



2023 UK greenhouse gas emissions, provisional figures

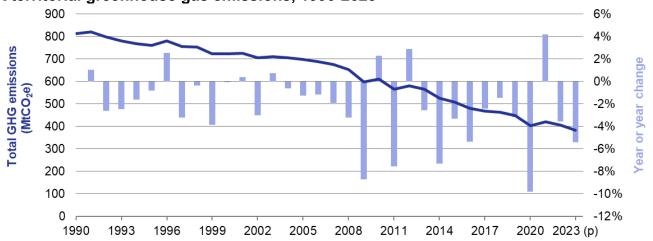
28 March 2024

Accredited Official Statistics

In 2023, net territorial greenhouse gas emissions in the UK are provisionally estimated to have been 384.2 million tonnes of carbon dioxide equivalent (MtCO₂e), a decrease of 5.4% from the 2022 figure of 406.2 MtCO₂e. Carbon dioxide (CO₂) emissions decreased by 6.6%, to 302.8 million tonnes (Mt). Total greenhouse gas emissions were 52.7% lower than they were in 1990.

- This decrease in 2023 is primarily due to a reduction in gas demand from the electricity supply and buildings and product uses sectors. Greenhouse gas emissions from electricity supply fell 10.8 MtCO₂e (19.6%) in 2023, primarily due to higher electricity imports from France, unlike 2022 when the UK had higher than usual exports, as well as UK electricity demand continuing to decline. This meant less gas was needed to meet the remaining electricity demand. Meanwhile, emissions from buildings and products uses fell 5.1 MtCO₂e (6.2%), with high energy prices likely to have been a factor in reduced gas use for heating buildings.
- Industry sector emissions fell 4.6 MtCO₂e (8.0%), largely due to reduced fuel consumption in the iron and steel industry. There was also a 1.6 MtCO₂e (1.4%) fall in greenhouse gas emissions from domestic transport. Compared to 2019, the most recent pre-pandemic year, domestic transport emissions are down 11.1%. Domestic transport remains the largest source of emissions in the UK, accounting for 29.1% in 2023.

UK territorial greenhouse gas emissions, 1990-2023



What you need to know about these statistics:

This publication provides provisional estimates of 2023 UK territorial greenhouse gas emissions, meaning emissions that occur within the UK's borders. Emissions are presented in million tonne carbon dioxide equivalent units (MtCO₂e) throughout this statistical release.

These estimates give an early indication of emissions in 2023 and are subject to revision when final estimates are published in February 2025. They also include estimates of quarterly emissions and the impact on emissions of external temperature changes.

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Introduction

This publication provides provisional annual and quarterly estimates of UK territorial greenhouse gas emissions for 2023, including estimates of carbon dioxide and total greenhouse gas emissions by source sector. It also provides an estimate of temperature adjusted emissions, which give an idea of overall trends in emissions without fluctuations due to changes in external temperature. More information about the underlying methodology for the provisional emissions statistics can be found in the methodology summary published alongside this report.

Data for 1990-2022 are consistent with the annual emissions presented in the Accredited Official Statistics publication 2022 final UK greenhouse gas emissions statistics. Data for 2023 emissions are provisional and do not follow the full methodology used for 1990-2022. The estimates of carbon dioxide (CO₂) emissions that are related to energy use are based on provisional inland energy consumption statistics, which are published at the same time by the Department for Energy Security and Net Zero (DESNZ) in the quarterly Energy Trends publication. These are the large majority of emissions in the UK.

CO₂ emissions that are not related to energy use are assumed to remain the same as in 2022 as we do not yet have data from which to produce estimates for them, while estimates of non-CO₂ gases are based on a simple approach which assumes that the changes in emissions of non-CO₂ gases in each sector between 2022 and 2023 were in line with the corresponding percentage change in non-CO₂ emissions from 2022 to 2023 in the Energy and Emissions Projections: 2022 to 2040 published by DESNZ. These emissions are assumed to be spread evenly over the year.

There are uncertainties associated with all estimates of greenhouse gas emissions. Although for any given year considerable uncertainties may surround the emissions estimates for a pollutant, trends over time are likely to be much more reliable. For more information on uncertainties in emissions estimates see the annex published alongside the 2022 final UK greenhouse gas emissions statistics.

The estimates present emissions on a "territorial" basis, so only include emissions which occur within the UK's borders. They therefore exclude emissions from UK businesses and residents that occur abroad, including from international aviation and shipping (although these are reported separately), and any emissions embedded within the supply chain of manufactured goods and services imported into the UK (while including emissions that occur in the UK resulting from exported goods and services). When emissions are measured on this basis, UK emissions account for around 1% of the global total, based on a range of estimates produced by the UN, the International Energy Agency and the World Resources Institute amongst others.

Two additional approaches to estimating UK emissions are also published and the Office for National Statistics (ONS) has published <u>an article</u> that compares these different measures of the UK's greenhouse gas emissions in more detail. The alternative measures are:

ONS publishes emissions on a "residency" basis in the <u>UK Environmental Accounts</u>. The
figures represent emissions caused by UK residents and businesses whether in the UK or
abroad, but exclude emissions within the UK which can be attributed to overseas residents
and businesses.

• The Department for Environment, Food and Rural Affairs (Defra) publishes the <u>UK's carbon footprint</u>. This estimates emissions on a "consumption" basis, meaning it covers emissions associated with the consumption of goods and services by households in the UK. It includes estimates of emissions associated with each stage of the supply chain for those goods and services, regardless of where they occur, while excluding emissions occurring in the UK that are associated with the consumption of goods and services by households outside the UK.

For the purposes of reporting, greenhouse gas emissions are allocated into sectors as follows:

Electricity supply	Emissions from power stations for electricity generation, including incinerators generating energy from waste. Excludes emissions from organisations generating their own electricity (autogeneration) even when exported to the electricity grid. These emissions are instead included in the sector in which they occur.
Fuel supply	Emissions from the supply of fuels, e.g. oil, gas, and coal. Includes activities such as extraction, production, venting, flaring, processing (e.g. oil refining) and distribution. Excludes emissions from coke production which are instead included in the <i>industry</i> sector as coke is primarily used in the iron and steel industry.
Domestic transport	Emissions from road vehicles, domestic aviation, and shipping (including military), fishing vessels, and railways. Also includes emissions from transport related mobile machinery (e.g. at airports and ports) and F-gases from mobile air conditioning and refrigeration. International aviation and shipping emissions are not included in the national total, though are reported separately.
Buildings and product uses	Emissions from fuel combustion in residential, public, and commercial buildings, largely for heating. Also includes emissions from house and garden mobile machinery, anaesthetics, F-gases from air conditioning, refrigeration, heat pumps, aerosols as well as other product uses. Excludes emissions from industrial buildings which are instead included in the <i>industry</i> sector.
Industry	Emissions from fuel combustion in the manufacturing and construction industries, industrial processes, and F-gases from industrial refrigeration. Emissions from coke production are included in this sector as coke is primarily used in the iron and steel industry. Includes emissions from organisations generating their own electricity and heat (autogeneration) even when exported to the electricity grid or used in heat networks.
Agriculture	Emissions from agricultural machinery and fuel combustion, livestock (enteric fermentation and manure management) and agricultural soils (excluding carbon stock changes which are included in the <i>LULUCF</i> sector).
Waste	Emissions from the treatment and disposal of waste, such as landfill, composting, incineration without energy recovery and wastewater handling. Excludes emissions from incinerators generating energy from waste as these are reported in the <i>electricity supply</i> sector.
Land use, land use change and forestry (LULUCF)	Includes emissions and removals of CO ₂ from changes in the carbon stock in forestland, cropland, grassland, wetlands, settlements and harvested wood products, and emissions of other greenhouse gases from drainage (excl. croplands and intensive grasslands) and rewetting of soils, nitrogen mineralisation associated with loss and gain of soil organic matter, and fires. As impacts of carbon stock changes are included in this sector, CO ₂ emissions of biogenic origin (e.g. burning biomass for energy) are excluded from other sectors to avoid double counting.

These high-level sectors are made up of several more detailed sectors, which largely follow the definitions set out by the Intergovernmental Panel on Climate Change (IPCC)¹ and which are used in international reporting tables which are submitted to the United Nations Framework Convention on Climate Change (UNFCCC)² every year. It is important to note that these figures are based on provisional energy data and are subject to change. The sectoral breakdown is given mainly for information, and is included in the publication for completeness, but sectoral estimates are more uncertain than the overall total.

These estimates cover the Kyoto "basket" of seven gases: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulphur hexafluoride (SF_6) and nitrogen trifluoride (NF_3). The last four gases are collectively referred to as fluorinated gases or F gases. In accordance with international reporting and carbon trading protocols, emissions from each of the gases is weighted by its global warming potential (CO_2), so that total greenhouse gas emissions can be reported on a consistent basis. The GWP for each gas is defined as its warming influence relation to that of carbon dioxide over a 100-year period. Greenhouse gas emissions are then presented in carbon dioxide equivalent units (CO_2 e).

Carbon dioxide is reported in terms of net emissions, which means total emissions minus total removals of carbon dioxide from the atmosphere by carbon sinks. Carbon sinks are defined by the UNFCCC as "any process, activity or mechanism which removes a greenhouse gas, an aerosol or a precursor of a greenhouse gas from the atmosphere".

The provisional estimates are not used for any formal reporting of how the UK is performing against its emissions reduction targets, as this requires final estimates based on the UK's greenhouse gas inventory. However, these statistics give policy makers and other users an initial steer as to the trend in emissions between 2022 and 2023, which helps them to form an initial assessment of the extent to which the UK is on track to meet targets. For information on UK emissions targets and progress towards them, see the 2022 final UK greenhouse gas emissions statistics.

¹ https://www.ipcc-nggip.iges.or.jp/

² https://unfccc.int/

³ The global warming potentials (GWPs) used are from table 8.A.1 (without climate-carbon feedback) of Working Group 1 of the IPCC Fifth Assessment Report: Climate Change 2013 and summarised in Table 6.4 in the Excel tables in the 2022 final UK greenhouse gas emissions statistics.

2023 UK provisional emissions results

In the <u>data tables</u> accompanying this publication, table 1a shows UK annual territorial greenhouse gas emissions by source sector and table 1b shows CO₂ emissions by source sector. Tables 2a and 2b show greenhouse gas and CO₂ emissions totals respectively for individual quarters, and tables 3a and 3b the moving annual totals. Temperature adjusted totals are also shown in each table.

Territorial greenhouse gas emissions are provisionally estimated to have decreased by 5.4% (22.0 MtCO₂e) in 2023, and CO₂ emissions by 6.6% (21.4 Mt). Total greenhouse gas emissions are estimated to be 14.2% lower than those in 2019, a decrease of 63.7 MtCO₂e. At 384.2 MtCO₂e, greenhouse gas emissions in the UK in 2023 were 52.7% lower than in 1990. UK emissions are dominated by CO₂, which is estimated to have accounted for 78.8% of total greenhouse gas emissions in the UK in 2023. Most of the provisional CO₂ emissions estimates are based on provisional UK energy data. Meanwhile, provisional estimates for non-CO₂ emissions are based on projections since they are largely not related to energy use. Therefore, the rest of this section presents the trends for the source sectors where carbon dioxide accounts for the majority of their emissions.

There was a fall in every quarter of 2023 compared to the year before. The first quarter (Q1) of 2023, from January to March, saw the smallest decrease in emissions of 3.8% (4.3 MtCO₂e) compared to the same period in 2022. Q4, October to December, of 2023 had the greatest quarterly fall of 6.3% (6.8 MtCO₂e) compared to the same period in 2022. All sectors saw an overall fall in emissions across 2023 when compared to 2022 apart from the fuel supply sector which saw a 1.0% (0.3 MtCO₂e) increase, concentrated in Q1 and Q2.

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Figure 1: Percentage change in quarterly UK greenhouse gas emissions from previous year, Q1 2009 - Q4 2023

Source: Table 1a, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables Note: (p) 2023 estimates are provisional.

The fall in emissions in 2023 is largely due to a reduction in gas use for electricity generation, as a result of higher net imports of electricity from France, contrasting with 2022 when the UK was a net exporter of electricity, as well as UK electricity demand continuing to decline.

Overall, greenhouse gas emissions from the electricity supply sector are provisionally estimated to have fallen by 19.6% (10.8 MtCO₂e) in 2023. Emissions from the buildings and product uses sector also fell 6.2% (5.1 MtCO₂e), largely as a result reduced demand for heating due to high energy and other costs. Emissions from the industry sector fell 8.0% (4.6 MtCO₂e) in 2023, largely as a result of reduced fuel consumption in the iron and steel industry.

The domestic transport sector remains the largest emitting sector in the UK, accounting for 29.1% of all greenhouse gas emissions in 2023. In comparison, 20.2% of greenhouse gas emissions were from buildings and product uses, 13.7% from industry, and 11.5% from electricity supply.



Figure 2: Net UK territorial greenhouse gas emissions by TES sector, 2023 (%)

Source: Tables 1a, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables

Note: 1. Also includes the land use, land use change and forestry (LULUCF) sector, accounting for 0.2% of net emissions in 2023.

2. Estimates of agriculture, waste, and LULUCF sector emissions for 2023 are derived from projections.

Between 1990 and 2023, UK territorial carbon dioxide emissions decreased by 49.8%, and total greenhouse gas emissions by 52.7%. The largest factor behind this long-term decrease was the change in the mix of fuels being used for electricity generation, with a shift away first from coal to gas in the 1990s, and more recently to renewable energy sources. This was combined with lower electricity demand, owing to greater efficiency resulting from improvements in technology and a decline in the relative importance of energy intensive industries. Overall inland energy consumption is provisionally estimated to have decreased by 24.1% since 1990, and if this figure is adjusted to allow for the effect of temperature, there was a 25.2% decrease over this period^{4,5}.

⁴ Digest of UK Energy Statistics (DUKES), Table 1.1.2 Availability and consumption of primary fuels and equivalents (energy supplied basis), 1970 to 2022, DESNZ: https://www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes

⁵ Energy Trends, Table 1.2 UK total energy, Inland energy consumption: primary fuel input basis, DESNZ: https://www.gov.uk/government/statistics/total-energy-section-1-energy-trends

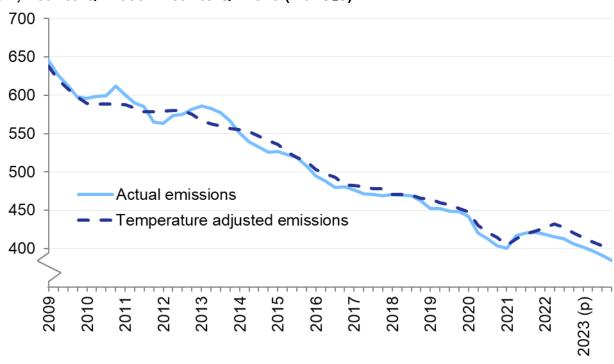


Figure 3: Actual and temperature adjusted annual territorial greenhouse gas emissions, UK, Year to Q1 2009 - Year to Q4 2023 (MtCO₂e)

Source: Tables 3a, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables Note:

1. Figures are annual totals including the preceding 4 quarters.

2. From year ending Q1 2023 onwards, figures include provisional data.

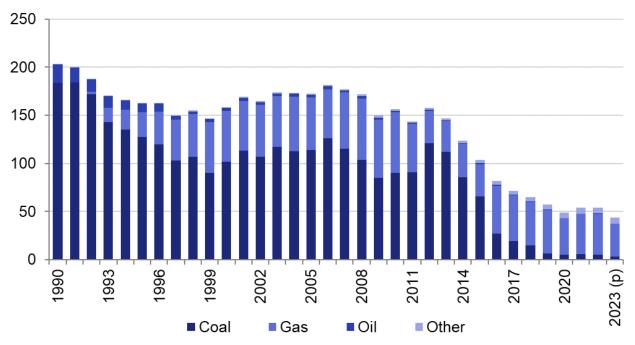
As shown in Figure 2 above, temperature adjusted territorial greenhouse gas emissions show a similar overall trend to non-temperature adjusted emissions. Over the most recent ten-year period, temperature adjusted UK territorial greenhouse gas emissions decreased by 28.5%, similar to the fall in actual emissions over this period (32.2%). When adjusted for temperatures, greenhouse gas emissions in 2023 were also 5.4% lower than in 2022, and 11.9% lower than they were in 2019.

Electricity supply

The electricity supply sector consists of emissions from the combustion of fuels in electricity generation from UK power stations. Greenhouse gas emissions from the electricity supply sector are provisionally estimated to have been 41.1 MtCO₂e in 2023, a decrease of 19.6% (10.8 MtCO₂e) compared to 2022.

In 2023, emissions from electricity supply accounted for 11.5% of all UK greenhouse gas emissions. Between 1990 and 2023 electricity supply emissions have fallen 78.4%. This is despite consumption of electricity being provisionally estimated to be only 4.2% lower in 2023 than in 1990^{6,7}. Carbon dioxide made up 98.7% of total electricity supply emissions in 2023.

Figure 4: Territorial carbon dioxide emissions from electricity supply, UK, 1990-2023 (MtCO₂e)



Source: Table 4, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables Note: (p) 2023 estimates are provisional.

The fall in emissions from electricity supply in 2023 is largely due to reduced use of gas use in UK power stations. Gas use for electricity generation fell 21.1% in 2023, primarily due to higher electricity imports from France, as well as UK electricity demand continuing to decline^{8,9}.

The long-term decrease in electricity supply emissions has mainly resulted from changes in the mix of fuels being used for electricity generation with a switch from coal to natural gas and growth in the use of renewable energy sources, combined with greater efficiency resulting from improvements in technology and a decline in the relative importance of energy intensive industries. In 2023 coal made up 1.8% of fuel used for electricity generation, compared to

⁶ Digest of UK Energy Statistics (DUKES), Table 5.1.2 Electricity supply, availability and consumption, 1970 to 2022, DESNZ: https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

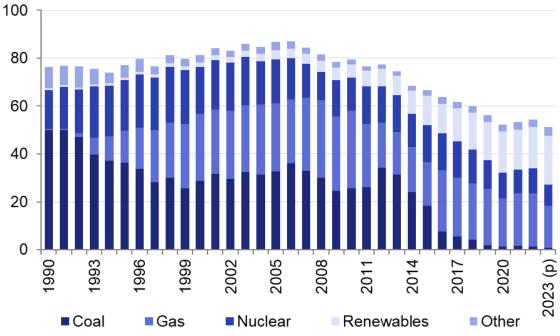
Energy Trends, Table 5.2 Supply and consumption of electricity, March 2023, DESNZ: https://www.gov.uk/government/statistics/electricity-section-5-energy-trends

⁸ Digest of UK Energy Statistics (DUKES), Table 5.1.1 Fuel input for electricity generation, 1970 to 2022, DESNZ: https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

⁹ Energy Trends, Table 5.1 Fuel used in electricity generation and electricity supplied, March 2023, DESNZ: https://www.gov.uk/government/statistics/electricity-section-5-energy-trends

65.3% in 1990. Nuclear and renewables, which are low carbon energy sources, accounted for 56.7% of fuel used for electricity generation in 2023, up from 22.2% in 1990.

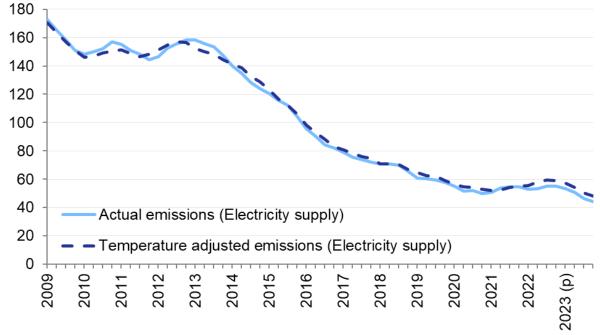
Figure 5: Fuel mix for UK electricity generation, 1990-2023 (Million tonnes of oil equivalent)



Source: Table 5.1.1, Digest of UK Energy Statistics (DUKES) 1970-2022 and Table 5.1, Energy Trends March 2023 Excel data tables Note: (p) 2023 estimates are provisional.

The overall trend in temperature adjusted electricity supply emissions is similar to the unadjusted trend, as the majority of electricity generated is used for other purposes rather than heating.

Figure 6: Actual and temperature adjusted electricity supply territorial greenhouse gas emissions, UK, Year to Q1 2009 - Year to Q4 2023 (MtCO₂e)



Source: Table 1a, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables Note: (p) 2023 estimates are provisional.

Fuel supply

The fuel supply sector consists of emissions that arise during the production and supply of fuels, for example from the combustion of fuels in oil refineries and at oil and gas platforms, the flaring and venting of gas from oil and gas facilities, leakages from the gas network and methane emissions from coal mining. Emissions from the fuel supply sector are provisionally estimated to have been 31.1 MtCO₂e in 2023, an increase of 1.0% (0.3 MtCO₂e) compared to 2022.

In 2023, emissions from fuel supply accounted for 8.1% of all UK emissions. Since 1990, fuel supply emissions have fallen by 59.7%. The main factor in the long-term decline in emissions in the fuel supply sector has been related to coal mining. The production of deep-mined coal in particular has declined steadily over the period, with the last three large deep mines all closing in 2015.

100 80 60 40 20 966 Carbon dioxide emissions Other greenhouse gas emissions

Figure 7: Territorial greenhouse gas emissions from fuel supply, UK, 1990-2023 (MtCO₂e)

Table 1a, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables Source: Note: (p) 2023 estimates are provisional.

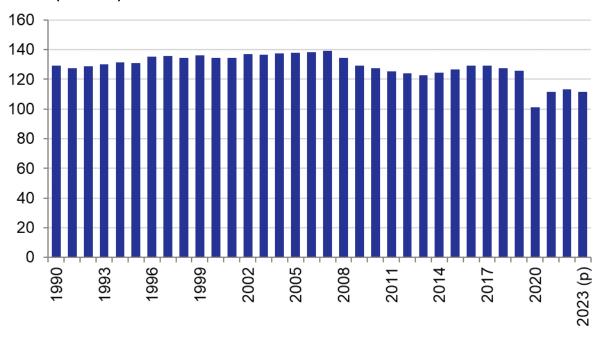
Domestic transport

The domestic transport sector consists of emissions from road vehicles, domestic aviation and shipping (including military), fishing vessels, and railways. It does not include emissions from international aviation or shipping. In 2023, domestic transport accounted for 29.1% of all territorial greenhouse gas emissions, compared to 27.9% in 2022 and 28.0% in 2019 (prepandemic). Almost all domestic transport emissions are from carbon dioxide, the main source of which is the use of petrol and diesel in road vehicles.

Overall, greenhouse gas emissions from the domestic transport sector are provisionally estimated to have been 111.6 MtCO₂e in 2023, a decrease of 1.4% (1.6 MtCO₂e) when compared to 2022, despite a 1.2% (0.4 MtCO₂e) increase in Q3 when compared to the same period in 2022. This is the first-time domestic transport emissions have fallen since 2020 when travel was heavily restricted due to the COVID-19 pandemic. Emissions from domestic transport are provisionally estimated be 11.1% (13.9 MtCO₂e) lower than in 2019, the last prepandemic year.

Primarily as a result of a continual growth in vehicle kilometres travelled on roads¹⁰, domestic transport emissions grew to a peak in 2007, 7.8% higher than in 1990. Since then, emissions from this sector had fallen back to around 1990 levels up until 2019, driven mainly by improvements in new car fuel efficiency¹¹, as well lower traffic growth than in previous years as a result of a dip following the 2008/2009 recession.

Figure 8: Quarterly territorial greenhouse gas emissions from domestic transport, UK, 2008-2023 (MtCO₂e)



Source: Table 1a, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables Note: (p) 2023 estimates are provisional.

¹⁰ Transport Statistics Great Britain, Roads and traffic (TSGB07), Table TSGB0702 (TRA0201) Road traffic (vehicle kilometres) by vehicle type in Great Britain, annual from 1949 https://www.gov.uk/government/statistical-data-sets/tsgb07

¹¹ Transport Statistics Great Britain, Energy and environment (TSGB03), Table TSGB0303 (ENV0103) Average new car fuel consumption: Great Britain from 1997 https://www.gov.uk/government/statistical-data-sets/tsgb03

Buildings and product uses

The buildings and product uses sector consists primarily of emissions from fuel combustion in buildings, largely from the use of natural gas and other fuels for heating and cooking. It also includes emissions that directly arise from the use of products such as refrigeration & air conditioning, garden machinery, anaesthetics, metered dose inhalers and aerosols. In 2023, it is estimated to have been responsible for 20.2% of greenhouse gas emissions in the UK. Of these emissions, 66.6% were from fuel combustion in residential buildings, 15.6% in commercial buildings, 10.5% in public sector buildings, with the remaining 7.3% from other buildings and product use.

It should be noted that emissions from this sector do not include emissions from the generation of electricity consumed, as these emissions are included in the electricity supply sector.

Total greenhouse gas emissions from the buildings and product uses sector are provisionally estimated to have been 77.6 MtCO₂e in 2023, a decrease of 6.2% (5.1 MtCO₂e) compared to 2022. Since 1990, emissions from buildings and product uses have fallen by 28.4%. High energy and other costs are likely to be the main factor in the fall in the latest year, having reduced demand for gas for heating. Emissions from buildings are also influenced by external temperatures, with colder temperatures driving higher emissions due to increased use of heating. Continued warmer weather has also kept emissions down relative to earlier years. Average temperatures across 2022 and 2023 were 0.9 and 0.8 degrees Celsius higher than the 30-year long-term average respectively.

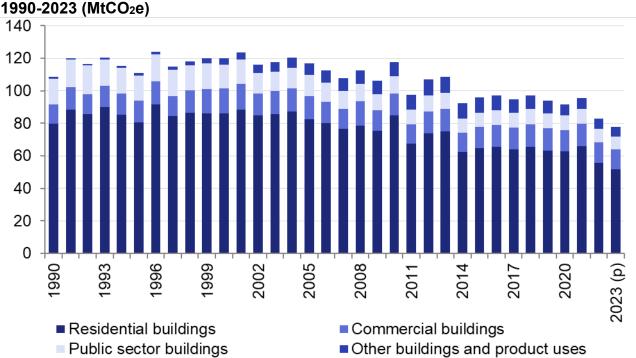


Figure 9: Territorial greenhouse gas emissions from buildings and product uses, UK, 1990-2023 (MtCO₂e)

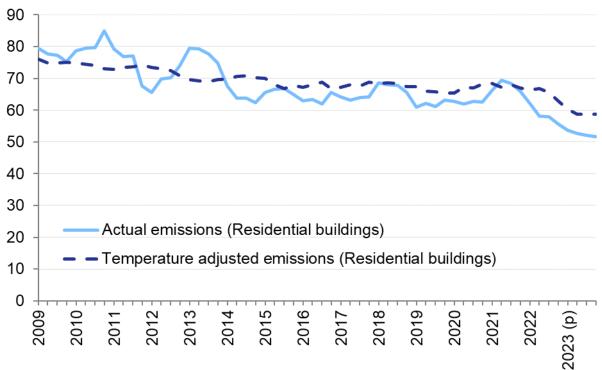
Source: Table 1a, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables Note: (p) 2023 estimates are provisional.

Residential buildings

The main source of emissions from residential buildings is the use of natural gas for heating and cooking. Greenhouse gas emissions from residential buildings are provisionally estimated to have been 51.7 MtCO₂e in 2023, a decrease of 7.2% (4.0 MtCO₂e) compared to 2022. Since 1990, emissions from residential buildings have fallen by 35.1%.

Emissions from residential buildings fluctuate owing to year-on-year variation in weather conditions. However, temperatures were similar across 2022 and 2023, indicating that variations in weather are only a small driver of the trend between 2022 and 2023. If temperatures for both 2022 and 2023 had followed long-term trends, then there would have still been a 6.8% (4.3 MtCO₂e) decrease.

Figure 10: Actual and temperature adjusted annual territorial greenhouse gas emissions from residential buildings, UK, Year to Q1 2009 - Year to Q4 2023 (MtCO₂e)



Source: Table 3a, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables Note:

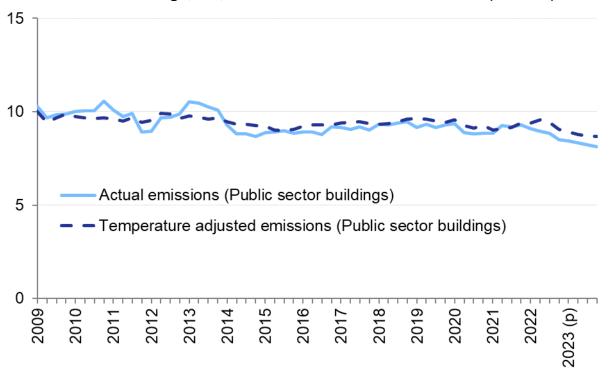
1. Figures are annual totals including the preceding 4 quarters.

2. From year ending Q1 2023 onwards, figures include provisional data.

Commercial buildings

Natural gas for heating is the main source of emissions from commercial buildings. Greenhouse gas emissions from commercial buildings are provisionally estimated to have been 12.1 MtCO₂e in 2023, a decrease of 3.1% (0.4 MtCO₂e) compared to 2022. Since 1990, emissions from commercial buildings have risen by 2.6%.

Figure 11: Actual and temperature adjusted annual territorial greenhouse gas emissions from commercial buildings, UK, Year to Q1 2009 - Year to Q4 2023 (MtCO₂e)



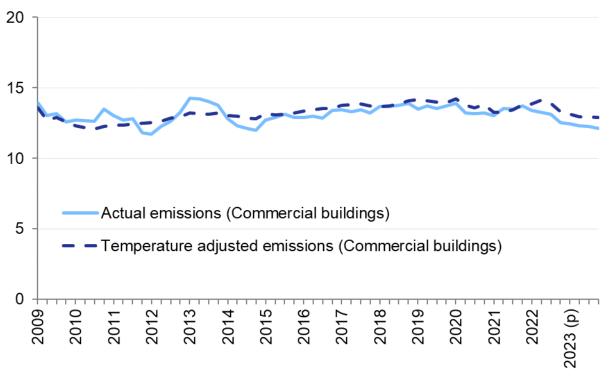
Source: Table 3a, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables Note: 1. Figures are annual totals including the preceding 4 quarters.

2. From year ending Q1 2023 onwards, figures include provisional data.

Public sector buildings

Natural gas for heating is the main source of emissions across public sector buildings. Greenhouse gas emissions from public sector buildings are provisionally estimated to have been 8.1 MtCO₂e in 2023, a decrease of 4.2% (0.4 MtCO₂e) compared to 2022. Since 1990, emissions from public sector buildings have fallen by 49.2%.

Figure 12: Actual and temperature adjusted annual territorial greenhouse gas emissions from public sector buildings, UK, Year to Q1 2009 - Year to Q4 2023 (MtCO₂e)



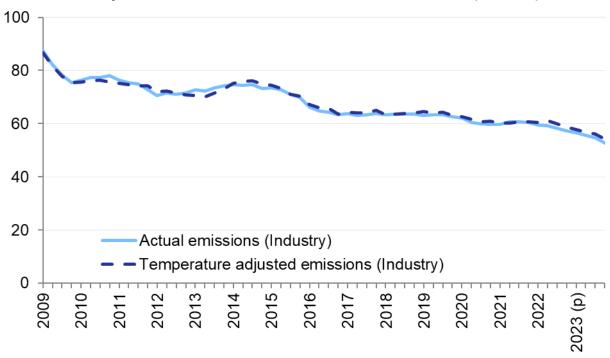
Source: Table 3a, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables 1. Figures are annual totals including the preceding 4 quarters.

2. From year ending Q1 2023 onwards, figures include provisional data.

Industry

The industry sector includes emissions from fuel combustion at industrial sites and in industrial machinery, emissions resulting from industrial processes and emissions of fluorinated gases from industrial uses such as in refrigeration systems. Greenhouse gas emissions from the industry sector are provisionally estimated to have been 52.8 MtCO₂e in 2023, a decrease of 8.0% (4.6 MtCO₂e) compared to 2022, largely due to reduced fuel consumption in the iron and steel industry¹². Since 1990, emissions from industry have decreased by 66.3%.

Figure 13: Actual and temperature adjusted annual territorial greenhouse gas emissions from the industry sector, UK, Year to Q1 2009 - Year to Q4 2023 (MtCO₂e)



Source: Table 1a, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables Note:

1. Figures are annual totals including the preceding 4 quarters.

2. From year ending Q1 2023 onwards, figures include provisional data.

Other sectors

For the *agriculture*, *waste*, and *land use*, *land use change and forestry* (LULUCF) sectors provisional territorial greenhouse gas emissions cannot be derived based on energy statistics. To enable overall greenhouse gas and carbon dioxide emissions totals to be produced, carbon dioxide emissions from these sectors are assumed to be the same as they were in 2022 and non-CO₂ emissions assumed to have changed in line with our latest projections¹³.

¹² Energy Trends, Table 1.3 Supply and use of fuels, March 2023, DESNZ: https://www.gov.uk/government/statistics/total-energy-section-1-energy-trends

¹³ Energy and Emissions Projections: 2022 to 2040, DESNZ: https://www.gov.uk/government/publications/energy-and-emissions-projections-2022-to-2040

Carbon dioxide emissions by fuel type

In the <u>data tables</u> accompanying this publication, table 4 shows UK territorial carbon dioxide emissions by sector and fuel type.

The combustion of fuel releases both energy and carbon dioxide. The amount of carbon dioxide released by the production of one unit of power depends on the type of fuel that is burned. For example, since coal has a higher carbon content than gas, more carbon dioxide emissions result from burning one tonne of coal to generate a unit of power than from one tonne of gas.

In 2023, total territorial carbon dioxide emissions from the use of fossil fuels, including fuel used for generating electricity, were estimated at 285.7 Mt. This was 6.8% less than the 2022 figure of 306.5 Mt and 15.6% lower than the 2019 figure of 338.4 Mt. The biggest absolute change in emissions was from the use of gas, down 17.0 Mt (10.4%) from 163.4 Mt in 2022 to 146.4 Mt in 2023. This largely resulted from decreased use of gas for UK electricity generation, as well as reduced use of gas for heating buildings due higher energy and other prices. However, the largest percentage decrease in emissions came from the use of coal, down 25.9% (2.3 Mt) from 2022 to 2023, as a result of its decreased use in the electricity supply sector. Carbon dioxide emissions from use of petroleum are down 1.4 Mt (1.1%) from 134.1 Mt in 2022 to 132.6 Mt in 2023. Carbon dioxide emissions from the use of other solid fuels also decreased by 9.9% (0.6 Mt).

Over the period 1990 to 2023, carbon dioxide emissions from fossil fuels decreased by 49.5%. Over the same period, primary consumption of fossil fuels dropped by 31.7%. This relatively large decrease in emissions can be attributed to a large decrease in the use of coal accompanied by an increase in the use of gas.

Territorial carbon dioxide emissions from gas increased from 26.1% of all carbon dioxide emissions from fossil fuels in the UK in 1990 to 51.2% in 2023, whilst emissions from coal decreased from 38.7% of all fossil fuel carbon dioxide emissions to 2.3% over the same period. Oil was responsible for 35.1% of carbon dioxide emissions from fossil fuels in 1990 and this has increased to 46.4% in 2023.

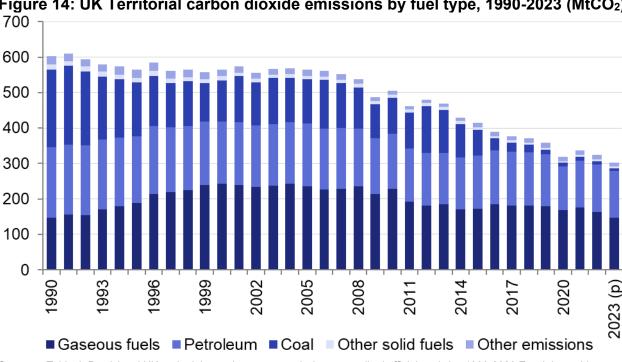


Figure 14: UK Territorial carbon dioxide emissions by fuel type, 1990-2023 (MtCO₂)

Table 4, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables Source: (p) 2023 estimates are provisional. Note:

2023 temperature adjusted provisional emissions results by sector

In the <u>data tables</u> accompanying this publication, tables 1a and 1b show annual greenhouse gas and CO₂ emissions respectively, including temperature adjusted totals. Quarterly temperature adjusted totals are shown in tables 2a and 2b.

A temperature adjustment has been applied to the quarterly carbon dioxide emissions to estimate what the overall trend of territorial emissions would have been without the impact of differences in external temperatures. Non-CO₂ emissions have not been adjusted. When temperatures are lower there is greater use of natural gas and electricity for heating buildings, so the buildings and product uses sector typically sees the largest deviations between temperature adjusted and actual emissions. Overall, GHG emissions in 2023 are estimated to be 13.9 MtCO2e (3.5%) lower than if temperatures had remained in line with the long-term average.

Table 1 compares temperature adjusted and unadjusted greenhouse gas emissions by sector in 2023. The adjustments are based on the estimated historical impacts of temperatures on emissions. As the average temperature in 2023 (0.8°C) and 2022 (0.9°C) were both similarly higher than the long-term average variations in temperature were not a significant factor driving the trends in emissions from 2022 to 2023.

Table 1: Percentage changes in territorial greenhouse gas emissions by sector between 2022 and 2023 based on the temperature adjusted emissions and actual emissions

	Temperature adjusted emissions			Actual e	missions	
	2022 (MtCO ₂ e)	2023 (MtCO ₂ e)	2022 - 2023 Percentage change	2022 _(MtCO₂e)	2023 (MtCO ₂ e)	2022 - 2023 Percentage change
Electricity supply	59.1	48.2	-18.5%	54.9	44.1	-19.6%
Fuel supply	30.8	31.1	1.0%	30.8	31.1	1.0%
Domestic transport	113.2	111.6	-1.4%	113.2	111.6	-1.4%
Buildings and product uses	91.4	86.0	-5.9%	82.8	77.6	-6.2%
Industry	58.8	54.2	-7.9%	57.4	52.8	-8.0%
Other	67.2	66.9	-0.4%	67.2	66.9	-0.4%
Total	420.6	398.0	-5.4%	406.2	384.2	-5.4%

Emissions from UK-based international aviation and shipping bunkers

In the <u>data tables</u> accompanying this publication, table 5 shows greenhouse gas emissions arising from use of fuels from UK international aviation and shipping bunkers since 1990.

Emissions from international aviation and shipping can be estimated from refuelling from bunkers ¹⁴ at UK airports and ports, whether by UK or non-UK operators. Under the reporting guidelines agreed by the UNFCCC, these emissions are not included in the UK's emissions total that is submitted to the UNFCCC but are reported as memo items in national greenhouse gas inventories. They are therefore shown in a separate table from the UK territorial greenhouse gas emissions estimates in the final and provisional UK greenhouse gas emissions publications. However, it is important to note that whether emissions from refuelling at UK-based international aviation and shipping bunkers can be used as an accurate estimate of UK international aviation and shipping emissions will depend on what assumptions are being made about how to allocate international aviation and shipping emissions to different countries.

In line with international reporting requirements, the UK's 2030 emissions reduction target under the Paris Agreement (known as the UK's Nationally Determined Contribution) does not include emissions from international aviation and shipping. Instead, Parties to the UNFCCC are required to act to limit or reduce emissions from international services working through the International Civil Aviation Organization (ICAO) and International Maritime Organization (IMO), the international organisations responsible for formulating policies and setting targets for reducing emissions from international aviation and shipping respectively^{15,16}.

In 2021 the UK government set the Sixth Carbon Budget (covering 2033-37) to include the UK's share of international aviation and shipping emissions, as recommended by the Climate Change Committee. This is the first time emissions from international aviation and shipping will be included in the UK's domestic carbon budget targets.

In 2023, emissions from international aviation fuel use from UK bunkers were estimated to be 32.9 MtCO₂e, an increase 15.6% from the 2022 figure of 28.5 MtCO₂e. Emissions from internation aviation bunkers have more than doubled since 2021 due to a recovery in air traffic following the COVID-19 pandemic. However, emissions remain 10.5% lower than in 2019, when it was 36.7 MtCO₂e, the highest annual figure since these estimates begin in 1990. High altitude aviation has a greater greenhouse effect due to the formation of persistent condensation trails (contrails) over and above that of carbon dioxide emissions from fuel alone, but this is not reflected in these estimates.

Emissions from UK international shipping bunkers were estimated to be 6.3 MtCO₂e in 2023, a decrease of 0.4% from the 2022 level, and 14.6% lower than the 2019 figure. These emissions did not see as pronounced a drop as aviation following the start of the COVID-19 pandemic, but also remain at a lower level than before the pandemic following the fall in shipping traffic

¹⁴ A large container or compartment that stores fuel for ships or aircraft.

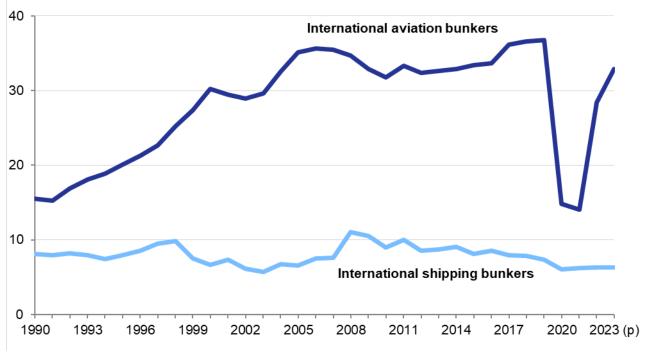
¹⁵ More information on ICAO strategies for reducing international aviation emissions: https://www.icao.int/environmental-protection/Pages/default.aspx

protection/Pages/defauit.aspx

16 More information on IMO strategies for reducing international shipping emissions:
https://www.imo.org/en/OurWork/Environment/Pages/2023-IMO-Strategy-on-Reduction-of-GHG-Emissions-from-Ships.aspx

that occurred during it. Since 1990, emissions from UK shipping bunkers have fluctuated, as can be seen in Figure 14 below, but in recent years before the reduction in 2020 had been at around the same level that they were in 1990.

Figure 15: Greenhouse gas emissions from UK-based international aviation and shipping bunkers, 1990-2023 (MtCO $_2$ e)



Source: Table 5, Provisional UK territorial greenhouse gas emissions accredited official statistics 1990-2023 Excel data tables Note: (p) 2023 estimates are provisional.

Accompanying tables

The following tables are available in Excel and ODS format on the department's <u>statistics</u> website:

Table 1a	UK annual territorial greenhouse gas emissions, including temperature adjusted greenhouse gas emissions and breakdowns by source sector
Table 1b	UK annual territorial carbon dioxide emissions, including temperature adjusted carbon dioxide emissions and breakdowns by source sector
Table 2a	UK territorial greenhouse gas emissions for individual quarters, including temperature adjusted greenhouse gas emissions and breakdowns by source sector
Table 2b	UK territorial carbon dioxide emissions for individual quarters, including temperature adjusted carbon dioxide emissions and breakdowns by source sector
Table 3a	UK territorial greenhouse gas emissions annual totals to the end of each quarter, including temperature adjusted greenhouse gas emissions and breakdowns by source sector
Table 3b	UK territorial carbon dioxide emissions annual totals to the end of each quarter, including temperature adjusted carbon dioxide emissions and breakdowns by source sector
Table 4	UK territorial carbon dioxide emissions by sector and fuel type
Table 5	Estimated greenhouse gas emissions, arising from the use of fuels from UK international aviation and shipping bunkers

Technical information

Basis of the provisional emissions estimates

The estimates of carbon dioxide emissions in 2023 have been produced based on provisional inland energy consumption statistics which are published in DESNZ's quarterly <u>Energy Trends</u> publication.

Carbon dioxide accounts for the majority of UK greenhouse gas emissions (79.8% in 2022). However, in order to give an indication of what the latest provisional carbon dioxide emissions estimates imply for the total, we need to also produce an estimate of emissions of the remaining non-CO₂ gases. Estimates of non-CO₂ gases are based on a simple approach which assumes that the changes in emissions of non-CO₂ gases in each sector between 2022 and 2023 were in line with the corresponding percentage change in non-CO₂ emissions from 2022 to 2023 in the Energy and Emissions Projections: 2022 to 2040 published by DESNZ. These emissions are assumed to be spread evenly over the year when producing quarterly estimates.

Estimates of emissions of all greenhouse gases for 1990-2022 come from the latest UK Greenhouse Gas Inventory. Information about the methodology behind these estimates can be found in the 2022 final UK greenhouse gas emissions statistics.

Quarterly totals

In order to remove the seasonality in the data so that a trend in emissions over time can be observed, quarterly emissions are reported as annual totals, covering the stated quarter plus the preceding three quarters. When data becomes available for each new quarter, the estimates for the latest quarter are added to the total, while at the same time the estimates for the same quarter from the previous year are removed from the series. This procedure serves to smooth out short-term fluctuations and highlights long term trends and can be used to show the underlying trend each quarter. Emissions estimates for each individual quarter are also reported in the data tables accompanying this publication.

Temperature adjustment

Carbon dioxide emissions are indirectly influenced by external temperatures. During the winter months, emissions are generally higher than in summer months, due to higher demand for fuel for space heating. During a particularly cold winter for example, it is likely that more fuel will be burnt for domestic or commercial use than during an average winter, and therefore emissions will be higher due to the additional fuel consumption.

Temperature adjusted quarterly emissions estimates therefore remove the effect of external temperatures. In a particularly cold winter quarter, for example, this will result in temperature adjusted emissions being lower than actual emissions, reflecting the lower fuel consumption which would have occurred if temperatures had been at average levels (based on the 30-year period 1991-2020). Temperature adjustment is determined by the average number of heating degree days in each quarter. This information can be found in Energy Trends.

The long-term average we use in the temperature adjustment is based on the 30-year period 1991-2020. We typically update the 30-year period used every decade, with the most recent change being made in Energy Trends from June 2022. The time period used will affect the absolute level of the temperature adjusted emissions values, but this should not have a significant effect on the trends derived from the adjusted data since all years are adjusted based on the same long-term average. More information about the most recent change can be found in the article about long term mean temperatures in the March 2022 Energy Trends.

Further details of how quarterly emissions have been estimated and of the methodology underlying the temperature adjusted estimates can be found alongside this statistical release in a separate <u>methodology summary</u>.

Further information

Future updates to these statistics

On Thursday 27 June 2024 DESNZ will publish estimates of greenhouse gas emissions by local authority for 2022.

On Thursday 27 June 2024 DESNZ will also publish estimates of 1990-2022 UK territorial emissions by Standard Industrial Classification (SIC), to supplement the sector breakdown included in this publication.

Final estimates of UK greenhouse gas emissions for 2023 will be published as Accredited Official Statistics in February 2025. These estimates will be based on the UK's Greenhouse Gas Inventory for 1990-2023.

In March 2025, the 1990-2023 UK emissions estimates will be updated to include estimates by end user and uncertainty estimates, and provisional 2024 greenhouse gas emissions estimates will be published.

Related publications

- The UK's National Inventory Document (NID) for 1990-2022 will be submitted to the United Nations Framework Convention on Climate Change (UNFCCC) later in 2024. The report will contain national territorial greenhouse gas emissions estimates for 1990-2022 and descriptions of the methods used to produce the estimates. Starting in 2024, the NID replaces the previously required National Inventory Report (NIR). To enable the use of new reporting tools, the UNFCCC has moved its usual submission deadline of 15th April to 31st December for 2024. Previous UK NIRs can be found on the NAEI website.
- The <u>background quality report</u> provides a summary of quality issues relating to statistics on UK territorial greenhouse gas emissions.
- DESNZ also publishes <u>UK territorial emissions projections</u> based on assumptions of future emission reduction policies, economic growth, fossil fuel prices, electricity generation costs, UK population and other key variables.
- Further information about the <u>Kyoto Protocol</u> and the <u>Paris Agreement</u> can be found on the UNFCCC's website.
- ONS publishes emissions on a "residence" basis in the <u>UK Environmental Accounts</u>.
 The figures represent emissions caused by UK residents and businesses whether in the UK or abroad but exclude emissions within the UK which can be attributed to overseas residents and businesses.
- Defra publishes the <u>UK's carbon footprint</u>. This estimates emissions on a "consumption" basis, meaning it covers emissions associated with the consumption of goods and services by households in the UK. It includes estimates of emissions associated with each stage of the supply chain for those goods and services, regardless of where they

occur, while excluding emissions occurring in the UK that are associated with the consumption of goods and services by households outside the UK.

- The latest UK energy statistics, including revisions to earlier years' data, can be found in the <u>Digest of UK Energy Statistics</u> and the <u>Energy Trends</u> quarterly bulletin produced by the Department for Energy Security and Net Zero. Any enquiries about the UK energy statistics should be sent to <u>energy.stats@energysecurity.gov.uk</u>.
- Detailed UK temperature data can be found on both the Met Office website and the weather statistics section of the Gov.uk website.

Revisions policy

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

Emissions estimates for 2023 are provisional and are based on UK energy statistics. They will be revised when the final 2023 estimates are published in February 2025. The full time series going back to 1990 will also be revised at this time in line with any methodology changes made to the UK greenhouse gas inventory.

Uses of these statistics

The provisional estimates are not used for any formal reporting of how the UK is performing against its emissions reduction targets, as this requires final estimates based on the UK's greenhouse gas inventory. However, these statistics give policy makers and other users an initial steer as to the trend in emissions between 2022 and 2023, which helps them to form an initial assessment of the extent to which the UK is on track to meet targets. They also include estimates of quarterly emissions and the impact on emissions of external temperature changes.

For more detailed information about the sources of UK greenhouse gas emissions and information on UK emissions targets and progress towards them, see the <u>2022 final UK greenhouse gas emissions statistics</u>.

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: GreenhouseGas.Statistics@energysecurity.gov.uk

Our statement on <u>statistical public engagement and data standards</u> sets out the department's commitments on public engagement and data standards as outlined by the <u>Code of Practice</u> for <u>Statistics</u>.

Accredited Official Statistics designation

Accredited Official Statistics are called National Statistics in the Statistics and Registration Service Act 2007.

These Accredited Official Statistics were <u>independently reviewed</u> by the Office for Statistics Regulation (OSR) in June 2014 and had their <u>accreditation reviewed</u> in September 2018. They comply with the standards of trustworthiness, quality and value in the Code of Practice for Statistics and should be labelled 'Accredited Official Statistics'.

Our statistical practice is regulated by the OSR.

OSR sets the standards of trustworthiness, quality and value in the Code of Practice for Statistics that all producers of official statistics should adhere to.

You are welcome to contact us by emailing <u>greenhousegas.statistics@energysecurity.gov.uk</u> with any comments about how we meet these standards.

Alternatively, you can contact OSR by emailing <u>regulation@statistics.gov.uk</u> or via the OSR website.

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 <u>statement of compliance</u> with the Pre-Release Access to Official Statistics Order 2008.

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