in data for each representative dwelling, performs building physics calculations, and outputs energy consumption and associated CO_2 emissions by fuel and by end-use, for each representative dwelling and for the whole English stock. To make it accessible and transparent to third parties, the CHM was built in Microsoft Excel, with calculations principally performed directly within worksheets.



Main components of the Cambridge Housing Model

The model uses monthly solar declination data and regional latitude data, both taken from SAP, monthly/regional solar radiation data from BREDEM-8, and monthly/regional year-specific wind speed and external temperature data taken from a series of weather station measurements for the year in question (see *A Guide to the Cambridge Housing Model*[91]).

The CHM performs building physics calculations on each of the representative dwellings in the EHS (16,670 of them in 2010). The EHS data includes weighting factors for each representative dwelling so the sum of these weightings equates to the total number of dwellings in England. Using these weightings we extrapolate from estimates for the 16,670 sampled dwellings to estimates of total domestic energy consumption in England. Scaling to GB or UK energy totals is achieved by simple pro rata calculations based on the number of households[92].

The SAP methodology is the accepted approach for assessing the energy performance of dwellings, intended primarily for checking compliance with Part L of the Building Regulations[93], and rather than estimating national household energy use. So we made a series of modifications to the original SAP calculations to produce a model for housing stock energy estimates.

We estimate appliances energy use based on SAP Appendix L, and cooking energy use is based on BREDEM-8 with adjustments relating to cooking heat gains. One of our key modifications relates to indoor demand temperature. In our baseline model we assume a demand temperature of 19°C for the living area for all dwellings, as opposed to 21°C in SAP – in part because SAP assumptions about demand temperature in new homes may not apply in older dwellings.

Other changes to the original SAP calculations include using regional and monthly external temperature, solar radiation and wind speed data – as opposed to national level data, and using EHS data on the number of occupants in each dwelling. For dwellings identified as having no occupants we simply assumed (in the absence of any reliable data) that these dwellings are vacant and use just 10% of SAP-calculated energy to simulate reduced energy use. There are more detailed descriptions of the CHM on DECC's website, see *The Cambridge Housing Model*[94], and *A Guide to the Cambridge Housing Model*[95].

Appendix 4: Uncertainty in modelling

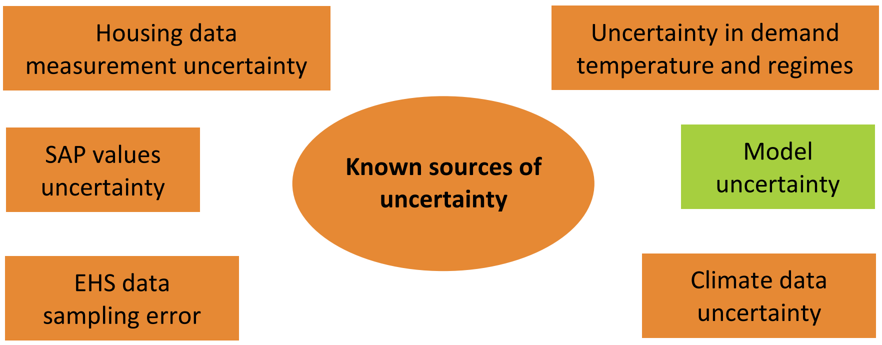
We noted in Appendix 3 that six of the tables and graphs included in Chapter 5 are based on modelled data. They are therefore subject to uncertainty, and although we have shown single point estimates for the breakdowns of energy use to maintain clarity, in reality a range of values is possible. We have specifically marked all modelled graphs with coloured borders to highlight the uncertainty.

This Appendix first considers possible sources of uncertainty in the modelling process, and then the Monte Carlo analysis we used to assess the potential impact of this uncertainty on our modelled estimates. We then summarise the results of two global sensitivity analyses: 'Elementary Effects' and a variance-based approach. Both help to identify the uncertain parameters most responsible for the observed range of estimates identified by the uncertainty analysis.

The baseline CHM v2.9 estimates total domestic energy use for England in 2011 as 432 TWh, against a measured value from DUKES[96] of 377 TWh, based on pro rata scaling. This suggests the model overestimates by about 15%. However, the 'measured' figure is itself subject to uncertainty, both how the DUKES data is assembled and how we scale from UK to England[97].

Uncertainty analysis

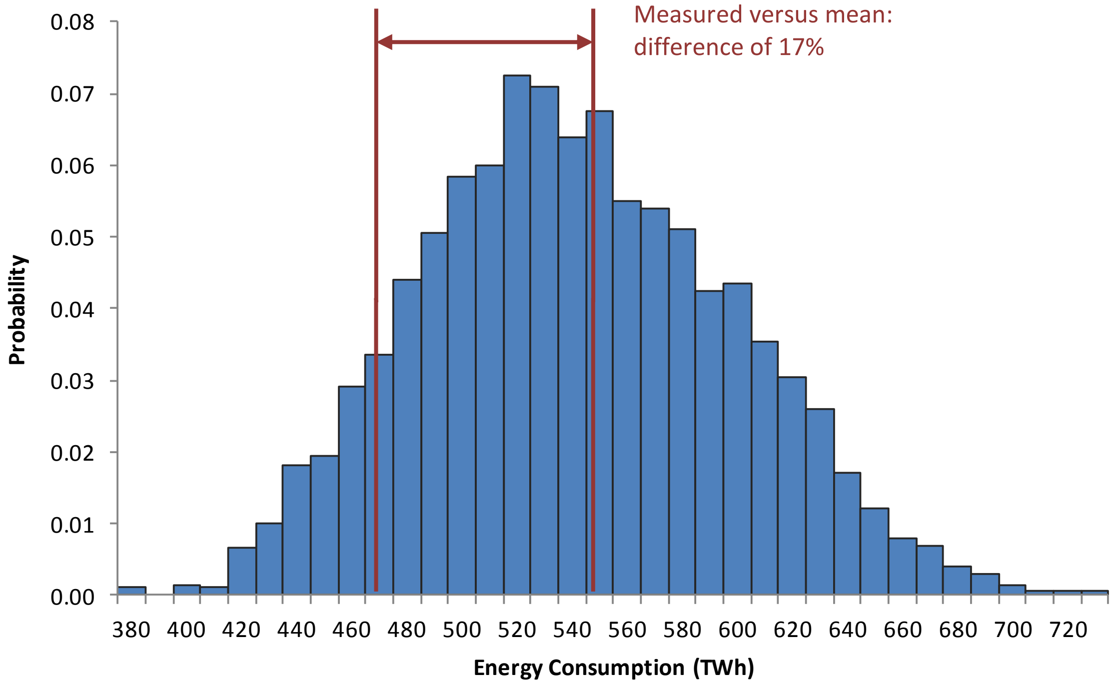
To appreciate the impact of uncertainty on model outputs involves estimating the nature of the uncertainty in modelling, and combining the effects of these uncertainties simultaneously. The figure below gives an overview of the known sources of uncertainty.



Known sources of uncertainty in the CHM

These sources of uncertainty are described in more detail elsewhere, along with a more thorough description of our uncertainty work[16]. We defined simple levels of uncertainty for 48 model parameters and carried out Monte Carlo simulation based on random sampling. This involves repeated running of the model with different randomly generated values for the uncertain parameters in each simulation run. This captures uncertainty in all the sources of uncertainty shown in the figure – except for 'model uncertainty', which is dealt with separately below. The output of a run is a single point estimate of total domestic energy, but repeated runs using random sampling generates a probabilistic distribution of energy estimates due to the uncertainty in the input parameters.

The distribution for total English domestic energy use in 2010 is shown below. The 95% confidence interval ranges from 439-655 TWh, illustrating the wide range in possible estimates of total energy use when all parameters are systematically varied between upper and lower limits. A similarly wide range of values was also observed in the 2009 analysis. Although we were not able to repeat the analysis for earlier years, it is reasonable to assume a similar level of uncertainty for past estimates, as shown in Graph 2b on page 10.



Monte Carlo distributions of total English domestic energy consumption in 2010 using the CHM. The 'measured' value from DUKES is 463 TWh and the difference between this and our mean is 17%.

'Model uncertainty' was omitted from the Monte Carlo analysis and is therefore not included in the distribution of values shown. However we know that the difference between our uncertainty analysis mean value and the 'measured' total energy use in 2010 was 17%. This is a systematic over estimate, or 'modelling gap', as distinct from the range of outputs shown. We have adjusted the estimates of energy use cited in the Fact File to reflect this modelling gap. To assess the full uncertainty in our figures, readers should consider both the 17% over estimate *and* the 95% confidence interval shown above.

Global sensitivity analysis

Sensitivity analysis is a systematic method for changing parameters in a model in order to assess the impacts of those changes, and a number of sensitivity analysis methods are available. Previously we adopted a local one-at-a-time approach to determine the relative significance of parameters. However, such an approach suffers from a number of limitations: the analysis is based around a single point, rather than considering the full space of uncertain values; nonlinear and non-additive effects are not accounted for (the response of a model is non-additive if the impact of adding the individual effects of changes to several parameters is different from the impact of changing those parameters simultaneously); and the actual uncertainty in the model is not considered directly, rather some simplistic variation is applied, e.g. changing all parameters by ±1%.

The Elementary Effects and variance-based analyses together overcome all of the limitations of a local one-at-a-time analysis[98]. Of the 48 uncertain parameters considered, the Elementary Effects analysis determined that fewer than ten were primarily responsible for the distribution of outputs shown above. The table below shows the results of the variance-based approach, considering only the nine parameters identified as most significant. The parameters are sorted into descending order in terms of the significance of their contribution to the range of outputs.

The table shows that uncertainty in SAP wall U-values and internal demand temperature have by far the most significance, accounting for 84% of the observed output uncertainty. This is followed by uncertainty in SAP roof, window and floor U-values. Taken together, uncertainty in these five parameters accounts for 96% of the observed output uncertainty.

	Input parameter	Uncertainty contribution
1	SAP Wall U-values	44%
2	Demand temperature	40%
3	SAP Roof U-values	5%
4	SAP Window U-values	4%
5	SAP Floor U-values	3%
6	External temperature (spatial)	3%
7	Heating regime	1%
8	Heating efficiency	0%
9	Window orientation	0%

Global sensitivity analysis for the nine most significant parameters in the Cambridge Housing Model

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