



## 2021 UK greenhouse gas emissions, provisional figures

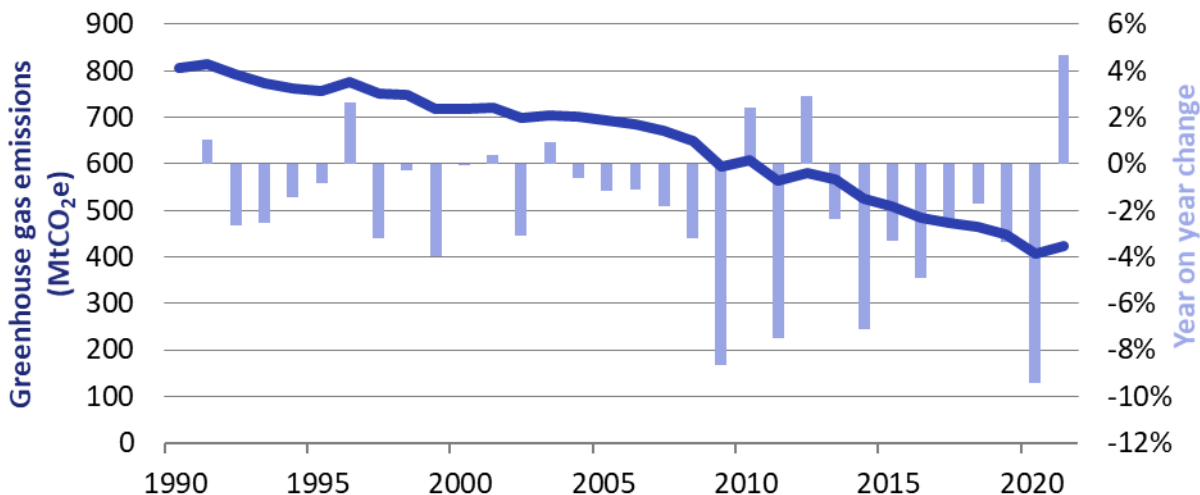
31 March 2022

National Statistics

The coronavirus (COVID-19) pandemic and the resulting restrictions introduced across the UK had a major impact on various aspects of society and the economy in 2020 and 2021 and this had a significant impact on greenhouse gas emissions in the UK over this period.

- Carbon dioxide (CO<sub>2</sub>) emissions in the UK are provisionally estimated to have increased by 6.3% in 2021 from 2020, to 341.5 million tonnes (Mt), and total greenhouse gas emissions by 4.7% to 424.5 million tonnes carbon dioxide equivalent (MtCO<sub>2e</sub>). Compared to 2019, the most recent pre-pandemic year, 2021 CO<sub>2</sub> emissions are down 5.0% and total greenhouse gas emissions are down 5.2%. Total greenhouse gas emissions were 47.3% lower than they were in 1990.
- This increase in 2021 is primarily due to the increase in the use of road transport as nationwide lockdowns were eased, along with increases in emissions from power stations and the residential sector. CO<sub>2</sub> emissions from transport rose 10.0% in 2021, accounting for almost half of the overall increase from 2020, and in power stations they rose by 9.2% due to an increased demand for electricity and the first increase in the use of fossil fuels for electricity generation from power stations since 2012. CO<sub>2</sub> emissions from the residential sector increased by 5.8% due to the colder weather in 2021 compared to 2020.

### UK territorial greenhouse gas emissions, 1990-2021



#### What you need to know about these statistics:

This publication provides provisional estimates of 2021 UK territorial greenhouse gas emissions, meaning emissions that occur within the UK's borders. Emissions are presented in carbon dioxide equivalent units (CO<sub>2e</sub>) throughout this statistical release.

These estimates give an early indication of emissions in 2021 and are subject to revision when final estimates are published in February 2023. 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 by source sector for 2021. 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 accompanying [methodology summary](#).

Data for 1990-2020 are consistent with the annual emissions presented in the National Statistics publication [2020 final UK greenhouse gas emissions statistics](#). Data for 2021 emissions are provisional and do not follow the full methodology used for 1990-2020. The estimates of carbon dioxide (CO<sub>2</sub>) emissions that are related to energy use are based on provisional inland energy consumption statistics, which are being published at the same time by BEIS in the quarterly [Energy Trends](#) publication. These are the large majority of emissions in the UK.

CO<sub>2</sub> emissions that are not related to energy use are assumed to remain the same as in 2020 as we do not yet have data from which to produce estimates for them, while estimates of non-CO<sub>2</sub> gases are based on a simple approach which assumes that the change in emissions of non-CO<sub>2</sub> gases between 2020 and 2021 will be in line with the percentage change in non-CO<sub>2</sub> emissions from 2020 to 2021 in the 2021 [Energy and Emissions Projections: Net Zero Strategy baseline](#) published by BEIS. 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. The provisional 2021 estimates are subject to a greater range of uncertainty than the final figures for earlier years and the Covid-19 pandemic means that, like the provisional 2020 estimates, they are more uncertain than usual. For non-CO<sub>2</sub> emissions and emissions not related to energy use in particular, the simple assumptions will not capture any impact of the pandemic, although we can expect these emissions to be less affected by it than emissions related to energy use. For more information on uncertainties in emissions estimates see the annex published alongside the [2020 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, 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 [an article](#) 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 [UK Environmental Accounts](#). 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 [UK's carbon footprint](#). 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:

Energy Supply	Emissions from electricity generation and other energy production activities such as mining, refining and manufacturing fuels.
Business	Emissions from fuel combustion and product use in industrial and commercial sectors, and F gas emissions from refrigeration and air conditioning in all sectors. Includes industrial off-road machinery but not business-related transport emissions, which are included in the <i>Transport</i> sector.
Transport	Emissions from road transport, domestic aviation, railways and domestic shipping. Only includes emissions from vehicles and not from transport related infrastructure or from air conditioning. International aviation and shipping emissions are not included in national totals.
Public	Emissions from the combustion of fuel in public sector buildings, e.g., hospitals and schools. Emissions from public transport are included in the <i>Transport</i> sector.
Residential	Emissions from residential properties, including from consumer product use. Primarily consists of fuel combustion for heating/cooking, garden machinery, and fluorinated gases released from aerosols and metered dose inhalers.
Agriculture	Emissions of greenhouse gases from livestock, agricultural soils (excluding carbon stock changes which are included in the <i>LULUCF</i> sector) and agricultural machinery.
Industrial processes	Emissions resulting from industrial processes, except for those associated with fuel combustion which are included in the <i>Business</i> sector.
Land use, land use change and forestry (LULUCF)	Emissions/removals of CO <sub>2</sub> from changes in the carbon stock in forestland, cropland, grassland, wetlands, settlements and harvested wood products, and 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. Because the impact of biomass harvest on carbon stocks in ecosystems is included in this sector, any emissions of CO <sub>2</sub> from burning biomass (regardless of the country of origin) are excluded from other sectors to avoid double counting them.
Waste management	Emissions resulting from the treatment and disposal of solid and liquid waste, for example from landfill, incineration and composting. Emissions from incineration with energy recovery are instead reported in the <i>Energy Supply</i> sector and emissions from residential composting are included in the <i>Residential</i> sector.

These high-level sectors are made up of several more detailed sectors, which follow the definitions set out by the Intergovernmental Panel on Climate Change (IPCC)<sup>1</sup> and which are used in international reporting tables which are submitted to the United Nations Framework Convention on Climate Change (UNFCCC)<sup>2</sup> 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<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulphur hexafluoride (SF<sub>6</sub>) and nitrogen trifluoride (NF<sub>3</sub>). 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 (GWP)<sup>3</sup>, 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<sub>2</sub>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 2020 and 2021, 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 [2020 final UK greenhouse gas emissions statistics](#).

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<sup>1</sup> <https://www.ipcc-nggip.iges.or.jp/>

<sup>2</sup> <https://unfccc.int/>

<sup>3</sup> The global warming potentials (GWPs) used are from Working Group 1 of the IPCC Fourth Assessment Report: Climate Change 2007 and summarised in a table published on the following page:  
<https://www.gov.uk/government/publications/uk-greenhouse-gas-emissions-explanatory-notes>

# 2021 UK provisional emissions results

In the [data tables](#) accompanying this publication, table 1 shows UK annual territorial greenhouse gas emissions, including a breakdown by source sector for carbon dioxide emissions. Table 3 shows quarterly moving annual totals for these emissions and table 5 the totals for individual quarters, with tables 4 and 6 respectively showing the equivalent temperature adjusted estimates.

In 2021, the coronavirus (COVID-19) pandemic and the continuing restrictions implemented across the UK had a major impact on various aspects of UK society and the economy. There are a range of statistics available from across the UK government and the devolved administrations showing the impact it has had, including profound changes to travel and economic activity<sup>4,5</sup>. As a result, COVID-19 will have had a significant impact on greenhouse gas emissions in the UK in 2021, in particular from transport and from business, although less so compared to 2020 as restrictions were gradually eased throughout the year. It is not possible to identify the exact size of this effect as other factors will have also played a part in the changes seen during 2021.

Territorial carbon dioxide emissions are provisionally estimated to have increased by 6.3% (20.4 Mt) in 2021 from 2020, and total greenhouse gas emissions by 4.7% (19.0 MtCO<sub>2e</sub>). This is the first increase in year-on-year total greenhouse gas emissions since 2012. However, total greenhouse gas emissions are still estimated to be 5.2% lower than those in 2019, which is a decrease of 23.4 MtCO<sub>2e</sub>. At 424.5 MtCO<sub>2e</sub>, greenhouse gas emissions in the UK in 2021 were 47.3% lower than in 1990. Because these provisional estimates are based on energy data it is only possible to make estimates of carbon dioxide emissions from different source sectors and not estimates of other gases, so the rest of this section presents the trends in carbon dioxide emissions.

Continuing from the large emissions reductions in 2020, the first quarter (Q1) of 2021, from January to March, saw carbon dioxide emissions fall 4.4% compared to the same period in 2020. This followed the various stringent restrictions that were in place throughout Q1 and into April of 2021, when many businesses were closed, and people were instructed to stay at home as much as possible. Transport was particularly affected in Q1 2021, with emissions falling by 23.1% from the same quarter the year before, largely as a result of the fall in the use of road transport<sup>6</sup>. Q2, April to June, of 2021 saw a stark increase of 29.3% in carbon dioxide emissions compared to the same period in 2020, with CO<sub>2</sub> emissions in transport, business, and energy supply up 58.0%, 18.9%, and 13.0% respectively. This is likely to have been impacted by the timings of the first lockdown in 2020 and easing of restrictions in 2021. Q3, from July to September, still saw an increase in carbon dioxide emissions of 8.1% from 2021 compared to 2020, again with transport, business and energy supply being the main

<sup>4</sup> Coronavirus (COVID-19): latest insights, Office for National Statistics (ONS):

<https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/coronaviruscovid19/latestinsights>

<sup>5</sup> Coronavirus (COVID-19) roundup, Office for National Statistics:

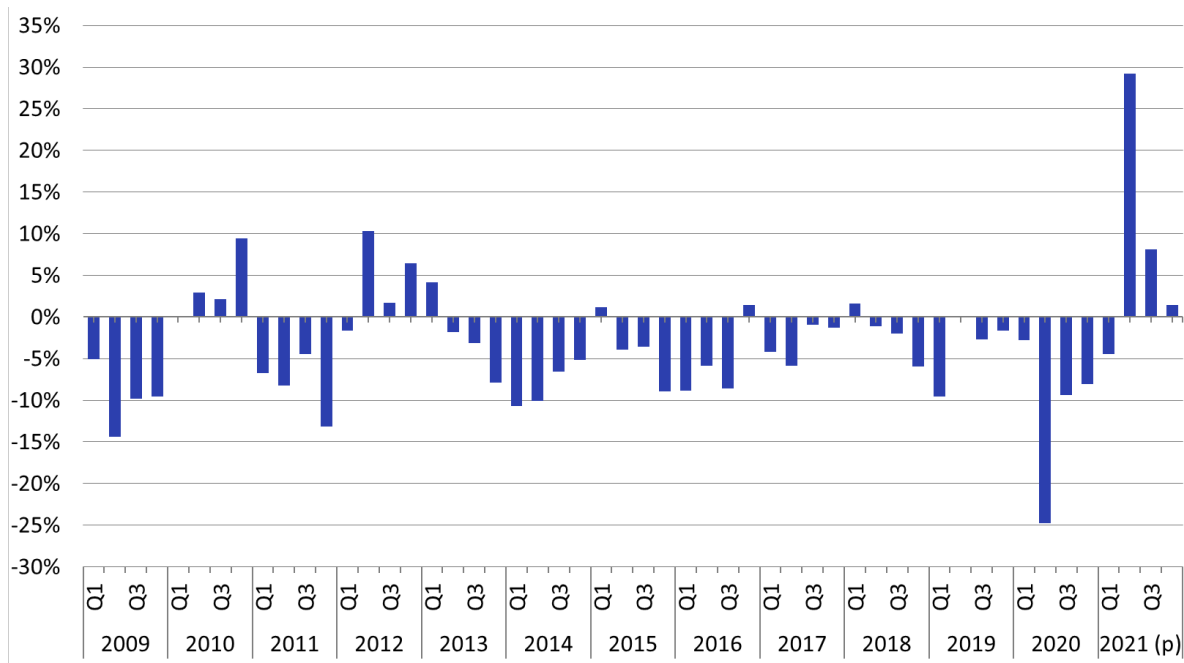
<https://www.ons.gov.uk/peoplepopulationandcommunity/healthandsocialcare/conditionsanddiseases/articles/coronaviruscovid19roundup/2020-03-26>

<sup>6</sup> Transport use during the coronavirus (COVID-19) pandemic, Department for Transport (DfT):

<https://www.gov.uk/government/statistics/transport-use-during-the-coronavirus-covid-19-pandemic>

sectors behind the increase. Carbon dioxide emissions in Q4, October to December, of 2021 were 1.4% greater than in the same period in 2020.

**Figure 1: Percentage change in quarterly UK carbon dioxide emissions from previous year, Q1 2009 - Q4 2021**



Source: Table 5, Provisional UK territorial greenhouse gas emissions national statistics 1990-2021 Excel data tables

Note: (p) 2021 estimates are provisional.

Overall, across 2021, carbon dioxide emissions in the transport sector increased by an estimated 10.0% (9.8 Mt), with it remaining the largest emitting sector in the UK, accounting for 31.5% of carbon dioxide emissions in 2021. A further 23.6% of carbon dioxide emissions were from energy supply, 19.9% from the residential sector and 19.1% from business.

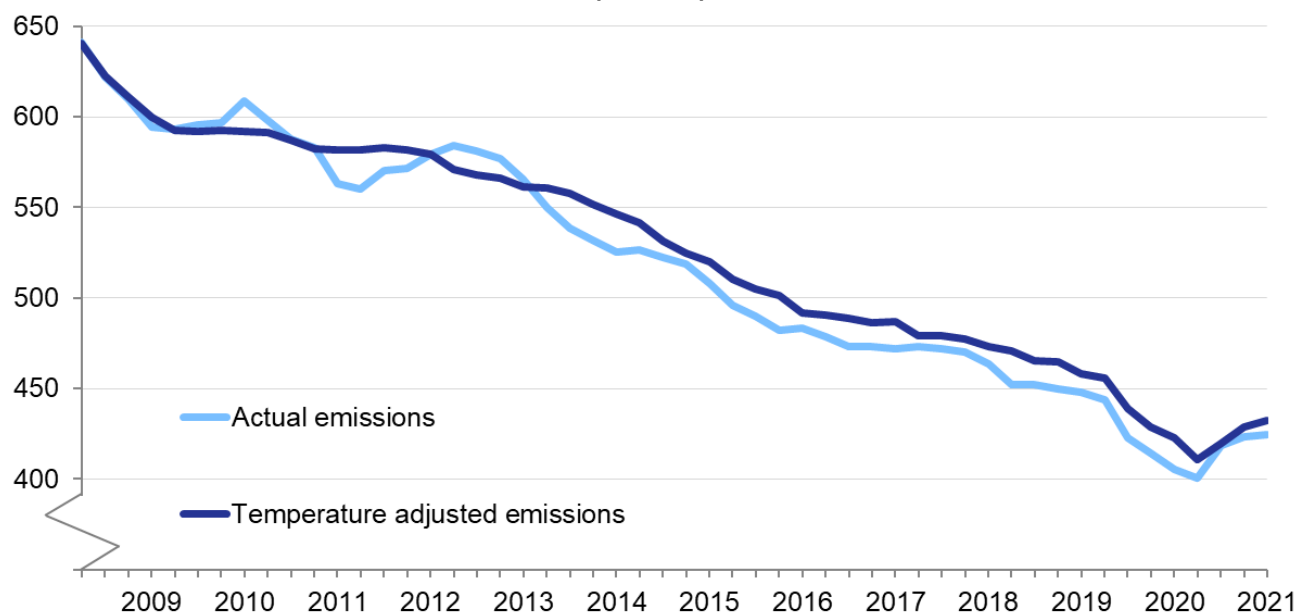
Carbon dioxide emissions in the energy supply sector increased by 3.3% (2.6 Mt), between 2020 and 2021. This will have been affected by the lifting of pandemic restrictions, with greater demand for electricity and fuels, and the 3.8% increase in carbon dioxide emissions from fossil fuels in the energy supply sector in 2021 compared to 2020. This increase in carbon dioxide emissions from fossil fuel use in the energy supply sector is contrary to long term trends, with emissions down 71.0% and 9.4% since 1990 and 2019 respectively.

Business sector territorial carbon dioxide emissions increased by 5.9% (3.6 Mt) and public sector emissions by 6.3% (0.5 Mt) between 2020 and 2021. Both will have been affected by the easing of restrictions during the pandemic, with businesses, schools and offices all reopening throughout 2021. Both will also have seen increased emissions due to the colder temperatures in 2021 compared to 2020, which will have increased the use of heating in buildings.

The residential sector saw an increase in carbon dioxide emissions in 2021, of 5.8% (3.7 Mt) compared to 2020. These emissions are predominantly from the use of fuels for heating and cooking, but do not include emissions associated with electricity use as these are included in the energy supply sector. This increase was due to the colder weather conditions and the ongoing instruction for people to stay at home for periods of the year, including many more people either working from home or unable to go to work due to the coronavirus restrictions.

Between 1990 and 2021, UK territorial carbon dioxide emissions decreased by 47.7%. While the pandemic led to a notable fall in emissions in 2020, 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 21.1% since 1990<sup>7</sup>, and if this figure is adjusted to allow for the effect of temperature, there was a 23.0%<sup>9</sup> decrease over this period.

**Figure 2: Actual and temperature adjusted annual territorial greenhouse gas emissions, UK, Year to Q1 2009 - Year to Q4 2021 (MtCO<sub>2</sub>)**



Source: Tables 3 & 4, Provisional UK territorial greenhouse gas emissions national statistics 1990-2020 Excel data tables

Note: 1. Figures are annual totals including the preceding 4 quarters.  
2. From year ending Q1 2021 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 25.6%, similar to the fall in actual emissions over this period (24.6%).

<sup>7</sup> Digest of UK Energy Statistics (DUKES), Availability and consumption of primary fuels and equivalents (energy supplied basis), 1970 to 2020 (DUKES1.1.2), Department for Business, Energy & Industrial Strategy: <https://www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes>

<sup>8</sup> Energy Trends: UK total energy, Inland energy consumption: primary fuel input basis (ET 1.2 – monthly), Department for Business, Energy & Industrial Strategy: <https://www.gov.uk/government/statistics/total-energy-section-1-energy-trends>

<sup>9</sup> Digest of UK Energy Statistics (DUKES), Primary energy consumption, gross domestic product, and the energy ration, 1970 to 2020 (DUKES1.1.4), Department for Business, Energy & Industrial Strategy: <https://www.gov.uk/government/statistics/energy-chapter-1-digest-of-united-kingdom-energy-statistics-dukes>



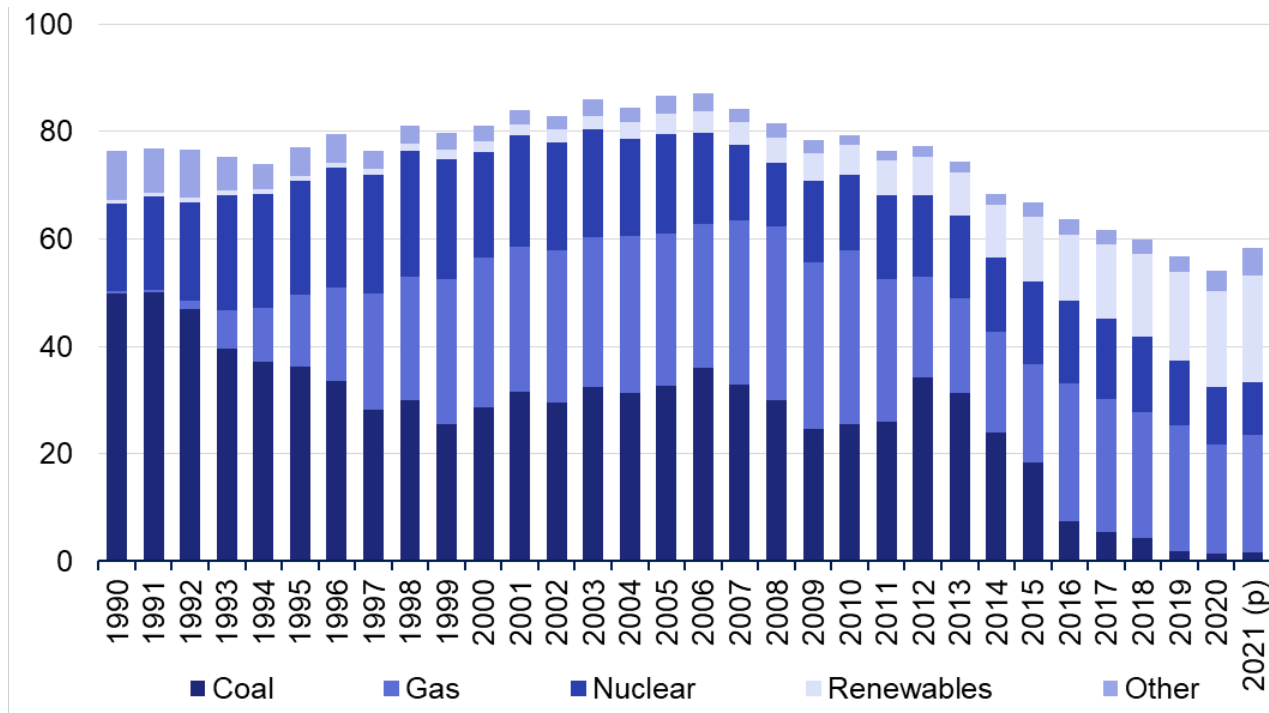
## Energy Supply

Carbon dioxide emissions from this sector are provisionally estimated to be 80.7 Mt in 2021, an increase of 3.3% (2.6 Mt) compared to 2020 and a decrease of 9.2% (8.2 Mt) compared to 2019, the last full pre-pandemic year.

This increase was mainly a result of a 9.2% (4.6 Mt) increase in carbon dioxide emissions from power stations. In 2021, carbon dioxide emissions from power stations, at 54.1 Mt, accounted for 15.8% of all carbon dioxide emissions. Carbon dioxide emissions from power stations were 73.4% lower in 2021 than in 1990. This is despite consumption of electricity being provisionally estimated to be around 3.5% higher in 2021 than in 1990. Consumption of electricity has continually been higher than 1990 levels, with figures peaking during the mid-2000's.

This long-term decrease 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 2021 coal made up 2.9% of fuel used for electricity generation, compared to 65.3% in 1990. Nuclear and renewables, which are low carbon energy sources, accounted for 50.6% of fuel used for electricity generation in 2021, up from 22.2% in 1990.

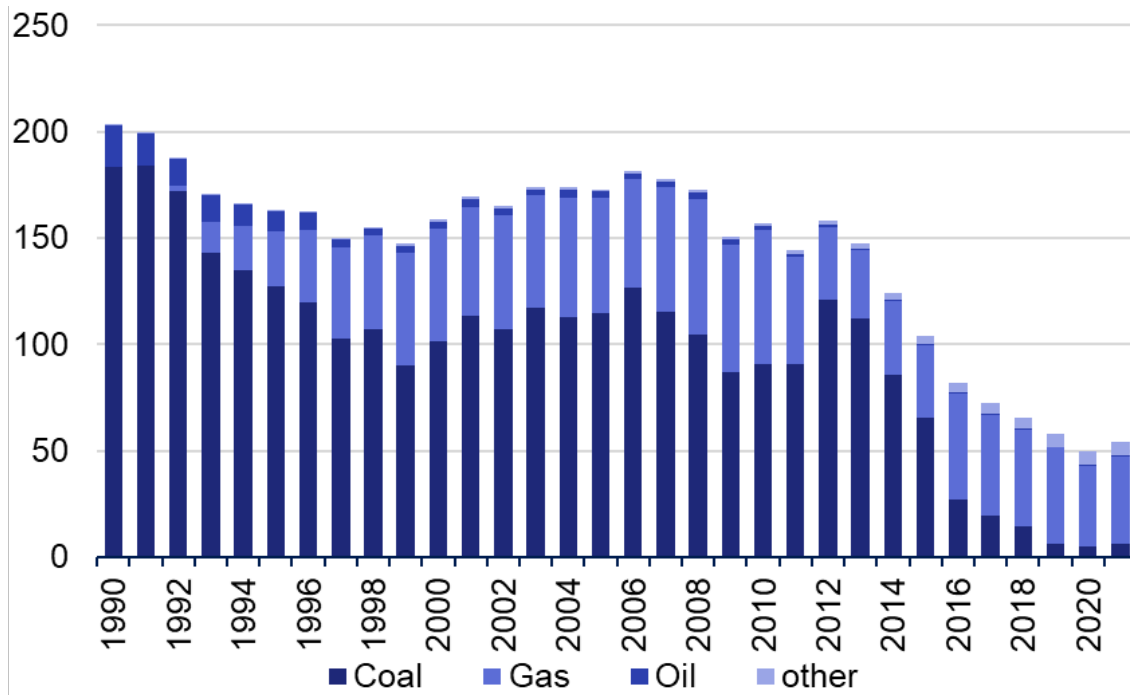
**Figure 3: Fuel mix for UK electricity generation, 1990-2021 (Million tonnes of oil equivalent)**



Source: Table 5.1.1, Digest of UK Energy Statistics (DUKES) 1970-2020 and Table 5.1 Energy Trends: March 2021 Excel data tables

Note: (p) 2021 estimates are provisional.

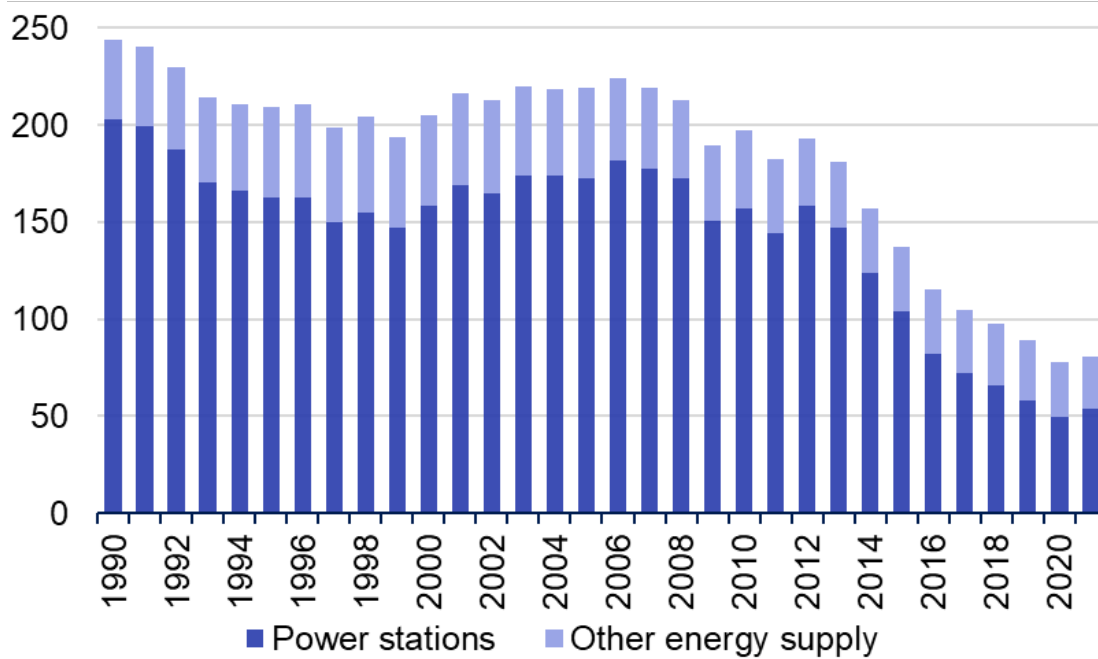
**Figure 4: Territorial carbon dioxide emissions from power stations, UK, 1990-2021 (MtCO<sub>2</sub>)**



Source: Tables 1 & 2, Provisional UK territorial greenhouse gas emissions national statistics 1990-2020 Excel data tables

Note: (p) 2021 estimates are provisional.

**Figure 5: Territorial carbon dioxide emissions from energy supply, UK, 1990-2021 (MtCO<sub>2</sub>)**



Source: Table 1, Provisional UK territorial greenhouse gas emissions national statistics 1990-2021 Excel data tables

Note: (p) 2021 estimates are provisional.

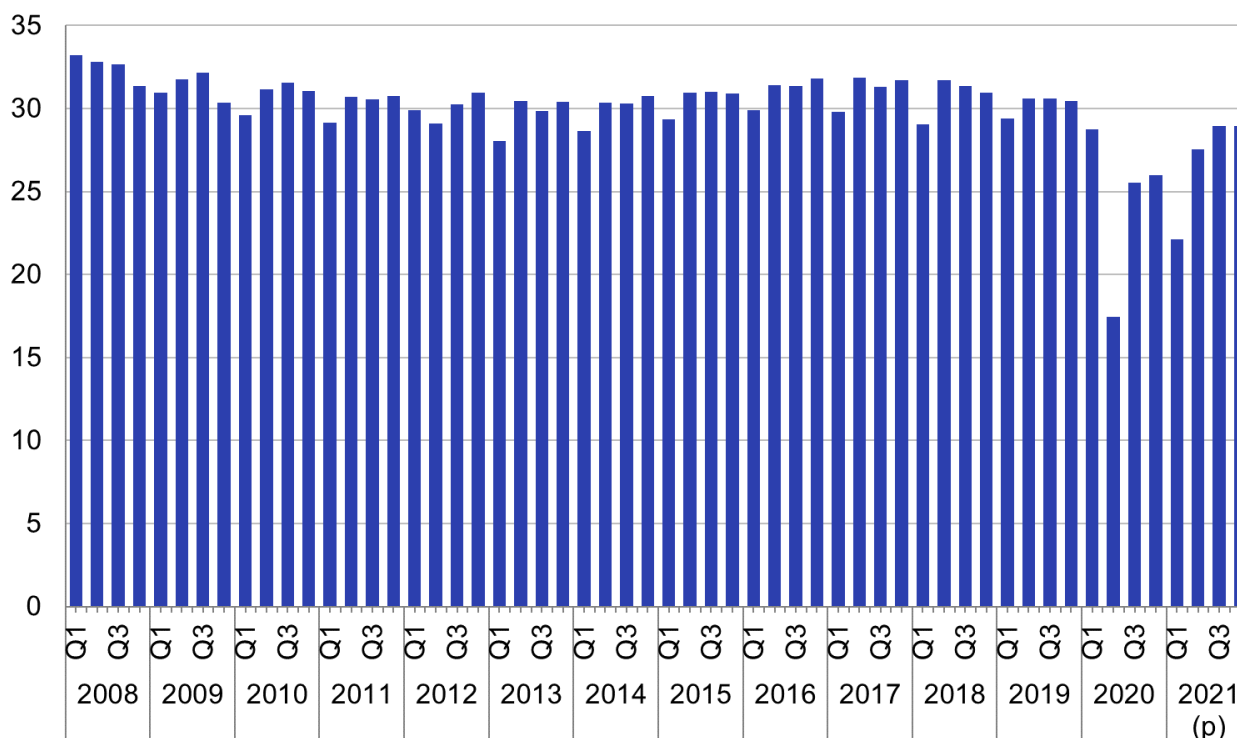
## Transport sector

In 2020 transport was significantly impacted by COVID-19, as people were instructed to stay at home as much as possible. In 2021, COVID-19 restrictions were eased, and people were able to travel more freely, resulting in the increase of territorial carbon dioxide emissions from the transport sector to 107.5 Mt, a 10.0% (9.8 Mt) rise from 2020, yet 11.2% (13.5 Mt) lower than in 2019. In 2021 transport accounted for 31.5% of all territorial carbon dioxide emissions, compared to 30.4% in 2020 and 33.7% in 2019 (pre-pandemic). The large majority of emissions from transport are from road transport.

Primarily as a result of a continual growth in vehicle kilometres travelled on roads<sup>10</sup>, transport carbon dioxide grew to a peak in 2007, 8.4% 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 efficiency<sup>11</sup>, as well lower traffic growth than in previous years as a result of a dip following the 2008/2009 recession.

It should be noted that these estimates do not include emissions from international aviation and shipping. Domestic aviation (i.e. flights taking off and landing within the UK) and shipping, however, are included.

**Figure 6: Quarterly territorial carbon dioxide emissions from transport, UK, 2008-2021 (MtCO<sub>2</sub>)**



Source: Table 5, Provisional UK territorial greenhouse gas emissions national statistics 1990-2021 Excel data tables

Note: (p) 2021 estimates are provisional.

<sup>10</sup> 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/tsqb07>

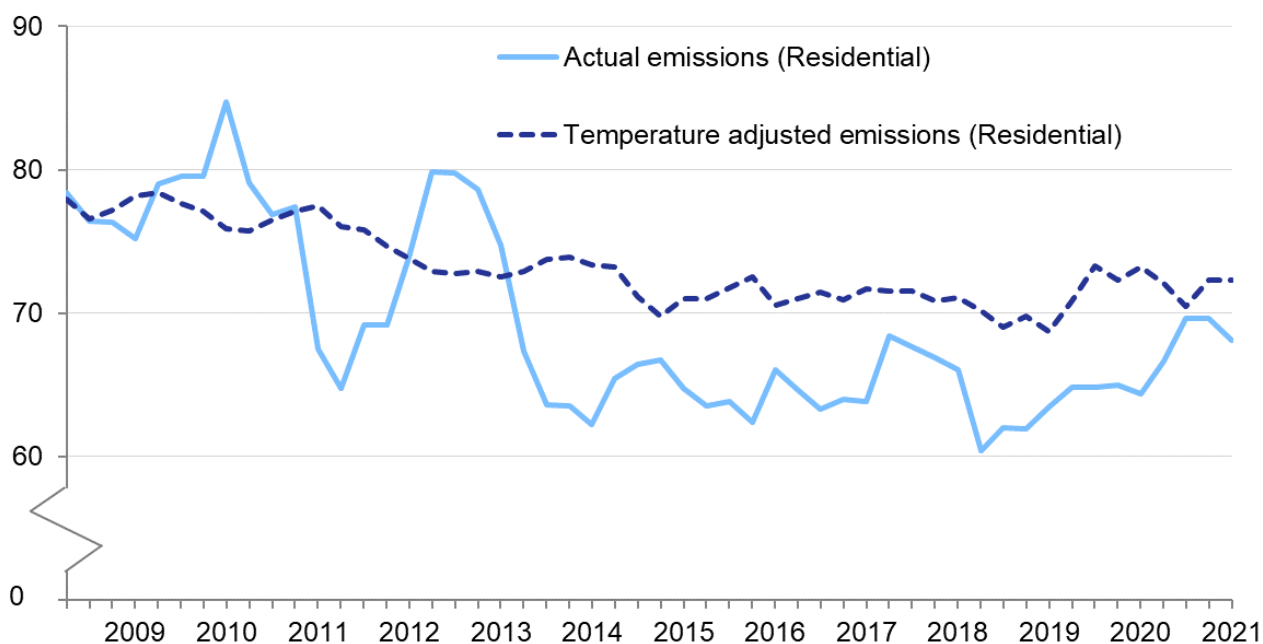
<sup>11</sup> Transport Statistics Great Britain, Energy and environment (TSGB03), Table TSGB0303 (ENV0103) Average new car fuel consumption: Great Britain from 1997 <https://www.gov.uk/government/statistical-data-sets/tsqb03>

## Residential

The main source of emissions in this sector is the use of natural gas for heating and cooking. 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 energy supply sector.

In 2021, the residential sector emitted 68.1 MtCO<sub>2</sub>, accounting for 19.9% of all carbon dioxide emissions in the UK. Whilst there was a 5.8% (3.7 Mt) increase in 2021 compared to 2020, between 1990 and 2021 territorial carbon dioxide emissions from the residential sector have fallen by 12.9%. The increase in carbon dioxide emissions between 2020 and 2021 was affected by the colder weather in 2021, resulting in more energy being used to heat homes, whereas if temperatures had followed the long-term average in both years we estimate there would have been a 1.2% (0.9 Mt) decrease. Residential emissions fluctuate owing to year-on-year variation in weather conditions, as seen in figure 7 below.

**Figure 7: Actual and temperature adjusted annual residential carbon dioxide territorial emissions, UK, Year to Q1 2009 - Year to Q4 2021 (MtCO<sub>2</sub>)**



Source: Tables 3 & 4, Provisional UK territorial greenhouse gas emissions national statistics 1990-2021 Excel data tables

Note: 1. Figures are annual totals including the preceding 4 quarters.  
2. From year ending Q1 2021 onwards, figures include provisional data.

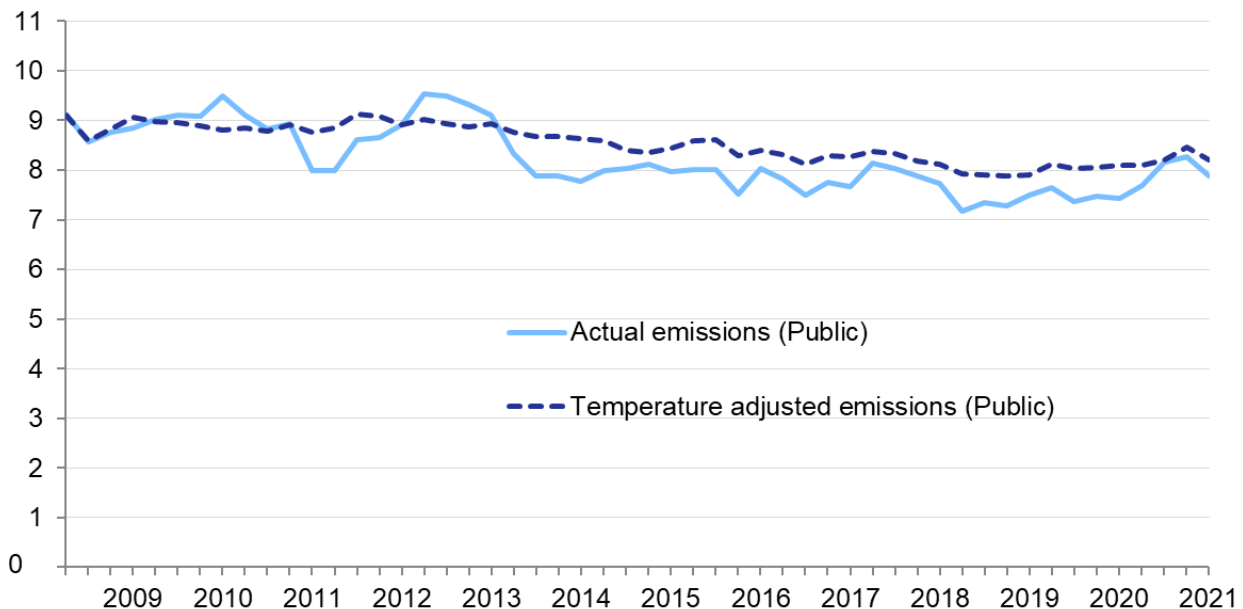
## Public sector

Natural gas for heating purposes is the main source of emissions in the public sector. Like the residential sector, emissions from the public sector do not include emissions from the generation of electricity consumed, as these emissions are included in the energy supply sector.

Emissions from the public sector were 7.9 MtCO<sub>2</sub> in 2021, a 6.3% (0.5 Mt) increase from 2020, and accounting for 2.3% of all territorial carbon dioxide emissions. These changes were

affected by colder weather in 2021. On a temperature adjusted basis between 2020 and 2021 we estimate there was a 1.3% (0.1 Mt) increase in emissions from the public sector. In the period from 1990 to 2021 territorial carbon dioxide emissions from the public sector decreased 40.5%.

**Figure 8: Actual and temperature adjusted annual public sector carbon dioxide territorial emissions, UK, Year to Q1 2009 - Year to Q4 2021 (MtCO<sub>2</sub>)**



Source: Tables 3 & 4, Provisional UK territorial greenhouse gas emissions national statistics 1990-2021 Excel data tables

- Note:
1. Figures are annual totals including the preceding 4 quarters.
  2. From year ending Q1 2021 onwards, figures include provisional data.

## Business sector

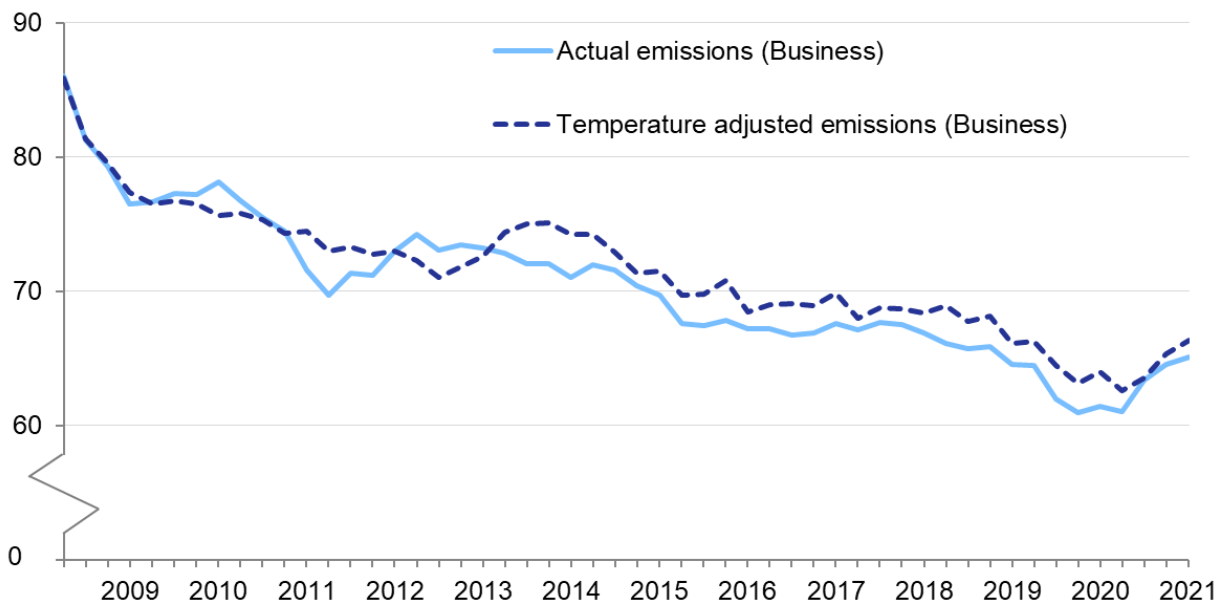
Territorial carbon dioxide emissions from the business sector were estimated to be 65.1 Mt in 2021 and accounted for around 19.1% of all carbon dioxide emissions. There has been a 41.5% decrease in business sector emissions since 1990. Most of this decrease came between 2001 and 2009, with a significant drop in 2009 likely to have been driven by economic recession.

Between 2020 and 2021 carbon dioxide emissions from this sector increased by 5.9% (3.6 Mt), also meaning 2021 carbon dioxide emissions were 0.8% (0.5 Mt) higher compared to 2019. This increase in 2021 follows the easing of nationwide lockdowns and restrictions due to the COVID-19 pandemic, including the re-opening of non-essential shops, pubs, restaurants and venues. Trading volumes increased, there was an increase in the number of businesses trading<sup>12</sup> and an increase in UK GDP was reported over the time period<sup>13</sup>.

<sup>12</sup> Business insights and impact on the UK economy, Office for National Statistics: <https://www.ons.gov.uk/businessindustryandtrade/business/businessservices/bulletins/businessinsightsandimpactontheukeconomy/24march2022>

<sup>13</sup> GDP monthly estimate, UK, Office for National Statistics: <https://www.ons.gov.uk/economy/grossdomesticproductgdp/bulletins/gdpmonthlyestimateuk/january2022>

**Figure 9: Actual and temperature adjusted annual business sector carbon dioxide territorial emissions, UK, Year to Q1 2009 - Year to Q4 2021 (MtCO<sub>2</sub>)**



Source: Tables 3 & 4, Provisional UK territorial greenhouse gas emissions national statistics 1990-2021 Excel data tables

- Note:
1. Figures are annual totals including the preceding 4 quarters.
  2. From year ending Q1 2021 onwards, figures include provisional data.

## Other sectors

For the *agriculture, waste management, and land use, land use change and forestry (LULUCF)* sectors provisional territorial carbon dioxide emissions cannot be derived based on energy statistics, so the carbon dioxide emissions from these sectors are assumed to be the same as they were in 2020. This is also the case for most of the emissions from the *industrial processes* sector.

# Carbon dioxide emissions by fuel type

In the [data tables](#) accompanying this publication, table 2 shows UK territorial carbon dioxide emissions by 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.

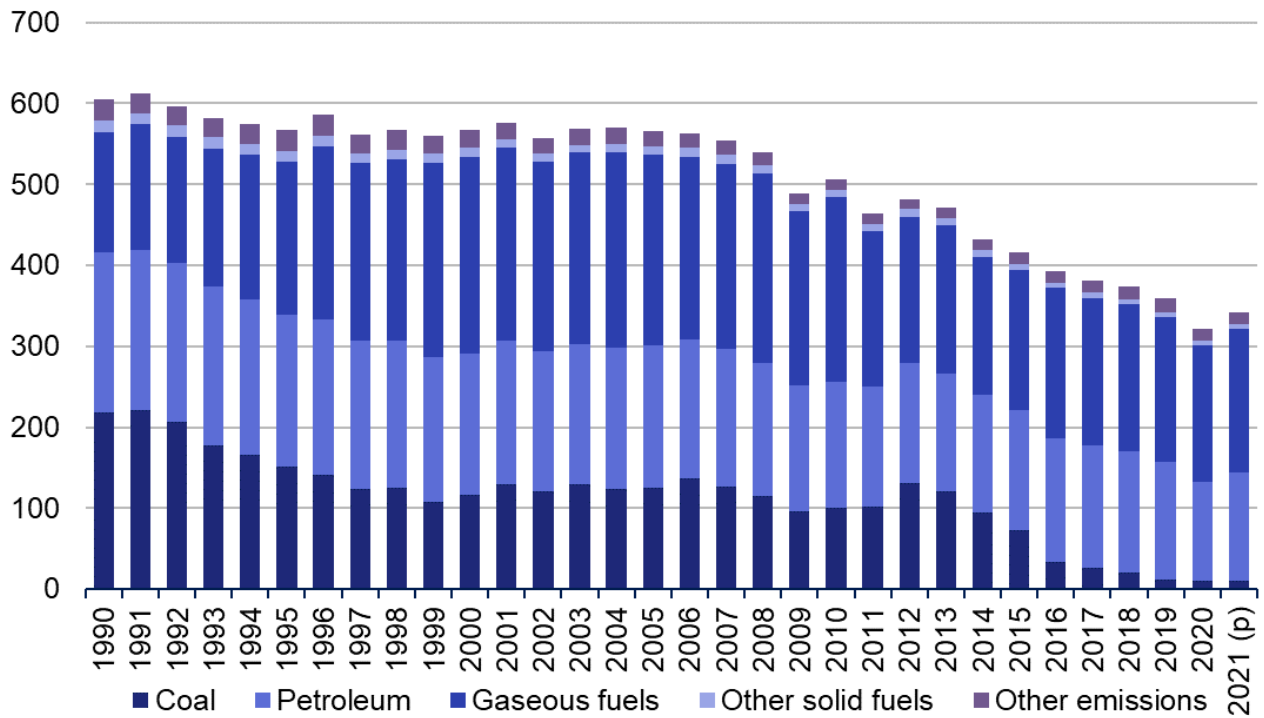
Emissions per unit of electricity supplied from fossil fuels are estimated to have been around 527 tonnes of carbon dioxide per gigawatt hour (GWh) overall in 2021 in the UK. Within this, emissions from electricity generated from coal (1,016 tonnes of carbon dioxide per GWh electricity supplied) were over twice as high as for electricity supplied by gas (489 tonnes of carbon dioxide per GWh). For all sources of electricity (including nuclear, renewables and autogeneration), the average amount of carbon dioxide emitted in 2021 amounted to 254 tonnes per GWh of electricity supplied.

In 2021, total territorial carbon dioxide emissions from the use of fossil fuels, including fuel used for generating electricity, were estimated at 320.9 Mt. This was 6.7% greater than the 2020 figure of 300.7 Mt and 4.4% lower than the 2019 figure of 335.7 Mt. The biggest absolute change in emissions was from the use of petroleum, up 11.0 Mt (9.0%) from 121.8 Mt in 2020 to 132.9 Mt in 2021. This largely resulted from the increase in road transport in the UK as nationwide restrictions were eased. However, the largest percentage increase in emissions came from the use of coal, up 9.4% (0.9 Mt) from 2020 to 2021, as a result of its increased use in energy supply from power stations. Gaseous fuel use also increased, 8.3 Mt (4.9%) from 2020 to 2021, mostly due to the higher use of gas for electricity generation and household heating.

Over the period 1990 to 2021, carbon dioxide emissions from fossil fuels decreased by 43.1%. Over the same period, primary consumption of fossil fuels dropped by 28.1%. 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 as a proportion of all carbon dioxide emissions from fossil fuels has increased from 24.4% in 1990 to 51.9% in 2021, whilst emissions from coal as a proportion of all fossil fuel carbon dioxide emissions has decreased from 36.1% to 3.2% over the same period. Oil was responsible for 32.7% of carbon dioxide emissions from fossil fuels in 1990 and this has increased to 38.9% in 2021.

**Figure 10: UK Territorial carbon dioxide emissions by fuel type, 1990-2021 (MtCO<sub>2</sub>)**



Source: Table 2, Provisional UK territorial greenhouse gas emissions national statistics 1990-2021 Excel data tables

Note: (p) 2021 estimates are provisional.



# 2021 temperature adjusted provisional emissions results by sector

In the [data tables](#) accompanying this publication, table 3 shows quarterly moving annual totals for UK emissions and table 5 the totals for individual quarters, with tables 4 and 6 respectively showing the equivalent temperature adjusted estimates.

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. Table 1 compares temperature adjusted and unadjusted carbon dioxide emissions by sector in 2021. The adjustments are based on the estimated historical impacts of temperatures on emissions, although as activity patterns were quite different to usual in 2020 and 2021 due to the coronavirus (COVID-19) pandemic, the adjustments may be less reliable than in other years at reflecting what emissions might have been had temperatures followed the long-term average rather than the temperature pattern actually seen.

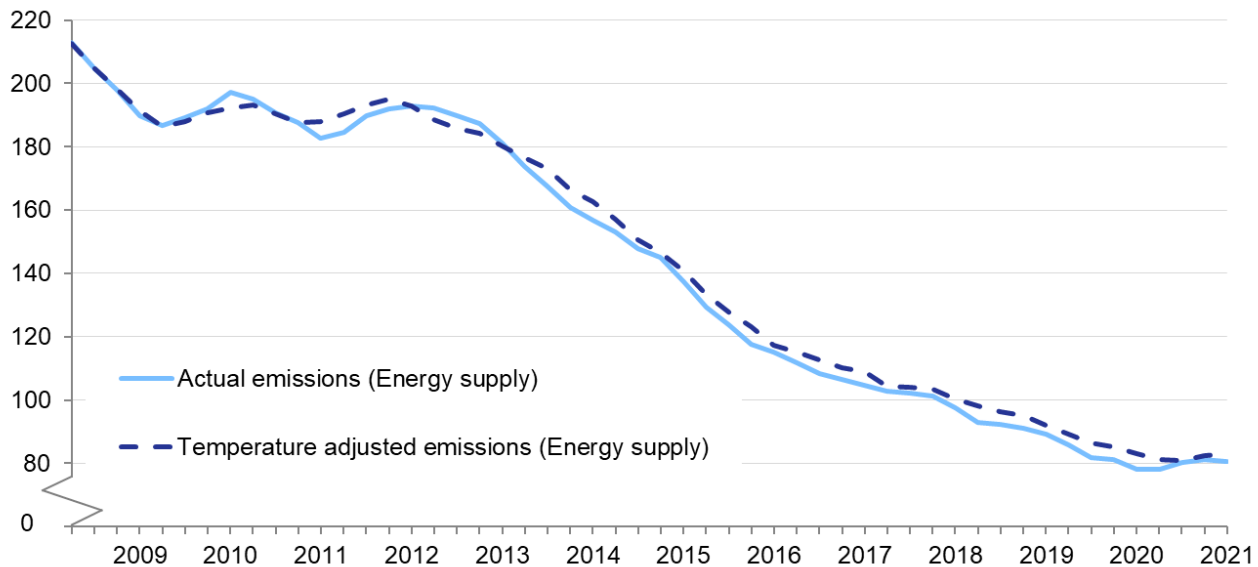
**Table 1: Percentage changes in territorial carbon dioxide emissions by sector between 2020 and 2021 based on the temperature adjusted emissions and actual emissions**

	Temperature adjusted emissions			Actual emissions		
	2020 (MtCO <sub>2</sub> )	2021 (MtCO <sub>2</sub> )	2020 - 2021 Percentage change	2020 (MtCO <sub>2</sub> )	2021 (MtCO <sub>2</sub> )	2020 - 2021 Percentage change
Energy supply	82.9	83.0	0.1%	78.2	80.7	3.3%
Business	64.0	66.3	3.6%	61.5	65.1	5.9%
Transport	97.7	107.5	10.0%	97.7	107.5	10.0%
Public	8.1	8.2	1.3%	7.4	7.9	6.3%
Residential	73.2	72.3	-1.2%	64.4	68.1	5.8%
Other	11.9	12.1	1.5%	11.9	12.1	1.5%
<b>Total CO<sub>2</sub></b>	<b>338.0</b>	<b>349.5</b>	<b>3.4%</b>	<b>321.1</b>	<b>341.5</b>	<b>6.3%</b>

Source: Tables 3 & 4, Provisional UK territorial greenhouse gas emissions national statistics 1990-2021 Excel data tables

Based on year-on-year percentage change, the sectors most affected by external temperatures are the residential sector and public sector. When temperatures are lower there is greater use of natural gas and electricity for heating buildings. The overall trend in temperature adjusted energy supply emissions is similar to the unadjusted trend, as the majority of electricity generated is used for other purposes rather than heating.

**Figure 11: Actual and temperature adjusted energy supply carbon dioxide territorial emissions, UK, Year to Q1 2009 - Year to Q4 2021 (MtCO<sub>2</sub>)**



Source: Tables 3 & 4, Provisional UK territorial greenhouse gas emissions national statistics 1990-2021 Excel data tables

## Accompanying tables

The following tables are available in Excel and ODS format on the department’s statistics website <https://www.gov.uk/government/collections/uk-territorial-greenhouse-gas-emissions-national-statistics>:

Table 1	UK annual territorial greenhouse gas emissions, including a breakdown by source sector for carbon dioxide emissions
Table 2	UK territorial carbon dioxide emissions by fuel type
Table 3	UK territorial greenhouse gas emissions, annual totals
Table 4	UK temperature adjusted territorial greenhouse gas emissions annual totals
Table 5	UK territorial greenhouse gas emissions for individual quarters
Table 6	UK temperature adjusted territorial greenhouse gas emissions for individual quarters
AR5 Table 1	UK annual territorial greenhouse gas emissions, including a breakdown by source sector for carbon dioxide emissions, using global warming potentials from Working Group 1 of the IPCC Fifth Assessment Report

# Technical information

## Basis of the provisional emissions estimates

The estimates of carbon dioxide emissions in 2021 have been produced based on provisional inland energy consumption statistics which are published in BEIS's quarterly [Energy Trends](#) publication.

Carbon dioxide accounts for the majority of UK greenhouse gas emissions (80.4% in 2021). 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-CO<sub>2</sub> gases. Estimates of non-CO<sub>2</sub> gases are based on a simple approach which assumes that emissions of non-CO<sub>2</sub> gases in 2021 will change from the 2020 total in line with the percentage difference between the estimates for the 2020 and 2021 non-CO<sub>2</sub> emissions in the 2021 [Energy and Emissions Projections: Net Zero Strategy baseline](#) published by BEIS.

Estimates of emissions of all greenhouse gases for 1990-2020 come from the latest UK greenhouse gas inventory. Information about the methodology behind these estimates can be found in the [2020 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 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 1981-2010). Temperature adjustment is determined by the average number of heating degree days in each quarter. This information can be found in [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 [methodology summary](#). It should be noted that the temperature adjustment methodology for 2021 is the same as in previous years and has not been updated to reflect any impacts of the COVID-19 pandemic.

## Upcoming change to Global Warming Potentials

As detailed in the introduction section, emissions of each greenhouse gas (carbon dioxide, methane, nitrous oxide, fluorinated gases) are expressed in terms of carbon dioxide equivalent (CO<sub>2</sub>e), recognising the different global warming potentials (GWP) of the different gases.

Figures for GWPs are set out in Intergovernmental Panel on Climate Change (IPCC) Assessment Reports (AR). In this publication, emissions estimates are primarily based on 100-year AR4 GWPs, consistent with international reporting and carbon trading protocols up to 2020. While this report covers the period up to 2021, we've retained the use of AR4 GWPs for consistency with our final GHG emissions 1990-2020 publication from February. We've included AR5 GWPs in the dataset accompanying this publication and an alternative AR5 version of one of the tables, ahead of the full transition to AR5 GWPs next year.

In November 2021, it was agreed by the international community at COP26 that greenhouse gas emissions shall be reported under the Paris Agreement transparency framework using 100-year AR5 GWPs (without climate-carbon feedback)<sup>14</sup>. Therefore, emissions estimates will primarily be based on 100-year AR5 GWPs in this publication next year.

As carbon dioxide is the base against which other greenhouse gas emissions are weighted and reported (MtCO<sub>2</sub>e), its GWP always remains 1, so there is no change to carbon dioxide emissions estimates. Therefore, as most UK greenhouse gas emissions are from carbon dioxide (80.4% in 2021 using AR4 GWPs), the difference in total emissions when reported in AR5 instead of AR4 is small: a 1.0% increase in 1990 and a 0.8% increase in 2021. The difference in non-CO<sub>2</sub> emissions when reporting in AR5 compared to AR4 results in an increase of 4.1% and 3.8% for 1990 and 2021 respectively.

For more details on the impact of moving to AR5 GWPs, see the dataset of greenhouse gas emissions by source published alongside the [2020 final UK greenhouse gas emissions statistics](#), which presents emissions in both AR4 and AR5 GWPs. Also, there is the [list of greenhouse gases with corresponding GWPs](#) available.

## Further information

### Future updates to these statistics

On Thursday 30<sup>th</sup> June 2022 BEIS will publish estimates of greenhouse gas emissions by local authority for 2020. We will also publish estimates of 1990-2020 UK territorial greenhouse gas emissions by Standard Industrial Classification (SIC), to supplement the sector breakdown included in the final 2020 UK greenhouse gas emissions publication.

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<sup>14</sup> <https://unfccc.int/documents/311138>

Final estimates of UK greenhouse gas emissions for 2021 will be published as National Statistics in February 2023. These estimates will be based on the UK's Greenhouse Gas Inventory for 1990-2021.

In March 2023, the 1990-2021 UK emissions estimates will be updated to include estimates by end user and uncertainty estimates, and provisional 2022 emissions estimates will be published.

## Related publications

- The UK's National Inventory Report (NIR) for 1990-2020 will be submitted to the United Nations Framework Convention on Climate Change (UNFCCC) on 15<sup>th</sup> April 2022. The report will contain national greenhouse gas emissions estimates for 1990-2020 and descriptions of the methods used to produce the estimates. Previous reports can be found on the [NAEI website](#).
- The [background quality report](#) provides a summary of quality issues relating to statistics on UK territorial greenhouse gas emissions.
- The [record of base year emissions](#) table shows how the UK base year for UK Carbon Budgets and the Kyoto Protocol has changed from 2008 to the latest inventory year.
- BEIS also publishes [emissions projections](#) 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 Kyoto Protocol can be found on the [UNFCCC's website](#).
- Further details of the European Union Emissions Trading System can be found at the [EU ETS section of the Gov.uk website](#).
- ONS publishes emissions on a "residential" basis in the [UK Environmental Accounts](#). 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 [UK's carbon footprint](#). 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 [Digest of UK Energy Statistics](#) and [Energy Trends](#) quarterly bulletin produced by BEIS. Any enquiries about the UK energy statistics should be sent to [energy.stats@beis.gov.uk](mailto:energy.stats@beis.gov.uk).
- 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 [BEIS 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](#).

Emissions estimates for 2021 are provisional and are based on UK energy statistics. They will be revised when the final 2021 estimates are published in February 2023. 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 2020 and 2021, 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 [2020 final UK greenhouse gas emissions 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: [GreenhouseGas.Statistics@beis.gov.uk](mailto:GreenhouseGas.Statistics@beis.gov.uk)

The BEIS 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 September 2018 following a [compliance check](#) by the Office for Statistics Regulation. The statistics last underwent a [full assessment](#) against the [Code of Practice for Statistics](#) in 2014.

Since the latest review by the Office for Statistics Regulation, we have continued to comply with the Code of Practice for Statistics, and have made the following improvements:

- Improved the accuracy of the historic emissions estimates by continuing to make [methodological changes](#) to the UK's Greenhouse Gas Inventory.
- Improved the accuracy of the provisional estimates by reviewing and changing the methodology for making provisional estimates of non-CO<sub>2</sub> emissions.
- Providing more methodological and background information about the statistics in the statistical releases.

## 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 [BEIS statement of compliance](#) with the Pre-Release Access to Official Statistics Order 2008.

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