United Kingdom housing energy fact file

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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 Econometrics. The views expressed are not necessarily DECC's. December 2012.

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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.

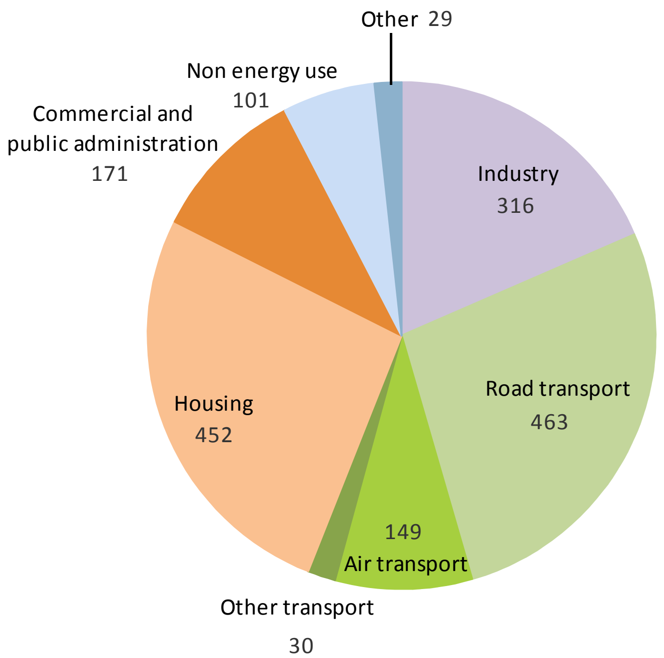
The UK's homes, and how they are used, has changed enormously since 1970.

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 6m, 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.

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.



Graph 1a: Final energy consumption by sector 2011 (UK, TWh, Total 1,710 TWh)

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. (Readers interested in even longer timescales can find information on some of the Fact File topics stretching back as far as 1921 in *Ninety Years of Housing, 1921 to 2011*[1].)

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

One significant change in this year's Fact File is that it focuses on the UK rather than Great Britain, as we did in 2011. This means we have revised all the data to describe the whole of the UK (including Northern Ireland).

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

Housing is 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[2] paved the way for the Green Deal[3], which is 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 will allow householders to pay for energy efficiency improvements through savings on their energy bills. Advisors and approved companies will be tasked with identifying improvements where savings are likely to be greater than the costs.

The Green Deal should work in tandem with the new Energy Company Obligation[4] (ECO), which will be funded by energy suppliers, and take the place of the old Carbon Emissions Reduction Target (CERT) and Community Energy Saving Programme (CESP). The ECO will provide extra assistance for properties that are harder to treat, including solid wall and 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 will create a new market place of nationwide brands, thousands of jobs among installers and manufacturers in small local businesses.

David Thomas. Deputy Director, Green Deal, DECC

The final regulations to support the Green Deal were placed before Parliament in June 2012, with an initial launch of the initiative in Autumn 2012 and full roll-out in 2013. The Government expects the Green Deal to bring a whole range of new players into the provision of energy efficiency, including large and small companies, local authorities and charities – thereby promoting a revolution in the energy efficiency of the nation's housing stock.

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 16,000 homes. These errors are described and quantified in some detail elsewhere, see *English Housing Survey: Homes 2010*[5].

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 1970-2010

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.

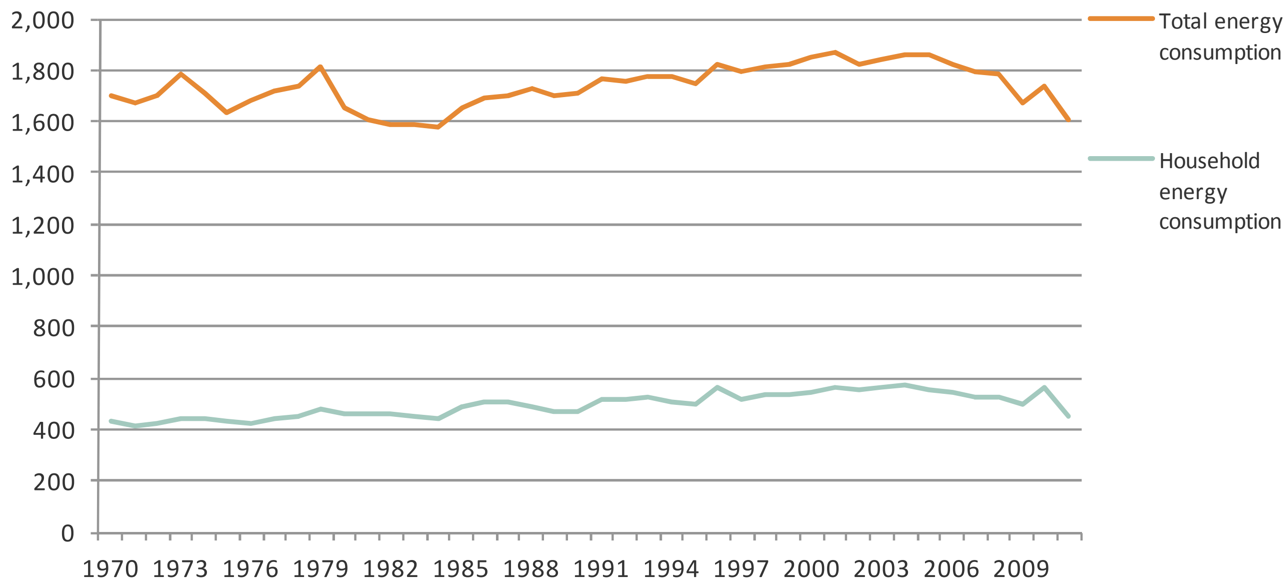
Similarly, the total use of energy hides variations in carbon emissions, because different fuels lead to higher, or lower, levels of CO_2 emissions. Nor does this aggregate information say anything about energy spending – because each fuel has a different price, which can vary independently.

Nevertheless, total fuel use is a simple barometer of whether more, or less, energy is used in all British 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 rose more than 12% in 2010 – largely because of the harsh winter weather. It fell back again by a staggering 20% in 2011.

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, TWh)

Total energy use in the UK rose and fell during the 42 years covered in the graph. However, it finished the period a little above the level of use in 1970: 1,600 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, continuously, 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.)

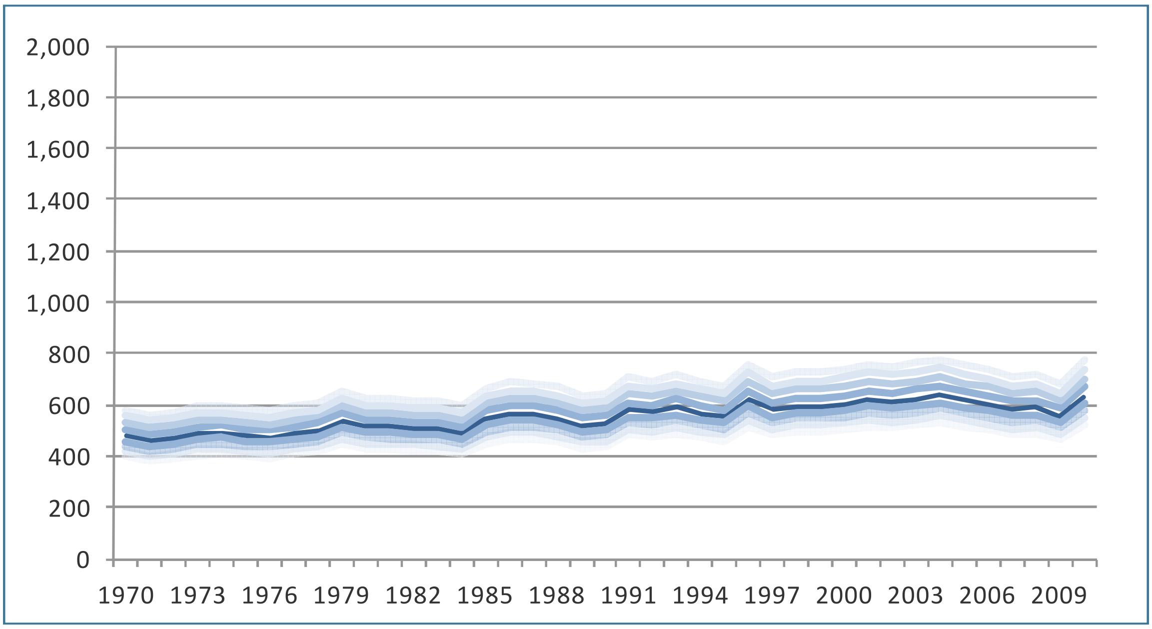
Energy use in housing rose by 5% from 1970 to 2011 – an average increase of just 0.1% per year. However, the number of homes also increased by half, and average household size has fallen (see Chapter 4). Taken together, this means average energy use per home has fallen – from 23,800 to 16,700 kWh – although 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 a little.

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 for total household energy use in 2009 and 2010. 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 1970-2010 (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 two key points raised:

- Carbon dioxide emissions from housing have fallen since 1990, even including the cold winter of 2010. 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 have increased in real terms, while gas costs per unit have fallen somewhat over the last 40 years. Rising costs for electricity hit poorer households with electric heating the hardest.

Carbon emissions

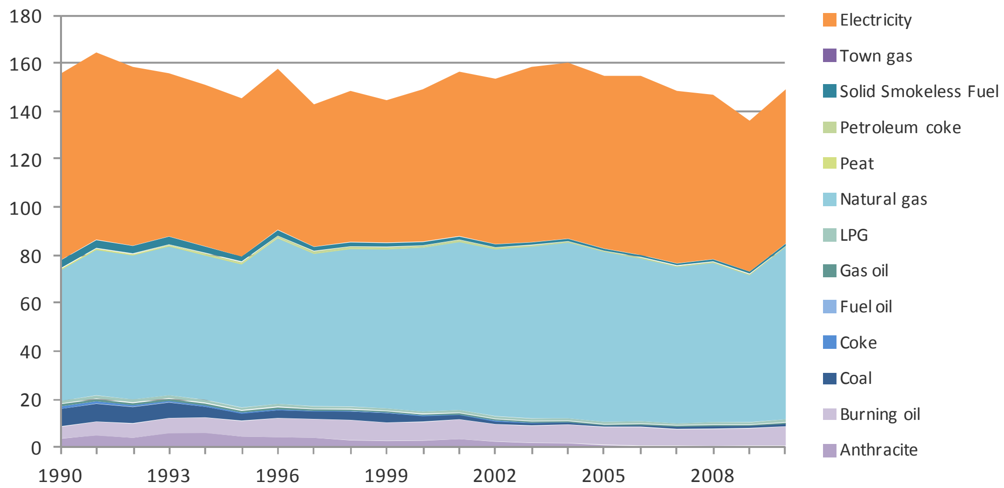
There are many more UK homes now than there were 40 years ago: nearly 27 million today, compared to nearly 19 million in 1970, and towards 23 million in 1990. Inevitably, this puts upward pressure on carbon emissions.

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 winter of 2010 lead to higher CO_2 emissions.

Emissions from gas use have increased by a third since 1990, while emissions from solid fuels used for heating have fallen away from more than a tenth in 1990 to less than 2% of housing CO_2 today. Carbon emissions from electricity, meanwhile, have fallen by nearly a fifth since 1990.

Indeed, electricity's share of total household CO_2 emissions fell from half in 1990, down to two-fifths in 2010 (see graph below).



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 from 5 to 8 million tonnes during the period. As a fraction of total household CO_2, they increased from 3 to 5%. 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.

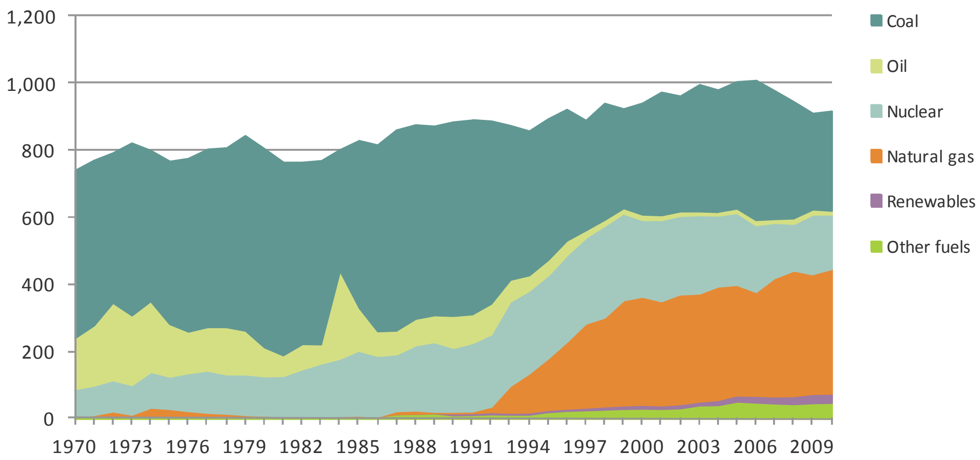
These changes alter the economics and the environmental impact of electricity use – in the home and beyond. Notably, coal has fallen steeply as an input into power generation (see graph next page).

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, 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 has been mainly 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 has fallen to under a third today.



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

Oil has declined even more rapidly in the electricity generating mix: from just over a fifth of Britain's electricity to under 2% now. (There was a big increase in oil use for power generation during the miners' strike in 1984-5.)

Coal and oil have witnessed a steep fall in their share of the power generation mix. Two-fifths of our electricity now comes from gas.

The share of electricity coming from nuclear power almost doubled over the period – from just over 10% in 1970 to just under 20% today. However, nuclear power peaked in 1998, when it generated towards a third of Britain's power, and 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 two-fifths 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 nearly 10%.

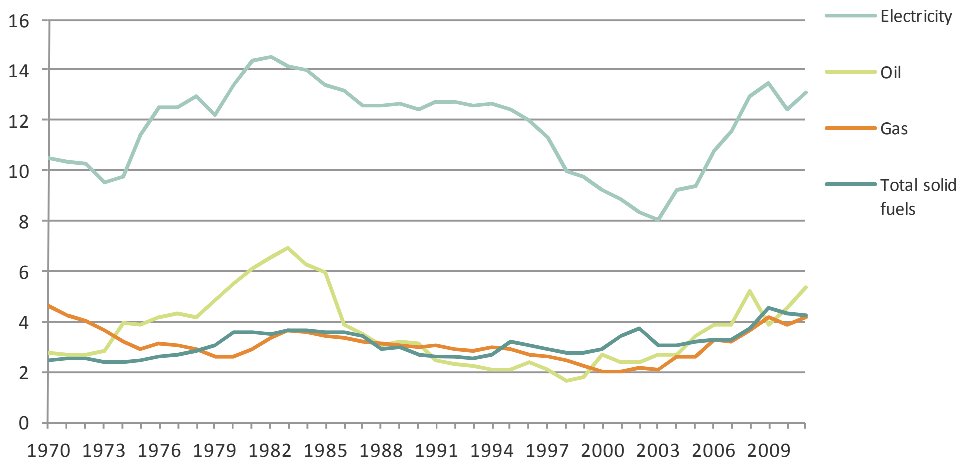
Energy prices

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 fifth 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.

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, 2010 prices)

Heating oil closed the period double the cost in real terms that 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 about 10% lower than they were at the beginning.

The price of solid fuels, including coal, coke and breeze, rose gradually during the period, finishing 75% more expensive in real terms. (This is probably less significant than price changes for electricity and gas because far fewer homes now use solid fuel heating.)

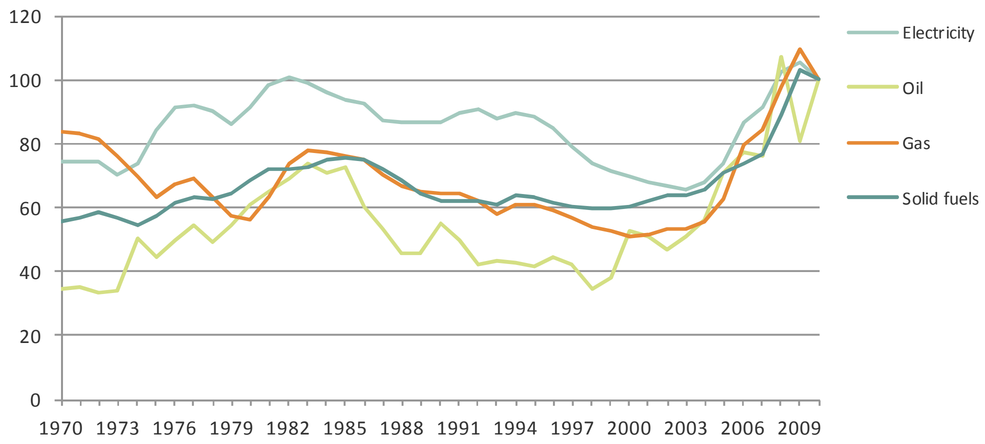
The demand for energy is usually reckoned to be 'inelastic' in the short term (i.e. energy use doesn't change much straight away when prices go up) but 'elastic' in the long term (i.e. a few years after price rises households are able to make changes to save energy).

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.

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[6,7]).

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[8], which comes into force in December 2012, and the phase-out of ordinary incandescent bulbs[9].



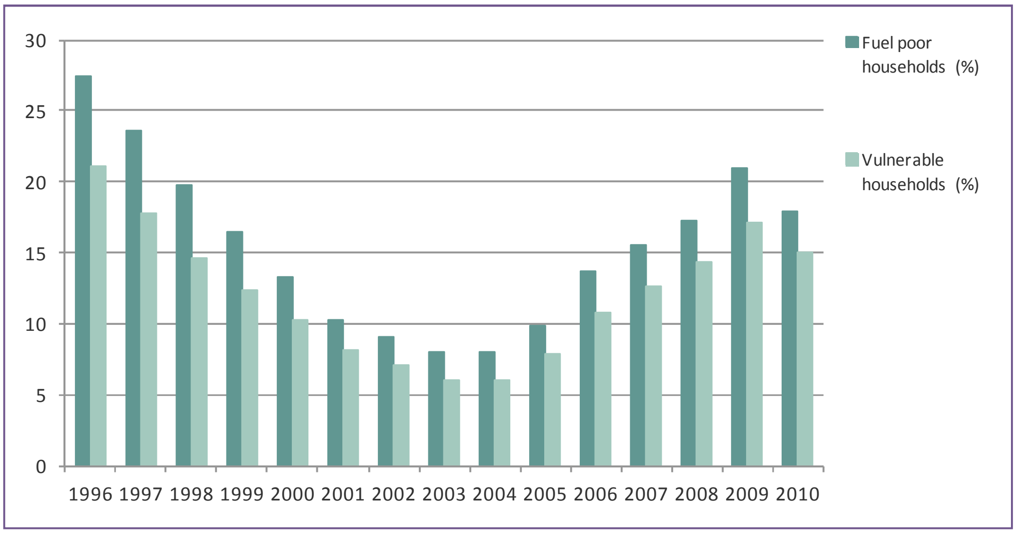
Graph 3d: Average deflated UK household fuel price indices (2010 = 100)

Indexed energy prices, with all fuels adjusted to a base of 100 for 2010, 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.

Fuel poverty

A household is defined as fuel poor if it would spend more than 10% of its income on fuel to maintain comfortable conditions[10]. This is usually defined as 21°C in the living room and 18°C in other occupied rooms. The emphasis is on heating, but the cost of hot water, lights, appliances and cooking are also included.

The graph below shows how fuel poverty has changed since 1970. 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: UK fuel poverty (%)

The modelling suggests that fuel poverty has fallen significantly – from 6.5 million households in 1996 to 4.75 million in 2010, although it rose from 2005 to 2009, largely because of increasing fuel prices.

Households with elderly people, children and people with disabilities or long-term illness are known as 'vulnerable households'. These make up about 70% of households, and it is particularly important to ensure that these households do not fall into fuel poverty, which would make it hard for them to stay comfortable, and bring greater risk of illness.

The number of vulnerable households in fuel poverty has also fallen over the last 14 years – from 5 million to 4 million. As for all fuel poor households, there was a rise in numbers from 2005 to 2009.

The proportion of fuel poor households that are vulnerable varied from 73 to 84%, with a gradual upward trend since 1996.

4. The housing stock, households and bills

The UK's housing stock changes very slowly. There are now 27.3 million dwellings in England, Scotland, Wales and Northern Ireland[11,12], but fewer than 180,000 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'[13].)

The total number of dwellings changes very slowly over time: the average growth in numbers of dwellings from 2000 to 2010 was only 210,000 – less than 1% per year. 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. More recently, CERT has accelerated the rate of 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 – 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 entertainment. 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 energy use in homes is strongly affected by both the population and the number of households. Hot water use and the use of some appliances (kettles, hair driers, washing machines) increase in proportion to household size.

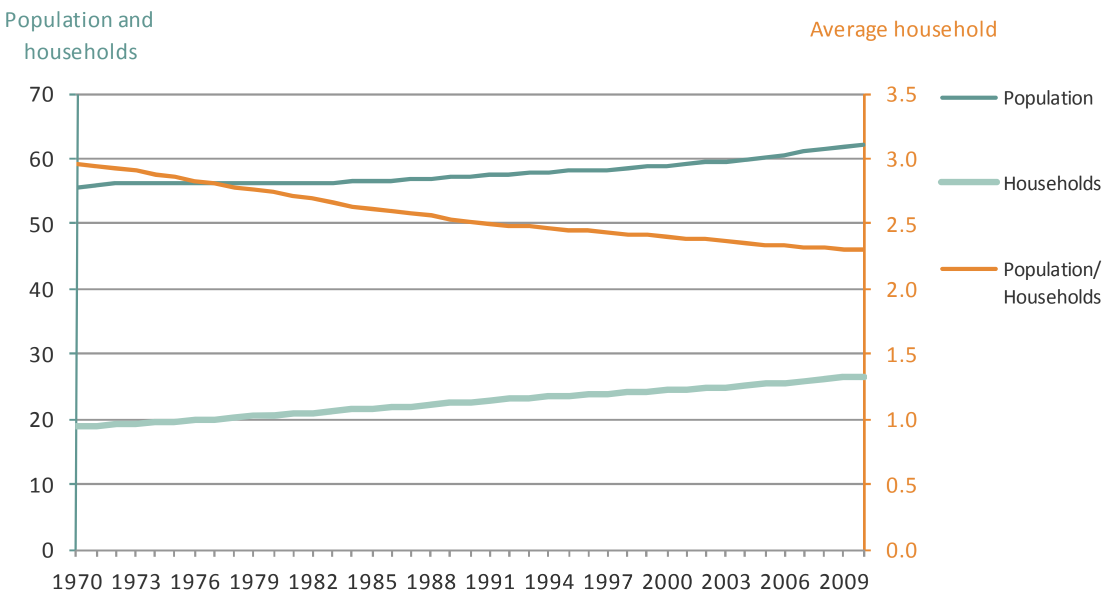
However, heating energy (which is the biggest slice of energy use in homes) usually correlates more strongly to the size of dwellings, and household size makes little difference to heating. (See *Sensitivity Analysis*, Appendix 4, and [14].)

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 (millions)

The population rose from 55.6 million in 1970 to 62.2 million in 2010 – an average 0.28% increase every year. However, the number of households grew more rapidly over the period, from 18.9 million in 1970 to 26.6 million in 2010. The average yearly increase in household numbers was 0.86% (note that this is a steeper rise than from 2000 to 2010).

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.

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.

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

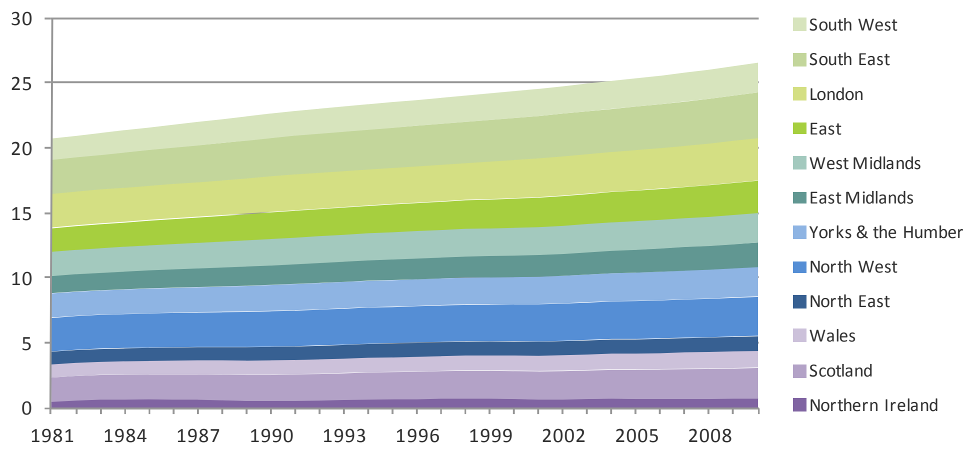
There are also demographic trends affecting how energy is used, and how much. An ageing population with more pensioners, and more flexible working practices – which make people more likely to work from home – mean an increased proportion of dwellings are heated between 9am and 5pm on weekdays. This also 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, one for Scotland and one for Wales, 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 (55% growth), despite declines in population due to outward migration in some years. The South West and the East also grew considerably (both more than 39%).

The North East and North West grew much more slowly – just 15% and 16%, respectively. Scotland's households grew by more than a quarter, while Wales's grew by 29%. 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.

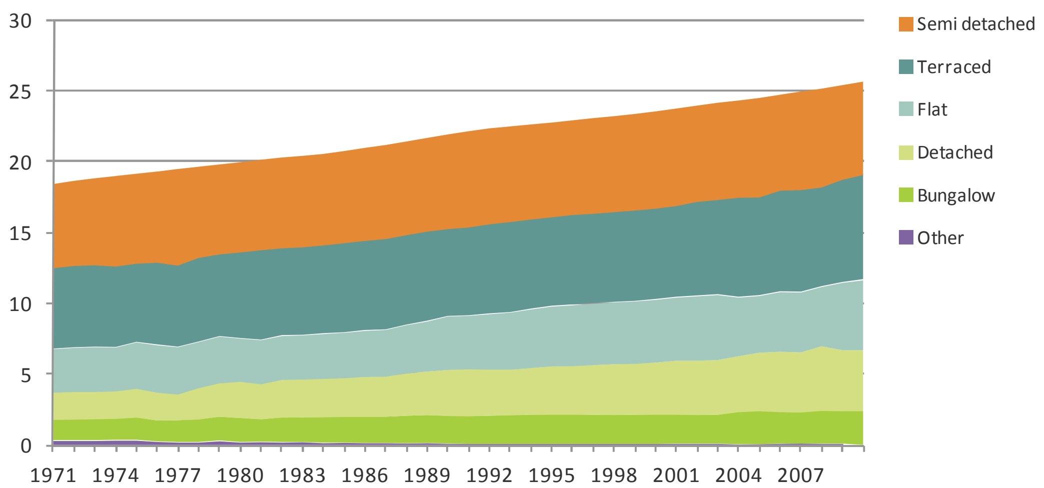
Type profile of homes

'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 19% 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.

Age profile of homes

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

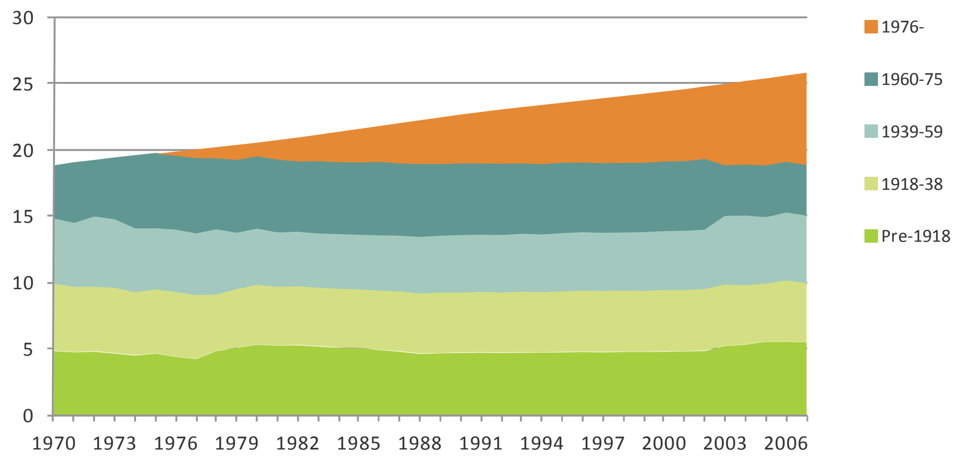
(Even if they have been improved over time and added insulation in the loft and double-glazing, older homes tend to have poorer thermal performance than new homes overall. First, because it is unusual to retrofit underfloor insulation and to insulate solid walls, and second because even older homes with 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.

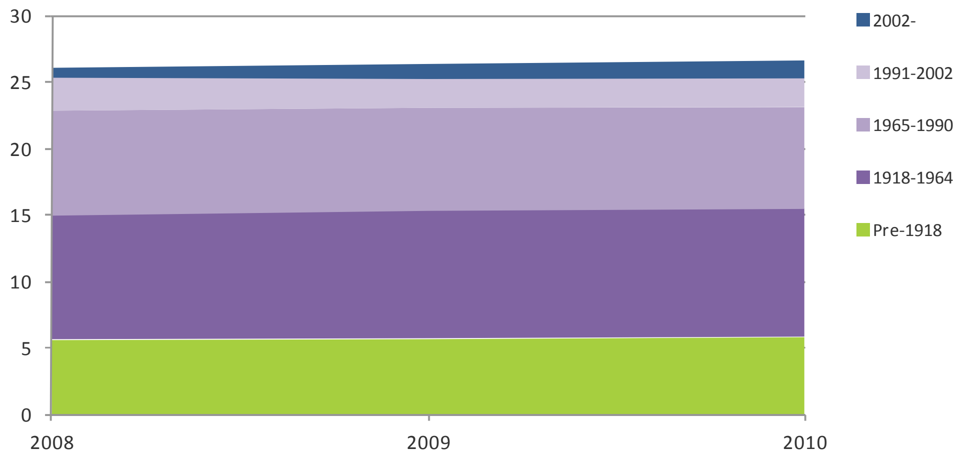
(This does not mean that older homes tend to have heating systems as efficient as those in new homes, and there is a time lag in heating upgrades.)

Because the demolition rate for housing is so low, the number of existing homes for all periods stays almost the same (see graphs below). 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 200,000 new homes were built each year on average from 2000 to 2010 (160,000 in England[15], 23,000 in Scotland[16], and 8,000 in Wales[17]).



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 just over a tenth of the stock.

The dip in the number of 1960s-70s homes shown in Graph 4d 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 force 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 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.

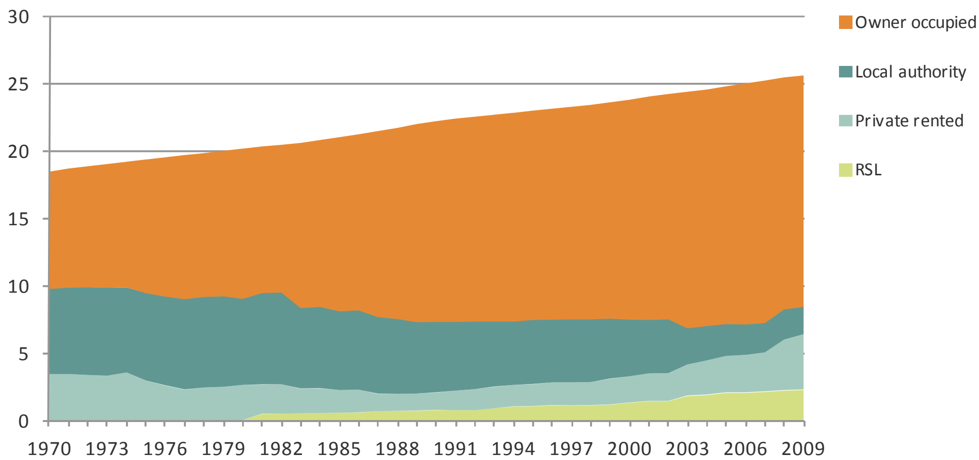
Home ownership

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[18].

Conversely, private rented homes are less well insulated[15]. (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 2008 nearly 70% 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 2009.

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 2008.

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.

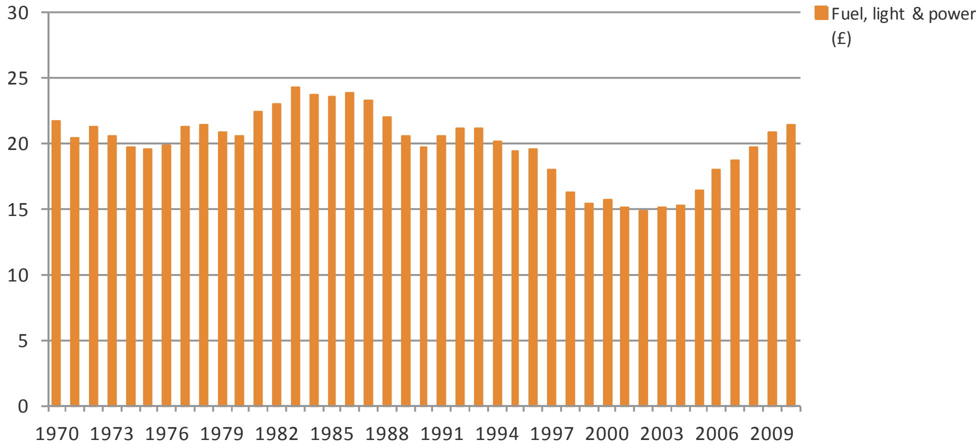
Fewer council-owned properties make it harder to carry out wholesale improvements to a whole street or estate, because of fragmented ownership.

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

Household spending on energy

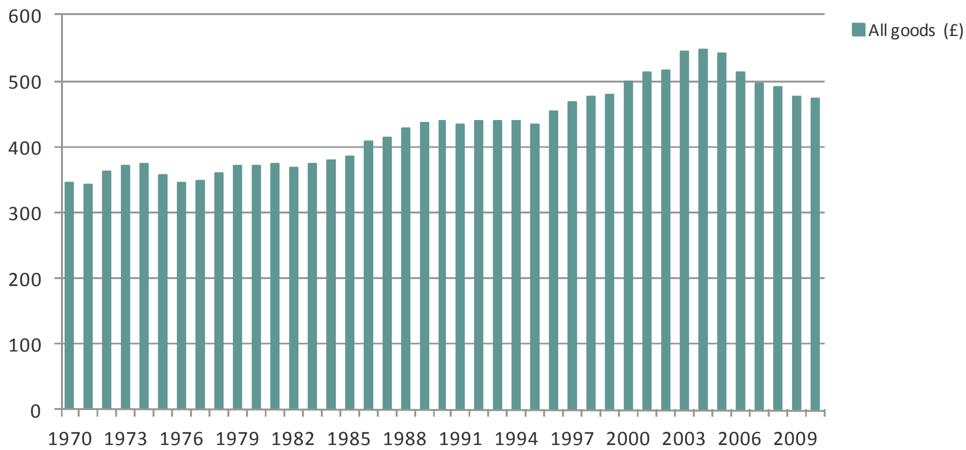
Spending per household on energy has varied markedly since 1970, but average weekly spending on heating, lighting and power reported in the Living Costs and Food Survey [19] was just 1% lower in 2010 than in 1970 (normalised to 2010 prices, see graph below).

Further, the graph below shows that total weekly spending by households has also risen over the period – by two-fifths. This means that energy costs have fallen as a proportion of total household spending: from more than 6% on average in 1970 to nearly 4.5% in 2010. 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 (£/week/household, 2010 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.



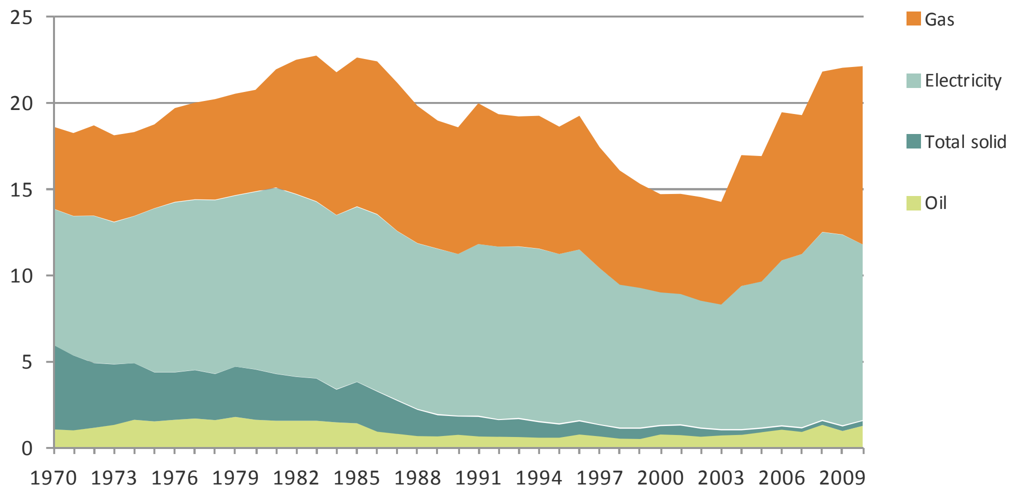
Graph 4g: Average weekly expenditure on all goods (£/wk/household, 2010 prices)

Energy costs have fallen in relation to total household spending – from 6% in 1970 to 4.4% in 2010.

For example, in 1970 total household spending on energy was £350 million per week, averaged over the year, in 2010 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 £6.25 a week.

Whereas, in 2010, total household spending on energy was £586 million per week. The population in 2010 had grown to 62 million, so the average energy cost per person was £9.45 a week. (This increase incorporates both an increase in the use of heating/appliances – see below – and the effect of smaller households.)

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 nearly half – see graph below. Conversely, expenditure on coal is only a twentieth of its level in 1970.



Graph 4h: UK Weekly energy expenditure by fuel (£/household, 2010 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 spend 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.

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

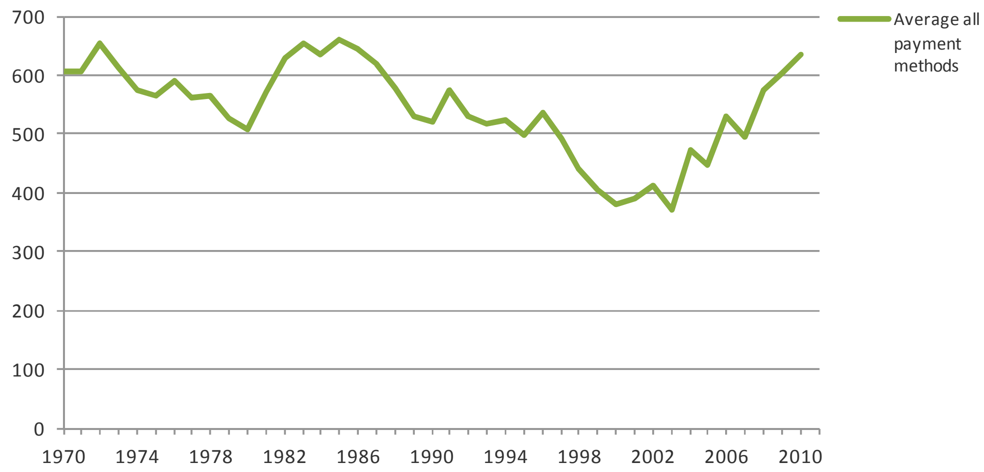
Gas bills

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 method of payment, and discounts are offered to households that pay for their gas using direct debit. Typically, it is around 8% cheaper for households to pay by direct debit and about 6% more expensive for households using prepayment meters[20].

Overall average gas bills per home with gas have fallen and risen again in real terms since 1970 (see Graph 4i below). They closed the period just 4% higher 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 Surveys5 suggest that the number of homes with a gas connection has risen from around 7.7 million in 1970 to around 22.5 million in 2010.

Increased use of gas displaced household spending on solid fuels – now a fraction 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 2010 values, so removing the effect of inflation.



Graph 4i: Average annual gas bill (£, 2010 prices)

Excluding inflation, then, gas bills have increased 70% since 2003, although part of this reflects the very cold winter in 2010, and bills have actually fallen a little since the mid-1980s (4% lower now than in 1985). The average gas bill in 2010 was £634 per year.

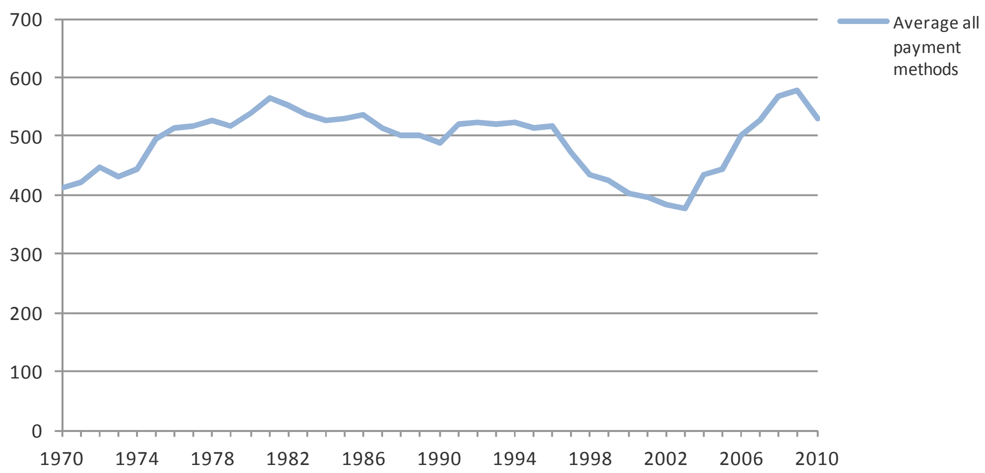
Electricity bills

Again, discounts are offered to electricity customers who pay using direct debit (typically about 5%), while households using prepayment meters pay about 4% more for their electricity.

As for gas, there was a downward trend in average prices until 2003, but then electricity prices rose, and by 2010 the average electricity bill was nearly two-fifths higher than in 2003 – £530 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 30-40% of power was generated from gas, see Table 3b in Appendix 1.

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

On average, despite the cold winter in 2010, electricity bills fell that year – partly because of lower costs per unit.



Graph 4j: Average annual electricity bill (£, 2010 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 2010. Households are divided into ten 'deciles', with the poorest 10% on the left and the richest 10% on the right.

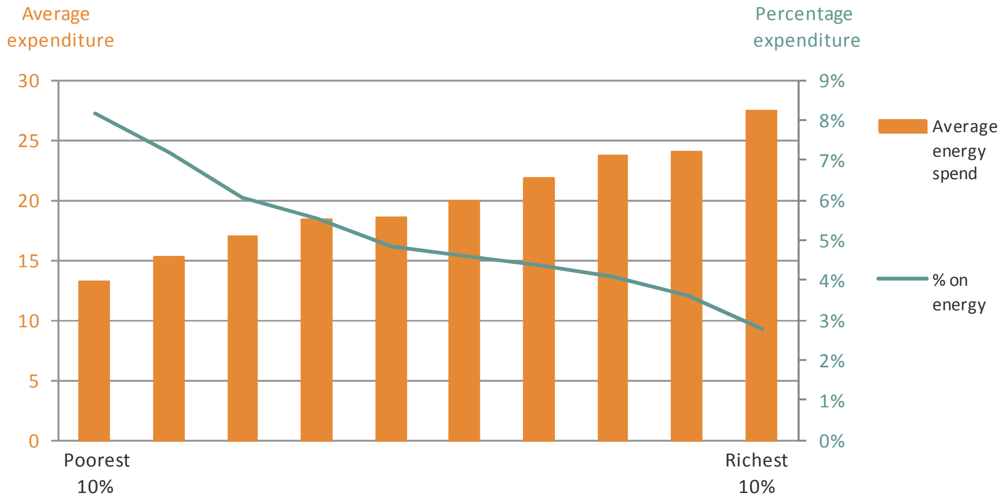
You can see that it is true that wealthier households do spend more on energy each week than poorer ones. Each successive band of income spends more than the one before it on energy, on average, in pounds per week. (The wealthiest 10% also spend significantly more on average – £3.50 a week – than the 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 8.1% on energy*, the wealthiest 10% of households devote just 2.8% 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 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 & power, & income (£/wk/household) 2010

This data is crude, and the reality is that there is limited understanding of how income and poverty affect energy use in homes. More research, along with better survey data would help to unpack the links between income and energy use.

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 41 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, 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) have improved every decade, and the average SAP rating for a UK home is 55.

Energy use and weather

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

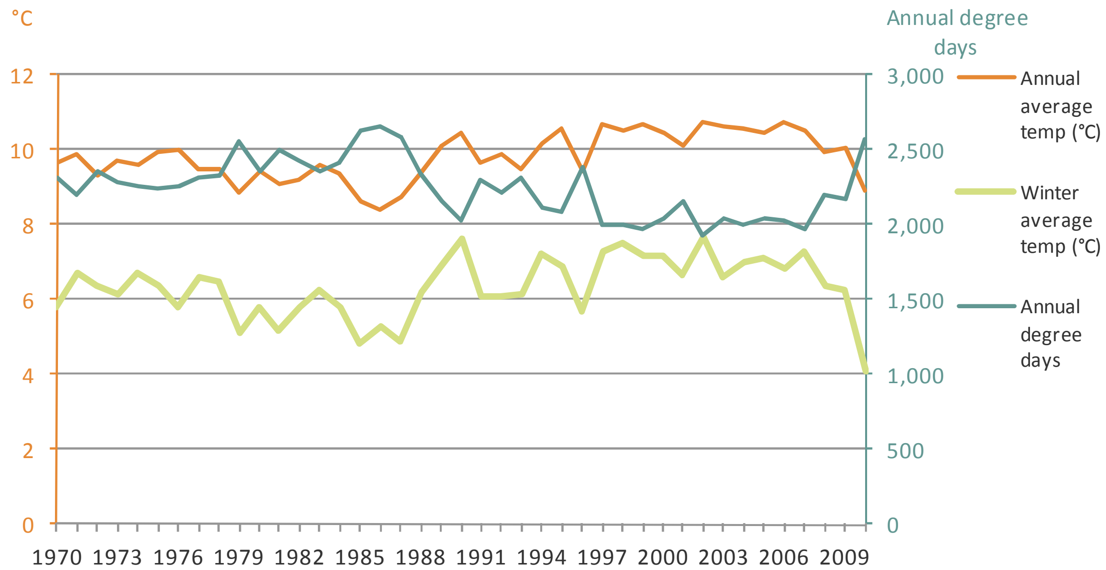
The difference in temperature between outside and inside homes in winter is the single most important factor shaping energy use at home. If it is very cold outside and householders choose to heat their home to 25°C, their home will inevitably use much more heating energy than if it were mild outside and the home were only heated to 18°C.

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 and 2002. You would expect above-average energy use and CO_2

emissions in 1985, 1987 and 2010, and below-average figures in 1990 and 2002.



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. Degree days can also be used to standardise energy use and CO_2 for different weather data.

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

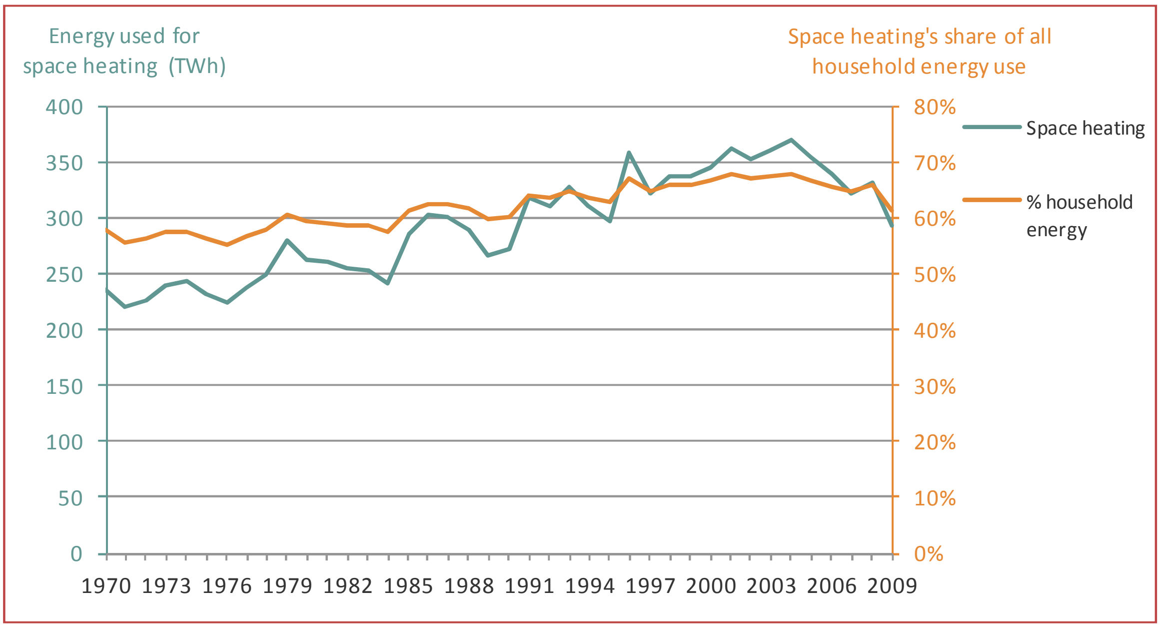
Space heating

Heating energy is by far the biggest slice of UK household energy use. To make serious inroads in cutting CO_2 from housing, 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 bold 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.

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

The four-decade story about heating energy is not the direction of travel needed to meet climate change objectives. In fact modelling suggests heating energy increased by nearly a quarter (see graph below). This is slightly more than the increase in the number of homes (up from 18.9 to 26.6 million – an increase of 41%). This means that improvements in insulation and heating system efficiency were offset by housing growth, and the demand for warmer homes, see Chapter 6.



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

Surprisingly, given the improvements in energy efficiency, heating's share of total energy use in homes has also grown – from 58% to 61.3% – although it fell in the last two years shown. This may indicate that the rise of central heating made more difference to energy use than better energy efficiency – by allowing people to heat the whole of their homes rather than just individual rooms.

Another interpretation is that this reflects 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[21].

However, the good news is that modelling suggests a significant reduction in heating energy used since 2004: a saving of 21%. This does not appear to be the result of milder winters, and some commentators (e.g.[22]) would argue that this is largely due to the increase in energy costs since 2004.

We have cut energy use for heating by 21% since 2004.

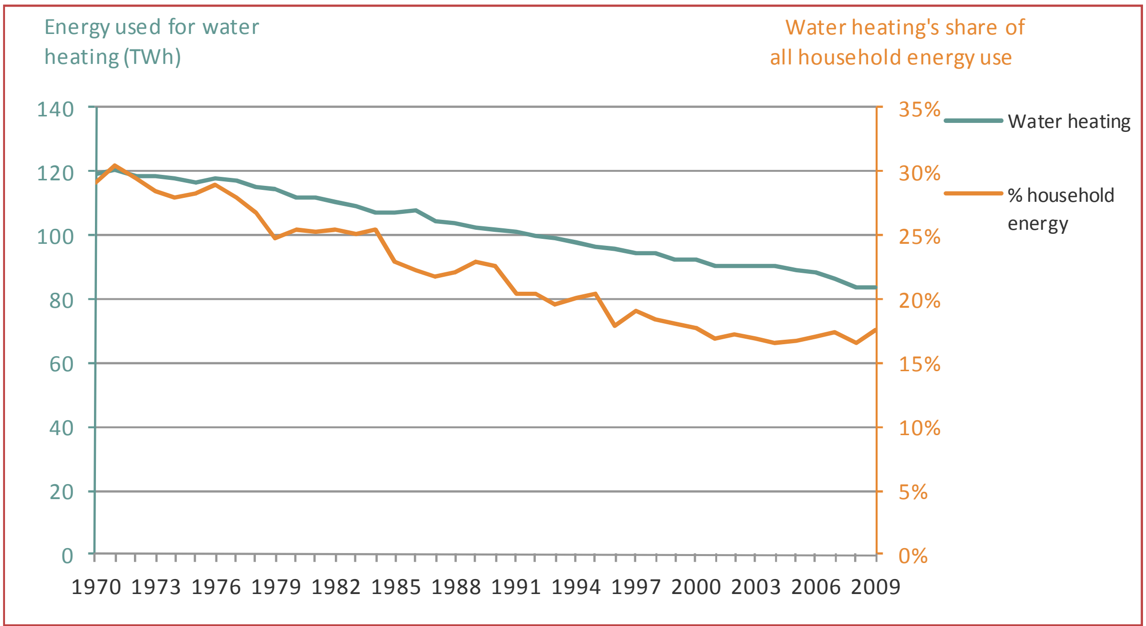
Hot water

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 30% cut 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%*.

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), more efficient heating systems, and also greater use of electric showers and dishwashers.

** Evidence from EST Field Trials[23] 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.*



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.

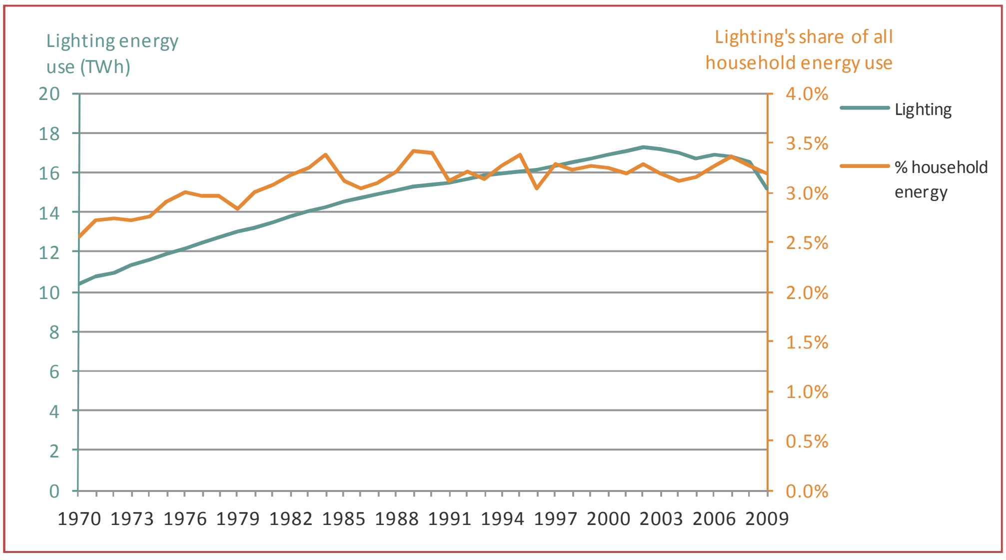
Lighting energy has always been a small proportion of total housing energy (around 3%) and here a very different story emerges. Energy use for lighting increased every year until 2002, and then began to decline – see graph below. Overall it increased by nearly 50% from 1970 to 2009.

(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[24], 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 3.2%. 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*[25]. 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.

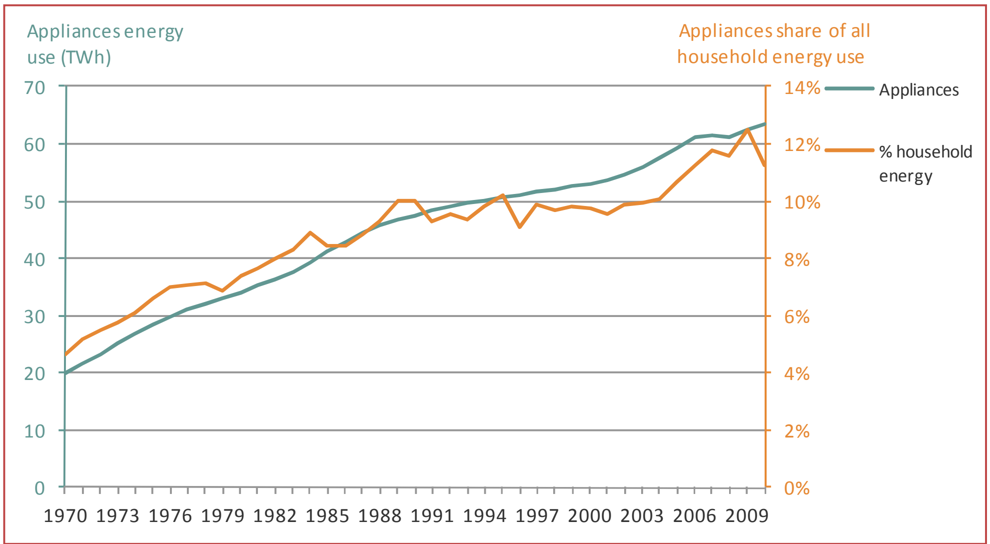
Appliances

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 12.5%.

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 driers, 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.

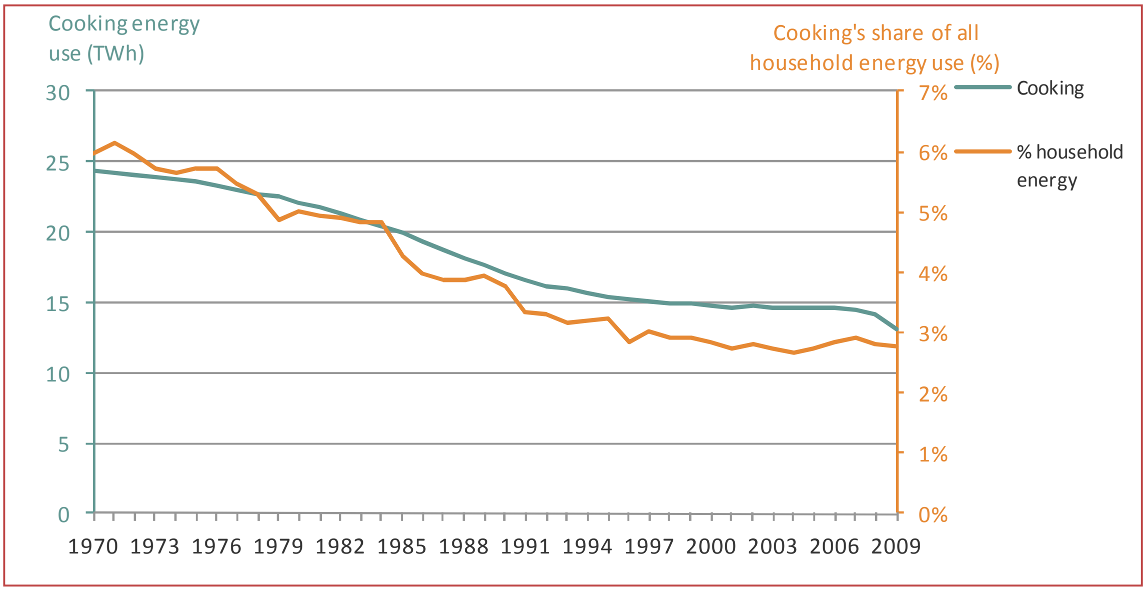
The *Powering the Nation*[25] survey mentioned above found that, on average, 50% or more of the electricity used in homes surveyed was used for appliances. The work suggested that 16% of household electricity powers cold appliances (fridges and freezers), 14% is used for wet appliances (washing machines and dishwashers), 14% for consumer electronics, and 6% for information and communication technology.

We now use 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 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[26]. 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. Indeed, there is evidence that cooking energy savings have been entirely offset by increased energy use for microwaves, kettles and cold appliances, see[27].

(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[25] 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 we will continue to use this for future Fact Files.

SAP rates homes based on the annual energy costs for space heating, water heating, ventilation and lighting (less 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).

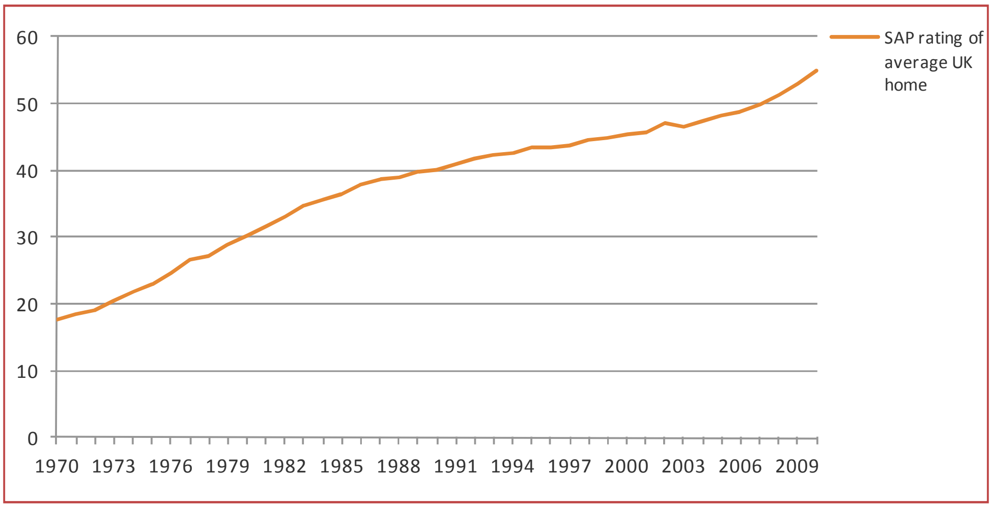
Average SAP ratings are a barometer for how the energy efficiency of the UK's homes has improved.

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 to 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 (outside of 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*[25]).

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.

We have achieved dramatic savings in CO_2 per home since 1970 – down by two-fifths.

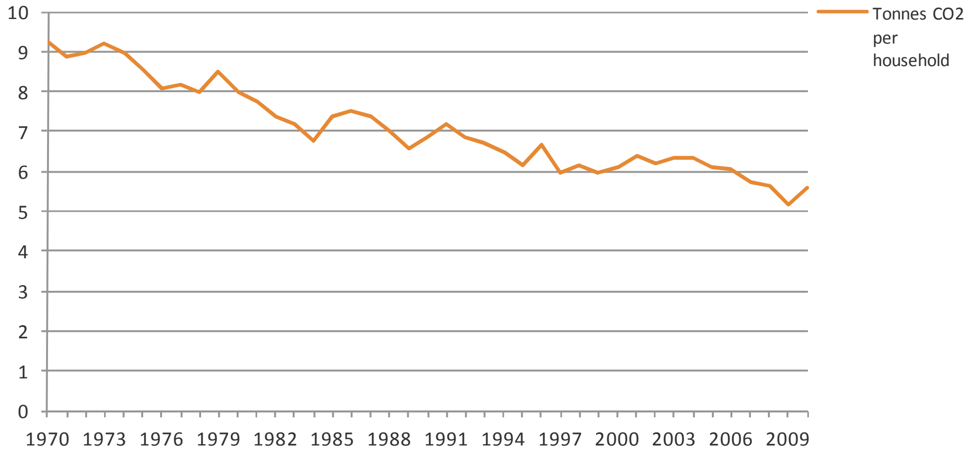
Average CO_2 per home

Carbon dioxide emissions per household have fallen markedly since 1970. This is another quiet success story: CO_2 per home is down by 40% compared to the start of the period, even with the increase caused by the very cold winter in 2010 (see graph below).

The success is particularly impressive given big improvements in winter comfort for nearly all households.

Part of the savings came from 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 (tonnes)

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 annual reduction in CO_2 per household is 1.2%.

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.

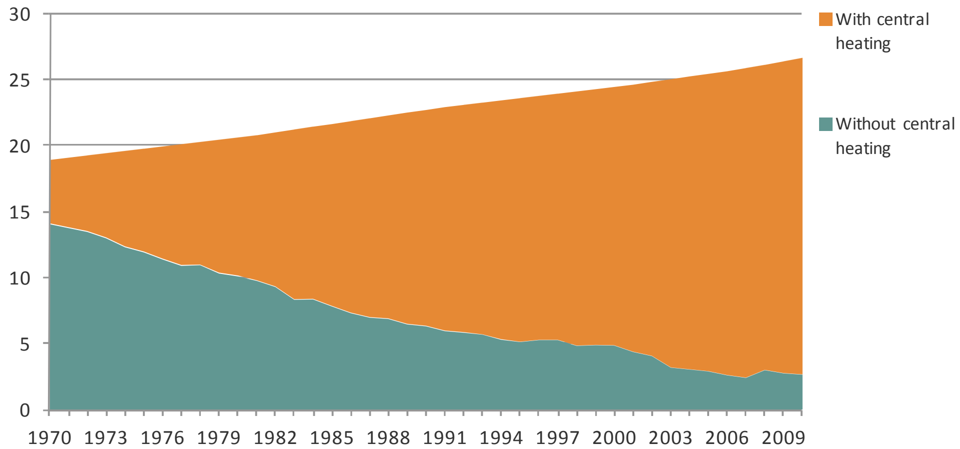
In summary, there are five main trends emerging from the data below:

- 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, less than 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 2010, 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: Households 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[28].

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 5 million so-called fuel poor households – still struggle[29]. Those classed as fuel poor 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.

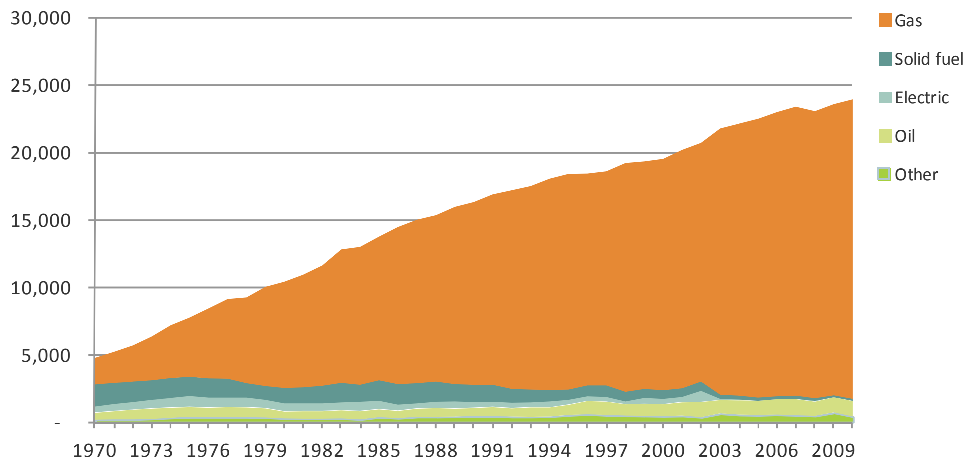
However, energy efficiency improvements are subject to a rebound effect where changes in behaviour – such as demand for warmer rooms – offset energy savings from the improvements. And it is only when indoor temperatures approach some ceiling level of 'comfort' that households are likely to cut heating energy after installing additional energy efficiency measures[30].

On top of this, research has shown[31] 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 Great Britain. 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 quarter of homes with central heating used solid fuel and more than a quarter used some form of electric heating, while 8% used oil and only a third used gas. In 2010, less than 1% used solid fuel or electricity, while oil use had nearly halved to 4.5%. By then, the proportion of households using gas for their central heating had risen to 93%.



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

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

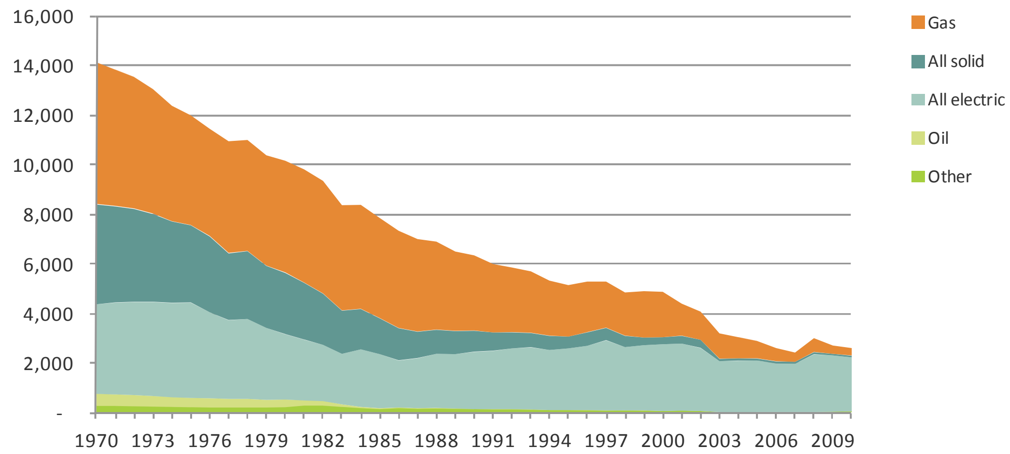
The growth in gas central heating – and especially switching from open fireplaces to condensing gas boilers – made average heating systems much more efficient. Average boiler efficiency (in terms of heating energy output/delivered energy input) has increased from 49 to 77% since 1970[32]. (For comparison, 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 2010, gas use had fallen to just 6% of homes without central heating, solid fuel had declined to 1%, while electric heating rose to 45% of these homes. The majority (four-fifths) of the electric heating was from electric storage heaters.



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

The increase in electric heating in homes without central heating since 2000 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.)

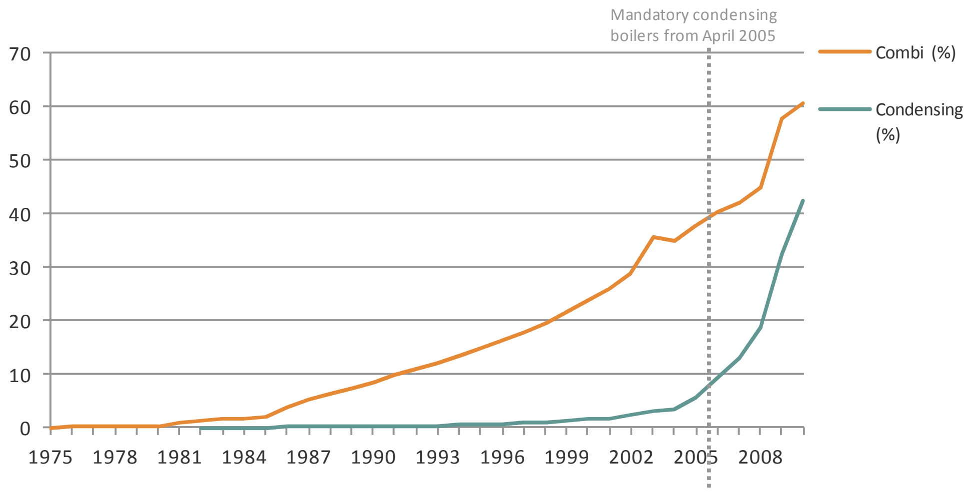
Condensing boilers

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.

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

(The kink in the graph for combi boilers in 2003 is due to changes in the English House Condition Survey.)

Before the 2005 regulation, condensing boilers made up only 6% of the gas and oil boilers in the UK. Five years later, they represented more than two-fifths. This increase translates into a significant improvement in energy efficiency.



Graph 6d: Ownership of condensing and combi boilers (%)

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[33]. However, field trials show lower efficiencies are achieved in practice[34].

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

As the graph above also shows, the growth in use of combination (or 'combi') boilers is almost as pronounced, and the growth started earlier. Their share of the boiler market is now approaching two-thirds of all boilers.

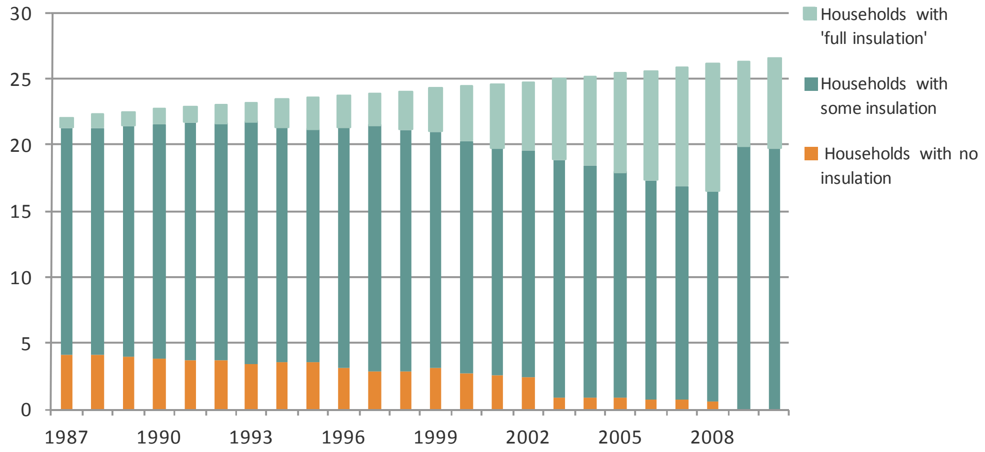
Combi boilers, as their name suggests, combine central heating with domestic hot water heating in one box. These boilers instantly heat water as it flows through the unit, and usually retain little water internally except for what is in the heat exchanger coil.

Until 1982, less than 1% of the gas and oil central heating boilers in the UK were combis. By 2004, more than a third were. Since 2005 combi boilers also have to be condensing. In 2010, condensing combis made up a third of gas and oil central heating boilers in the UK, and these are included in the graph in both the 'Combi' (orange) and 'Condensing' (blue) lines. (This means the total sums to more than 100% for 2010.)

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 2010, the number of households with no insulation fell by 99%, from nearly a fifth to just 0.2%. 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 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 6e: Households with no, some and 'full' insulation measures (millions)

So now there are hardly any homes with no insulation, but nearly 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.

(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[35]. However, we have retained the definition, using 100mm as the break-point, to allow for consistency and so readers can see trends.)

DECC estimates that more than three-fifths of homes built with cavity walls now have cavity wall insulation[35].

'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[36], 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[37].

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[38], and the proposed changes to the 2013 Regulations range from an 8% to a 26% improvement relative to 2010 standards[39].

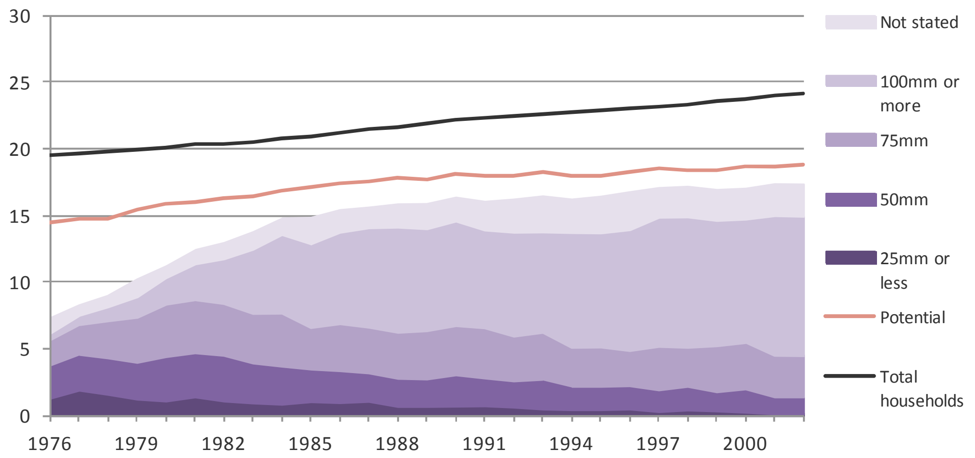
Other initiatives, such as the Energy Efficiency Commitments (EEC1 and EEC2) and the Carbon Emissions Reduction Target (CERT), have also contributed to improving insulation in existing homes[40]. Modelling for the Green Deal also estimates that the Green Deal and Energy Company Obligation will lead to around 2.7 million cavity wall insulations, 1.6 million loft insulations, and 1 million solid wall insulations by 2022[41].

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%[42]. But most of these homes still had what would be seen today as inadequate levels of loft insulation (from 25-100mm).

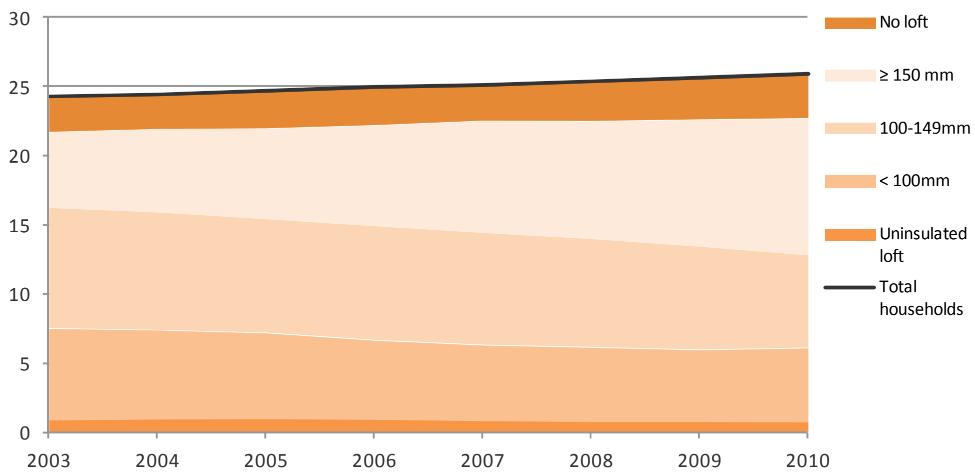
The Building Regulations, EEC and CERT have been effective in raising standards of insulation.

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 graphs have been split in 2002 because of changes to the way data was collected in the English Housing Survey. They, and Graph 6h, also report insulation figures for Great Britain, rather than the UK like the rest of the Fact File. This is because DECC's insulation data is based on Great Britain.)



Graph 6f: Depth of loft insulation (millions of households, GB) – pre EHS

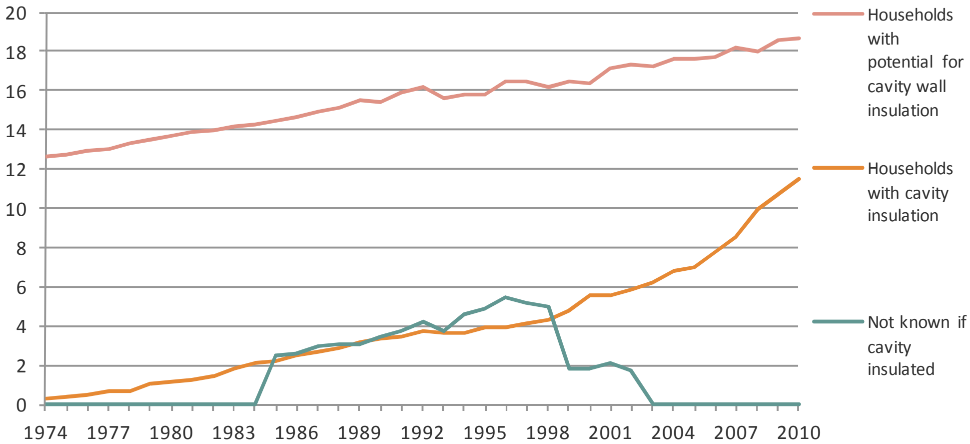
Since 2002, the number of homes with higher levels of insulation has increased notably. By 2010, nearly two-fifths had 150mm or more of loft insulation (six inches or more), nearly a third had 100-149mm (4-6 inches), just over a fifth had up to 100mm (4 inches), and 3% of homes had no loft insulation.



Graph 6g: Depth of loft insulation (millions of households, GB) – post EHS

Cavity wall insulation

There has been a stark increase in cavity wall insulation in Britain's housing stock, see graph below.



Graph 6h: Cavity wall insulation (GB, millions)

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 2010, the proportion of the stock capable of having this form of insulation had grown a little to 70% and three-fifths (61%) had it. This was nearly 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 less information available about the take-up of wall insulation for homes without cavities. This is unfortunate, because this insulation is often cited as a major opportunity for improving energy efficiency in older homes.

In 2008, annual installations of solid wall insulation were estimated in the range from 25,000 to 35,000[43]. 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.

There is an emerging consensus of opinion that insulating the existing stock of solid wall homes is one of the strategic opportunities for improving energy efficiency[44]. This is one of the priorities for the Green Deal, which is expected to have a major impact on the solid wall insulation market.

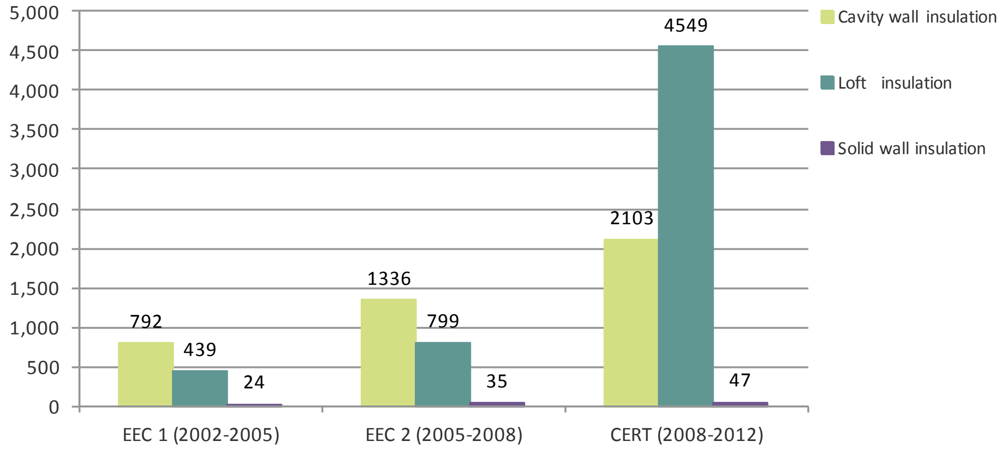
Impact of Government initiatives

Between 2002-2008 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[45].

The Carbon Emissions Reduction Target (CERT) 2008 followed on from the EEC. It sets out the carbon reductions to be achieved by suppliers between 2008-12[46].

The graph below shows the number of insulation measures installed under these two initiatives (up to March 2012).

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



Graph 6i: Insulation measures installed under EEC and CERT (thousands of households)

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.

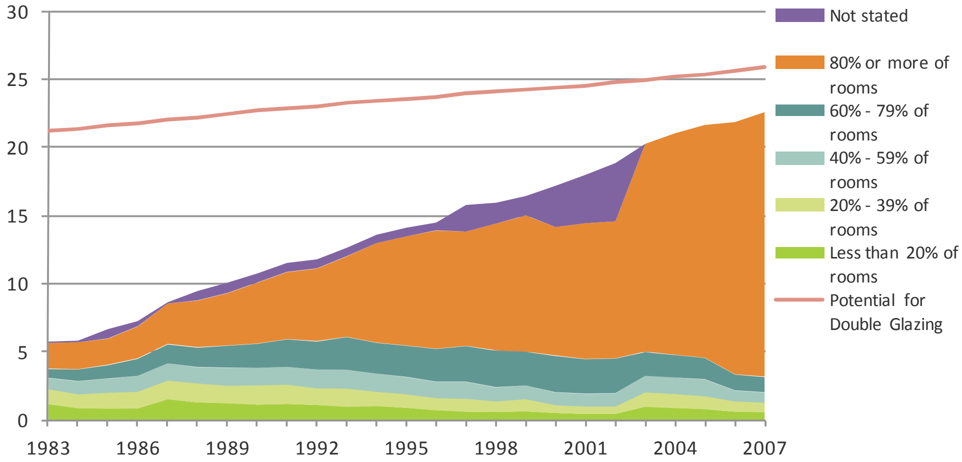
Glazing

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 nearly 12-fold, from just under 8% to 90% in 2010, see graphs below*.

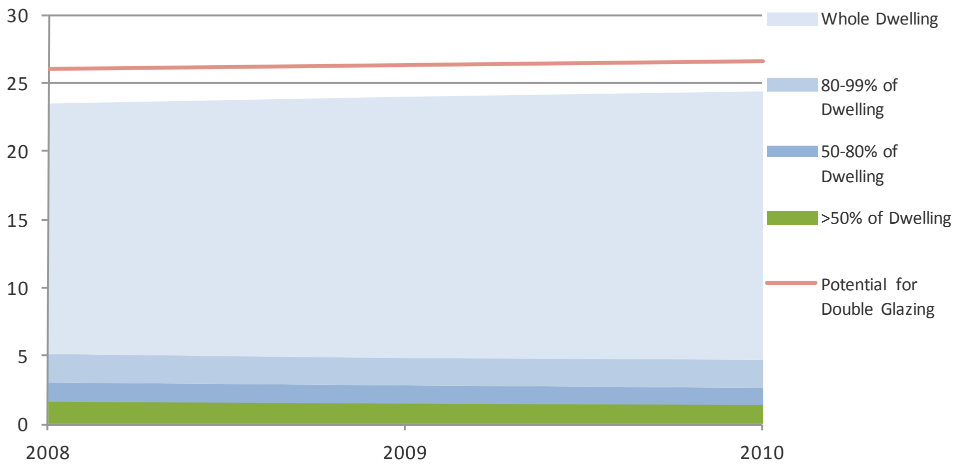
Since 1983 (the first time figures for double-glazing penetration became available), the proportion of homes with 80% or more of their rooms double-glazed has increased nine-fold, from 9% to 82% in 2010.

**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.*

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



Graph 6j: Double-glazing 1970-2007 (millions)



Graph 6k: Double-glazing 2008-2010 (millions)

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.

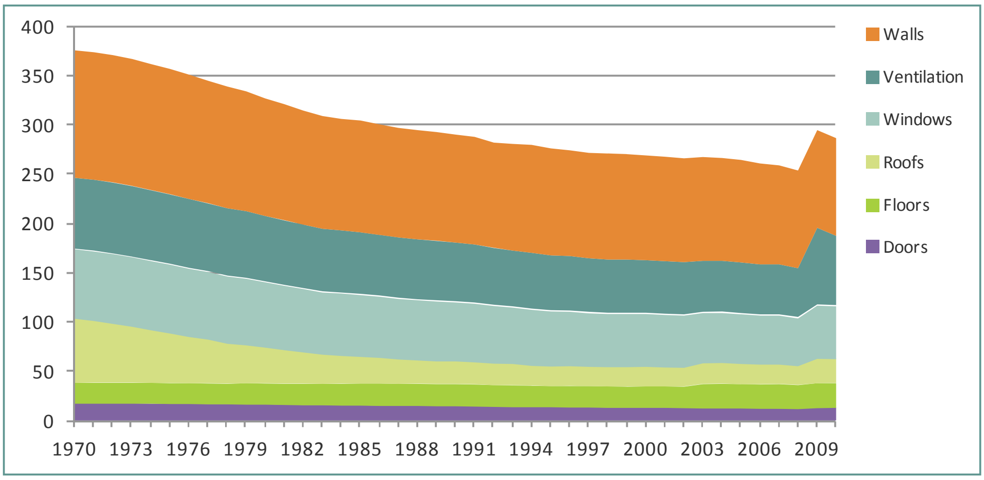
Double-glazed units have a limited life-span. Eventually their seals fail, the units mist up internally and their capacity for saving energy declines. Units can perform well for up to 35 years. However, they often fail long before this. Failed units cannot be repaired and have to be replaced[47,48].

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[49].

Heat loss

The rate at which homes in Great Britain 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 287W/°C, see graph below.



Graph 6l: Average heat loss per dwelling (W/°C)

(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 60% 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 about 25%.

According to these figures, heat loss through floors appears to have increased by nearly a fifth, but this may be due to changes in data collection, or to more accurate judgements about whether floors lack insulation.

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 by nearly 13% since 1970, largely because many more homes have been added to the stock.

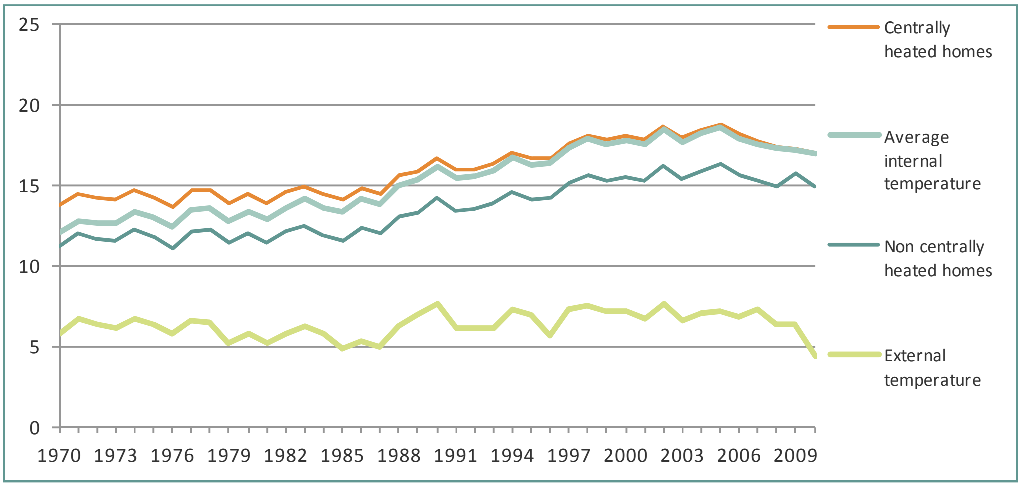
**Heat loss is linked to the difference between internal and external temperature, called the 'temperature difference'. This measure of heat loss says that for an average home, if it is 1℃ cooler outside than inside, you need 376 watts of heating to maintain a stable temperature. The measure is affected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

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.



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

In 1970, during the winter, the average internal temperature in homes with central heating was estimated at 13.7°C. Thirty-eight years later, this estimate had risen by 3.2°C to 16.9°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[50], 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 last year of the graph than usual – the fall does not signal a reduction in living temperatures.)

The average internal temperatures of Britain's homes in winter seems to have gone up by more than 3°C 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 14.9°C – a rise of 3.7°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 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 appear to 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 British homes (although this would have been offset, to some degree, by the increase in the number of households). This has not happened, even excluding 2010, 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

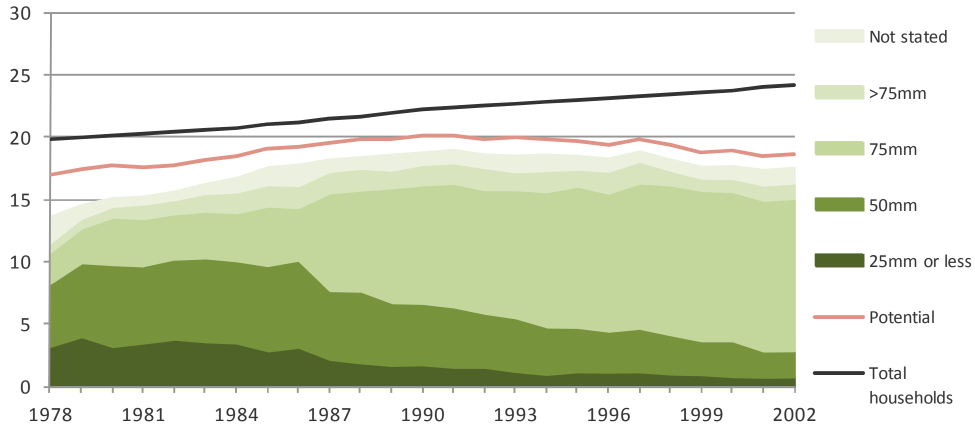
Installing adequate insulation on hot water tanks is an easy way to raise energy efficiency. It is cheap, fast, and does not require specialist skills.

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.)

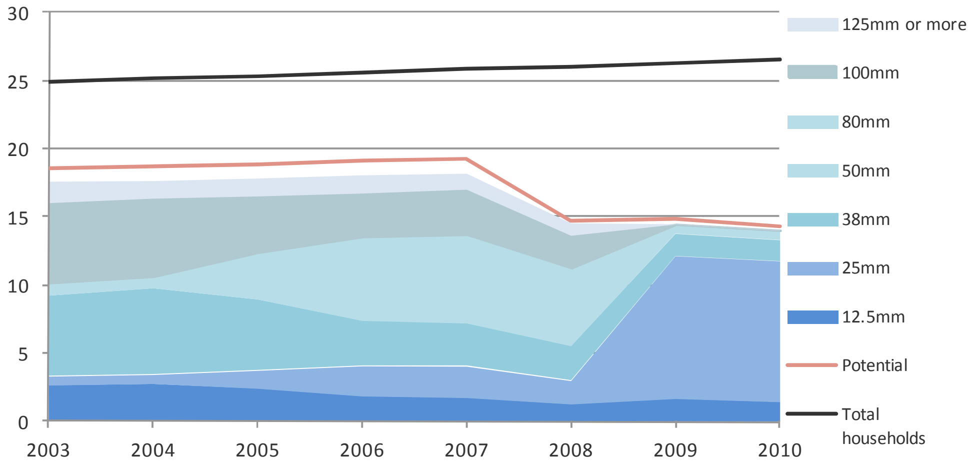
And, by 2002, only 5% of homes had more than 75mm of hot water tank insulation (however, by then 9% more homes had replaced their hot water tanks, using combi boilers instead, Graph 6d above).

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 6n: Hot water tank insulation (millions of households) – pre EHS



Graph 6o: Hot water tank insulation (millions of households) – post EHS

By 2010, more than a third of homes had hot water tanks with 25mm of insulation, with far fewer homes having more insulation on their tanks. (There are discontinuities in the time series data for 2003 to 2010, but 2009 and 2010 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 will lessen over time.

7. Breaking down energy use by fuel type

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.

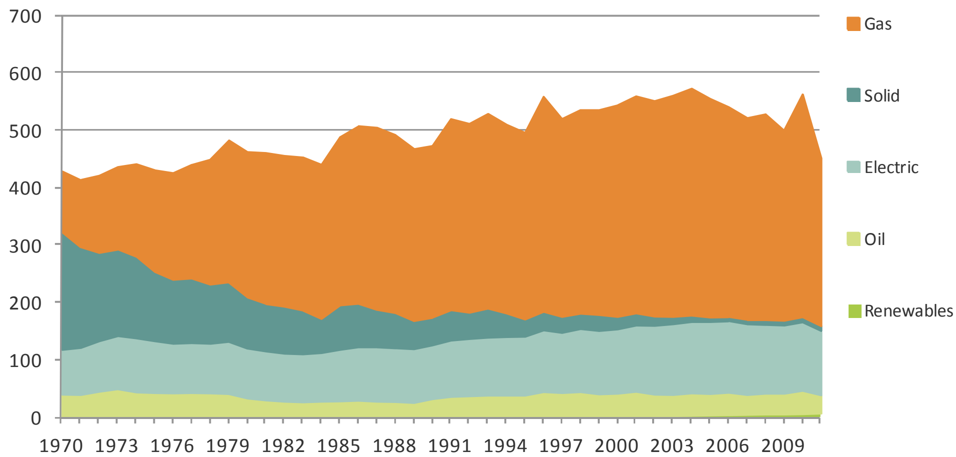
The mix of fuels is significant, because each fuel implies different carbon emissions, cost and different implications for fuel security.

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 in 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, continuously, 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 7a: Energy use in housing by fuel type (TWh)

The demise of solid fuels (for heating) was even more stark: they provided nearly half of the energy used in homes in 1970, 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's share of household energy rose from a fifth in 1970 to nearly a quarter in 2009. It slipped back to a fifth again in 2010 because the exceptionally cold winter weather meant more energy was needed for heating. (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.

Most of the expansion from 1970-2009 was due to increased ownership and use of electrical appliances, although in the recent past (since around 2000) more electric heating contributed to the growth.

Heating oil's share of household energy use declined from nearly a tenth in 1970 to just 7% today – partly because of increased gas-fired central heating.

8. Renewables and microgeneration

Renewables meet only a small proportion of the UK's overall demand for energy – just over 3% of primary energy demand (the energy in natural resources before they have been converted, for example, into electricity). However, renewables account for more than 9% of the UK's electrical supply[51].

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.*

Housing can also benefit from renewable energy systems that provide heat or electricity directly to the house. In both cases, there can be major advantages in generating energy close to the place it is used, at 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. For this reason, there is less data available than there is for other parts of this Fact File. Future editions of the Fact File will extend this part of the report.

UK generation of renewable electricity grew over 220% from 2003 to 2011, and every kind of renewable technology experienced the growth.

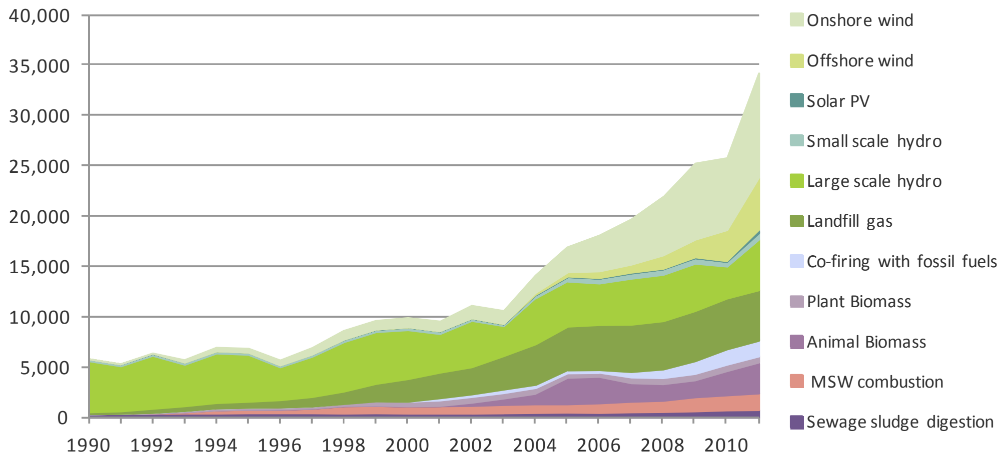
In summary, there are three main trends emerging from the data below:

- renewable energy – as electricity and heat – is growing rapidly in the UK
- onshore and offshore wind are now the largest contributors to renewable power
- the number of installed photovoltaics systems (solar electric) has increased massively since 2010, but their contribution to total renewable power in 2011 was still tiny: less than 1%.

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.

The largest growth in renewable energy was in offshore wind – predominantly power generated on wind farms out to sea – where output increased five-hundred-fold, from 10 GWh to 5 TWh from 2003 to 2011. The UK now gets more energy from offshore wind than it does from large-scale hydroelectric plants.



Graph 8a: Renewable electricity generation by fuel (GWh)

The DUKES data shows that even in the six-year period from 2003 to 2011, there was significant growth in total renewable electricity generation – up by more than 220% 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, driven partly by the sweetener of Feed-In Tariffs (see below). There was an 85-fold increase from 2003 to 2011, and output rose more than seven-fold in 2011 alone. However, total output from solar photovoltaics remains very small compared to wind, at 252 GWh in 2011. It contributed less than 1% of all renewable electricity.

Offshore wind grew much faster than other technologies, and now more than 5 TWh comes from offshore wind farms each year.

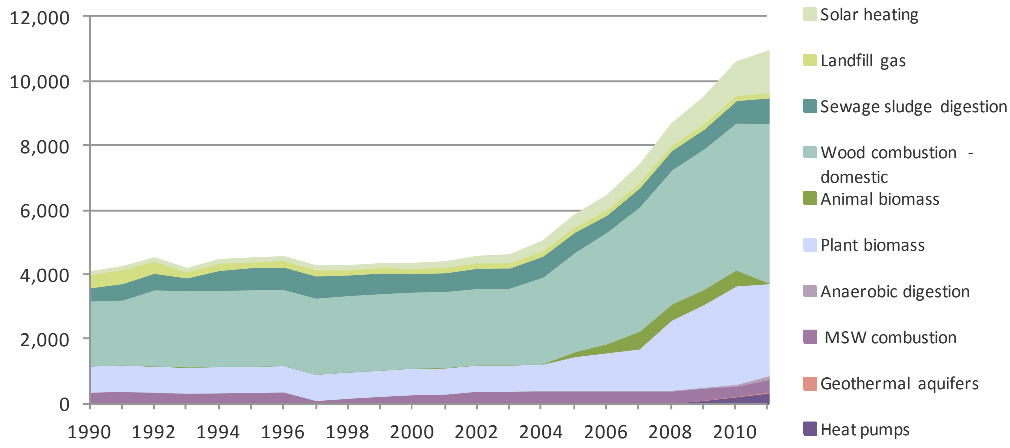
Onshore wind, animal biomass, and small-scale hydro-electric have also grown many times over since 2003, and the UK gets well over 10TWh from onshore wind turbines – enough electricity for around 2.5 million homes.

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 more than tripled since 1990, and 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 half of all renewable heat used in housing in 2011.

However, wood combustion has grown much more slowly than other sources of renewable heat. It grew 140% from 1970 to 2011, while active solar heating (mainly solar water heating) grew by a factor of 17, and plant biomass more than tripled. Solar water heating is now more than a tenth of renewable heat used in housing.



Graph 8b: Renewable heat generation by fuel (GWh)

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.

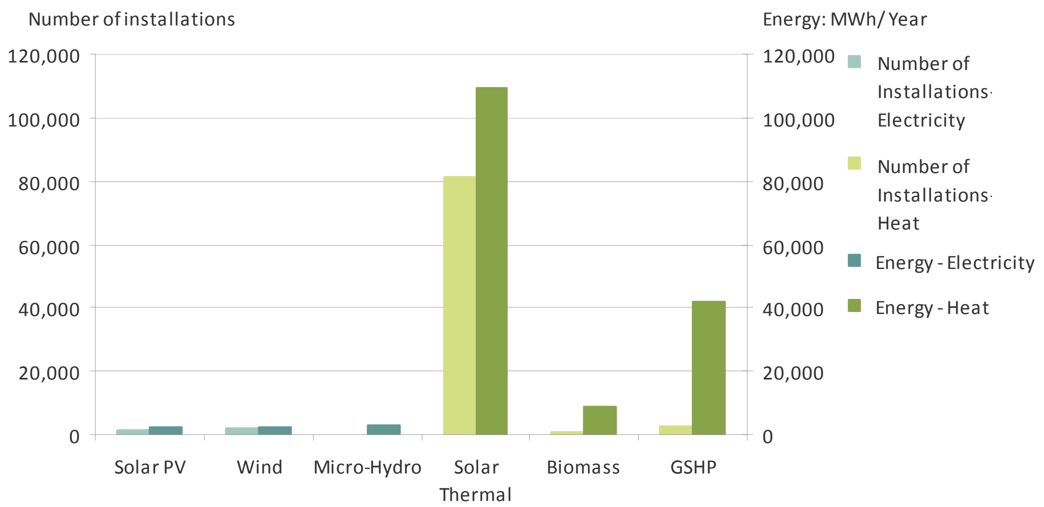
FITs provide a guaranteed payment for electricity generated by renewables – both power that is used, and unused power that is sold into the electricity grid. They encouraged hundreds of thousands of households to install photovoltaics.

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 8c: Household renewable technologies (cumulative installations and annual energy, 2008)

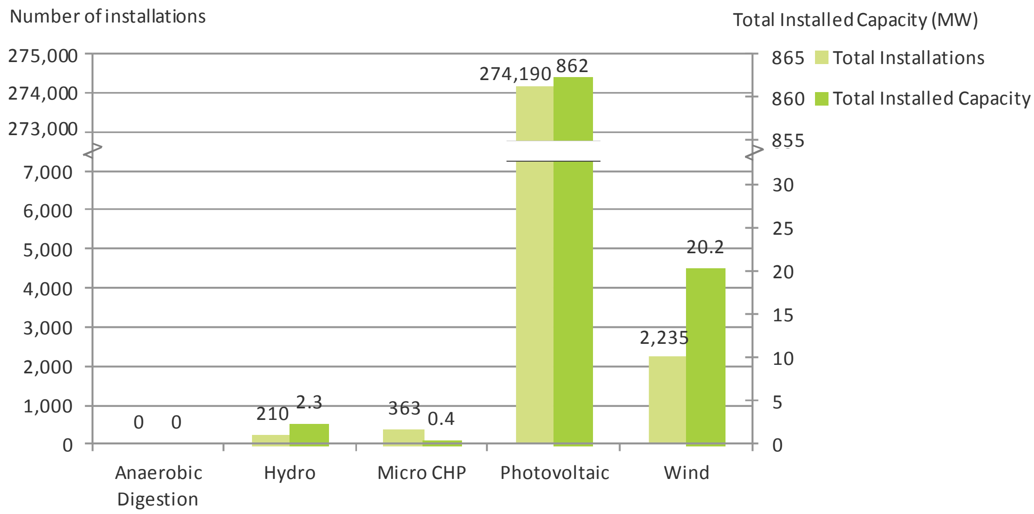
On the electric side, there were 50% more wind installations than photovoltaics ('PV'). Although a tiny number of micro-hydro systems had been installed – just 56, too few to show up on the graph – their annual output was considerable: nearly 3 GWh. This is more than the output of either PV or wind.

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 – 274,000 in two 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 because of reductions in FIT payments.

There have been 2,235 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 363 installations so far.

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[52].



Graph 8d: 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.

9. Summary and conclusions

Patterns of energy use and generation

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 about the same as road transport, see Chapter 1.

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

Despite widespread uptake of central heating and increased ownership and use of appliances, energy use per household has fallen by 30% 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 5%.

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.

Energy and CO_2 in homes	1970	2011
Total energy use	429 TWh	452 TWh
Total energy spending (2010 prices)	£18 billion/year	£27 billion/year
CO_2 from housing	182	126 (estimated)
Number of households	18 million	27 million
UK population	56 million	64 million

Energy and CO_2 per home and per person	1970	2011
Average energy use per household	23,800 kWh	16,700 kWh
Average energy use per person	7,700 kWh	7,000 kWh
Average energy spend per household (2010 £s)	£960	£1,030
Average energy spend per person (2010 £s)	£320	£420
Average CO_2 per household	10.1 tonnes	4.6 tonnes
Average CO_2 per person	3.3 tonnes	2.0 tonnes

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.

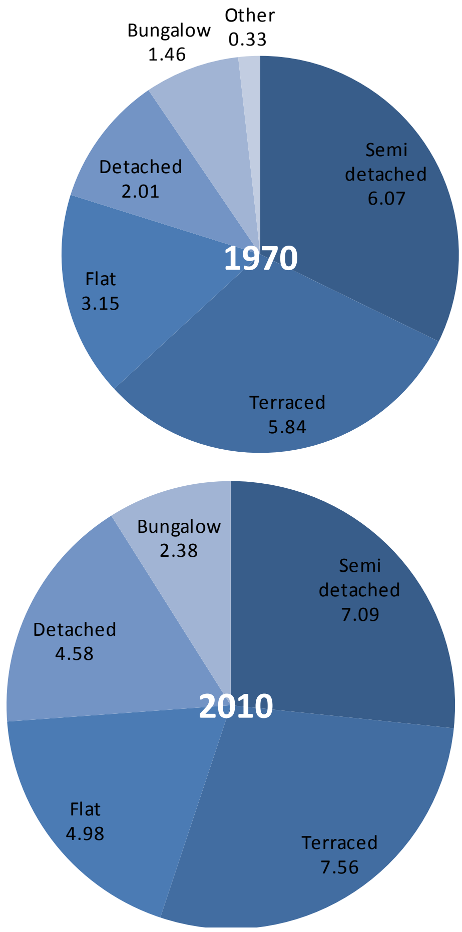
Two trends are apparent in the overall housing stock: an increase in the number of flats, and a parallel increase in the number of detached houses (see pie charts, right). The rise of flats seems like a logical response to the growth in smaller (one-or two-person) households. The increasing proportion of detached houses is harder to explain, but this seems to be linked to the increase in the percentage of incomes spent on housing[53].

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 Britain's homes has also changed markedly since the 1970s, with a huge expansion in the number of people owning their own homes. Getting on for 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 9a: Housing stock broken down by type, 1970 and 2010 (millions)

Energy spending and incomes

Energy bills for households have increased overall in real terms since 1970, but the increase is small – just 6.5% in 41 years. Energy prices rose steeply from 2003 to 2008, and energy 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 just over 4% 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.

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

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 CERT does with 'priority groups'. 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.

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 quarter since 1970 – in part because of widespread take-up of central heating and higher average internal temperatures, but also because there are over 9 million more households today.

The huge growth in central heating is mainly fuelled by gas, which has brought great improvements in carbon efficiency. However, homes with central heating also tend to use much more energy than homes without – often twice as much – because they allow households 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 30% 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 grew rapidly after 1970 – up by nearly half. (It has started to decline 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.

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.

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

For televisions and home computing, for example, many households now own multiple TV sets and computers. Hours of use of TVs and computers have increased significantly over the period.

Energy use in cooking reveals a very different trend: now nearly 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 higher internal temperature[54, 55].

Carbon emissions

Average CO_2 emissions per household have more than halved 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 2011.

Across the whole economy, renewable electricity rose nearly six-fold from 1990 to 2011. The UK currently gets around 9% 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. So far, this direct use of renewable energy in housing is mainly for heating using wood.

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 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 robust 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 has funded research into heating levels and other aspects of energy use in homes, as part of the Energy Follow-up Survey to the English Housing Survey. Findings will be published in 2013 and summarised in next year's Housing Energy Fact File[56].

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.

Appendices

Appendix 1: Tables

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

Table 1a: UK Final Energy Consumption by Energy Users (2011)

Energy users	Final energy consumption (TWh)	Final energy consumption (%)
Industry	316	18.5%
Road transport	463	27.1%
Air transport	149	8.7%
Other transport	30	1.8%
Housing	452	26.4%
Commercial and public administration	171	10.0%
Non energy use	101	5.9%
Other	29	1.7%
Total	1,710	100%

Source:

DECC: DUKES 2012, Table 1.1

http://www.decc.gov.uk/en/content/cms/statistics/source/total/total.aspx

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	1,788	529
2009	1,668	501
2010	1,740	564
2011	1,609	452

Sources:

DECC: DUKES, table 1.1.5 - internet only [1970-2011]/ ONS: Regional Accounts

http://www.decc.gov.uk/en/content/cms/statistics/source/total/total.aspx

Notes:

1) Domestic energy consumption figures were converted from the units in DUKES (thousand toe) to TWh: 1 toe = 11,630 kWh.
2) Total UK energy consumption figures from DUKES were scaled to Great Britain by dividing by 1.048.
3) 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.

4) All tables provide data for GB, unless otherwise stated.

5) 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	78.0	155.4
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	78.3	164.4
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	74.8	158.4
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	68.2	155.7
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	67.5	150.9
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	66.1	145.3
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	67.3	157.6
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	59.5	142.7
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	63.1	148.3
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	59.5	144.4
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	63.6	149.0
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	68.7	156.3
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	69.2	153.5
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	73.2	158.3
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	73.4	160.1
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	72.2	154.6
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	74.8	154.6
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	72.1	148.3
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	68.7	146.7
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	63.1	135.9
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	64.3	149.0

Sources:

UK Greenhouse Gas Inventory Statistics:
http://www.decc.gov.uk/media/viewfile.ashx?filetype=4&filepath=11/stats/climate-change/4819-2010-inventory-tables--uk-greenhouse-gas-statisti.XLS&minwidth=true

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) The DEFRA emission factors are: gas = 0.185, solid = 0.296, and oil = 0.245 (kgCO2/kWh).

2) The emission factors for electricity come from the Market Transformation Programme.

3) The domestic energy consumption figures in GB come from Table 7a to calculate carbon emissions.

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

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	948.6	348.5	18.4	376.8	138.5	21.9	44.4
2009	913.6	286.8	17.6	359.3	177.1	25.3	47.5
2010	920.4	297.3	13.7	373.6	162.0	25.8	48.0
2011	889.6	302.7	10.5	307.3	181.7	34.4	53.0

Sources:

DECC: DUKES, table 5.1.1, 6.1.1 - internet only

http://www.decc.gov.uk/en/content/cms/statistics/source/electricity/electricity.aspx

http://www.decc.gov.uk/en/content/cms/statistics/source/renewables/renewables.aspx

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.

Table 3c: Average UK Household Fuel Prices (p/KWh, 2010 prices)

Year	Coal	Coke, breeze + other solid	Total solid fuels	Gas	Electricity	Oil	Total (weighted average all fuels)	Retail Price Index (2010 = 100)	Fuel Price Index (2010 = 100)
1970	1.92	3.19	2.42	4.58	10.51	2.74	4.45	8.3	5.7
1971	1.97	3.30	2.52	4.22	10.36	2.68	4.56	9.1	6.2
1972	1.96	3.25	2.51	4.05	10.27	2.67	4.62	9.7	6.5
1973	1.87	3.15	2.41	3.66	9.50	2.84	4.37	10.6	6.8
1974	1.88	3.01	2.41	3.19	9.74	3.93	4.40	12.3	8.7
1975	1.89	3.10	2.49	2.93	11.37	3.84	4.66	15.3	12.0
1976	2.01	3.27	2.63	3.16	12.50	4.15	5.00	17.8	13.6
1977	2.06	3.29	2.66	3.08	12.52	4.34	4.95	20.6	15.1
1978	2.16	3.42	2.81	2.93	12.92	4.19	4.94	22.3	15.5
1979	2.30	3.82	3.06	2.63	12.24	4.86	4.70	25.3	18.2
1980	2.70	4.27	3.58	2.59	13.39	5.54	5.01	29.9	23.3
1981	2.83	3.83	3.59	2.92	14.39	6.07	5.36	33.5	27.8
1982	2.68	3.82	3.48	3.37	14.51	6.54	5.61	36.3	31.1
1983	2.80	3.89	3.65	3.62	14.17	6.95	5.76	38.0	33.3
1984	2.68	4.17	3.62	3.57	13.99	6.27	5.74	39.9	34.4
1985	2.64	3.84	3.56	3.44	13.41	5.98	5.43	42.3	36.2
1986	2.65	3.90	3.55	3.38	13.17	3.87	5.22	43.8	34.3
1987	2.42	3.99	3.45	3.23	12.55	3.49	5.01	45.6	34.2
1988	2.05	3.25	2.93	3.09	12.54	3.06	4.86	47.8	34.6
1989	2.14	2.93	3.00	3.01	12.66	3.20	4.94	51.5	36.8
1990	2.10	2.94	2.68	3.01	12.39	3.13	4.83	56.4	40.3
1991	2.04	3.05	2.62	3.04	12.71	2.46	4.77	59.7	43.4
1992	1.99	2.90	2.59	2.91	12.69	2.32	4.73	61.9	44.5
1993	2.19	3.03	2.54	2.79	12.58	2.21	4.57	62.9	45.7
1994	2.05	2.97	2.64	2.97	12.62	2.12	4.78	64.4	47.7
1995	2.52	3.00	3.17	2.90	12.39	2.12	4.80	66.7	49.4
1996	2.48	2.66	3.02	2.66	11.96	2.36	4.43	68.3	50.6
1997			2.90	2.64	11.35	2.11	4.35	70.4	52.1
1998			2.77	2.43	9.99	1.62	3.92	72.9	52.2
1999			2.73	2.22	9.76	1.79	3.76	74.0	54.5
2000			2.88	2.04	9.20	2.69	3.58	76.2	58.4
2001			3.39	2.04	8.84	2.36	3.51	77.5	56.8
2002			3.73	2.15	8.32	2.39	3.54	78.8	56.5
2003			3.07	2.09	8.05	2.64	3.45	81.1	58.1
2004			3.08	2.62	9.22	2.66	4.05	83.5	61.7
2005			3.24	2.63	9.39	3.43	4.19	85.9	68.4
2006			3.25	3.26	10.76	3.84	5.00	88.6	78.0
2007			3.30	3.20	11.56	3.83	5.18	92.4	81.7
2008			3.74	3.66	12.97	5.24	5.84	96.1	95.2
2009			4.51	4.16	13.45	3.90	6.01	95.6	93.6
2010			4.30	3.84	12.43	4.55	5.40	100.0	100.0
2011			4.25	4.19	13.12	5.39	6.12	105.2	112.9

Sources:

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

http://www.decc.gov.uk/en/content/cms/statistics/source/prices/prices.aspx

Notes:

1) Household fuel prices are deflated 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 (2010 = 100)

Year	Solid fuels	Gas	Electricity	Oil
1970	55.64	83.47	74.06	34.42
1971	56.89	82.99	74.45	35.03
1972	58.44	81.40	74.40	33.57
1973	56.59	76.20	70.43	34.15
1974	54.39	69.44	73.86	50.06
1975	57.14	62.97	84.30	44.48
1976	61.69	67.19	91.48	49.67
1977	63.32	69.03	91.87	54.40
1978	62.61	63.32	90.29	49.17
1979	64.24	57.42	85.79	54.37
1980	68.40	56.00	91.10	60.85
1981	72.12	63.40	98.49	65.06
1982	72.10	73.51	100.65	68.84
1983	72.66	78.06	98.86	73.73
1984	74.86	77.37	95.89	70.82
1985	75.31	76.04	93.51	72.67
1986	75.04	74.91	92.39	60.40
1987	71.86	70.52	87.27	53.07
1988	68.33	66.79	86.51	45.41
1989	64.53	64.78	86.37	45.48
1990	62.16	64.34	86.73	55.13
1991	62.16	64.65	89.66	49.78
1992	62.15	62.08	90.81	42.22
1993	60.77	58.09	88.03	43.60
1994	63.68	60.63	89.58	42.97
1995	63.07	61.07	88.44	41.85
1996	61.39	58.93	84.86	44.41
1997	60.40	56.93	78.84	42.20
1998	59.71	53.85	73.69	34.64
1999	59.74	52.52	71.37	38.02
2000	60.33	50.89	69.44	52.95
2001	62.29	51.51	67.81	50.81
2002	63.90	53.42	66.50	46.76
2003	63.84	53.20	65.70	50.70
2004	65.48	55.70	67.88	56.27
2005	70.62	62.58	73.55	70.68
2006	73.51	79.88	86.62	77.46
2007	76.98	84.10	91.46	76.36
2008	88.97	97.75	102.60	106.99
2009	102.80	109.27	105.41	80.62
2010	100.00	100.00	100.00	100.00

Sources:

DECC: DUKES 2011/DECC: Quarterly Energy Prices - Table 2.1.1 [1980-2011] http://www.decc.gov.uk/en/content/cms/statistics/source/prices/prices.aspx

Notes:

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

2) Each deflated series is indexed to 2010.

Table 3e UK Fuel Poverty

Year	Number of fuel poor households (millions)	Number of vulnerable households (millions)	UK households (millions)	Fuel poor households (%)	Vulnerable households (%)
1996	6.50	5.00	23.7	27.41	21.09
1997	5.63	4.25	23.9	23.56	17.80
1998	4.75	3.50	24.0	19.75	14.55
1999	4.00	3.00	24.2	16.52	12.39
2000	3.25	2.50	24.4	13.33	10.25
2001	2.50	2.00	24.6	10.18	8.14
2002	2.25	1.75	24.8	9.09	7.07
2003	2.00	1.50	25.0	8.01	6.01
2004	2.00	1.50	25.2	7.95	5.96
2005	2.50	2.00	25.4	9.85	7.88
2006	3.50	2.75	25.6	13.68	10.75
2007	4.00	3.25	25.8	15.50	12.59
2008	4.50	3.75	26.0	17.28	14.40
2009	5.50	4.50	26.3	20.90	17.10
2010	4.75	4.00	26.6	17.86	15.04

Source:

DECC: Annual Report on Fuel Poverty Statistics 2012

http://www.decc.gov.uk/assets/decc/11/stats/fuel-poverty/5270-annual-report-fuel-poverty-stats-2012.pdf

Notes:

1) 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.
3) As a result of missing data, fuel poor and vulnerable household data are interpolated for 1997, 1999 and 2000.

Table 4a: Population and Households (millions)

Year	Population	Households	Population/ Households	Mean Size (Households)
1970	55.63	18.9	2.95	
1971	55.93	19.0	2.94	2.91
1972	56.10	19.2	2.92	
1973	56.22	19.4	2.90	2.83
1974	56.24	19.5	2.88	
1975	56.23	19.7	2.85	2.78
1976	56.22	19.9	2.83	
1977	56.19	20.0	2.80	2.71
1978	56.18	20.2	2.78	
1979	56.24	20.4	2.76	2.67
1980	56.33	20.6	2.74	
1981	56.36	20.7	2.72	2.70
1982	56.29	20.9	2.69	
1983	56.32	21.2	2.66	2.64
1984	56.41	21.4	2.64	2.59
1985	56.55	21.6	2.61	2.56
1986	56.68	21.8	2.59	2.55
1987	56.80	22.0	2.58	2.55
1988	56.92	22.2	2.56	2.48
1989	57.08	22.4	2.54	2.51
1990	57.24	22.6	2.52	2.46
1991	57.44	22.9	2.50	2.48
1992	57.59	23.0	2.49	2.45
1993	57.71	23.2	2.48	2.44
1994	57.86	23.4	2.46	2.44
1995	58.03	23.5	2.45	2.40
1996	58.16	23.7	2.44	
1997	58.31	23.9	2.43	
1998	58.48	24.0	2.42	2.32
1999	58.68	24.2	2.41	
2000	58.89	24.4	2.40	2.30
2001	59.11	24.6	2.39	2.33
2002	59.32	24.8	2.38	
2003	59.56	25.0	2.36	
2004	59.85	25.2	2.35	
2005	60.24	25.4	2.34	
2006	60.59	25.6	2.33	2.32
2007	60.98	25.8	2.32	
2008	61.38	26.0	2.31	
2009	61.79	26.3	2.30	
2010	62.22	26.6	2.29	

Sources:

CLG, Live Table 401/ ONS: General Register Office for Scotland, Mid Year Population Estimates, Population Estimates Unit/ General Household Survey (updated November 2010).
http://www.communities.gov.uk/housing/housingresearch/housingstatistics/housingstatisticsby/householdestimates/livetables-households/

Notes:

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

2) The 'mean size of households' is obtained from the General Household Survey, 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 2009. The 2010 figure is the ONS projection.

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	26.32
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	26.59
% Change	0.39	0.34	0.26	0.39	0.22	0.35	0.23	0.16	0.15	0.28	0.29	0.26	0.55	0.28	0.28

Sources:

CLG: Live Table 403 - Household projections by region, England, 1971-2033 (updated Nov 2010).
http://www.communities.gov.uk/housing/housingresearch/housingstatistics/housingstatisticsby/householdestimates/livetables-households/

Notes:

1) Household figures for Wales are interpolated for the years 2005, 2007-2010 and for Scotland from 2007-2010.

2) Figures for England are interpolated for 2009-2010.

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	6.07	5.84	3.15	2.01	1.46	0.33	18.86
1971	6.13	5.89	3.18	2.03	1.47	0.34	19.03
1972	6.24	5.90	3.23	1.98	1.50	0.34	19.20
1973	6.51	5.81	3.16	2.02	1.50	0.36	19.37
1974	6.47	5.66	3.34	2.12	1.59	0.36	19.54
1975	6.58	5.92	3.42	2.06	1.48	0.25	19.71
1976	6.94	5.88	3.41	1.90	1.56	0.19	19.88
1977	6.55	6.06	3.32	2.30	1.61	0.20	20.05
1978	6.47	5.92	3.37	2.45	1.69	0.32	20.22
1979	6.51	6.19	3.11	2.65	1.71	0.21	20.39
1980	6.52	6.46	3.19	2.56	1.61	0.21	20.56
1981	6.54	6.31	3.18	2.76	1.74	0.21	20.73
1982	6.61	6.37	3.21	2.79	1.76	0.21	20.94
1983	6.64	6.43	3.26	2.84	1.84	0.15	21.15
1984	6.71	6.50	3.29	2.86	1.86	0.15	21.37
1985	6.76	6.50	3.36	2.95	1.88	0.13	21.58
1986	6.84	6.58	3.38	2.96	1.90	0.13	21.80
1987	6.78	6.52	3.52	3.10	1.98	0.11	22.01
1988	6.78	6.49	3.62	3.20	2.00	0.13	22.22
1989	6.84	6.30	3.86	3.37	1.98	0.09	22.44
1990	6.95	6.36	3.85	3.44	1.97	0.07	22.65
1991	6.93	6.47	4.00	3.38	2.01	0.07	22.86
1992	6.91	6.54	4.12	3.34	2.05	0.07	23.03
1993	6.87	6.50	4.25	3.43	2.09	0.07	23.20
1994	6.87	6.45	4.34	3.53	2.10	0.07	23.37
1995	6.87	6.52	4.40	3.58	2.10	0.07	23.54
1996	6.92	6.52	4.46	3.65	2.09	0.07	23.71
1997	6.97	6.54	4.49	3.73	2.08	0.07	23.88
1998	7.02	6.59	4.52	3.75	2.09	0.07	24.05
1999	7.05	6.61	4.55	3.83	2.11	0.07	24.22
2000	7.07	6.61	4.58	3.95	2.10	0.07	24.39
2001	6.97	6.80	4.66	3.98	2.06	0.07	24.56
2002	7.03	6.86	4.70	4.01	2.08	0.07	24.76
2003	7.06	7.21	4.26	4.09	2.32	0.03	24.97
2004	7.22	7.13	4.11	4.30	2.38	0.04	25.17
2005	6.94	7.34	4.32	4.42	2.29	0.07	25.37
2006	7.12	7.40	4.34	4.41	2.23	0.10	25.58
2007	7.16	7.19	4.29	4.72	2.36	0.08	25.81
2008	6.85	7.45	4.86	4.48	2.34	0.08	26.05
2009	6.76	7.60	5.07	4.47	2.41	0.00	26.32
2010	7.09	7.56	4.98	4.58	2.38	0.00	26.59

Sources:

GfK Home Audit/CLG: English House Condition Survey, English Housing Survey, Table 401 (updated November 2010)

www.communities.gov.uk/englishhousingsurvey

http://www.communities.gov.uk/housing/housingresearch/housingstatistics/housingstatisticsby/householdestimates/livetables-households/

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 households
1970	4.78	5.11	4.94	3.96		18.79
1971	4.67	4.99	4.83	4.53		19.03
1972	4.73	4.92	5.31	4.23		19.20
1973	4.58	5.00	5.17	4.62		19.37
1974	4.44	4.81	4.83	5.46		19.54
1975	4.57	4.89	4.62	5.63		19.71
1976	4.33	4.94	4.72	5.56	0.33	19.88
1977	4.16	4.87	4.66	5.71	0.64	20.05
1978	4.77	4.29	4.95	5.36	0.84	20.22
1979	5.00	4.47	4.26	5.52	1.14	20.39
1980	5.25	4.55	4.25	5.45	1.05	20.56
1981	5.18	4.48	4.10	5.51	1.46	20.73
1982	5.21	4.49	4.10	5.34	1.80	20.94
1983	5.12	4.46	4.13	5.44	2.01	21.15
1984	5.02	4.49	4.14	5.42	2.29	21.37
1985	4.98	4.48	4.14	5.45	2.53	21.58
1986	4.84	4.53	4.19	5.56	2.68	21.80
1987	4.73	4.58	4.22	5.46	3.02	22.01
1988	4.56	4.60	4.27	5.51	3.29	22.22
1989	4.60	4.62	4.31	5.41	3.50	22.44
1990	4.64	4.58	4.36	5.41	3.66	22.65
1991	4.66	4.60	4.34	5.37	3.89	22.86
1992	4.63	4.58	4.35	5.39	4.08	23.03
1993	4.66	4.62	4.39	5.31	4.22	23.20
1994	4.65	4.60	4.37	5.31	4.44	23.37
1995	4.68	4.64	4.40	5.30	4.52	23.54
1996	4.69	4.67	4.44	5.27	4.65	23.71
1997	4.68	4.66	4.42	5.26	4.87	23.88
1998	4.69	4.67	4.42	5.24	5.03	24.05
1999	4.70	4.65	4.43	5.26	5.18	24.22
2000	4.73	4.68	4.44	5.27	5.26	24.39
2001	4.74	4.67	4.47	5.28	5.40	24.56
2002	4.78	4.71	4.51	5.32	5.44	24.76
2003	5.15	4.67	5.18	3.84	6.12	24.97
2004	5.24	4.52	5.27	3.85	6.29	25.17
2005	5.46	4.44	5.01	3.95	6.52	25.37
2006	5.47	4.66	5.11	3.88	6.46	25.58
2007	5.44	4.50	5.09	3.85	6.94	25.81
	Pre-1918	1918-1964	1965-1990	1991-2002	2002-	Total households
2008	5.58	9.38	7.93	2.44	0.73	26.05
2009	5.65	9.65	7.79	2.11	1.11	26.32
2010	5.78	9.68	7.70	2.10	1.33	26.59

Sources:

GfK: Home Audit. CLG: English House Condition Survey, English Housing Survey. CLG: Table 401: www.communities.gov.uk/englishhousingsurvey

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 households
1970	8.86	6.51	3.49		18.86
1971	8.97	6.59	3.46		19.03
1972	9.11	6.69	3.40		19.20
1973	9.32	6.69	3.36		19.37
1974	9.46	6.47	3.61		19.54
1975	10.05	6.67	2.98		19.71
1976	10.49	6.78	2.61		19.88
1977	10.85	6.89	2.30		20.05
1978	10.85	6.90	2.47		20.22
1979	10.97	6.91	2.51		20.39
1980	11.32	6.58	2.66		20.56
1981	11.07	6.96	2.21	0.48	20.73
1982	11.18	7.03	2.23	0.50	20.94
1983	12.55	6.21	1.87	0.52	21.15
1984	12.67	6.28	1.87	0.54	21.37
1985	13.23	6.06	1.73	0.56	21.58
1986	13.36	6.12	1.73	0.58	21.80
1987	14.11	5.89	1.32	0.68	22.01
1988	14.47	5.78	1.27	0.71	22.22
1989	14.95	5.49	1.28	0.72	22.44
1990	15.15	5.41	1.31	0.77	22.65
1991	15.36	5.28	1.46	0.75	22.86
1992	15.50	5.18	1.59	0.76	23.03
1993	15.66	5.01	1.62	0.90	23.20
1994	15.80	4.91	1.61	1.05	23.37
1995	15.87	4.94	1.67	1.06	23.54
1996	16.01	4.83	1.73	1.14	23.71
1997	16.14	4.87	1.74	1.12	23.88
1998	16.31	4.86	1.75	1.13	24.05
1999	16.42	4.65	1.96	1.19	24.22
2000	16.68	4.39	1.97	1.34	24.39
2001	16.89	4.13	2.09	1.45	24.56
2002	17.03	4.16	2.11	1.46	24.76
2003	17.91	2.82	2.37	1.87	24.97
2004	17.94	2.66	2.63	1.94	25.17
2005	18.01	2.47	2.79	2.10	25.37
2006	18.23	2.39	2.85	2.10	25.58
2007	18.38	2.27	2.99	2.17	25.81
2008	17.12	2.32	3.76	2.28	26.05
2009	17.51	2.14	4.22	2.32	26.32
2010	17.65	2.14	4.40	2.40	26.59

Sources:

GfK Home Audit/CLG: English Housing Condition Survey, English Housing Survey: www.communities.gov.uk/englishhousingsurvey

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 English Housing Survey in 2008.

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

	Contemporary prices		2010 prices		% on fuel, light & power
Year	All goods (£)	Fuel, light & power (£)	All goods (£)	Fuel, light & power (£)	
1970	28.57	1.79	344.55	21.59	6.3%
1971	30.99	1.85	341.23	20.37	6.0%
1972	35.06	2.06	361.36	21.23	5.9%
1973	39.43	2.17	371.81	20.46	5.5%
1974	46.13	2.42	375.13	19.68	5.2%
1975	54.58	2.99	357.04	19.56	5.5%
1976	61.70	3.53	346.14	19.80	5.7%
1977	71.84	4.38	347.97	21.22	6.1%
1978	80.26	4.76	359.30	21.31	5.9%
1979	94.17	5.25	371.81	20.73	5.6%
1980	110.60	6.15	369.94	20.57	5.6%
1981	125.41	7.46	374.92	22.30	5.9%
1982	133.92	8.35	368.65	22.99	6.2%
1983	142.59	9.22	375.05	24.25	6.5%
1984	151.92	9.42	380.94	23.62	6.2%
1985	162.50	9.95	384.10	23.52	6.1%
1986	178.10	10.43	406.87	23.83	5.9%
1987	188.62	10.55	413.89	23.15	5.6%
1988	204.41	10.48	427.56	21.92	5.1%
1989	224.32	10.58	435.40	20.54	4.7%
1990	247.16	11.11	438.26	19.70	4.5%
1991	259.04	12.25	433.87	20.52	4.7%
1992	271.83	13.02	438.85	21.02	4.8%
1993	276.68	13.24	439.70	21.04	4.8%
1994	283.58	12.95	440.03	20.09	4.6%
1995	289.86	12.92	434.69	19.38	4.5%
1996	309.07	13.35	452.57	19.55	4.3%
1997	328.78	12.66	466.76	17.97	3.9%
1998	346.58	11.78	475.72	16.17	3.4%
1999	353.47	11.39	477.85	15.40	3.2%
2000	379.61	11.92	498.42	15.65	3.1%
2001	397.20	11.70	512.49	15.10	2.9%
2002	406.20	11.70	515.47	14.85	2.9%
2003	441.25	12.20	544.20	15.05	2.8%
2004	457.90	12.70	548.40	15.21	2.8%
2005	465.43	13.99	542.03	16.29	3.0%
2006	455.90	15.90	514.58	17.95	3.5%
2007	459.20	17.20	496.99	18.62	3.7%
2008	470.99	18.90	490.29	19.67	4.0%
2009	455.00	19.90	476.08	20.82	4.4%
2010	466.50	20.50	466.50	20.50	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/datasets-and-tables/index.html

Notes:

1) UK weekly expenditure figures have been deflated to 2009 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 is known as Living Costs and Food Survey from 2008 onwards

Table 4h: UK Weekly Energy Expenditure by Fuel (£/HH, 2010 prices)

Year	Coal	Coke, breeze & other solid	Total solid	Gas	Electricity	Oil	Total
1970	3.38	1.48	4.86	4.74	7.93	1.05	18.57
1971	2.95	1.34	4.28	4.79	8.12	1.00	18.20
1972	2.53	1.19	3.72	5.21	8.57	1.14	18.64
1973	2.39	1.08	3.46	5.01	8.29	1.31	18.07
1974	2.24	1.00	3.24	4.84	8.56	1.60	18.25
1975	1.92	0.89	2.81	4.85	9.54	1.50	18.70
1976	1.87	0.84	2.71	5.43	9.91	1.60	19.65
1977	1.95	0.81	2.76	5.60	9.92	1.67	19.96
1978	1.87	0.77	2.64	5.81	10.13	1.58	20.16
1979	2.03	0.84	2.87	5.87	9.96	1.77	20.47
1980	2.02	0.86	2.88	5.87	10.36	1.60	20.70
1981	1.98	0.68	2.66	6.82	10.83	1.55	21.87
1982	1.87	0.64	2.52	7.76	10.62	1.54	22.44
1983	1.79	0.63	2.43	8.42	10.28	1.54	22.67
1984	1.39	0.49	1.87	8.25	10.14	1.44	21.71
1985	1.80	0.56	2.36	8.61	10.19	1.40	22.57
1986	1.74	0.54	2.29	8.84	10.29	0.93	22.34
1987	1.33	0.57	1.90	8.56	9.86	0.79	21.10
1988	1.02	0.48	1.50	7.94	9.67	0.66	19.77
1989	0.83	0.38	1.21	7.41	9.65	0.65	18.92
1990	0.69	0.37	1.05	7.32	9.42	0.73	18.53
1991	0.75	0.37	1.12	8.14	10.01	0.65	19.91
1992	0.63	0.33	0.96	7.66	10.06	0.62	19.30
1993	0.68	0.34	1.03	7.51	10.00	0.61	19.15
1994	0.61	0.27	0.87	7.69	10.05	0.58	19.19
1995	0.52	0.23	0.75	7.36	9.87	0.58	18.57
1996	0.51	0.25	0.76	7.73	9.95	0.75	19.19
1997			0.64	7.00	9.11	0.64	17.39
1998			0.58	6.60	8.34	0.51	16.03
1999			0.58	6.02	8.16	0.50	15.26
2000			0.48	5.68	7.74	0.76	14.66
2001			0.54	5.79	7.62	0.72	14.68
2002			0.46	6.00	7.40	0.64	14.50
2003			0.30	5.95	7.28	0.69	14.22
2004			0.26	7.58	8.35	0.74	16.92
2005			0.19	7.25	8.53	0.89	16.86
2006			0.17	8.57	9.62	1.04	19.41
2007			0.19	8.02	10.11	0.91	19.23
2008			0.23	9.28	10.95	1.30	21.76
2009			0.27	9.64	11.11	0.95	21.97
2010			0.27	10.32	10.19	1.25	22.03
2011			0.26	8.38	10.00	1.15	19.78

Sources:

DECC: DUKES 2012, Table 1.1.6 - Internet only [1970-2011]/CLG, Live Table 401 (updated November 2011)

Office for National Statistics CPI And RPI Reference Tables, June 2012 (published 17 July 2012)

http://www.decc.gov.uk/en/content/cms/statistics/source/total/total.aspx
www.communities.gov.uk/

http://www.statistics.gov.uk/statbase/Product.asp?vlnk=15106
www.ons.gov.uk/ons/rel/cpi/consumer-price-indices/june-2012/cpi-and-rpi-detailed-reference-tables.xls

Notes:

1) DUKES tables are revised regularly.

2) Total expenditure figures are deflated 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 (£, 2010 prices, UK)

Year	Average Annual Gas Bill (£, 2010 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

Sources:

DECC: DUKES 2012, table 1.1.6 - internet only [1970-2011]/ CLG, live table 401 (updated November 2011)

Office for National Statistics CPI And RPI Reference Tables, June 2012 (published 17 July 2012)

EHS 2010 Homes with gas central heating and non-central-heated homes with gas (see Tables 6b and 6c)

http://www.decc.gov.uk/en/content/cms/statistics/source/total/total.aspx

www.communities.gov.uk/
http://www.statistics.gov.uk/statbase/Product.asp?vlnk=15106

www.ons.gov.uk/ons/rel/cpi/consumer-price-indices/june-2012/cpi-and-rpi-detailed-reference-tables.xls

www.communities.gov.uk/englishhousingsurvey

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 (£, 2010 prices, UK)

	Average Annual Electricity Bill (£, 2010 prices)
Year	Average all payment methods
1970	413
1971	422
1972	446
1973	431
1974	445
1975	496
1976	515
1977	516
1978	527
1979	518
1980	539
1981	563
1982	552
1983	535
1984	527
1985	530
1986	535
1987	512
1988	503
1989	502
1990	490
1991	521
1992	523
1993	520
1994	523
1995	513
1996	518
1997	474
1998	433
1999	424
2000	402
2001	396
2002	385
2003	378
2004	434
2005	444
2006	500
2007	526
2008	569
2009	578
2010	530
2011	520

Sources:

DECC: DUKES 2012, table 1.1.6 - internet only [1970-2011]/ CLG, Live Table 401 (updated November 2011)

Office for National Statistics CPI And RPI Reference Tables, June 2012 (published 17 July 2012)

http://www.decc.gov.uk/en/content/cms/statistics/source/total/total.aspx

www.communities.gov.uk/
http://www.statistics.gov.uk/statbase/Product.asp?vlnk=15106
www.ons.gov.uk/ons/rel/cpi/consumer-price-indices/june-2012/cpi-and-rpi-detailed-reference-tables.xls

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 (£/wk/hh) 2010

Gross income decile group (per cent)	Lower boundary of income	Average energy spend	Average total spend	% on energy
Poorest 10%		13.50	186	7.3%
Second Decile	160	17.10	215	8.0%
Third Decile	238	18.70	273	6.9%
Fourth Decile	315	19.00	344	5.5%
Fifth Decile	413	20.70	400	5.2%
Sixth Decile	522	21.80	459	4.8%
Seventh Decile	651	22.30	531	4.2%
Eighth Decile	801	23.30	591	3.9%
Ninth Decile	1,015	26.00	721	3.6%
Wealthiest 10%	1,368	31.50	1,019	3.1%

Sources:

ONS: Living Costs and Food Survey, Appendix A - table A6, Family Spending (2011): a report on the 2010 Living Costs and Food Survey, Houndmills: Palgrave Macmillan

http://www.ons.gov.uk/ons/rel/family-spending/family-spending/family-spending-2011-edition/index.html

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	1,924
2003	6.6	10.6	2,042
2004	7.0	10.6	2,007
2005	7.1	10.5	2,048
2006	6.9	10.8	2,033
2007	7.3	10.5	1,978
2008	6.4	9.9	2,195
2009	6.3	10.1	2,166
2010	4.1	8.9	2,576

Sources:

DECC: DUKES 2011, table 1.1.8 - internet only (2311-dukes-2011-long-term-trends.pdf) [1970-2009]

http://www.decc.gov.uk/en/content/cms/statistics/source/total/total.aspx

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	236.3	57.8%
1971	219.5	55.5%
1972	226.5	56.3%
1973	239.3	57.4%
1974	242.6	57.5%
1975	231.8	56.4%
1976	224.8	55.3%
1977	237.9	56.6%
1978	248.1	57.8%
1979	279.6	60.6%
1980	261.9	59.3%
1981	259.7	59.0%
1982	254.8	58.6%
1983	253.2	58.5%
1984	241.6	57.5%
1985	285.5	61.2%
1986	302.1	62.3%
1987	301.3	62.5%
1988	289.3	61.5%
1989	266.4	59.6%
1990	272.4	60.2%
1991	317.3	63.9%
1992	310.5	63.5%
1993	327.0	64.7%
1994	310.4	63.7%
1995	297.4	62.8%
1996	358.2	67.1%
1997	321.4	64.7%
1998	336.2	65.7%
1999	337.3	65.9%
2000	345.3	66.4%
2001	361.3	67.6%
2002	352.0	66.8%
2003	359.9	67.2%
2004	370.1	67.6%
2005	353.5	66.6%
2006	338.7	65.6%
2007	321.7	64.5%
2008	331.7	65.7%
2009	292.9	61.3%

Source:

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

Cambridge Housing Model (2008 onwards)

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	118.9	29.1%
1971	120.3	30.4%
1972	118.8	29.5%
1973	118.5	28.4%
1974	117.9	28.0%
1975	116.7	28.4%
1976	117.7	29.0%
1977	117.4	27.9%
1978	115.1	26.8%
1979	114.4	24.8%
1980	112.2	25.4%
1981	111.6	25.4%
1982	110.5	25.4%
1983	108.9	25.1%
1984	106.9	25.4%
1985	107.3	23.0%
1986	107.8	22.2%
1987	104.7	21.7%
1988	103.9	22.1%
1989	102.8	23.0%
1990	102.0	22.6%
1991	101.2	20.4%
1992	99.9	20.4%
1993	99.2	19.6%
1994	97.8	20.1%
1995	96.6	20.4%
1996	95.7	17.9%
1997	94.8	19.1%
1998	94.4	18.4%
1999	92.7	18.1%
2000	92.3	17.8%
2001	90.5	16.9%
2002	90.6	17.2%
2003	90.7	16.9%
2004	90.6	16.6%
2005	89.2	16.8%
2006	88.2	17.1%
2007	86.7	17.4%
2008	83.8	16.6%
2009	83.8	17.6%

Source:

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

Cambridge Housing Model (2008 onwards)

Notes:

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

Source:

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

Cambridge Housing Model (2008 onwards)

Notes:

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

Source:

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

Cambridge Housing Model (2008 onwards)

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	24.4	6.0%
1971	24.2	6.1%
1972	24.0	6.0%
1973	23.9	5.7%
1974	23.8	5.6%
1975	23.6	5.7%
1976	23.3	5.7%
1977	23.1	5.5%
1978	22.8	5.3%
1979	22.5	4.9%
1980	22.1	5.0%
1981	21.7	4.9%
1982	21.4	4.9%
1983	20.9	4.8%
1984	20.3	4.8%
1985	20.0	4.3%
1986	19.3	4.0%
1987	18.7	3.9%
1988	18.2	3.9%
1989	17.6	3.9%
1990	17.0	3.8%
1991	16.6	3.3%
1992	16.2	3.3%
1993	15.9	3.1%
1994	15.6	3.2%
1995	15.4	3.2%
1996	15.2	2.8%
1997	15.1	3.0%
1998	15.0	2.9%
1999	14.9	2.9%
2000	14.7	2.8%
2001	14.7	2.7%
2002	14.7	2.8%
2003	14.7	2.7%
2004	14.6	2.7%
2005	14.6	2.7%
2006	14.7	2.8%
2007	14.5	2.9%
2008	14.2	2.8%
2009	13.2	2.8%

Source:

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

Cambridge Housing Model (2008 onwards)

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 2005 Ratings by Year

Year	SAP rating of average GB house
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

Sources:

Building Research Establishment Housing Model for Energy Studies (1970-2002)/CLG: English Housing Condition Survey, English Housing Survey (2003-2010)

www.communities.gov.uk/englishhousingsurvey

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

Table 5h: Effect of Energy Efficiency Improvements on Energy Use (TWh)

Year	Actual energy used	Energy use if 1970 insulation standard	Energy use if 1970 insulation and efficiency standard	Saving due to better insulation	Saving due to improved efficiency	Total saving
1970	409.2	409.2	409.2	0.0	0.0	0.0
1971	395.2	397.6	400.5	2.4	2.9	5.3
1972	402.3	408.4	415.6	6.1	7.2	13.3
1973	416.9	428.2	439.3	11.3	11.1	22.4
1974	421.6	439.5	454.7	17.9	15.2	33.1
1975	411.2	435.1	455.0	23.9	19.9	43.8
1976	406.5	438.0	456.5	31.5	18.5	50.0
1977	420.5	461.9	484.0	41.4	22.1	63.5
1978	429.3	480.3	507.1	51.0	26.8	77.8
1979	461.2	523.5	558.8	62.3	35.3	97.6
1980	442.0	513.6	550.8	71.6	37.1	108.7
1981	440.2	521.9	561.6	81.8	39.6	121.4
1982	435.1	526.5	572.8	91.3	46.3	137.6
1983	432.9	533.5	587.2	100.6	53.7	154.3
1984	420.5	523.0	583.1	102.5	60.1	162.6
1985	466.7	582.4	654.3	115.7	71.9	187.6
1986	484.9	612.6	690.8	127.7	78.2	205.9
1987	482.2	616.4	703.2	134.2	86.8	221.0
1988	470.1	604.4	696.3	134.4	91.9	226.3
1989	446.7	578.2	669.9	131.5	91.7	223.3
1990	452.2	590.2	690.6	138.0	100.4	238.4
1991	496.7	652.5	774.6	155.8	122.1	277.9
1992	488.9	655.1	785.1	166.2	130.0	296.2
1993	505.4	678.7	821.6	173.3	143.0	316.3
1994	487.6	657.2	800.4	169.6	143.2	312.8
1995	473.7	646.0	793.6	172.4	147.6	319.9
1996	533.9	733.1	915.7	199.2	182.6	381.8
1997	496.8	686.9	863.4	190.1	176.6	366.7
1998	511.8	708.9	896.7	197.1	187.8	384.9
1999	511.7	709.2	908.6	197.5	199.3	396.9
2000	519.8	723.3	935.1	203.5	211.8	415.3
2001	534.5	746.0	978.7	211.5	232.7	444.1
2002	526.7	736.7	974.4	210.0	237.7	447.7
2003	535.8	757.9	1,007.6	222.1	249.7	471.8
2004	547.3	782.8	1,042.4	235.4	259.6	495.1
2005	530.4	790.6	1,079.2	260.2	288.5	548.8
2006	516.7	767.7	1,048.6	251.0	280.9	531.9
2007	498.5	716.9	978.3	218.4	261.4	479.8

Source:

Building Research Establishment Housing Model for Energy Studies (1970-2008)/ DECC: DUKES, table 1.1.5: internet version only (1970-2008)

http://www.decc.gov.uk/en/content/cms/statistics/source/total/total.aspx

Notes:

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

2) 'Total savings' are calculated by adding savings due to improved insulation and savings due to improved efficiency.

3) DUKES tables are revised regularly.

4) Figures may not always add up to totals due to rounding.

5) The time series is discontinued in 2007 because of concerns about the reliability of the heat balance equation used to generate figures.

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

Year	Tonnes CO_2 per household
1970	9.5
1971	9.1
1972	9.1
1973	9.4
1974	9.1
1975	8.7
1976	8.2
1977	8.3
1978	8.1
1979	8.7
1980	8.2
1981	7.9
1982	7.6
1983	7.4
1984	7.0
1985	7.6
1986	7.8
1987	7.6
1988	7.2
1989	6.7
1990	6.9
1991	7.2
1992	6.9
1993	6.7
1994	6.5
1995	6.2
1996	6.6
1997	6.0
1998	6.2
1999	6.0
2000	6.1
2001	6.4
2002	6.2
2003	6.3
2004	6.4
2005	6.1
2006	6.0
2007	5.7
2008	5.6
2009	5.2
2010	5.6

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

DECC: UK Greenhouse Gas Inventory Statistics (1990-2010)

http://www.decc.gov.uk/en/content/cms/statistics/source/total/total.aspx/

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

www.communities.gov.uk/ http://www.statistics.gov.uk/statbase/Product.asp?vlnk=15106

http://www.decc.gov.uk/media/viewfile.ashx?filetype=4&filepath=11/stats/climate-change/4819-2010-inventory-tables--uk-greenhouse-gas-statisti.XLS&minwidth=true

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 in GB 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: Households with Central Heating (millions)

Year	With central heating	Without central heating	Total households
1970	4.78	14.08	18.86
1971	5.24	13.79	19.03
1972	5.71	13.49	19.20
1973	6.37	12.99	19.37
1974	7.21	12.33	19.54
1975	7.76	11.95	19.71
1976	8.47	11.41	19.88
1977	9.14	10.91	20.05
1978	9.26	10.95	20.22
1979	10.05	10.34	20.39
1980	10.44	10.12	20.56
1981	10.96	9.77	20.73
1982	11.63	9.31	20.94
1983	12.82	8.33	21.15
1984	13.02	8.35	21.37
1985	13.77	7.82	21.58
1986	14.49	7.31	21.80
1987	15.03	6.98	22.01
1988	15.36	6.87	22.22
1989	15.97	6.47	22.44
1990	16.34	6.31	22.65
1991	16.90	5.96	22.86
1992	17.20	5.83	23.03
1993	17.53	5.68	23.20
1994	18.07	5.30	23.37
1995	18.42	5.12	23.54
1996	18.45	5.26	23.71
1997	18.61	5.27	23.88
1998	19.22	4.83	24.05
1999	19.34	4.87	24.22
2000	19.54	4.85	24.39
2001	20.19	4.37	24.56
2002	20.71	4.05	24.76
2003	21.79	3.18	24.97
2004	22.14	3.03	25.17
2005	22.50	2.87	25.37
2006	22.99	2.59	25.58
2007	23.41	2.40	25.81
2008	23.07	2.98	26.05
2009	23.58	2.74	26.32
2010	23.95	2.64	26.59

Sources:

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

www.communities.gov.uk/englishhousingsurvey

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 Homes (thousands)

Year	Solid fuel	Electric	Gas	Oil	Other
1970	1,702	459	1,957	485	176
1971	1,619	535	2,310	582	193
1972	1,553	591	2,684	680	198
1973	1,500	669	3,252	716	235
1974	1,527	735	3,916	719	309
1975	1,453	837	4,392	704	375
1976	1,462	776	5,198	673	358
1977	1,447	723	5,903	694	370
1978	1,109	739	6,363	688	366
1979	1,086	646	7,342	635	338
1980	1,170	618	7,893	493	263
1981	1,247	598	8,353	503	260
1982	1,341	587	8,924	520	260
1983	1,495	599	9,897	559	272
1984	1,304	725	10,218	565	204
1985	1,555	646	10,655	540	371
1986	1,556	476	11,659	500	297
1987	1,532	413	12,128	577	383
1988	1,550	485	12,326	614	380
1989	1,316	559	13,142	549	402
1990	1,309	466	13,559	571	431
1991	1,293	423	14,121	635	431
1992	1,069	429	14,723	581	399
1993	998	383	15,098	670	377
1994	900	473	15,662	633	402
1995	793	398	15,993	726	511
1996	846	393	15,710	921	576
1997	900	402	15,865	935	512
1998	741	256	16,961	782	482
1999	721	465	16,860	842	456
2000	667	435	17,163	839	434
2001	670	430	17,670	951	468
2002	712	866	17,697	1,073	365
2003	365	112	19,733	946	633
2004	327	93	20,166	1,021	535
2005	286	43	20,655	1,007	512
2006	263	44	21,050	1,079	554
2007	269	77	21,438	1,126	501
2008	230	99	21,281	995	464
2009	184	45	21,575	1,063	712
2010	179	57	22,212	1,088	412

Sources:

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

www.communities.gov.uk/englishhousingsurvey

Notes:

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

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.

Table 6c: 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	3,369	647	4,016	1,153	2,459	3,612	5,697	491	262
1971	3,244	624	3,868	1,343	2,368	3,711	5,484	473	252
1972	3,130	602	3,732	1,484	2,284	3,768	5,292	456	244
1973	2,957	569	3,526	1,649	2,158	3,807	5,000	431	230
1974	2,742	527	3,269	1,811	2,001	3,812	4,638	400	213
1975	2,605	501	3,107	1,949	1,902	3,850	4,405	380	203
1976	2,559	492	3,052	1,807	1,669	3,475	4,316	370	198
1977	2,250	432	2,682	1,683	1,504	3,187	4,499	354	189
1978	2,286	440	2,725	1,720	1,514	3,233	4,454	352	188
1979	1,869	626	2,495	1,504	1,404	2,908	4,433	311	192
1980	1,773	696	2,469	1,438	1,208	2,646	4,490	308	207
1981	1,666	618	2,283	1,257	1,199	2,456	4,545	216	266
1982	1,428	634	2,062	1,095	1,170	2,266	4,525	184	273
1983	1,089	647	1,735	972	1,074	2,046	4,234	95	222
1984	1,026	588	1,614	1,351	974	2,325	4,190	59	165
1985	929	514	1,442	1,342	844	2,186	4,022	33	132
1986	840	452	1,292	1,179	725	1,904	3,916	23	172
1987	692	371	1,064	1,294	733	2,028	3,721	26	137
1988	629	338	967	1,416	768	2,183	3,539	24	153
1989	606	326	933	1,550	641	2,191	3,188	16	140
1990	550	296	846	1,683	636	2,319	3,018	7	123
1991	477	257	734	1,845	507	2,353	2,740	15	120
1992	421	227	648	1,921	535	2,456	2,601	10	116
1993	372	200	572	2,024	494	2,518	2,474	6	105
1994	367	197	564	1,932	497	2,429	2,218	3	86
1995	307	165	472	2,009	482	2,491	2,064	7	84
1996	347	187	534	2,127	476	2,603	2,041	4	83
1997	320	172	492	2,258	583	2,841	1,861	4	68
1998	296	159	455	2,109	452	2,561	1,737	2	72
1999	198	106	304	2,171	466	2,637	1,860	5	69
2000	183	98	281	2,136	561	2,697	1,821	2	49
2001	200	108	308	1,957	753	2,711	1,286	-	64
2002	209	112	321	1,644	915	2,559	1,123	-	46
2003	63	34	96	1,797	261	2,057	1,015	-	7
2004	60	32	93	1,854	232	2,087	849	-	-
2005	51	27	78	1,859	226	2,086	699	-	9
2006	51	27	78	1,765	202	1,968	531	-	12
2007	45	24	70	1,771	188	1,959	368	-	6
2008	53	28	81	1,885	454	2,339	553	-	7
2009	27	29	55	1,809	467	2,276	326	-	28
2010	41	23	64	1,736	458	2,193	290	-	32

Sources:

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

www.communities.gov.uk/englishhousingsurvey

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 English Housing Survey in 2008.

3) The sample size of 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 6d: Gas and Oil Condensing Boilers and Combi Boilers

Year	Condensing boilers (1000s)	Condensing (%)	Combi boilers (1000s)	(Of which condensing combi boilers (1000s)	Combi (%)	All gas and oil boilers (1000s)
1975			1		0.02	4,635
1976			6		0.13	5,097
1977			11		0.19	5,870
1978			17		0.26	6,597
1979			23		0.32	7,051
1980			28		0.36	7,977
1981			68		0.82	8,387
1982	1	0.01	107		1.21	8,855
1983	1	0.01	146		1.54	9,444
1984	1	0.01	192		1.84	10,455
1985	2	0.02	226		2.09	10,783
1986	6	0.06	413		3.69	11,195
1987	12	0.10	620		5.10	12,159
1988	17	0.14	807		6.35	12,705
1989	22	0.17	966		7.47	12,941
1990	26	0.19	1,160		8.47	13,691
1991	33	0.24	1,373	1	9.71	14,131
1992	42	0.28	1,612	1	10.93	14,755
1993	51	0.33	1,863	3	12.17	15,303
1994	71	0.45	2,123	5	13.46	15,768
1995	88	0.54	2,410	7	14.79	16,295
1996	114	0.68	2,716	11	16.24	16,720
1997	139	0.84	2,970	19	17.86	16,631
1998	173	1.03	3,295	32	19.61	16,801
1999	222	1.25	3,824	57	21.55	17,743
2000	263	1.49	4,197	82	23.71	17,702
2001	332	1.84	4,697	122	26.09	18,002
2002	456	2.45	5,335	202	28.65	18,621
2003	601	3.20	6,686	425	35.62	18,770
2004	706	3.41	7,240	475	35.01	20,680
2005	1,171	5.53	7,958	829	37.56	21,187
2006	2,003	9.25	8,674	1,479	40.04	21,662
2007	2,890	13.06	9,261	2,094	41.85	22,129
2008	4,242	18.80	10,095	3,161	44.74	22,564
2009	7,244	32.52	12,842	5,456	57.65	22,276
2010	9,600	42.41	13,737	7,195	60.68	22,637

Sources:

DEFRA: Market Transformation Programme boiler model - based on sales data from the Heating and Hotwater Industry Council

CLG: English House Condition Survey, English Housing Survey

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 1976-1979, 1981-1984, and 1986-1989 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 6e 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	4.07	17.20	0.74	22.01
1988	4.16	17.07	0.99	22.22
1989	3.95	17.44	1.04	22.44
1990	3.79	17.79	1.08	22.65
1991	3.71	17.95	1.20	22.86
1992	3.67	17.97	1.40	23.03
1993	3.44	18.31	1.45	23.20
1994	3.58	17.73	2.06	23.37
1995	3.50	17.68	2.36	23.54
1996	3.14	18.16	2.41	23.71
1997	2.77	18.72	2.39	23.88
1998	2.78	18.33	2.93	24.05
1999	3.05	17.94	3.23	24.22
2000	2.66	17.59	4.14	24.39
2001	2.55	17.20	4.80	24.56
2002	2.40	17.16	5.20	24.76
2003	0.90	17.99	6.07	24.97
2004	0.81	17.59	6.77	25.17
2005	0.79	17.13	7.45	25.37
2006	0.77	16.56	8.25	25.58
2007	0.65	16.20	8.96	25.81
2008	0.59	15.92	9.54	26.05
2009	0.07	19.87	6.38	26.32
2010	0.05	19.70	6.85	26.59

Sources:

CLG: English House Condition Survey, English Housing Survey

www.communities.gov.uk/englishhousingsurvey

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

Year	25mm or less	50mm	75mm	100mm or more	Not stated	Potential	Total with	Total households
1976	1.32	2.48	1.93	0.43	1.18	14.51	7.34	19.45
1977	1.91	2.69	2.27	0.63	0.80	14.75	8.30	19.62
1978	1.61	2.70	2.83	1.00	0.88	14.72	9.03	19.78
1979	1.26	2.73	3.43	1.48	1.35	15.36	10.25	19.94
1980	1.12	3.31	3.96	1.95	0.91	15.83	11.24	20.11
1981	1.42	3.30	4.01	2.64	1.08	15.93	12.45	20.27
1982	1.11	3.40	3.93	3.33	1.22	16.23	12.99	20.38
1983	0.97	2.96	3.77	4.77	1.35	16.47	13.82	20.53
1984	0.87	2.82	4.03	5.86	1.25	16.85	14.83	20.73
1985	1.06	2.42	3.18	6.22	2.01	17.07	14.89	20.94
1986	1.00	2.37	3.57	6.82	1.72	17.42	15.47	21.16
1987	1.09	2.09	3.49	7.41	1.58	17.45	15.66	21.39
1988	0.72	2.04	3.53	7.83	1.76	17.77	15.89	21.64
1989	0.72	2.01	3.68	7.61	1.91	17.60	15.93	21.91
1990	0.75	2.28	3.76	7.80	1.81	18.04	16.39	22.13
1991	0.76	2.05	3.82	7.30	2.18	17.95	16.10	22.32
1992	0.67	1.90	3.44	7.74	2.50	17.93	16.25	22.47
1993	0.53	2.18	3.57	7.50	2.72	18.26	16.50	22.60
1994	0.47	1.70	2.99	8.57	2.51	17.88	16.25	22.73
1995	0.47	1.69	3.02	8.51	2.76	18.01	16.47	22.90
1996	0.52	1.68	2.74	9.00	2.86	18.26	16.80	23.04
1997	0.34	1.55	3.35	9.64	2.23	18.46	17.12	23.19
1998	0.45	1.72	3.01	9.72	2.32	18.42	17.22	23.34
1999	0.39	1.37	3.54	9.33	2.35	18.35	16.98	23.51
2000	0.30	1.67	3.57	9.21	2.33	18.70	17.08	23.71
2001	0.18	1.19	3.20	10.42	2.41	18.61	17.40	23.93
2002	0.18	1.18	3.18	10.41	2.43	18.78	17.38	24.13

Sources:

GfK Home Audit

www.communities.gov.uk/englishhousingsurvey

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 un-insulated lofts, which can be calculated from the difference between "Total with" and "Potential".
5) Data is for GB, for consistency with DECC insulation statistics.

Table 6g: Depth of Loft Insulation (millions, GB) - post EHS

Year	No loft	Uninsulated loft	< 100mm	100-149mm	≥ 150 mm	≥ 125 mm (DECC Insulation Statistics)	Total with	Potential	Total households
2003	2.57	0.87	6.64	8.75	5.46	-	20.86	21.73	24.30
2004	2.51	0.93	6.44	8.56	6.01	-	21.02	21.95	24.47
2005	2.69	0.97	6.21	8.27	6.55	-	21.02	22.00	24.69
2006	2.68	0.93	5.71	8.29	7.29	-	21.30	22.22	24.91
2007	2.58	0.83	5.47	8.15	8.09	-	21.71	22.54	25.13
2008	2.85	0.76	5.37	7.88	8.49	10.09	21.74	22.51	25.36
2009	2.98	0.76	5.19	7.50	9.19	10.87	21.88	22.64	25.62
2010	3.17	0.74	5.35	6.73	9.90	12.40	21.98	22.72	25.89

Sources:

CLG: English House Condition Survey, English Housing Survey

www.communities.gov.uk/englishhousingsurvey

DECC Insulation Statistics

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

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 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.

3) '25mm or less' excludes homes with un-insulated lofts, which can be calculated from the difference between 'Total with' and 'Potential'.

4) Data is for GB, for consistency with DECC insulation statistics.

5) These figures are higher than those published in ECUK 2012 because of improvements in estimating loft insulation figures, and notably using figures from Living in Wales and the Scottish House Condition Survey, see DECC Insulation Statistics.

Table 6h: Cavity Wall Insulation (millions, GB)

Year	Households with cavity insulation	Not known if cavity insulated	Households with potential for cavity wall insulation	Total households
1974	0.30		12.64	19.13
1975	0.38		12.77	19.29
1976	0.49		12.90	19.45
1977	0.63		13.05	19.62
1978	0.68		13.31	19.78
1979	1.04		13.51	19.94
1980	1.12		13.68	20.11
1981	1.28		13.85	20.27
1982	1.47		13.98	20.38
1983	1.77		14.13	20.53
1984	2.15		14.30	20.73
1985	2.22	2.45	14.46	20.94
1986	2.49	2.61	14.63	21.16
1987	2.66	2.92	14.89	21.39
1988	2.89	3.06	15.10	21.64
1989	3.15	3.08	15.50	21.91
1990	3.37	3.45	15.45	22.13
1991	3.47	3.74	15.84	22.32
1992	3.74	4.18	16.21	22.47
1993	3.62	3.74	15.62	22.60
1994	3.62	4.61	15.75	22.73
1995	3.90	4.84	15.80	22.90
1996	3.94	5.44	16.43	23.04
1997	4.10	5.15	16.47	23.19
1998	4.32	4.93	16.13	23.34
1999	4.74	1.78	16.49	23.51
2000	5.54	1.81	16.37	23.71
2001	5.53	2.09	17.12	23.93
2002	5.81	1.75	17.29	24.13
2003	6.24		17.18	24.30
2004	6.81		17.59	24.47
2005	6.99		17.62	24.70
2006	7.77		17.70	24.91
2007	8.49		18.15	25.13
2008	9.98		18.01	25.36
2009	10.71		18.56	25.62
2010	11.44		18.70	25.89

Sources:

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

www.communities.gov.uk/englishhousingsurvey

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 is taken from the DECC Insulation Statistics publication.

4) Data is for GB, for consistency with DECC insulation statistics.

Table 6i: The Number of 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	799	35
CERT (2008-2012)	2,103	4,549	47

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

http://www.ofgem.gov.uk/Sustainability/Environment/EnergyEff/Documents1/CERT%20Annual%20report%20second%20year.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 are estimated using 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 6j: Double Glazing 1970-2007 (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 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.

Table 6k: Double Glazing 2008-2010 (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	2.52	1.63	1.42	2.03	18.44	23.53	26.05
2009	2.32	1.49	1.34	1.99	19.19	24.00	26.32
2010	2.18	1.39	1.26	2.04	19.73	24.41	26.59

Sources:

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

www.communities.gov.uk/englishhousingsurvey

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) A change in methodology changed the categories of glazing shown in the EHS in 2009.

Table 6l: 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	7.76
2010	99.6	70.7	53.5	24.3	25.1	13.3	286.6	7.62

Source:

Building Research Establishment Housing Model for Energy Studies (1970-2008), Cambridge Housing Model (2009-2010)

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 the year in question from 2009.

Table 6m: Average Winter Internal and External Temperatures (°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

Sources:

Building Research Establishment Housing Model for Energy Studies/ DECC: DUKES 2011, table 1.1.8 [1970-2009]

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 6n: Hot Water Tank Insulation (millions) – pre-EHS

Year	25mm or less	50mm	75mm	>75mm	Not stated	Total with insulation	Potential	Total households
1978	3.23	5.06	2.52	0.76	2.14	13.71	16.89	20.22
1979	4.01	5.93	2.77	0.81	1.13	14.65	17.41	20.39
1980	3.20	6.59	3.76	0.92	0.72	15.19	17.66	20.56
1981	3.50	6.19	3.76	1.18	0.68	15.31	17.55	20.73
1982	3.79	6.44	3.60	1.16	0.74	15.74	17.68	20.94
1983	3.59	6.75	3.71	1.46	0.84	16.35	18.12	21.15
1984	3.49	6.61	3.81	1.71	1.22	16.84	18.45	21.37
1985	2.86	6.85	4.73	1.78	1.45	17.67	19.07	21.58
1986	3.14	6.99	4.18	1.81	1.75	17.88	19.22	21.80
1987	2.19	5.51	7.77	1.80	1.02	18.30	19.50	22.01
1988	1.89	5.76	8.05	1.81	0.96	18.47	19.74	22.22
1989	1.69	5.04	9.17	1.47	1.31	18.68	19.87	22.44
1990	1.75	4.92	9.43	1.73	1.02	18.86	20.05	22.65
1991	1.53	4.83	9.88	1.73	1.11	19.08	20.15	22.86
1992	1.55	4.30	9.88	1.84	1.12	18.69	19.86	23.03
1993	1.21	4.29	10.23	1.52	1.36	18.61	19.88	23.20
1994	0.97	3.79	10.82	1.76	1.36	18.69	19.82	23.37
1995	1.19	3.54	11.28	1.43	1.14	18.58	19.68	23.54
1996	1.16	3.25	11.05	1.83	1.10	18.39	19.42	23.71
1997	1.18	3.46	11.62	1.82	0.86	18.94	19.81	23.88
1998	1.01	3.13	11.99	1.23	0.93	18.29	19.35	24.05
1999	0.96	2.67	12.06	1.03	1.00	17.72	18.74	24.22
2000	0.80	2.84	11.95	1.13	1.06	17.77	18.91	24.39
2001	0.75	2.06	12.09	1.27	1.27	17.45	18.41	24.56
2002	0.76	2.08	12.21	1.29	1.29	17.63	18.62	24.76

Sources:

GfK Home Audit [1978 - 2002]

Notes:

1) The differences in the 'Potential' and 'Total households' is the number of households in GB without hot water tanks.

2) The tables are split pre- and post-2003 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 6o: Hot Water Tank Insulation (millions) - post-EHS

Year	12.5mm	25mm	38mm	50mm	80mm	100mm	125mm or more	Total with	Potential	Total households
2003	2.66	0.65	5.87	0.72	0.29	5.85	1.54	17.59	18.60	24.97
2004	2.78	0.65	6.29	0.69	0.26	5.69	1.28	17.64	18.66	25.17
2005	2.43	1.30	5.19	0.57	2.91	4.13	1.29	17.83	18.86	25.37
2006	1.86	2.20	3.28	0.57	5.64	3.19	1.33	18.07	19.14	25.58
2007	1.75	2.31	3.12	0.54	6.00	3.30	1.16	18.17	19.25	25.81
2008	1.28	1.70	2.50	0.44	5.36	2.38	0.90	14.58	14.76	26.05
2009	1.67	10.44	1.62	0.67	0.06	0.03	0.01	14.49	14.82	26.32
2010	1.45	10.28	1.53	0.70	0.06	0.03	0.02	14.06	14.28	26.59

Sources:

CLG: English House Condition Survey, English Housing Survey [2003- 2010]

www.communities.gov.uk/englishhousingsurvey

Notes:

1) The differences in the 'Potential' and 'Total households' is the number of households in Great Britain without hot water tanks for insulation.

2) This table shows figures from 2003 onwards, and was separated due to discontinuities in figures, resulting from a change in data source.

3) 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.

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 6p: Number of Measures Installed and their Energy Savings Under EEC1 and EEC2[1]

Measure	EEC1[2] Number of measures installed	Energy savings[4] (GWh)	EEC2[3] Number of measures installed	Energy savings[4] (GWh)
Cavity wall insulation	791,524	25,069	1,760,829	76,654
Loft insulation (virgin)	226,245	9,697	490,770	31,005
Loft insulation (top-up)	528,496	4,139	1,297,257	19,086
DIY loft insulation (m2)	15,979,367	8,101	31,982,937	9,073
Solid wall insulation	23,730	973	41,319	2,209
Hot water tank jackets	195,832	434	231,854	507
Draught stripping	22,743	39	30,299	70
Radiator panels (m2)	38,878	13	62,160	8
Other insulation (m2)	2,625	21	1,460,359	230
Compact fluorescent lamps (CFLs)	39,737,570	20,977	101,876,023	21,911
Other lighting	..	..	373,015	8
Energy efficiency cold and wet appliances	6,507,821	9,642	8,345,987	3,130
TVs	..	..	9,450,182	3,471
Standby savers	..	..	2,913,804	1,993
Other appliances	93,837	42	2,145,010	486
All boilers	278,991	2,362	2,082,812	7,837
Heating controls	2,366,128	1,220	2,236,412	210
Heating controls installed with replacement boilers	87,497	1,233	108,571	135
CHP[5]/ Communal heating	615	39	9,767	1,135
Other heating	202	5	199,786	66
Fuel switching	41,077	2,763	78,010	4,462

Source

Energy Consumption in the United Kingdom (2012) - Domestic Sector, Table 3.20 (Updated 26/07/2012)

http://www.decc.gov.uk/assets/decc/Statistics/publications/ecuk/4186-ecuk-domestic-2010.xls

http://www.decc.gov.uk/assets/decc/11/stats/publications/energy-consumption/2323-domestic-energy-consumption-factsheet.pdf

Notes:

1) The Energy Efficiency Commitment was a set of obligations set out by Ofgem, requiring certain gas and electricity suppliers to meet an energy saving target in domestic properties.

2) The first phase of EEC (EEC1) ran from 2002 to 2005.

3) The second phase of EEC (EEC2) ran from 2005 to 2008, and these figures exclude the carryover from EEC1.

4) Modelled energy savings, as defined in the Energy Efficiency Commitment obligations.

5) Number of properties served by the heating system.

Table 6q: Carbon emissions savings achieved under CERT (2008)

Upgrade measures	Percentage of savings in priority groups	Percentage of savings outside priority groups
EEC2 carryover	13.50	27.10
Insulation	19.80	13.40
Lighting	10.40	12.30
Appliances	0.80	1.20
Heating	0.60	0.60
Microgen and CHP	0.00	0.20
Total	45.10	54.90

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 6r: Number of measures delivered by suppliers in the CERT programme[1]

		Insulation				Heating	Lighting	Microgeneration		
Year	CERT Phase	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 (m^2)[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	-	-
	Total	2,103,150	2,915,390	1,633,790	47,410	90,480	303,555,480	6,620	3,090	-

Source:

Energy Consumption in the United Kingdom (2012) - Chapter 3: Domestic Sector, Table 3.21 (Updated 26/07/2012)

http://www.decc.gov.uk/assets/decc/Statistics/publications/ecuk/4186-ecuk-domestic-2010.xls

http://www.decc.gov.uk/assets/decc/11/stats/publications/energy-consumption/2323-domestic-energy-consumption-factsheet.pdf

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.

5) In addition, provisional data is subject to change based on more up to date data being submitted by third parties.

6) Ofgem do not revise data from previous quarters when these revisions occur as it is only the latest cumulative total which is published.

Table 7a: 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	529.0
2009	8.1	317.2	113.1	33.4	28.8	500.6
2010	8.7	371.7	113.4	38.0	32.1	563.9
2011	8.4	279.5	106.5	29.7	27.6	451.7

Sources:

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 estimate Great Britain 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 8a.

5) Household renewable energy consumption data for the UK have been scaled to GB using the ratio of total household energy in the UK to that of GB as the scaling factor (x0.954).

6) From 2000 onwards, 'Renewables' are separated from 'Solid Fuels'.

Table 8a: 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	MSW combustion	Co-firing with fossil fuels	Animal biomass	Plant biomass	Anaerobic digestion	Total bioenergy	Total renewable generation
1990	274,430	93,790	-	-	9	0	0	0	127	5,080	139	316	141	0	0	0	0	596	5,812
1991	281,050	98,100	-	-	9	0	0	0	142	4,482	208	328	150	0	0	1	0	688	5,320
1992	281,470	99,480	-	-	33	0	0	0	149	5,282	377	328	177	0	0	52	1	934	6,398
1993	286,130	100,460	-	-	217	0	0	0	159	4,143	447	378	252	0	0	121	1	1,198	5,717
1994	285,310	101,410	-	-	344	0	0	0	159	4,935	517	361	449	0	0	192	0	1,518	6,956
1995	295,850	102,210	-	-	392	0	0	0	166	4,672	562	410	471	0	0	198	0	1,642	6,872
1996	310,567	107,510	-	367,622	488	0	0	0	118	3,275	708	410	489	0	0	197	0	1,805	5,685
1997	312,441	104,460	-	367,240	667	0	0	0	164	4,005	918	408	585	0	0	199	0	2,110	6,946
1998	316,944	109,410	361,078	375,170	877	0	0	0	206	4,911	1,185	386	849	0	0	234	0	2,654	8,649
1999	324,016	110,308	365,250	382,396	850	0	0	1	207	5,128	1,703	410	856	1	0	459	0	3,429	9,616
2000	330,593	111,842	374,374	391,243	945	1	0	1	214	4,871	2,188	367	840	31	0	456	0	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	0	542	0	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	0	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	607	1,757	585	15	9,325	19,690
2008	342,390	119,800	384,900	400,011	5,792	1,305	0	17	555	4,600	4,757	532	1,239	912	1,575	620	13	9,649	21,918
2009	322,352	118,541	373,089	379,635	7,564	1,740	1	20	577	4,664	4,952	598	1,509	1,343	1,625	637	30	10,694	25,259
2010	329,205	118,820	378,622	384,436	7,137	3,044	2	33	497	3,147	5,014	698	1,597	1,624	2,332	627	92	11,986	25,845
2011	318,378	111,590	364,897	374,024	10,372	5,126	1	252	697	4,989	4,979	755	1,739	1,683	2,964	614	239	12,973	34,410

Source:

DECC: DUKES 2012, 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) Energy use figures were converted from the units in DUKES (thousand toe) to TWh: 1 toe = 11,630 kWh.

2) Electricity Supply for 1996-97 is from DUKES 2011.

3) The drop in Large scale hydro power production in 2010 was due to low rainfall in Scotland, see Energy Trends (http://www.decc.gov.uk/assets/decc/Statistics/publications/energytrends/1082-trendsdec10.pdf)

4) 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 8b: Renewable Heat Generation (GWh)

	Household consumption (modelled)	Solar heating	Landfill gas	Sewage sludge digestion	Wood combustion - domestic	Wood combustion - industrial	Animal biomass[1]	Plant biomass[2]	Anaerobic digestion[3]	MSW combustion	Total bioenergy	Geothermal aquifers	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	648	158	579	4,170	2,562	470	2,213	23	366	10,542	10	31	11,230
2009	399,649	808	158	593	4,363	2,599	445	2,602	23	364	11,147	10	127	12,091
2010	464,933	1,011	158	672	4,556	2,974	469	3,098	56	298	12,281	10	247	13,549
2011	353,683	1,271	158	769	4,942	3,263	0	2,897	114	380	12,524	10	378	14,183

Source:

DECC: DUKES 2012, table 5.1, 5.1.2 (internet only), 6.1.1

http://www.decc.gov.uk/en/content/cms/statistics/source/source.aspx

Energy Consumption in the United Kingdom (2012) - Domestic Sector, Table 3.6 (Updated 26/07/2012)

http://www.decc.gov.uk/assets/decc/Statistics/publications/ecuk/4186-ecuk-domestic-2010.xls

http://www.decc.gov.uk/assets/decc/11/stats/publications/energy-consumption/2323-domestic-energy-consumption-factsheet.pdf

Notes:

1. Includes heat from meat & bone combustion and sewage sludge combustion.
2. Includes heat from straw, energy crops and paper & 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.

Table 8c: 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 8d: FIT Installations and Capacity

Year	Feed in Tariff Reporting Period	Anaerobic digestion Installations	Anaerobic digestion Installed Capacity (MW)	Hydro Installations	Hydro Installed Capacity (MW)	Micro CHP Installations	Micro CHP Installed Capacity (MW)	Photovoltaic Installations	Photovoltaic Installed Capacity (MW)	Wind Installations	Wind Installed Capacity (MW)	Total (Domestic) Installations	Total (Domestic) Installed Capacity (MW)	Total (Domestic, Commercial, Industrial, Community) Installations	Total (Domestic, Commercial, Industrial, Community) Installed Capacity (MW)
2010	FIT Q1	0	0.0	0	0.0	0	0.0	2,684	6.6	40	0.3	2,724	6.9	2,763	15.197
	FIT Q2	0	0.0	93	1.1	5	0.0	7,729	19.1	587	3.9	8,414	24.0	8,555	28.687
	FIT Q3	0	0.0	31	0.4	17	0.0	6,443	16.8	212	1.5	6,703	18.6	7,062	23.851
	FIT Q4	0	0.0	29	0.3	78	0.1	11,109	30.7	202	1.6	11,418	32.7	11,818	40.570
2011	FIT Q5	0	0.0	8	0.1	58	0.1	14,280	41.6	135	1.3	14,481	43.1	14,793	55.138
	FIT Q6	0	0.0	10	0.1	94	0.1	34,823	104.3	243	2.5	35,170	107.0	35,880	152.876
	FIT Q7	0	0.0	10	0.1	64	0.1	64,242	204.8	181	2.4	64,497	207.3	66,338	341.9
2012	FIT Q8	0	0.0	9	0.1	33	0.0	97,263	313.6	270	2.7	97,575	316.4	100,696	432.2
	FIT Q9	0	0.0	20	0.2	14	0.0	35,617	124.9	365	4.1	36,016	129.2	37,701	178.8
	Total Installations	0		210		363		274,190		2,235		276,998		285,606	
	Total Installed Capacity		0.0		2.3		0.4		862.3		20.2		885.2		952.9

Source:
Ofgem Renewables and CHP Register, FIT Installations Statistical Reports for all technologies, tariff codes and locations
https://www.renewablesandchp.ofgem.gov.uk/

Table 8e: 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 9a: Housing Stock Distribution by Type (millions)

Year	Semi detached	Terraced	Flat	Detached	Bungalow	Other
1970	6.07	5.84	3.15	2.01	1.46	0.33
2010	7.09	7.56	4.98	4.58	2.38	0.00

Sources:
GfK Home Audit/CLG: English House Condition Survey, English Housing Survey, Table 401 (updated November 2010)
www.communities.gov.uk/englishhousingsurvey
http://www.communities.gov.uk/housing/housingresearch/housingstatistics/housingstatisticsby/householdestimates/livetables-households/

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 robust 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 BREHOMES, and a significant part of this report[57].

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.

Switching from GfK to EHS data meant that BREHOMES itself also had to be revised[57].

Appendix 3: Modelling GB housing energy

Six of the tables and graphs included here 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, this year we have 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 is a multiple dwellings model of domestic energy consumption in Britain. BREHOMES is 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 assumes 1008 different categories of dwelling, based on tenure, house type, age, and the inclusion or exclusion of central heating. For primary data sources BREHOMES currently uses 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 calculates heat losses and energy consumption for each of the 1008 categories of dwelling, and then aggregates to give GB totals, based on the number of dwellings in each category and an extrapolation from the numbers of English to GB dwellings[58].

The Digest of UK Energy Statistics (DUKES) publishes national totals of energy consumption broken down by sector, including totals for domestic energy consumption. Whilst outputs from BREHOMES are estimates, and are unlikely to match these actual figures exactly, BREHOMES allows the user to reconcile calculated outputs with actual domestic energy totals from DUKES. The reconciliation process involves the user modifying assumptions within plausible boundaries and re-running the model. (The main way to ensure that BREHOMES outputs are consistent with DUKES is by altering the internal demand temperature.) This process is repeated iteratively until the model and DUKES totals are in reasonable agreement.

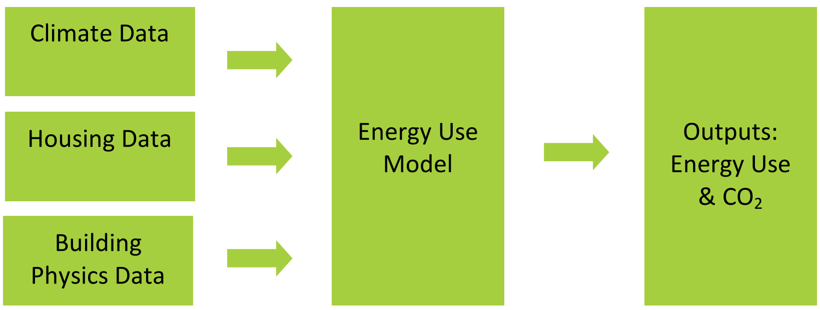
The reconciliation is intended to ensure that modelling assumptions are reasonable. This provides a more reliable basis for predicting future domestic energy consumption and possible savings from energy efficiency measures.

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[59] and BREDEM[60] 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)[61], 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, e.g. 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*[62]).

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[63].

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[64], 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*[65], and *A Guide to the Cambridge Housing Model*[66].

Appendix 4: Uncertainty in modelling

We noted in Appendix 3 that eight of the tables and graphs included here 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 summarises a simple one-at-a-time analysis we used to assess the sensitivity of total domestic energy estimates to variations in individual model parameters. We go on to consider possible sources of uncertainty in modelling, and the Monte Carlo analysis we used to assess the potential impact of such uncertainty on our modelled estimates. (Monte Carlo analysis involves running the model many times, with different values for each uncertain parameter each time it is run.)

The baseline CHM estimates total domestic energy use for England in 2009 as 445.3TWh, against a measured value from DUKES[67] of 417.6TWh, based on pro rata scaling, suggesting the model overestimates by 6.6%. However, the 'measured' figure is itself subject to uncertainty, both how the DUKES data is assembled and how we scale from UK to England[68].

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[69]. We adopted a one-at-a-time approach, which involves changing input parameters individually and assessing the effect on outputs. This allows you to determine the relative significance of parameters.

The table below shows the results of applying a one-at-a-time approach to the parameters in the CHM for the top 15 parameters. The parameters are sorted into descending order in terms of the absolute value of their 'normalised sensitivity parameter'. A normalised sensitivity figure of, say, -0.66 for heating system efficiency, means that a 1% increase in the efficiency of the heating systems in all dwellings results in a 0.66% fall in the estimate of total domestic energy consumption in England in 2009.

The table shows that internal demand temperature is by far the most significant parameter, followed by main heating system efficiency, external temperature, floor area, storey height and heating regimes. These are all inputs to the CHM, as opposed to SAP constants or values.

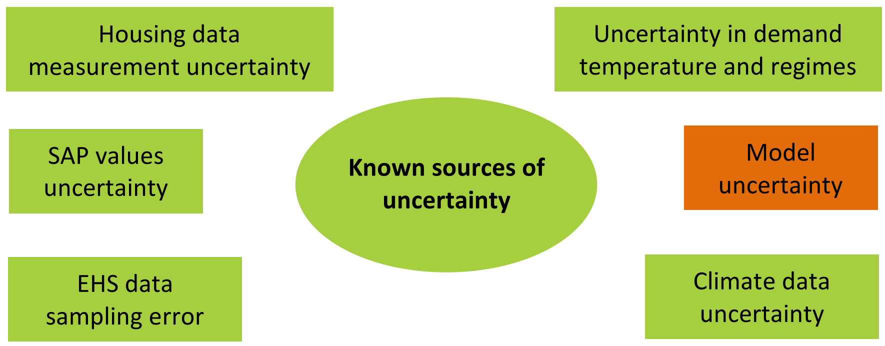
Although the one-at-a-time sensitivity analysis is informative, it does not quantify uncertainty – combining parameters is not considered, and for well-known parameters (where there is lower uncertainty), the sensitivity figures do not reflect this.

	Input parameter	Initial set value x_i	Normalised sensitivity coefficient S_i
1	Internal demand temperature (°C)	19.0	1.54
2	Main heating system efficiency (%)	80.5	-0.66
3	External temperature (°C)	7.5	-0.59
4	Total floor area (m^2)	96.4	0.53
5	Storey height (m)	2.5	0.46
6	Daily heating hours (hrs)	11.0	0.27
7	DHW system efficiency (%)	76.6	-0.19
8	Wall U-value (W/m^2K)	1.2	0.18
9	Effective air change rate (ach)	1.0	0.18
10	Wind factor parameter	4.0	-0.17
11	Wind speed (m/s)	4.8	0.17
12	Infiltration rate (ach)	0.8	0.17
13	Appliances energy: TFAxN coefficient	0.47	0.17
14	Shelter factor	0.9	0.16
15	Main heating responsiveness	0.9	-0.15

Local sensitivity analysis for the 15 most sensitive parameters in the Cambridge Housing Model

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.

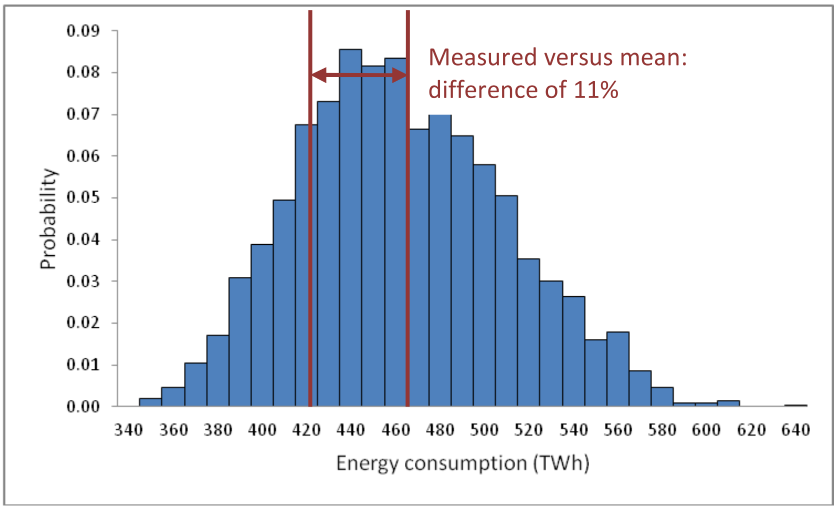


Known sources of uncertainty in the CHM

These sources of uncertainty are described in more detail elsewhere, along with a more thorough description of our uncertainty work[14]. We defined simple levels of uncertainty for each input into the Model 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 except for 'Model uncertainty' in the figure, 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.

For some uncertain parameters the values were applied in each run as a constant across the whole stock (e.g. demand temperature, and heating regimes), while for other uncertain parameters the values were applied in each run in a random manner for each dwelling (e.g. wall U-value, and floor area). This is because of the weaker evidence base informing some parameters, and to account for the increased uncertainty that results from the limited evidence.

The distribution for total English domestic energy use in 2009 is shown below. This illustrates the wide range in possible estimates of total energy use when all parameters are systematically varied between upper and lower limits. The 95% confidence interval ranges from 380-559 TWh – so we are 95% confident that true energy use lies between these values, within the limitations of this work.



Monte Carlo distributions of total English domestic energy consumption in 2009 using the CHM. The 'measured' value from DUKES is 417 TWh and the difference between this and our mean is 11%.

To return to 'Model uncertainty', which we consciously omitted from the Monte Carlo analysis, we know that the difference between the Monte Carlo mean value and the 'measured' total energy use in 2009 was 11%. This is a systematic over estimate, or 'modelling gap', as distinct from the *range* of outputs shown by the Monte Carlo analysis.

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 11% over estimate *and* the 95% confidence interval shown above.

We carried out the uncertainty analysis using modelled estimates of 2009 energy use. 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.

We cannot repeat the analysis for earlier years because we do not have input data for the model. We therefore used DUKES data for the 'central' model estimate, which is reasonable because we know that past work adjusted total energy use to match DUKES. We assume simplistically that past modelling was subject to similar uncertainties, so the variation from DUKES is a fixed percentage for all years.

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