Department for Energy Security & Net Zero

National Energy Efficiency Data-Framework (NEED): Summary of Analysis, Great Britain, 2023

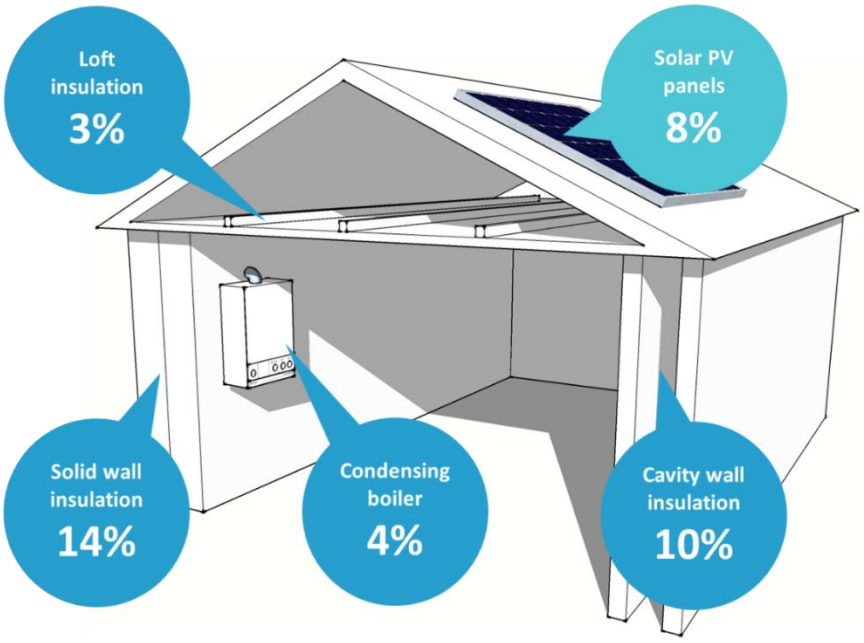
29 June 2023 **National Statistics**

This report presents analysis of domestic energy consumption using the latest version of the National Energy Efficiency Data-Framework (NEED).

Key findings

- Median domestic electricity and gas consumption is higher for larger properties (as measured by floor area) and increases with adult occupancy.
- More energy efficient properties (as measured by having a higher Energy Performance Certificate rating) have lower gas consumption overall, and per square metre.
- Newer properties consume less gas, including on a per square metre basis, particularly for those built since 2000. There is a trend of successive waves of new builds since 2010 having progressively lower electricity consumption.
- Considering trends from 2018 to 2021 provides some insight on the impact of the COVID-19 pandemic. Gas consumption increased during the pandemic restrictions and this increase was highest among smaller properties in urban areas. Overall, the post-pandemic figures show gas consumption to be 4 per cent lower than it was pre-pandemic, with larger reductions in rural areas compared to urban areas.
- Estimated savings in consumption in 2021 from energy efficiency measures installed in England and Wales are shown below. Gas savings for solid wall and cavity wall insulation remain similar in the 5 years after installation, while the savings from loft insulation or a new condensing boiler are around a tenth lower in the fifth year after installation.

Typical gas savings in 2021 from measures installed in 2020, England and Wales (electricity savings are shown for Solar Photovoltaic (PV))



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Developments since the last edition of this report

In December 2021 we published our response to the 2021 NEED user survey and took the decision to pause the NEED publication in 2022 to allow time for development work. The developments made since then include:

- A new processing system has been built for preparing meter level gas consumption data. This new system improves efficiency, quality assurance and methodological consistency across the time series. This had a negligible impact on domestic consumption statistics and a modest impact for non-domestic consumption statistics, which can be sensitive to changes for a very small number of high consuming meters (see the Subnational electricity and gas consumption summary report 2021, page 16). Work is underway to produce an equivalent new processing system for the meter level electricity data.
- Heating accounts for the vast majority of household gas consumption, and so larger properties consume more gas than smaller properties. Therefore, to compare subgroups of properties on a more like for like basis, this report now provides gas consumption statistics on a per square metre basis (except for flats for the reasons discussed on page 5 in the 'Floor area data' section of this report).
- For the Impact of Measures analysis, historic measures data was reprocessed using the latest address matching algorithm, improving consistency and quality assurance.
- The Impact of Measures analysis now also makes use of data from the following more recent government energy efficiency schemes:
  - Green Homes Grant Voucher Scheme (GHGV)
  - Green Homes Grant Local Delivery Scheme (LAD)
  - Home Upgrade Grant (HUG)
  - Social Housing Decarbonisation Fund (SHDF)

  In terms of renewable technologies, the following data sources are now included to better control for other factors affecting consumption and to expand the population of solar PV installations covered:
  - Renewable Heat Incentive (RHI)
  - MCS (Microgeneration Certification Scheme) accredited installations
- For Scotland, new Energy Performance Certificate (EPC) data have been processed and two new tables added which show gas and electricity consumption by EPC band.
- EPC ratings are now included in the NEED data explorer which allows users to view cross-tabulations of mean and median electricity and gas consumption based on two variables. We are also planning to add EPC rating to the next release of the NEED Anonymised Dataset (subject to the assurance that disclosure control remains adequate).

Contents

1. Introduction

NEED includes a range of property and household characteristics data linked to property level consumption data. This linked dataset provides insight on factors affecting household energy consumption and the consumption savings resulting from installation of government supported energy efficiency measures. As such, it is a key part of the evidence base used within and beyond government.

Within the Department for Energy Security and Net Zero (DESNZ), these data are used to develop, monitor and evaluate energy policies for specific government energy efficiency schemes. Beyond government, NEED is used by a variety of stakeholders, such as academics, local authorities, and other organisations. Uses vary, but they include using NEED data to look at trends in specific areas, and supporting analysis on housing, energy efficiency and Net Zero.

This publication only covers domestic properties. Non-domestic consumption is analysed in the Non-Domestic NEED publication.

Summary of documents and tables in NEED 2023

This report presents key findings from the latest version of Domestic NEED. Chapter 2 presents evidence on how domestic gas and electricity consumption vary by different property and household characteristics. Chapter 3 estimates the average impact of the most common energy efficiency measures on household energy consumption. This also includes common combinations of measures installed in the same year. As well as the estimated savings in the first year after the installation of the given measure, Chapter 3 also looks at how these savings change in subsequent years.

Published alongside this report are the following tables and documents:

- **Consumption data tables** – gas and electricity consumption estimates for different property attributes and household characteristics
- **Impact of measures data tables** – estimated consumption savings arising from installation of different energy efficiency measures
- **Annex A: What is Domestic NEED?** – an introductory overview of the NEED framework
- **Annex B: Overview of data tables** – a list of all the published tables and their contents
- **Annex C: Comparisons with other Sources** – a summary of comparisons of NEED outputs with other data sources for quality assurance purposes
- **Annex D: Methodology Note** – details of how the estimates of domestic electricity and gas consumption by property attributes and household characteristics are produced. It also sets out how the estimates of the impact of energy efficiency measures are derived.

What you need to know about these statistics

Electricity and gas consumption data

Consumption years, outlier removal and weather correction

For gas, from 2018 onwards the consumption year covers the period mid-May to mid-May, for example 2021 covers mid-May 2021 to mid-May 2022. Prior to 2018 the period associated with gas years varies (see Annex D: Methodology Note). For electricity, the consumption years cover the period February to January (2021 covers February 2021 to January 2022).

For gas, only households with gas consumption in the range of 100 to 50,000 kWh (kilowatt hours) have been included. For electricity, only households with electricity consumption in the range of 100 to 25,000 kWh are included. All consumption figures have been rounded to the nearest 100 kWh.

As gas is predominantly a heating fuel, its use depends heavily on the weather. Because of this, gas consumption for each household has been adjusted for differences in temperature and wind speed in each year ("weather correction"). This allows for a like-for like comparison of gas consumption over time. As electricity is used far less often as a heating fuel, electricity consumption is less affected by the weather, so this data has not been weather corrected.

Breaks in gas time series

The summer of 2017 saw the implementation of new gas meter point management and settlement processes, which changed the period of gas consumption covered by the 2016 data and the way that this was collected. Due to this, a large proportion of meters which had not reported for some time had their annual consumption figures updated in the 2017 gas consumption figures.

This large update led to an increase in the total gas consumption reported in 2017. With the majority of gas meters now providing timely meter readings, the figures from 2017 onwards are a more accurate reflection of gas consumption. Further details are contained in Annex D: Methodology Note.

Floor area data

Data on floor area are taken from the Valuation Office Agency (VOA) Council Tax Database. While for houses the floor area includes the entire floor area for the house (Reduced Cover Area), the floor area for flats only includes the Effective Floor Area, which excludes bathrooms, WCs, showers and lobby areas. Therefore, in this report, any comparisons made of average gas consumption on a per square metre of floor area basis, exclude flats.

2. Domestic energy consumption

This section presents a summary of how domestic gas and domestic electricity consumption vary by property and household characteristics, showing trends in median gas and electricity consumption between 2005 and 2021. No attempt is made to control for relationships between characteristics, or characteristics not present in this data.

The analysis presented in this section is based on median gas and electricity consumption. This is generally a better indicator of typical consumption than the mean, as the mean can be influenced by a relatively small number of high-consuming households that are not representative of the population as a whole.

NEED and Subnational Consumption estimates

The Domestic NEED consumption statistics differ from those published in the Subnational electricity and gas consumption report as summarised below[1]:

Subnational Consumption	Domestic NEED Consumption
Primarily seeks to provide geographical breakdowns of **total** gas/electricity consumption, broken down by domestic and non-domestic meters.	Primarily seeks to provide analysis on **typical** domestic consumption, broken down by property and household characteristics
The summary report focuses on **mean** statistics, as these aggregate transparently across subnational geographies.	The summary report focuses on **median** statistics, as these are more relevant to typical consumption patterns.
Based on all meters (aside from a few non-domestic gas meters which are too disclosive) which are classified as domestic or non-domestic based on meter profile and consumption.	Based on domestic properties only, and restricted to the sub-population to which electricity/gas meters could be successfully address matched. The Valuation Office Agency (VOA) Council Tax Database is used as the population of all domestic properties in England and Wales, while the Scottish Assessors Association (SAA) data is used for Scotland.
Consumption is provided for Great Britain as a whole and for a range of geographies from countries/regions down to postcodes.	As mentioned above, the dataset used for the population of all domestic properties differs between 'England and Wales' (VOA) and Scotland (SAA). The categories used differ between these two datasets which is why separate analysis is provided for 'England and Wales' and Scotland.

[1] Also see Annex C for comparisons with other data sources.

Domestic energy consumption in England and Wales

Figure 2.1 shows estimated median household gas and electricity consumption. Data for 2005 to 2010 cover England only, while the data for all subsequent years cover both England and Wales. Also note that the gas consumption estimates for the years 2017 onwards are not fully comparable with those for earlier years owing to changes in how gas meter readings are processed by Xoserve (see page 5).

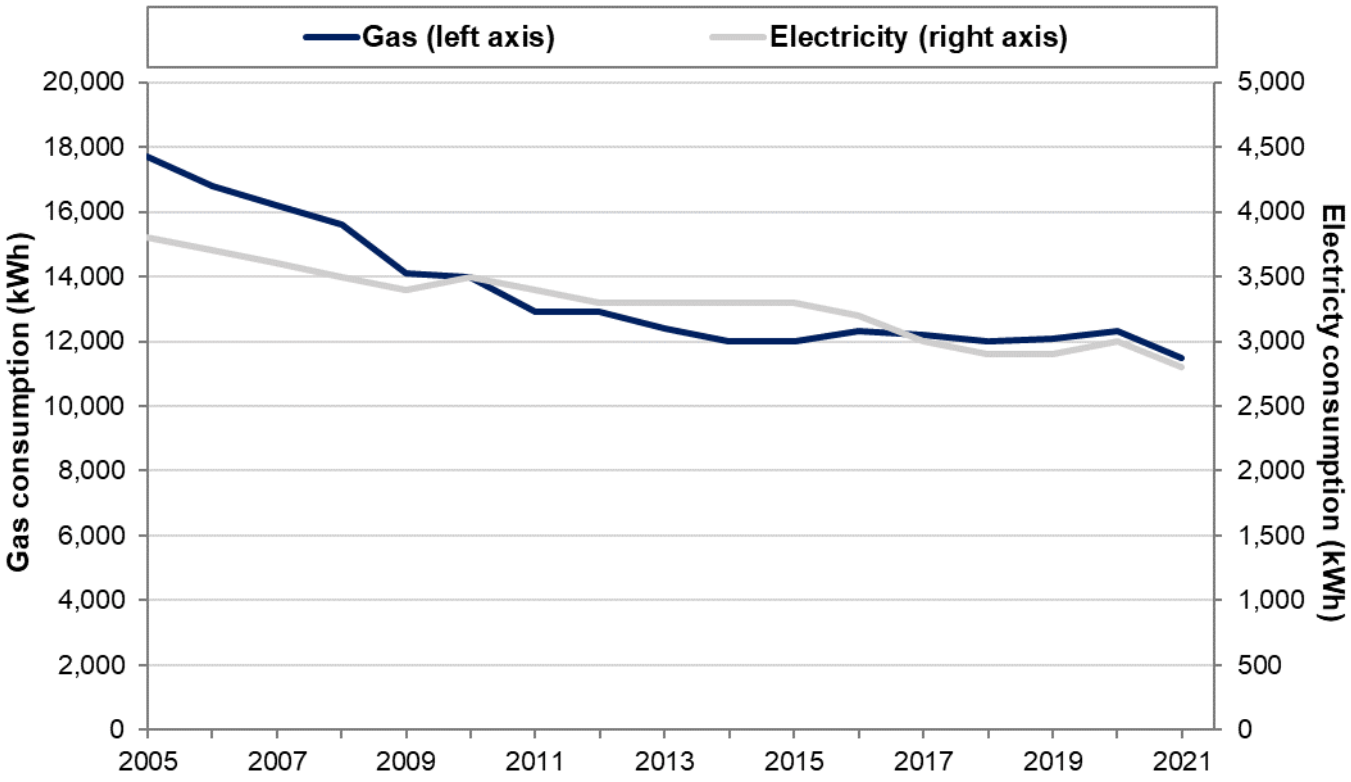
Median gas consumption was 35 per cent lower in 2021 than in 2005. Median electricity consumption decreased by 26 per cent over the same period. There has been a fall in median consumption since 2005 across all property types, household characteristics, and different socio-demographic area characteristics.

For both gas and electricity, the latest estimates show that, following an increase in consumption during the COVID-19 pandemic, median gas and electricity consumption in 2021 was below pre-pandemic levels.

Table 2.1: Annual 2021 consumption summary statistics, England and Wales
All consumption values are in kWh

	Properties (millions)	Mean	Standard Deviation	Lower Quartile	Median	Upper Quartile
Gas	18.6	12,800	7,500	7,700	11,500	16,400
Electricity	23.0	3,600	2,900	1,800	2,800	4,300

Figure 2.1: Trends in median annual domestic gas and electricity consumption, England and Wales, 2005 – 2021



Domestic consumption by floor area and adult occupancy

Figure 2.2 shows that consumption increases with property floor area. Floor area impacts gas consumption more strongly than electricity consumption because gas is mostly used for space heating and space heating demands are higher for larger properties. Figure 2.2 also shows that both gas and electricity consumption increase with adult occupancy.

Figure 2.2: Median annual domestic gas and electricity consumption in 2021, by floor area and adult occupancy, England and Wales

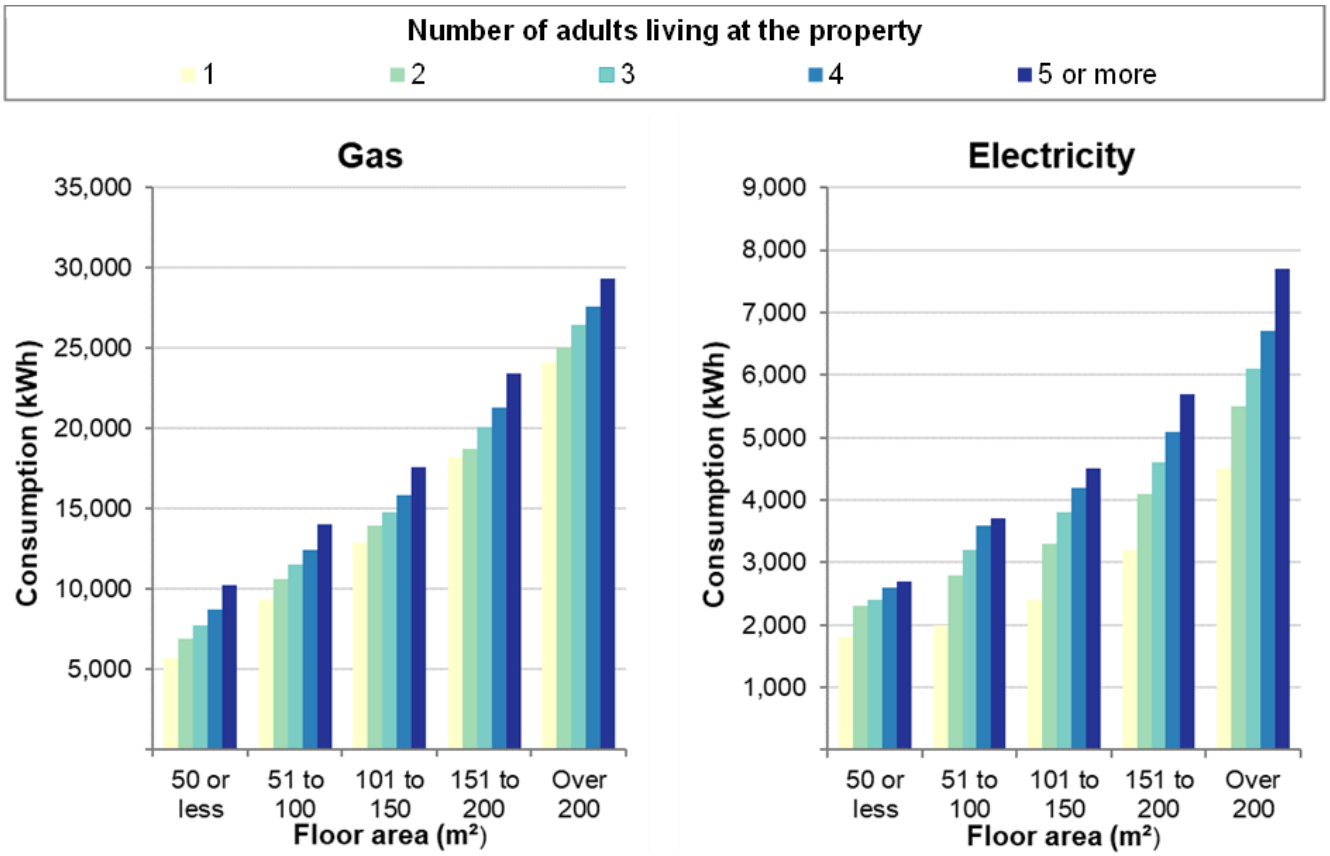
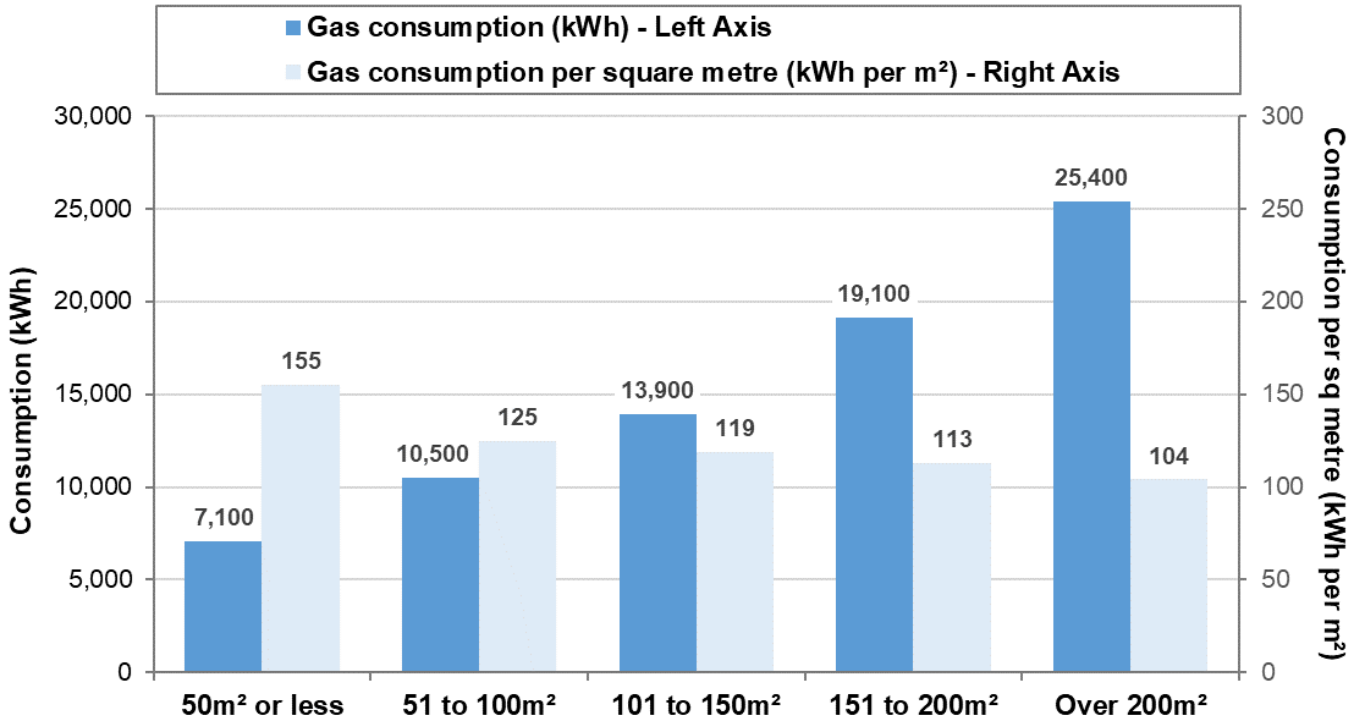


Figure 2.3 shows *Median gas consumption* and *Median gas consumption per square metre* for houses by floor area band. The vast majority (around 90 per cent) of houses are in the '51 to 100 m^2' and '100 to 150 m^2' bands, both of which had a median consumption close to 120 kWh per m^2 in 2021. For uncommonly small or large houses, a greater degree of variation in gas consumption per square metre is seen, with the largest houses (those over 200 m^2) consuming around 33 per cent less gas per square metre than the smallest properties (those up to 50 m^2) in 2021.

Figure 2.3: Median annual domestic gas consumption in 2021, per property and per square metre, by floor area, for houses in England and Wales



Part of the reason for the smallest properties having a higher gas consumption per metre squared is likely to be that, with much less gas required for space heating in smaller properties, other sources of gas use less related to the size of the property are likely to play a greater role than for larger properties. For larger properties this residual gas not used for space heating is likely to be less significant relative to the much higher amount of gas required for space heating.

Domestic consumption by Energy Performance Certificate (EPC) Rating

Energy Performance Certificate (EPC) ratings provide an assessment of the intrinsic energy efficiency of a property (based on the physical characteristics of the property). EPC ratings range from A to G, where A represents the most efficient properties and G represents the least efficient. EPC ratings are valid for ten years, so they may not provide an up-to-date picture of the current energy efficiency of each property.

It is also worth noting that around 40 per cent of domestic properties in England and Wales do not have an EPC rating, such as owner-occupied properties which have not been sold since EPC ratings came into use.

Figure 2.4: Median annual domestic gas consumption in 2021, per property and per square metre, by EPC Rating, for houses in England and Wales

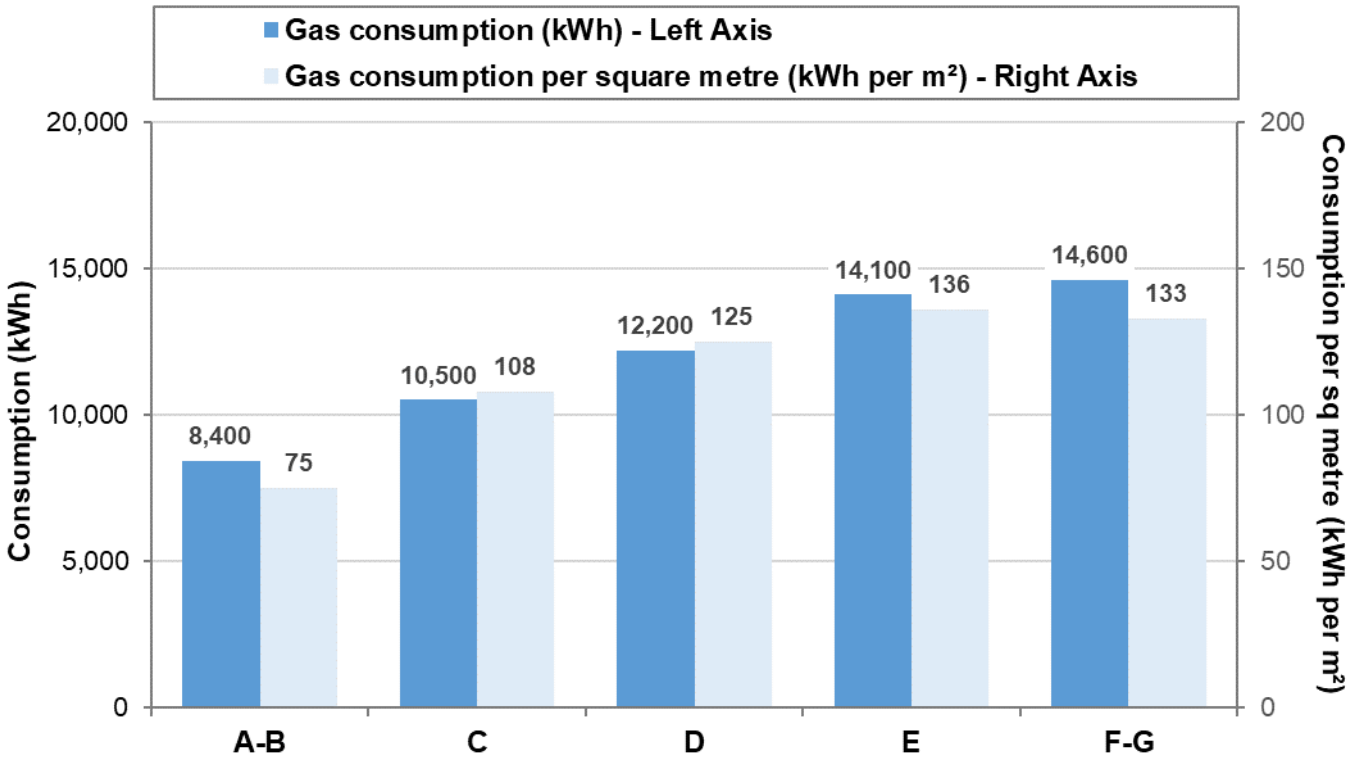


Figure 2.4 shows *Median gas consumption* and *Median gas consumption per square metre* by EPC rating (flats are excluded here for reasons discussed in *Floor Area* on page 5). This illustrates that more energy efficient houses (as measured by the EPC rating) tend to have lower gas consumption in practice, even after adjusting for the floor area of the property.

Domestic consumption by property age

In general, newer properties tend to have lower average gas consumption (see Figure 2.6), as they tend to have higher quality insulation, with building regulations becoming more rigorous over time. For properties with an Energy Performance Certificate, around 20 per cent of those built before 1945 have the highest EPC ratings A-C, compared to around 90 per cent among properties built from 2000 onwards.

Median gas consumption is lowest among properties built from 2000 onwards. The relationship between consumption and age of the property persists when adjusting for the floor area of houses (see Figure 2.5).

Figure 2.5: Median annual domestic gas consumption in 2021, per property and per square metre, by year of property build, for houses in England and Wales

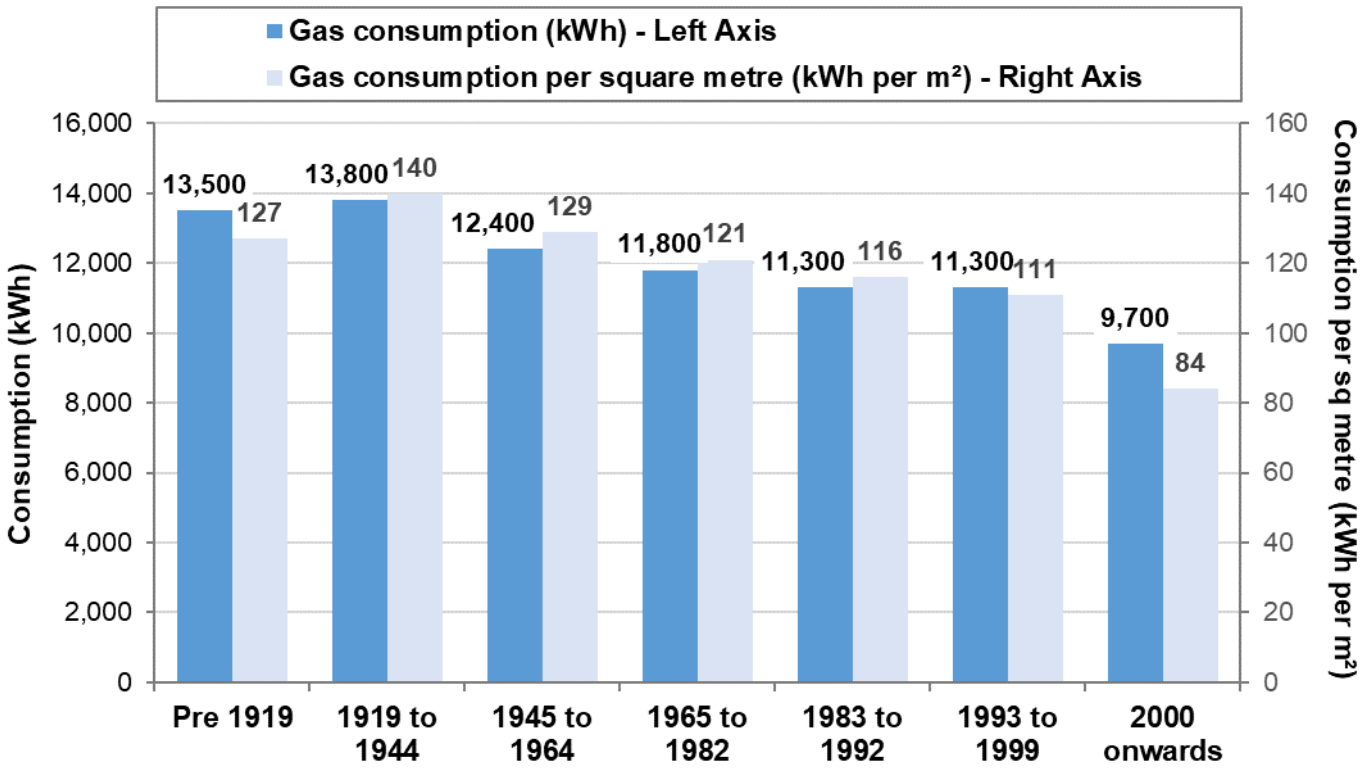


Figure 2.6: Median annual domestic gas consumption over time by year of property build, England and Wales, 2005 – 2021

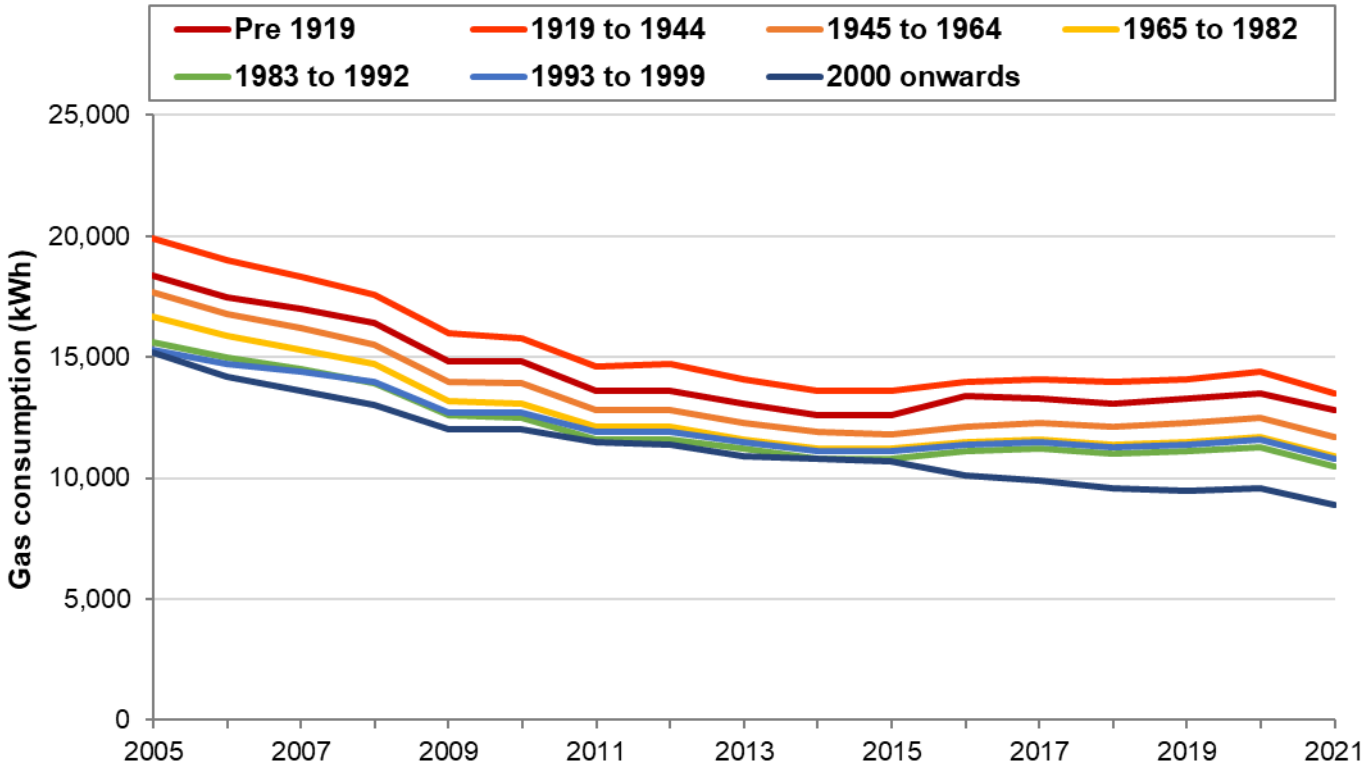


Figure 2.7: Median annual domestic electricity consumption over time by year of property build, England and Wales, 2005 – 2021

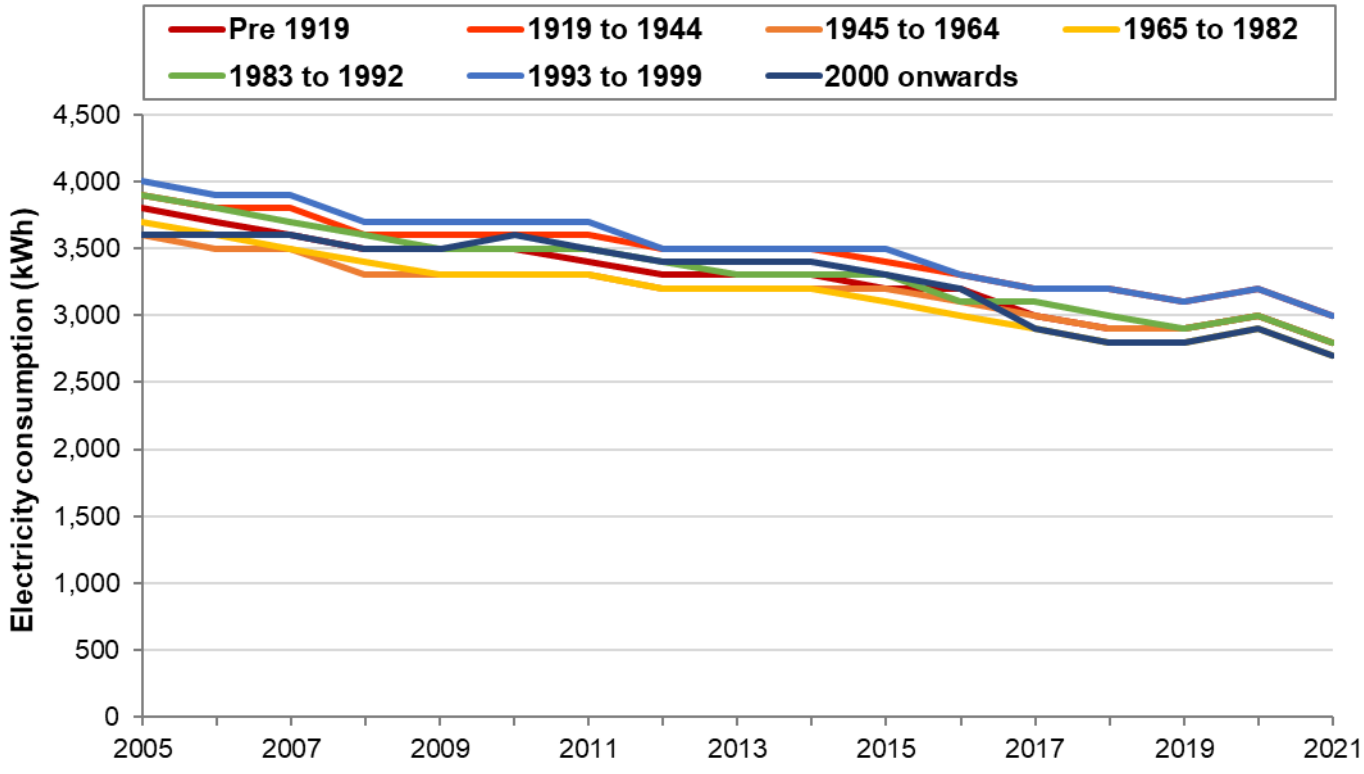
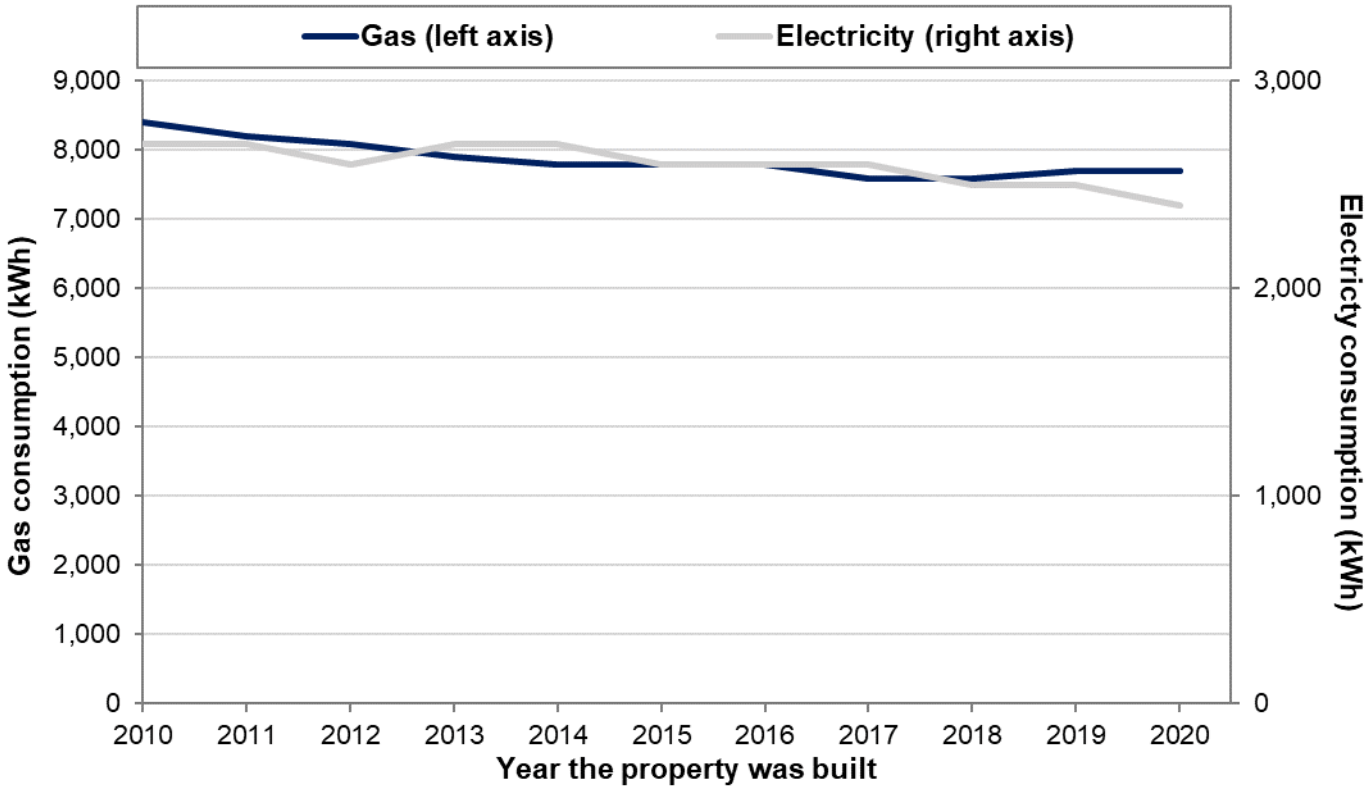


Figure 2.8: Median annual domestic gas and electricity consumption in 2021 for properties built since 2010, by year of property build, England and Wales



Among properties built from 2000 onwards, median gas consumption continues to fall with successive waves of more efficient new builds contributing to this trend. Figure 2.8 shows median domestic gas consumption in 2021 for properties built in each year since 2010. In 2021, median gas consumption for properties built in 2020 was 8 per cent lower than for properties built in 2010.

Figure 2.7 shows a trend of reducing electricity consumption since 2005 across all property ages, but there is no broad pattern of newer properties consuming more or less electricity than older properties. This is likely to be because electricity is only used for space heating in a minority of properties; in England, 8 per cent of dwellings[2] in 2020 were fuelled by electricity.

However, there is some indication of a trend of electricity consumption decreasing with successive waves of new builds for properties built more recently. Figure 2.8 shows median domestic electricity consumption in 2021 for properties built since 2010, by the year in which they were built. In 2021, median electricity consumption for properties built in 2020 was 11 per cent lower than for properties built in 2010.

[2] English Housing Survey data on energy performance, 2020, table DA6101: heating - dwellings.

Domestic consumption by property type

Figure 2.9: Median annual domestic gas consumption over time by property type, England and Wales, 2005 – 2021

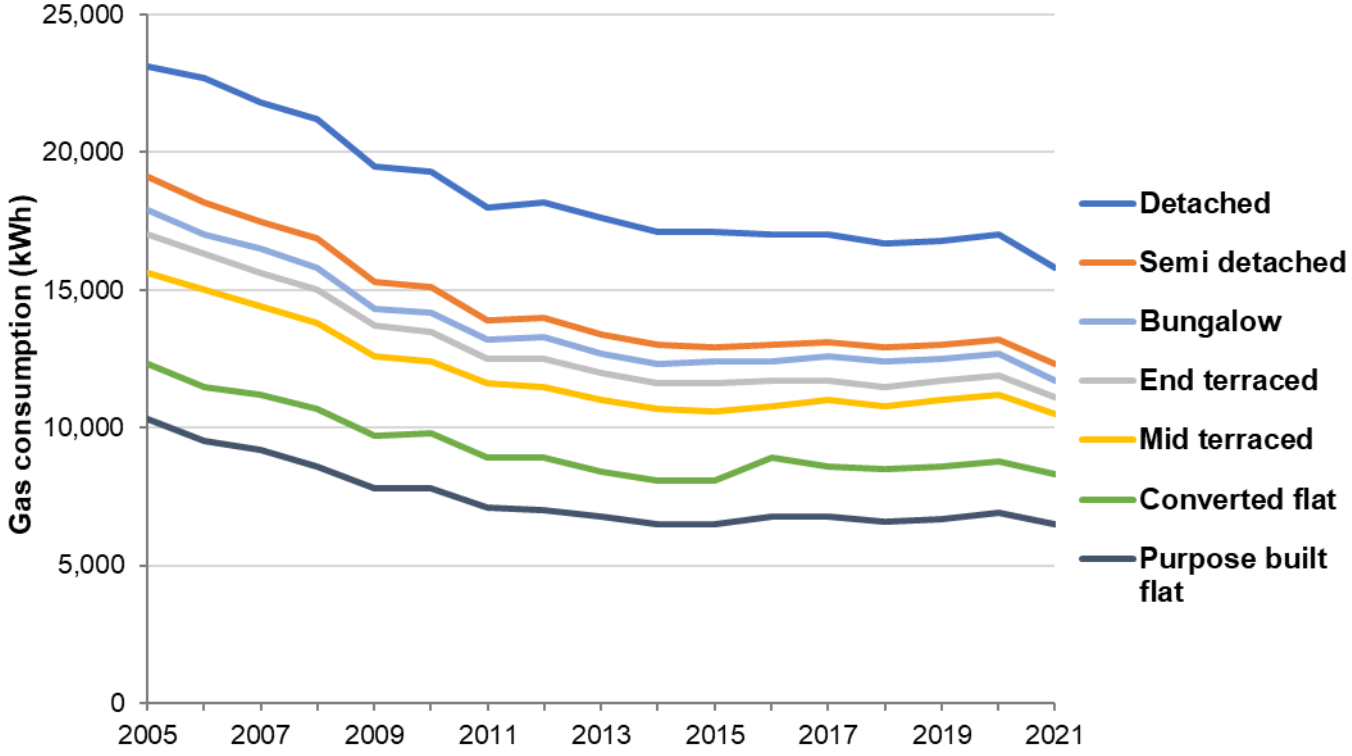


Figure 2.10: Median annual domestic electricity consumption over time by property type, England and Wales, 2005 – 2021

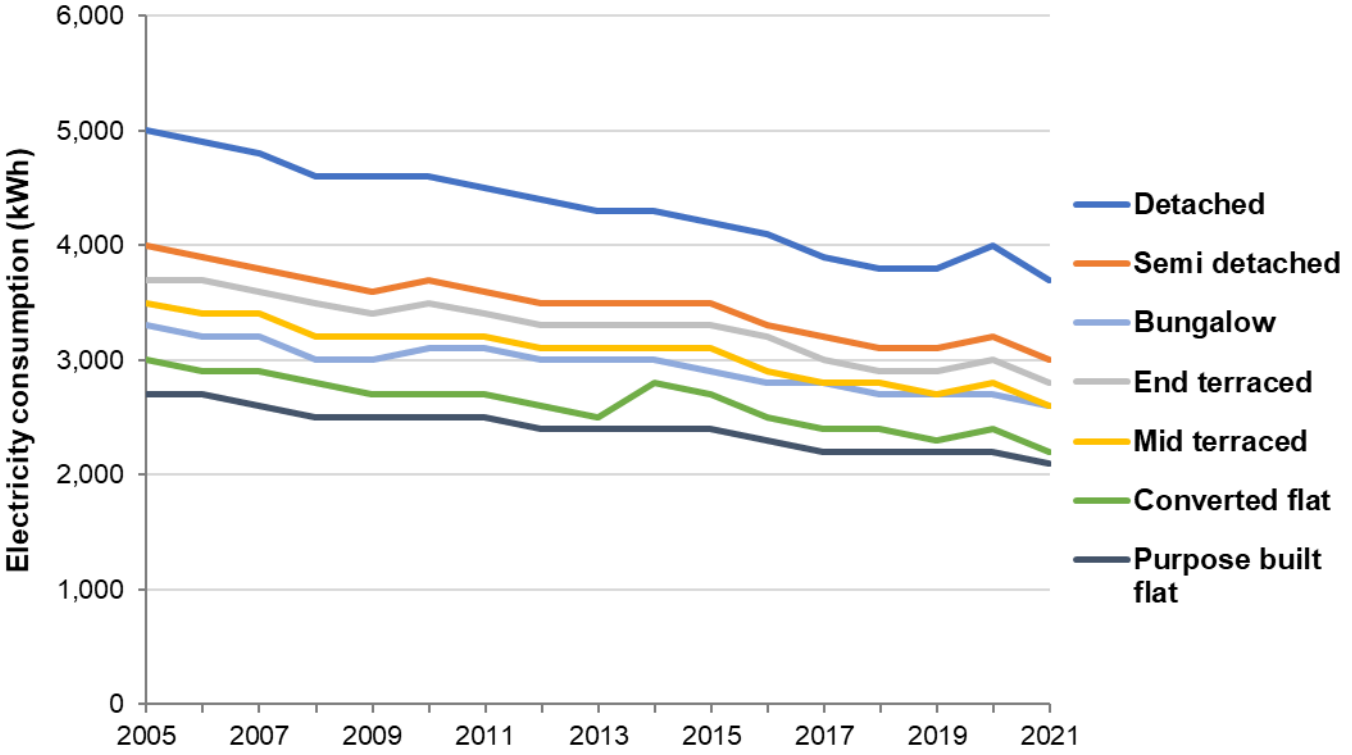
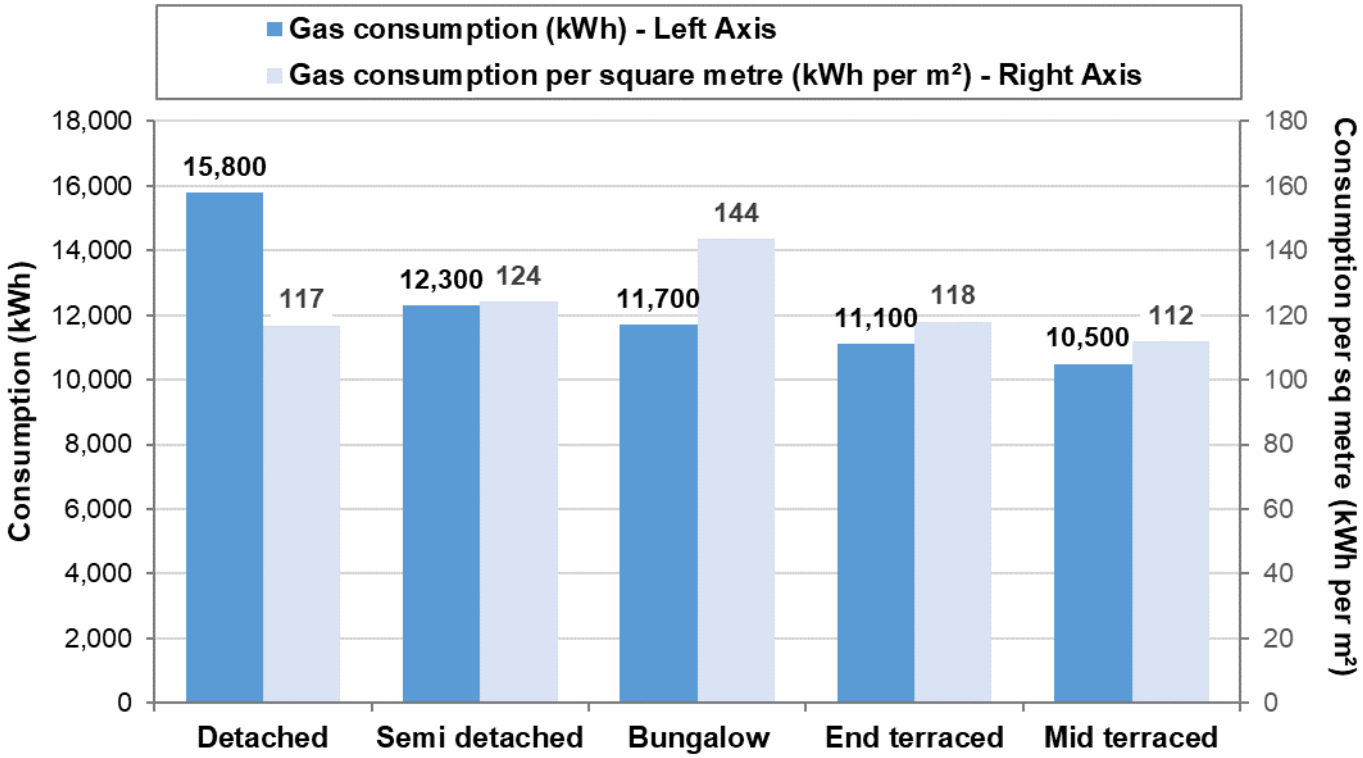


Figure 2.11: Median annual domestic gas consumption in 2021, per property and per square metre, by property type, for houses in England and Wales



The downward trend in median gas consumption and subsequent levelling off in more recent years is reflected across all property types (see Figure 2.9). In 2021 median gas consumption was 30 to 40 per cent lower than in 2005, across all property types.

Figure 2.11 shows median gas consumption per property and per square metre by property type (excluding flats). Key things to note are:

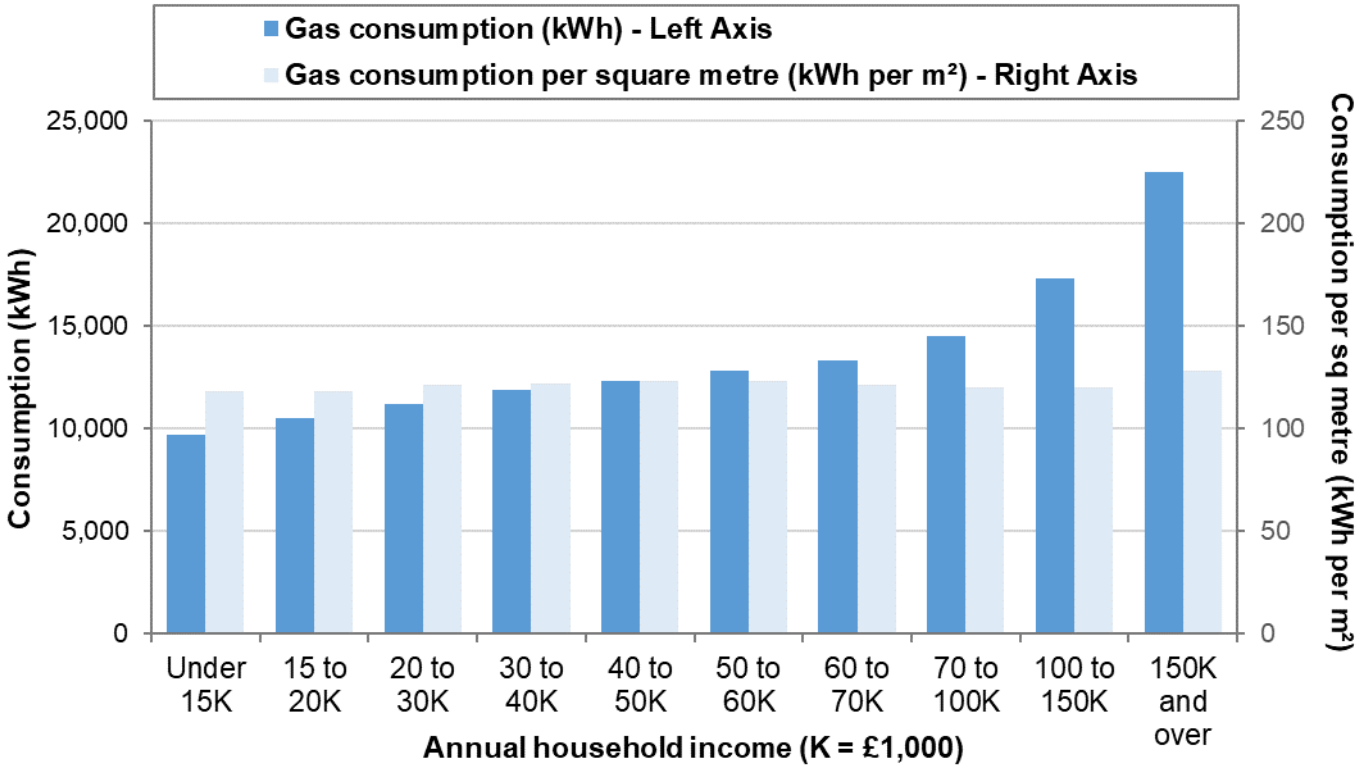
- Detached houses have the highest gas and electricity consumption of all property types, but on a per square metre basis they have a similar consumption to other types of houses (with the exception of bungalows).
- Bungalows have a higher gas consumption per square metre than other types of houses. This suggests that bungalows are the least energy efficient type of house. It is indeed the case that among Energy Performance Certificate (EPC) rated properties, a lower proportion of bungalows have the highest EPC ratings (A-C) than any other type of property (including flats).

With flats generally being the smallest properties, they tend to have the lowest gas and electricity consumption. In 2021, converted flats had a median gas consumption 28 per cent higher than purpose-built flats, despite the fact that both property types tend to be similar sizes. This reflects the fact that most converted flats are in dwellings originally built before 1919, and are therefore among the least energy efficient properties, while the majority of purpose-built flats were built from 1965 onwards. Note that lower address matching rates tend to be achieved for flats compared to other property types which may affect the reliability of trends over time.

Domestic consumption by household income

Median domestic gas consumption increases with household income. Figure 2.12 shows *Median gas consumption* and *Median gas consumption per square metre* by household income (excluding flats). Although households with greater incomes tend to consume more gas overall, on a per square metre basis households across all income bands consume a similar amount of gas (120 kWh per m^2). This means that the higher consumption for households with higher earnings is largely explained by the larger size of the properties that they live in.

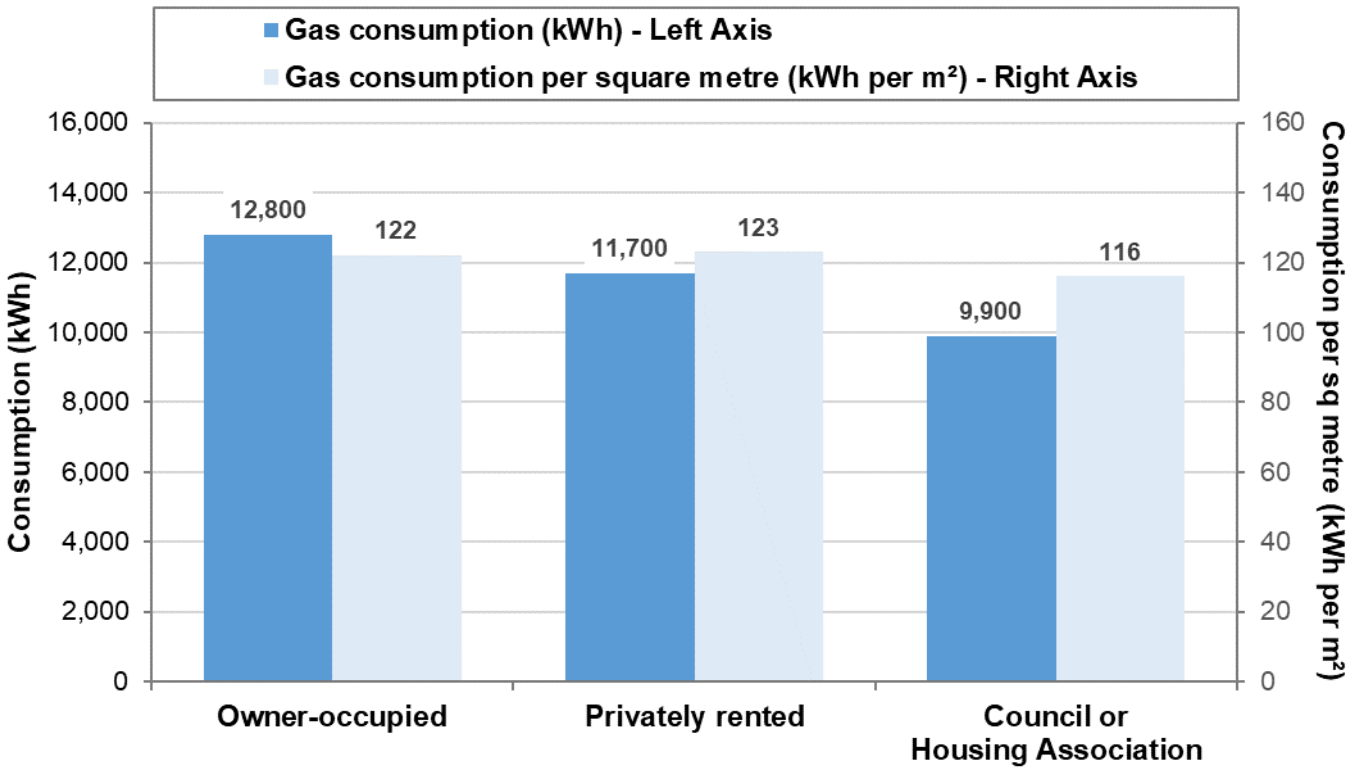
Figure 2.12: Median annual domestic gas consumption in 2021, per property and per square metre, by annual household income, for houses in England and Wales



Domestic consumption by tenure

Figure 2.13 shows *Median gas consumption* and *Median gas consumption per square metre* by tenure (excluding flats). While there are differences in overall consumption by tenure, on a per square metre basis households across all tenure types consume a similar amount of gas. This means that the differences by tenure can largely be explained by the differences in property size.

Figure 2.13: Median annual domestic gas consumption in 2021, per property and per square metre, by tenure, for houses in England and Wales



Below the broad impact of property size, we see that Council or Housing Association houses have a slightly lower gas consumption per square metre than houses in other tenure types. Looking at the EPC ratings of Council or Housing Association houses, around 60 per cent have the highest EPC ratings A-C, compared to around 40 per cent of houses in other tenure types.

Domestic consumption around the COVID-19 pandemic

This section looks at recent changes in domestic gas and electricity consumption (which have been affected by the COVID-19 pandemic) and whether these differed by any property or household characteristics.

Unlike for electricity (for which reporting years are more closely aligned to calendar years), gas years are not closely aligned with calendar years. So, to examine changes in gas consumption during the pandemic, the estimates for the following gas years are used:

- 2018 (mid-May 2018 to mid-May 2019) to represent pre-pandemic consumption.
- 2020 (mid-May 2020 to mid-May 2021) to represent consumption during the pandemic. The start of the first national lockdown, when COVID-19 restrictions were at their

tightest, is covered by the 2019 gas year (mid-May 2019 to mid-May 2020). However, more of the 2020 gas year was affected by restrictions and that is when annualised domestic gas consumption peaked.

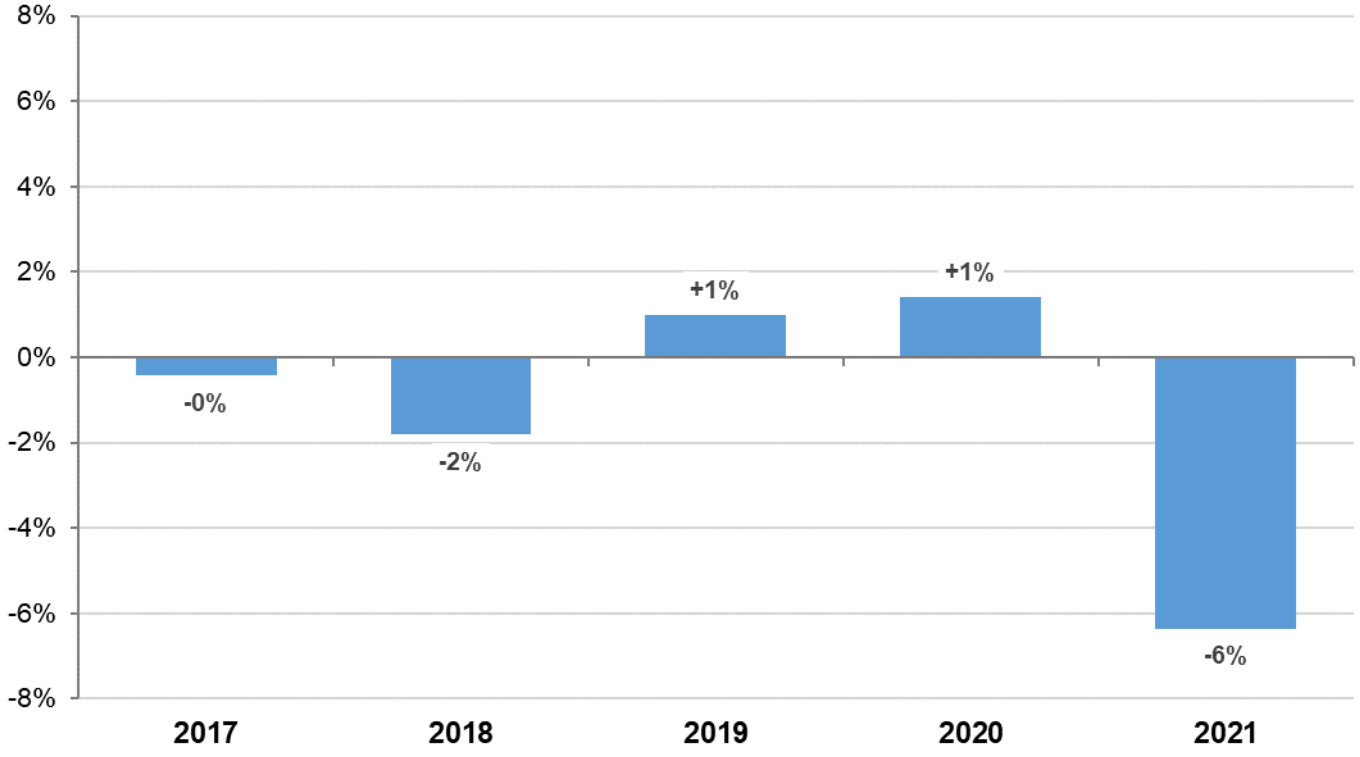
- 2021 (mid-May 2021 to mid-May 2022) to represent post-pandemic gas consumption. While it is the case that some restrictions were still in place after mid-May 2021, they were considerably reduced, with indoor venues (including pubs, restaurants and cinemas) reopened.

On this basis the percentage changes in mean and median domestic gas consumption are shown in Table 2.2 and Figure 2.14 shows year on year percentage changes in median domestic gas consumption for the past 5 years.

Table 2.2: Average domestic gas consumption and the pandemic, England and Wales

Consumption/ Percentage change	Time period	Mean	Median
Pre-pandemic (kWh)	2018 (mid-May 2018 to mid-May 2019)	13,200	12,000
Pandemic (kWh)	2020 (mid-May 2020 to mid-May 2021)	13,500	12,300
Post-pandemic (kWh)	2021 (mid-May 2021 to mid-May 2022)	12,800	11,500
Percentage change	Pre-pandemic to Pandemic	+2%	+2%
Percentage change	Pandemic to Post-pandemic	-5%	-6%
Percentage change	Pre to Post pandemic	-3%	-4%

Figure 2.14: Year on year percentage changes in median domestic gas consumption, England and Wales, 2017 – 2021



Going into the pandemic (pandemic consumption compared to the pre-pandemic consumption), median domestic gas consumption increased by 2 per cent (between 2018 and 2020). This increase is likely to be related to restrictions during the pandemic, particularly increased working from home. Over this period, the most urban areas experienced the largest increase in median gas consumption, while in the most rural areas (Villages, Hamlets and Isolated Dwellings) there was little change (see Figure 2.15). In both urban and rural areas, the smallest properties saw the largest increase (see Figure 2.16).

In 2021 (coming out of the pandemic), median gas consumption fell by 6 per cent compared to 2020. In addition to the ending of the pandemic, this large fall in domestic gas consumption may reflect higher domestic gas prices (Quarterly Energy Prices Table 2.1.1) which were, on average, 80 per cent higher during April-June 2022 than in the previous four quarters.

Median domestic gas consumption in 2021 (post pandemic) was 4 per cent lower than prior to the pandemic (2018). This reduction in consumption was greatest in the most rural areas (see Figure 2.15). In both urban and rural areas, the smallest properties saw the smallest reduction in consumption (see Figure 2.17).

Figure 2.15: Year on year percentage changes in median domestic gas consumption around the pandemic by Urban-Rural Category, England and Wales

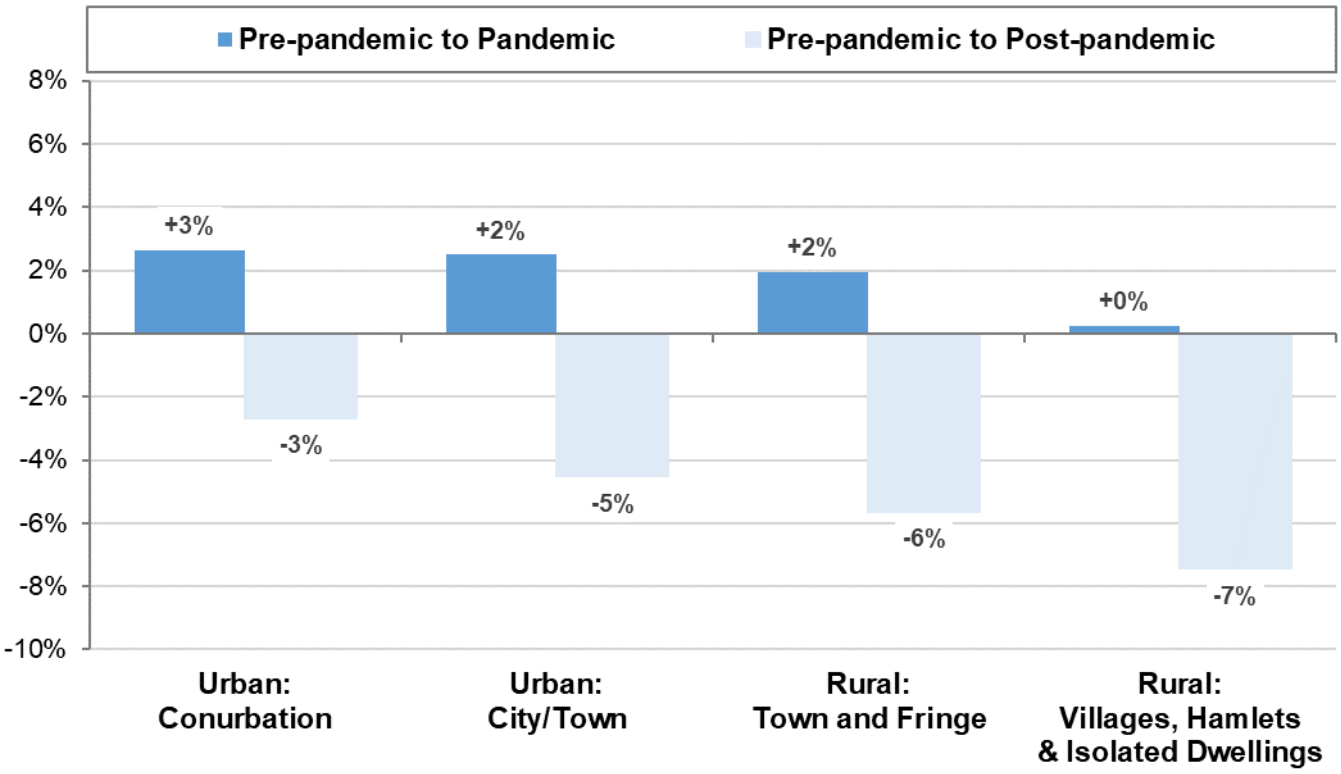


Figure 2.16: Year on year percentage changes in median domestic gas consumption Pre-Pandemic to Pandemic, by Urban-Rural Category and Floor area (m^2), England and Wales

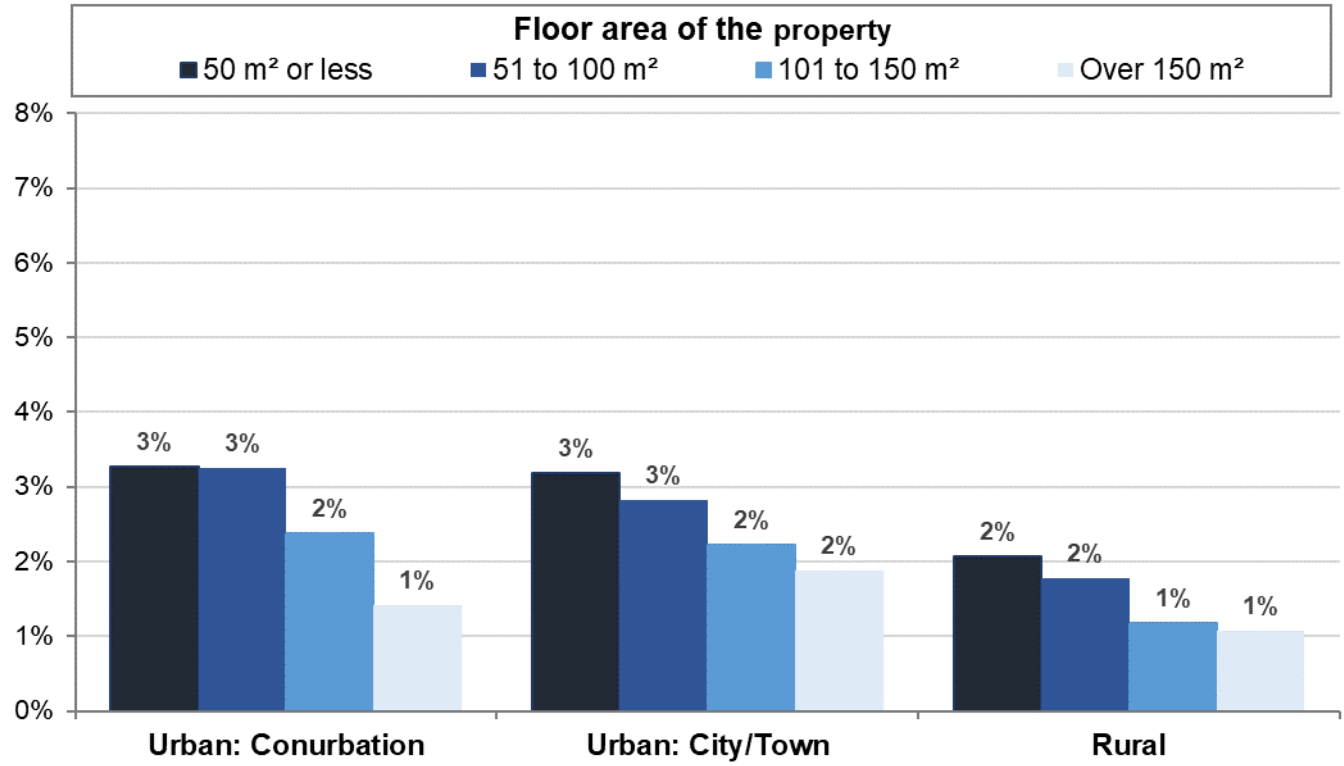
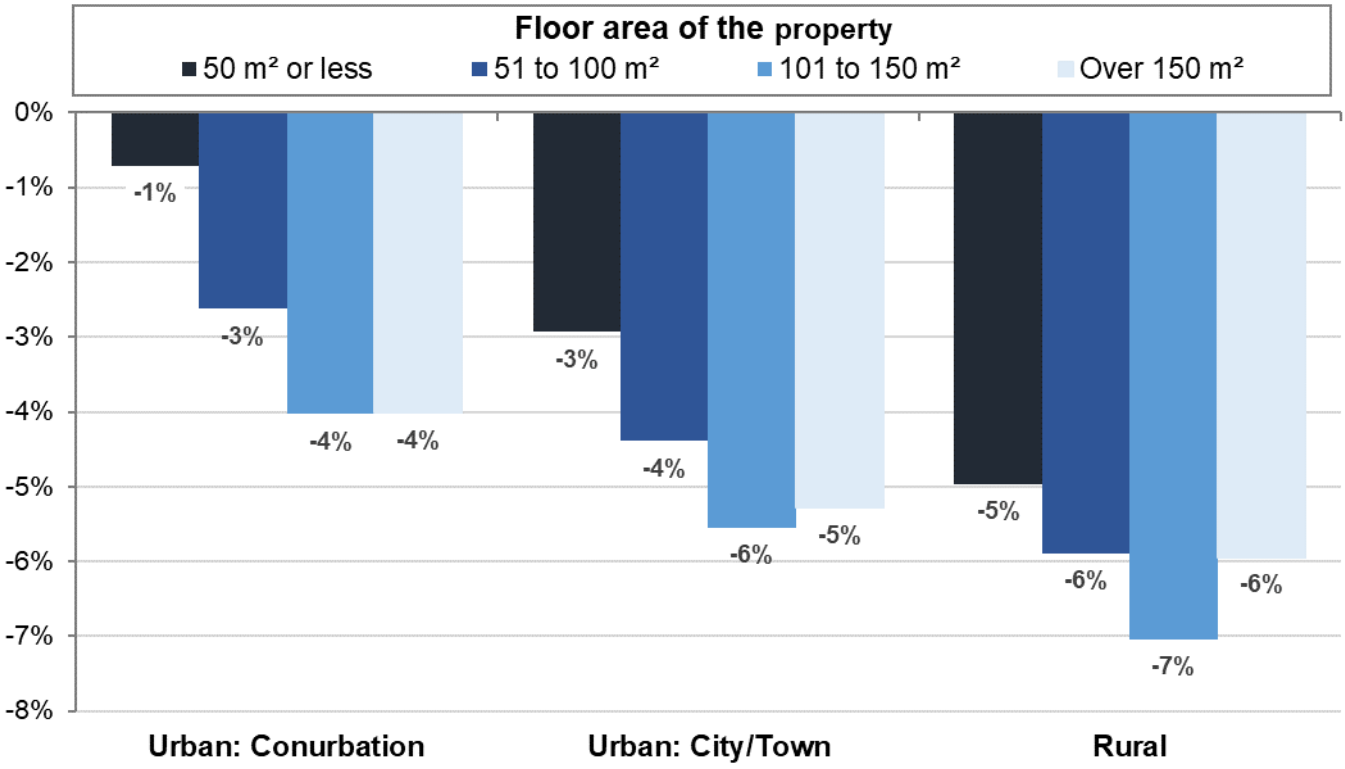


Figure 2.17: Year on year percentage changes in median domestic gas consumption Pre-pandemic to Post-pandemic, by Urban-Rural Category and Floor area (m^2), England and Wales



For examining changes in electricity consumption during the pandemic, the estimates for the following electricity years will be used:

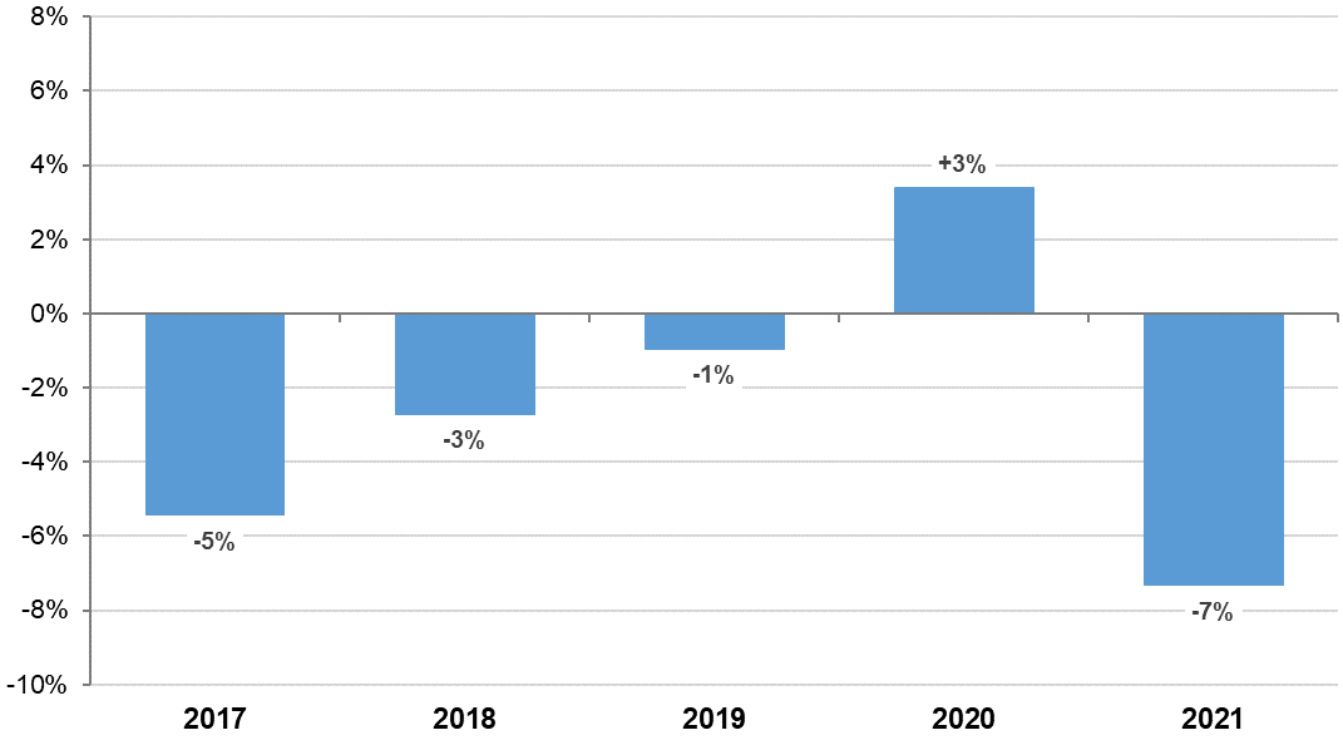
- 2019 (Feb 2019 to Jan 2020) to represent pre-pandemic consumption.
- 2020 (Feb 2020 to Jan 2021) to represent consumption during the pandemic.
- 2021 (Feb 2021 to Jan 2022) to represent post-pandemic consumption. The first few months of 2021 consumption will have been affected by lockdowns, however, this is the best proxy of post-pandemic consumption available in the meter level electricity consumption data.

Unlike for gas there were no notable patterns in the changes in electricity consumption around the pandemic differing by property attributes or household characteristics.

Table 2.3: Average domestic electricity consumption and the pandemic, England and Wales

Consumption/ Percentage change	Time period	Mean	Median
Pre-pandemic (kWh)	2019 (Feb 19 - Jan 20)	3,600	2,900
Pandemic (kWh)	2020 (Feb 20 - Jan 21)	3,800	3,000
Post-pandemic (kWh)	2021 (Feb 21 - Jan 22)	3,600	2,800
Percentage change	Pre-pandemic to Pandemic	+5%	+3%
Percentage change	Pandemic to Post-pandemic	-7%	-7%
Percentage change	Pre to Post-pandemic	-3%	-5%

Figure 2.18: Year on year percentage changes in median domestic electricity consumption, England and Wales, 2017 – 2021



Energy consumption in Scotland

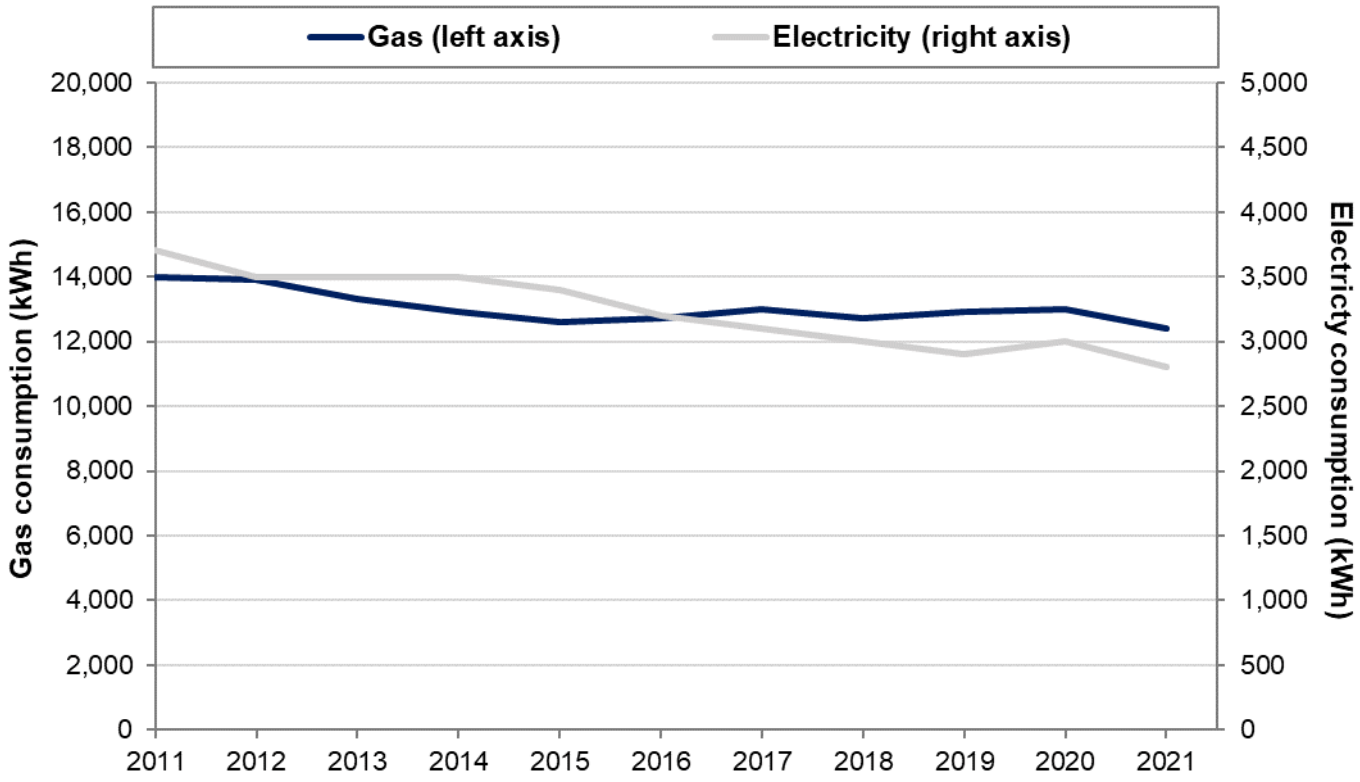
For Scotland, for both property type and floor area, data from the Scottish Assessors Association[3] (SAA) are used. Modelled data from Experian have been used for all other property attributes and household characteristics.

Table 2.4: Annual 2021 consumption summary statistics, Scotland
All consumption values are in kWh

	Properties (millions)	Mean	Standard Deviation	Lower Quartile	Median	Upper Quartile
Gas	1.6	13,800	8,000	8,300	12,400	17,600
Electricity	2.1	3,600	3,000	1,800	2,800	4,300

Users should be aware that while the data provided by the Scottish Assessors Association is considered accurate, the SAA data held in NEED was last updated several years ago. This means that properties built more recently have not been included in the analysis. Therefore, mean and median consumption figures given may be overestimating consumption, as newer properties tend to be more energy efficient.

Figure 2.19: Trends in median annual domestic gas and electricity consumption, Scotland, 2011 – 2021



[3] The Scottish Assessor Association is the organisation responsible for valuing properties in Scotland.

Figure 2.20: Median annual gas consumption over time by property type, Scotland, 2011 – 2021

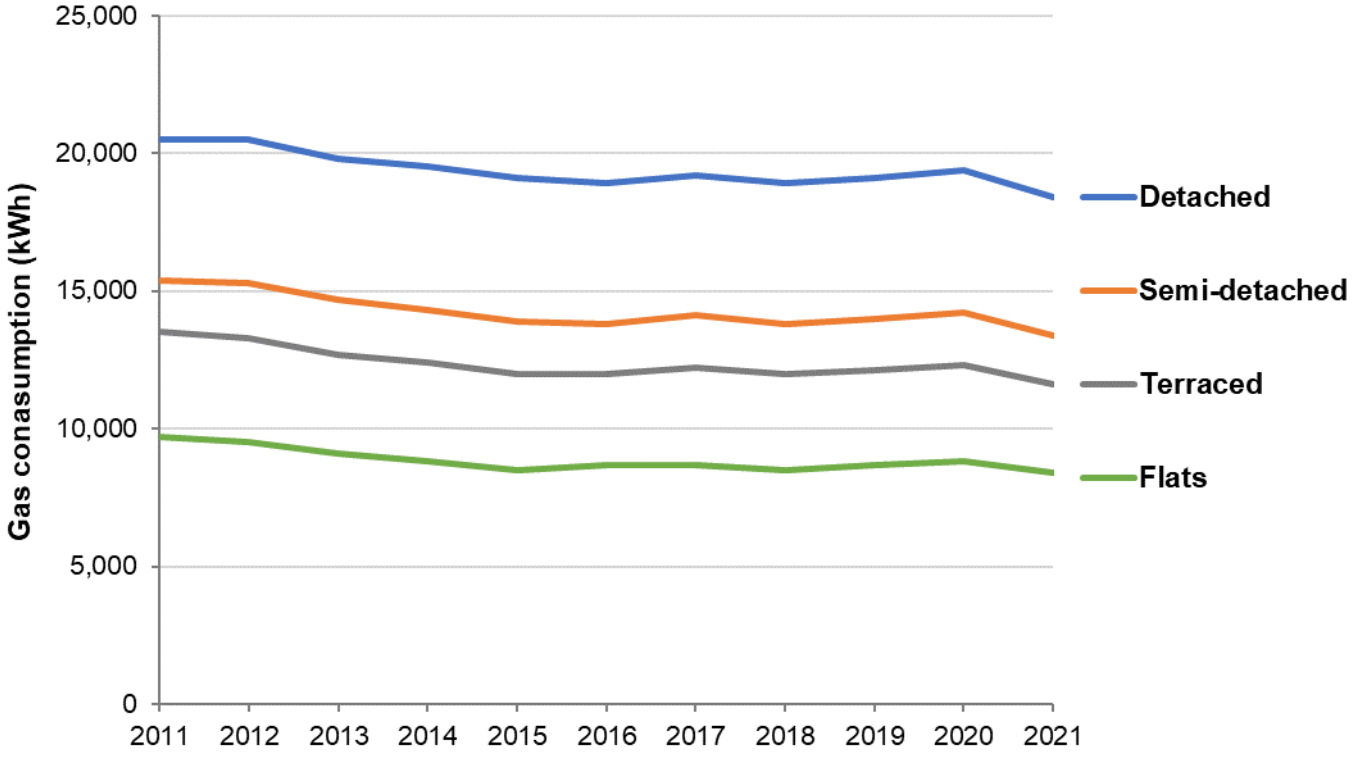
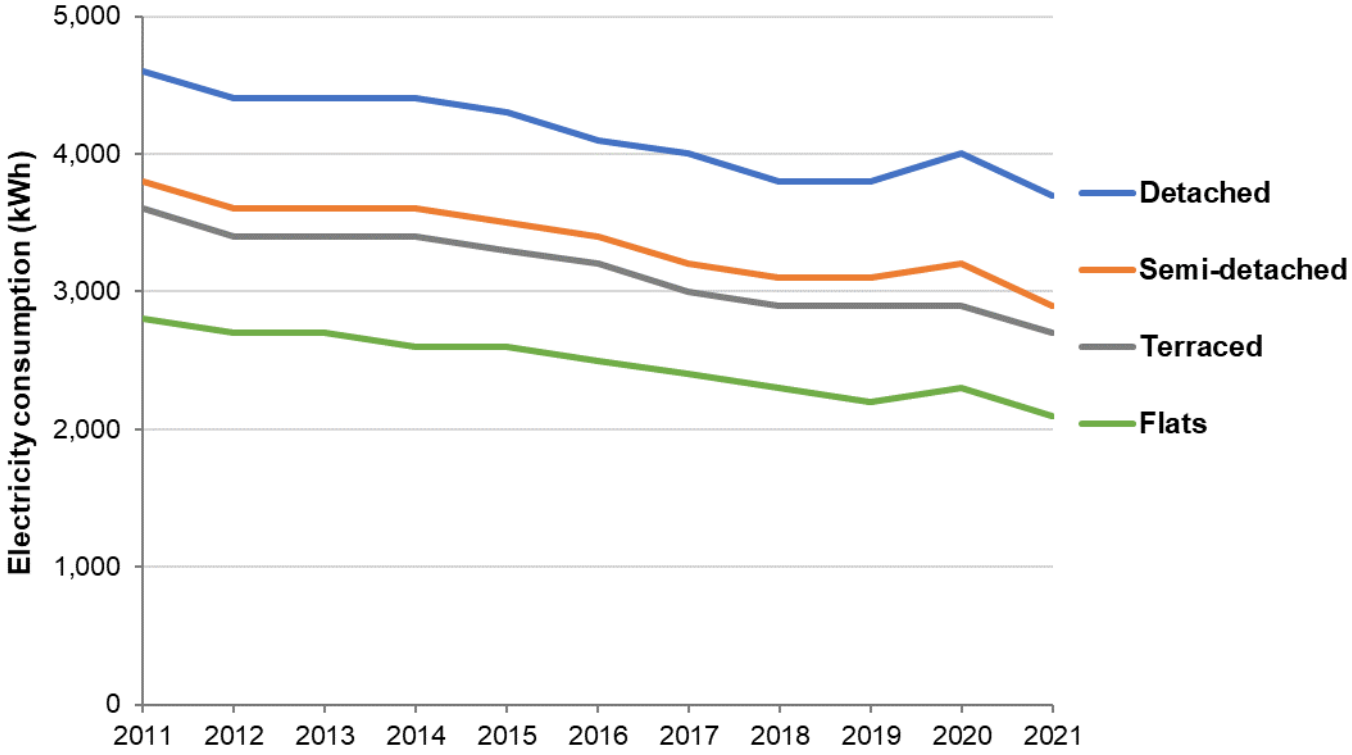


Figure 2.21: Median annual electricity consumption over time by property type, Scotland, 2011 – 2021



Median gas consumption was 11 per cent lower in 2021 than in 2011 (see Figure 2.19), the same reduction as seen in England and Wales over the same period. Similar to England and Wales, the downward trend in median gas consumption appears to have levelled off in recent years, and this is reflected across all property types (see Figure 2.20).

Median electricity consumption in Scotland fell by around a quarter (24 per cent) between 2011 and 2021 compared to a fall of 18 per cent for England and Wales over the same period. The downward trend in median electricity consumption in Scotland is reflected across all property types (see Figure 2.21).

Tables 2.5 and 2.6 summarise changes in median domestic electricity and gas consumption around the COVID-19 pandemic. These changes are similar to those seen for England and Wales (see Tables 2.2 and 2.3).

Table 2.5: Average domestic gas consumption and the pandemic, Scotland

Consumption/ Percentage change	Time period	Mean	Median
Pre-pandemic (kWh)	2018 (mid-May 2018 to mid-May 2019)	14,100	12,700
Pandemic (kWh)	2020 (mid-May 2020 to mid-May 2021)	14,400	13,000
Post-pandemic (kWh)	2021 (mid-May 2021 to mid-May 2022)	13,800	12,400
Percentage change	Pre-pandemic to Pandemic	+2%	+2%
Percentage change	Pandemic to Post-pandemic	-4%	-5%
Percentage change	Pre to Post-pandemic	-2%	-3%

Table 2.6: Average domestic electricity consumption and the pandemic, Scotland

Consumption/ Percentage change	Time period	Mean	Median
Pre-pandemic (kWh)	2019 (Feb 19 - Jan 20)	3,700	2,900
Pandemic (kWh)	2020 (Feb 20 - Jan 21)	3,900	3,000
Post-pandemic (kWh)	2021 (Feb 21 - Jan 22)	3,600	2,800
Percentage change	Pre-pandemic to Pandemic	+4%	+2%
Percentage change	Pandemic to Post-pandemic	-7%	-8%
Percentage change	Pre to Post-pandemic	-3%	-5%

3. Impact of energy efficiency measures

This chapter presents estimates of the impact of installing energy efficiency measures[4] on gas consumption for properties in England and Wales, and separately for Scotland.

The analysis compares:

- gas consumption changes in properties which had energy efficiency measures installed (the intervention group), before and after the measure was installed with;
- the change in consumption over the same period for similar properties which have not had any measure installed the year before, the year after or during the year of installation (the comparator group).

This method is also applied to solar PV, with corresponding comparisons of electricity consumption. For more details on how the impact of energy efficiency measures estimates are derived, please see Annex D: Methodology Note.

Note that this analysis mainly makes use of data on measures installed under government schemes, with the Energy Company Obligation (ECO) schemes accounting for around 90 per cent of such measures during the period the mid-May 2020 to mid-May 2021 which the latest NEED impact of measures gas savings estimates refer to. A full list of government schemes included in NEED analysis can be found in Annex A: What is Domestic NEED? Besides data on measures installed under government schems the other sources of data used are the Gas Safe Register (which provides data on all boiler installations in England and Wales, but not all installations in Scotland) and the MCS Accreditation data (used for solar PV installations).

The headline estimates refer to energy savings in 2021 from energy efficiency measures installed in 2020. The key energy efficiency measures included in this analysis are:

- Condensing boiler (gas savings)
- Solid wall insulation (gas savings)
- Cavity wall insulation (gas savings)
- Loft insulation (gas savings)
- Solar PV (electricity savings)

Not all properties where a measure has been installed are included in the analysis. The properties excluded are:

- Flats, due to issues with matching these meters to properties. This is because including flats with the wrong meter point readings matched to them may result in inaccurate estimates.
- Where the consumption estimates are extreme compared to the previous year or are thought to be imputed.

[4] Apart from solar PV, the impact of measures analysis is presented for measures installed between mid-May 2020 and mid-May 2021, as the savings are based on comparing 2019 (before installation) and 2021 (after installation) gas years. For Solar PV the analysis refers to installations made during the months February 2020 to January 2021 as the savings are based on comparing the 2019 and 2021 electricity years.

All figures in this chapter are weighted, meaning that savings have been adjusted to be representative of the complete housing stock (excluding flats) rather than just the properties which have had the measure installed in the year under consideration. For more information on the weighting used, see Annex D: Methodology Note.

Uncertainty in estimated savings

The savings estimates for each measure vary from year to year and should be considered indicative rather than precise. There are a number of factors that are likely to contribute to variations in estimated savings from one year to the next:

Methodology and data

- While the fundamental methodological approach used for the impact of measures estimates has remained consistent since the creation of NEED, refinements have been made over time. The sensitivity of the estimates to these changes has not been fully assessed and therefore variation seen in estimates may in part be a result of methodological changes. Comparisons between the results published in different years should therefore be treated with caution.
- Measures installed outside of government schemes are mostly "hidden" from this methodology. Properties in our comparator group having energy measures installed which are not known about can lead to savings being underestimated.

Unknown information about the installations or property

- The quality or size of installations may vary between years. For example, trends in the size and quality of solar panels being installed will impact the estimated savings.
- The attributes of the property may vary between years. For example, property extensions will likely increase consumption and could be made alongside installation of energy efficiency measures, masking the savings benefit of those measures.
- The performance of a measure can vary by the brand or subtype of measure. For example, while cavity wall insulation is considered to be a single class of intervention, there are several types of cavity fill (PDF, 162KB), notably bead and mineral wool, which may have different impacts.

Unknown information about the household

- The results may be different for early adopters of novel measures because this self-selecting population may have a different energy consumption pattern to other consumers.
- Any variation between the treated populations which is not available in the data cannot be controlled for, for example, age of residents and the number of children in the home.
- Changes in energy consumption behaviour which follow the installation of an energy efficiency measure and may also vary over time and between different types of household. An example is when a household chooses to heat their home to a higher temperature following installation of a measure; this is a known phenomenon referred to as *comfort taking* (see following box).

Comfort taking

A known phenomenon when properties become more energy efficient is *comfort taking*. Rather than heating their home to the same temperature after the installation of the measure as before it, the resident takes advantage of the more efficient home by heating it more frequently and/or to a higher temperature ("taking comfort"). The impact of measures analysis presented here is based on metered savings and these will also reflect any extra consumption due to comfort taking. Therefore, the consumption savings presented here may be lower than expected based on energy efficiency considerations alone.

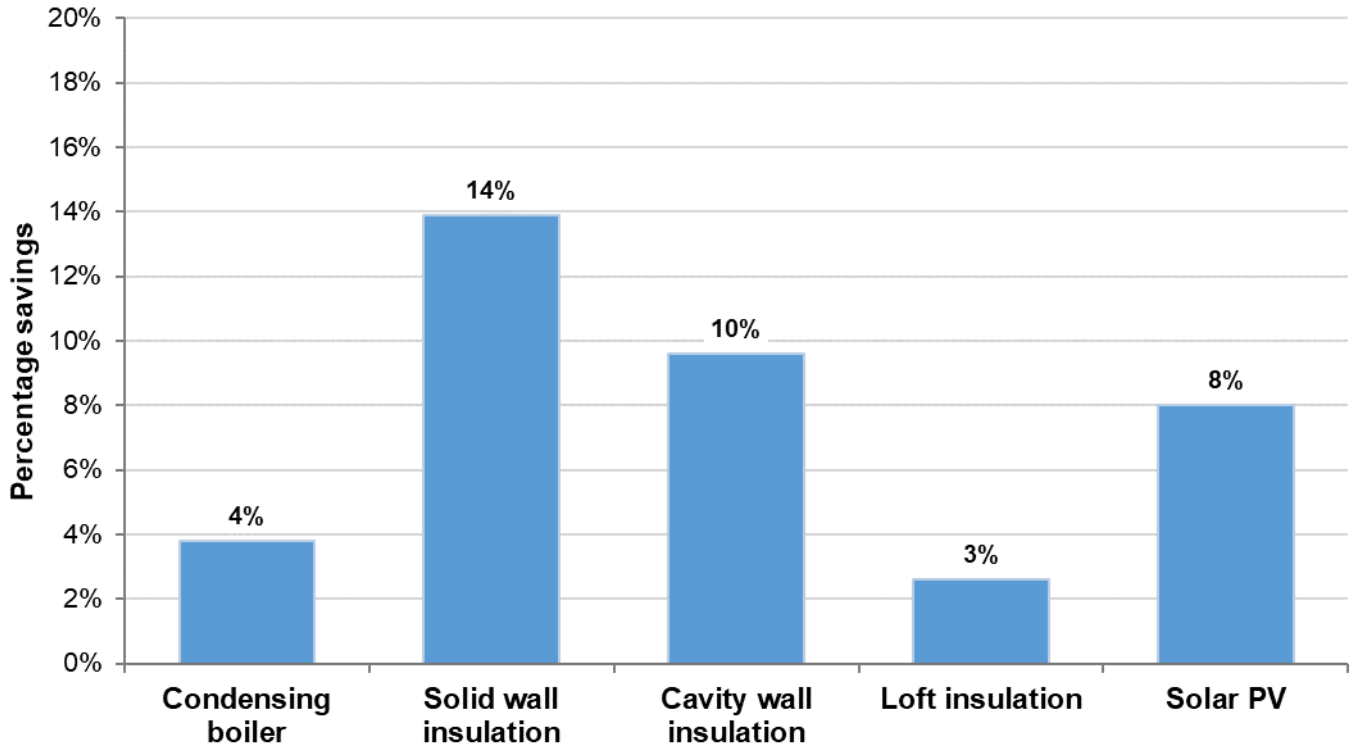
A similar effect can be expected with the installation of solar PV. The installation of solar PV may result in less electricity being drawn from the grid (which is detectable in NEED). However, this fall in electricity use from the grid may be partially offset by the household changing their consumption habits to use more electricity following the installation of a solar PV measure. Therefore, the grid-consumption savings following the installation of a solar PV measure may be lower than expected based on solar PV generation capacity alone.

Impact of Measures Installed in England and Wales

Single measures

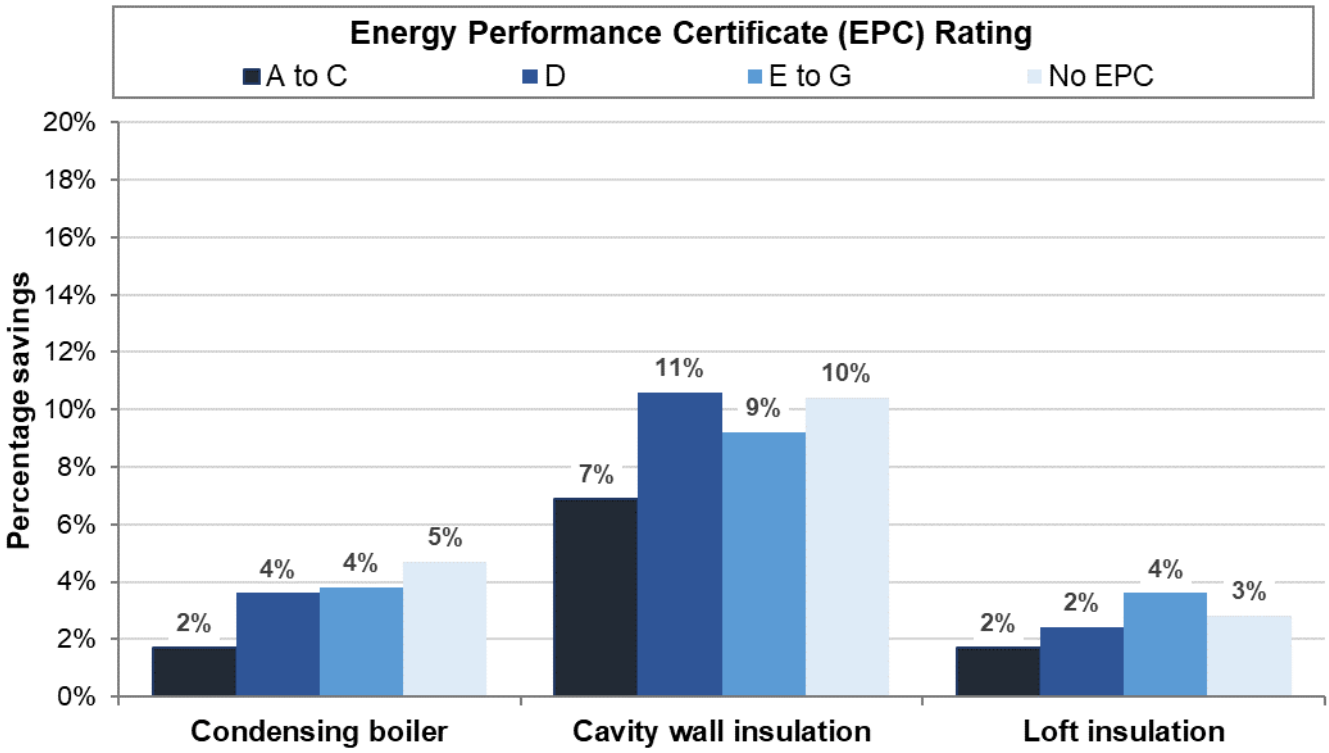
Figure 3.1 shows the median savings in 2021 from measures installed in 2020. Solid wall insulation has the highest median gas savings (14 per cent). The median is regarded as a more appropriate measure of typical savings as a small number of extreme values for individual properties (which are not representative of the rest) can distort the mean.

Figure 3.1: Median gas savings in 2021 for measures installed in 2020, England and Wales (electricity savings are shown for Solar PV)



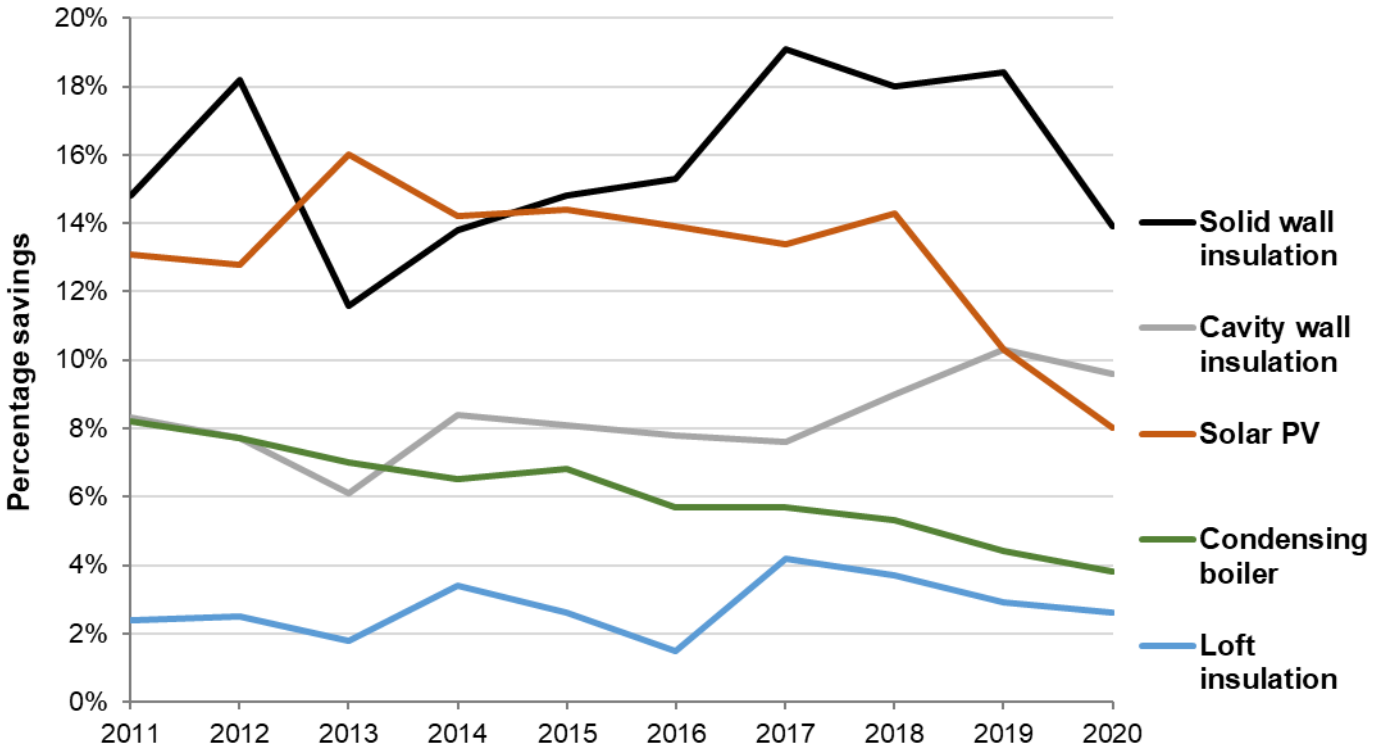
The accompanying attributes tables include estimates of the savings from each measure by household and property characteristics. There are broadly consistent savings across these characteristics from installing the main energy efficiency measures. However, one apparent systematic difference to note is that the gas savings from energy efficiency measures tend be lower when they are being applied to properties which have been assessed as already having a relatively high energy efficiency (EPC ratings A-C), see Figure 3.2. This likely reflects the more marginal energy efficiency improvements available to be made on already efficient properties.

Figure 3.2: Median gas savings in 2021 for measures installed in 2020, by Energy Performance Certificate (EPC) rating, England and Wales



The median savings from the main energy efficiency measures installed in previous years have been recalculated using the latest methodology (as used for 2020 installations) and based on the latest version of Domestic NEED. The resulting estimates are presented in Figure 3.3.

Figure 3.3: Median gas savings from energy efficiency measures in the first year after installation, by year of installation, England and Wales, 2011 – 2020
(electricity savings are shown for Solar PV)

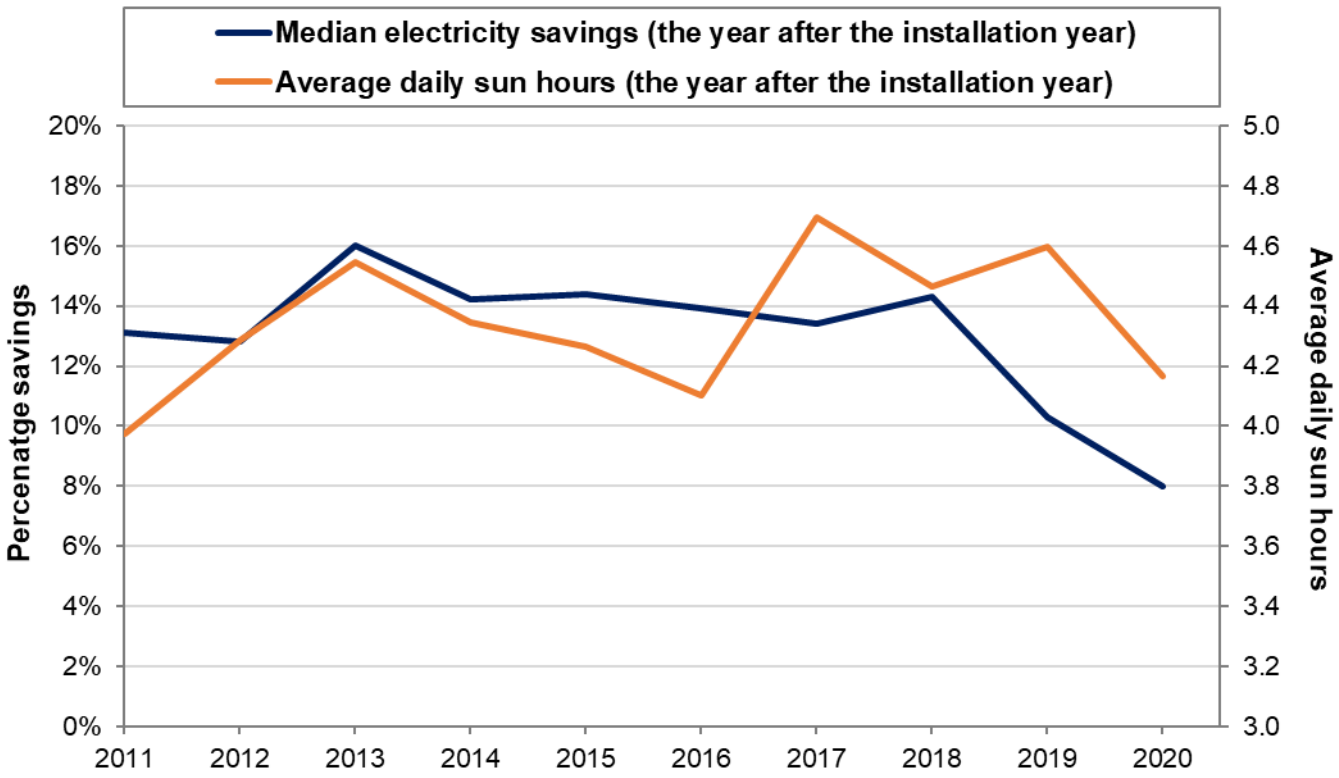


It should be noted that possible reasons for changes in the savings from energy efficiency measures from one installation year to the next are outlined on pages 26 and 27. In general, the trends over time appear fairly volatile, which is probably a result of the low sample sizes on which these estimates are based. An example of this is solid wall insulation, which has a consistently large percentage saving, but the variation between years is most likely due to volatility originating from the small sample size combined with a large degree of variability in the savings estimates between individual properties in the sample. Solid wall insulation consistently yields the highest gas savings while loft insulation has consistently resulted in the lowest gas savings of the five measures reported in Figure 3.3.

Condensing boilers show a relatively smooth trend of decreasing savings. The smoothness of this trend likely reflects the relatively large sample sizes (hundreds of thousands) on which the estimates for this measure are based. The downward nature of this trend needs careful interpretation. In each year there is a saving in average gas consumption from installation of a new condensing boiler (relative to the old boiler it replaced). However, this analysis indicates that average savings have reduced slightly over time. This suggests that the greater efficiency of the replacement boilers *relative* to those being replaced is decreasing over time.

It is unclear why the electricity savings from solar panels installed in 2019 and 2020 are notably lower than in previous years, however, for 2020, the amount of sunlight may have played some part, with the average daily sun hours being at their lowest since 2016 (see Figure 3.4). The average capacity of installations has not changed significantly in these years. However, factors such as the orientation of installation sites, the use of batteries and other influences on consumption such as electric vehicle ownership may affect the observed savings.

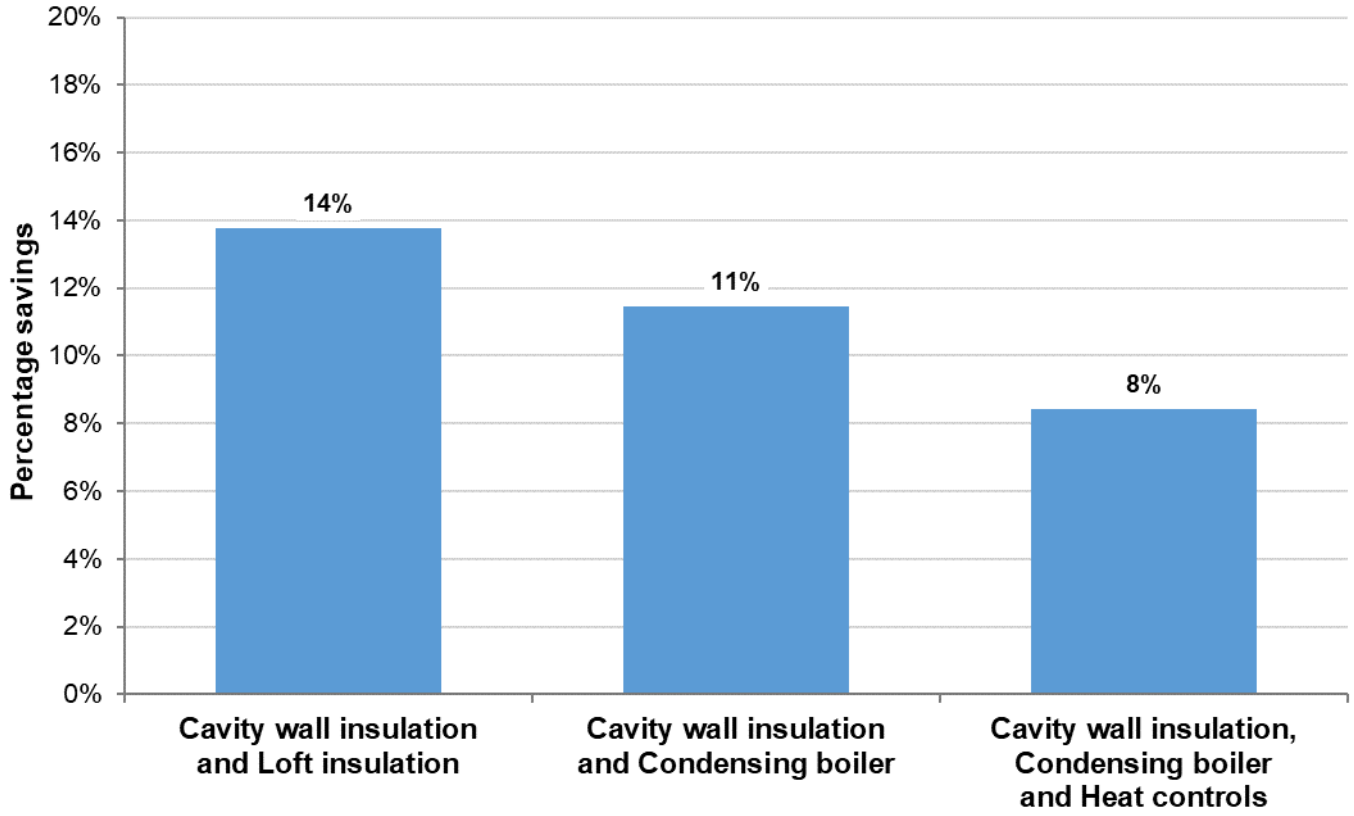
Figure 3.4: Median electricity savings from Solar PV and the average daily sun hours on the savings year, England and Wales, 2011 – 2020



Combinations of measures

Where a large enough number of properties have installed a particular combination of measures in a single year, the impact of that combination of measures can be estimated. Figure 3.5 below shows the savings from the most common combinations of measures installed in 2020. The combination of measures with the greatest estimated median gas saving were cavity wall insulation and loft insulation, with a median saving of 14 per cent.

Figure 3.5: Median gas savings in 2021 from common combinations of measures installed in 2020, England and Wales

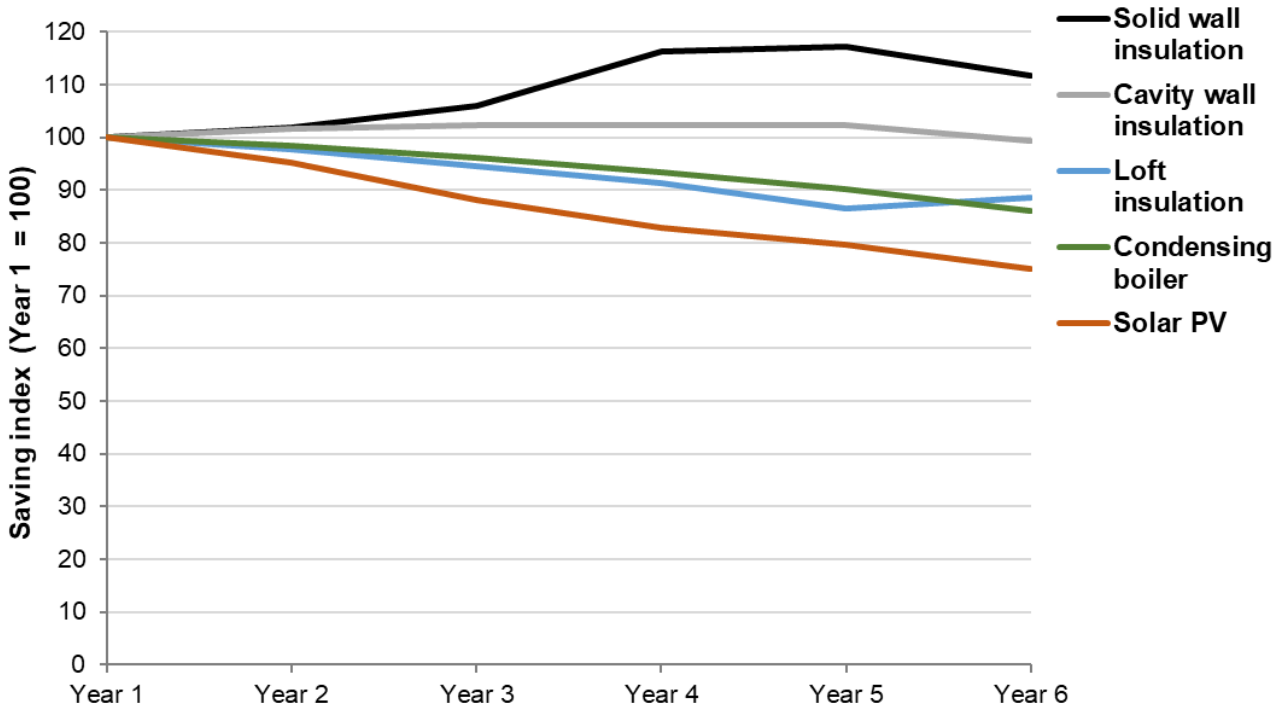


The combination of cavity wall insulation and new condensing boiler appears to yield a lower gas saving when combined with heat controls (8 per cent compared to 11 per cent). This suggests that heating controls may increase gas consumption. This finding should be interpreted with caution as properties that have all three measures installed may differ in systematic ways unmeasured by NEED from those which only had a cavity wall insulation and a new condensing boiler installed. However, a research paper assessing the evidence on heating controls suggests that comfort taking may be a key factor.

Savings in the years following installation

Estimates of savings over time for measures installed in 2011, 2012, 2013, 2014 and 2015 are published alongside this report in the table “Impact of measures in years following installation”. The method used for these estimates was the same as that used for the other impact of measures analyses. The difference is that, instead of comparing the year before installation (Year -1) to the year after (Year +1), the year before installation is also compared to further years moving forward from Year +1 (Year +2, Year +3, etc). This is to estimate how savings change over time. More details on this can be found in Annex D: Methodology Note which accompanies this report.

Figure 3.6: Median annual percentage gas savings (electricity savings for Solar PV), in the 6 years following installation, relative to savings in Year 1, averaged over the installation years 2011 – 2015, England and Wales



The gas savings from solid wall insulation[5] and cavity wall insulation were sustained in the 5 years following installation (see Figure 3.6), while the savings from loft insulation and new condensing boilers decreased by around a tenth between Year 1 and Year 5 after installation. While this may indicate the physical degradation of these measures over time, other possible reasons for this reduction in savings may include increased comfort taking (see page 27).

The electricity savings from solar PV declined by around a fifth between Year 1 and Year 5 after installation. Degradation of a solar PV panel is likely to be below 1 per cent per year; however, this can be expected to vary between solar PV installations[6]. It is therefore likely that, in this case, the reduction in metered savings over time is too large to be attributed to physical degradation of the measure alone and is likely to be due to other factors. This may include residents taking advantage of the energy generated on-site and increasing their overall electricity use, or other factors not captured by this analysis.

[5] Savings for solid and cavity wall insulation appear to increase in the years after installation. This arises due to the statistical variation in savings estimates that are particularly noticeable when the number of properties receiving the measure is small, as is the case for solid wall insulation.

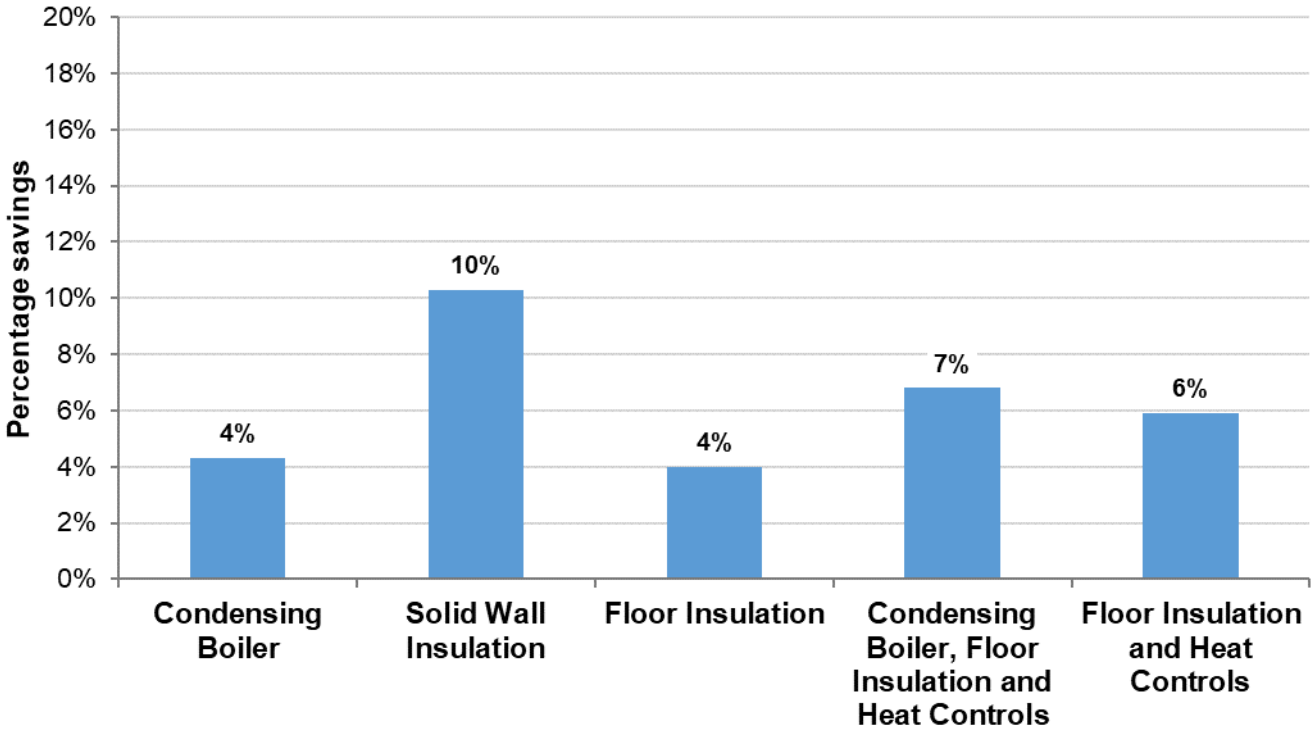
[6] For example, Compendium of photovoltaic degradation rates, Jordan et al., 2016.

Impact of Measures Installed in Scotland

The following section sets out the results for the impact of measures analysis for measures installed in Scotland. Apart from different sources of information being used for the property characteristics used in the analysis[7], the method for Scottish properties is identical to that used for properties in England and Wales.

Estimates for the median gas savings from various measures installed in 2020 are shown in Figure 3.7. Solid wall insulation yields the highest median gas savings (10 per cent).

Figure 3.7: Median gas savings in 2021 for measures installed in 2020, Scotland



[7] For Scotland, property characteristics are taken from a combination of data supplied by the Scottish Assessors Association (which is several years out of date) and Experian data (which is modelled). For England and Wales, the equivalent information is taken from Valuation Office Agency data that is updated annually.

Further Information

Supporting data tables

Data tables are available as part of this publication:

- Electricity and gas consumption data tables
- Impact of energy efficiency measures data tables

Access to data

Domestic NEED provides a valuable resource, and the team recognises potential uses beyond the projects currently taking place. There is published guidance which outlines routes for individuals or organisations to access property level data. Samples of anonymised record-level data are currently available up to 2019, and will be updated soon after this report is published.

Future updates to these statistics

The next release of these statistics, covering 2022 data, is planned for publication in June 2024. Sub-national consumption statistics for 2022 will next be published in December 2023.

Related statistics

Non-domestic National Energy Efficiency Data-Framework
Statistics on the metered energy consumption of non-domestic buildings in England and Wales by sector, building size and occupying business size.

Sub-national electricity consumption statistics
Summary statistics of domestic and non-domestic electricity consumption at different geographic levels from local authority to postcode level.

Sub-national gas consumption statistics
Summary statistics of domestic and non-domestic gas consumption at different geographic levels from local authority to postcode level.

Sub-national total final energy consumption statistics
Summary statistics of domestic and non-domestic consumption of all fuels reported on by DESNZ at local authority level.

Household energy efficiency statistics
Monthly statistics on installations under the Energy Company Obligation (and previous schemes such as the Green Deal).

Green Homes Grant and Home Upgrade Grant statistics
Monthly statistics on installations under the Green Homes Grant Local Authority Delivery (LAD) and Home Upgrade Grant (HUG) schemes.

Social Housing Decarbonisation Fund statistics
Monthly statistics on installations under the Social Housing Decarbonisation Fund (SHDF) scheme.

Solar photovoltaics deployment statistics
Monthly statistics on deployment of all solar photovoltaic capacity in the United Kingdom.

Renewable Heat Incentive statistics
Summary statistics of deployment data for the domestic and non-domestic Renewable Heat Incentive (RHI).

Revisions policy

The DESNZ statistical revisions policy sets out the revisions policy for these statistics, which has been developed in accordance with the UK Statistics Authority Code of Practice for Statistics.

User engagement

Users are encouraged to provide comments and feedback on how these statistics are used and how well they meet user needs. Comments on any issues relating to this statistical release are welcomed and should be sent to the Energy Efficiency Statistics mailbox.

The DESNZ statement on statistical public engagement and data standards sets out the department's commitments on public engagement and data standards as outlined by the Code of Practice for Statistics.

National Statistics designation

National Statistics status means that our statistics meet the highest standards of trustworthiness, quality, and public value, and it is our responsibility to maintain compliance with these standards.

The continued designation of these statistics as National Statistics was confirmed in February 2015 following a compliance check by the Office for Statistics Regulation.

Pre-release access to statistics

Some ministers and officials receive access to these statistics up to 24 hours before release. Details of the arrangements for doing this and a list of the ministers and officials that receive pre-release access to these statistics can be found in the DESNZ statement of compliance with the Pre-Release Access to Official Statistics Order 2008.

This publication is available from:
www.gov.uk/government/collections/national-energy-efficiency-data-need-framework

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