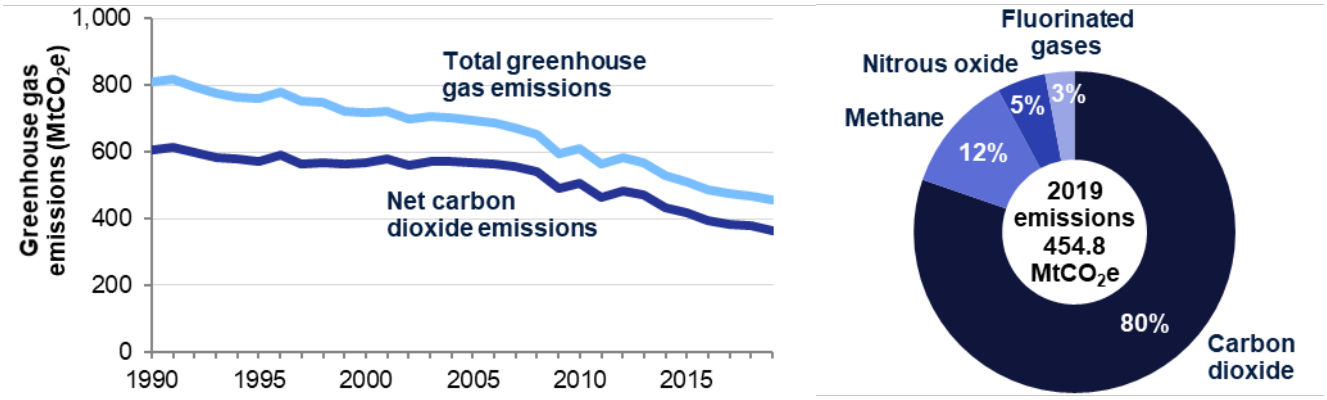
Department for Business, Energy & Industrial Strategy

2019 UK Greenhouse Gas Emissions, Final Figures

2 February 2021 **National Statistics**

In 2019, net territorial emissions in the UK of the basket of seven greenhouse gases covered by the Kyoto Protocol were estimated to be 454.8 million tonnes carbon dioxide equivalent ($MtCO_2e$), a decrease of 2.8% compared to the 2018 figure of 468.1 million tonnes and 43.8% lower than they were in 1990. Carbon dioxide made up around 80% of the 2019 total.

UK territorial greenhouse gas emissions, 1990-2019



- The decrease in greenhouse gas emissions from 2018 was mainly caused by reductions in emissions in the energy supply sector, down 8.1% (8.4 $MtCO_2e$). This was driven by the continued decrease in power station emissions due to the change in the fuel mix for electricity generation, in particular a reduction in the use of coal. Emissions from energy supply are now 65.5% lower than they were in 1990.

- Emissions from transport fell by 1.8% (2.2 $MtCO_2e$) in 2019, their second year of falls having previously risen since 2013. Despite this transport remains the largest emitting sector, responsible for 27% of all greenhouse gas emissions in the UK. Transport emissions are only 4.6% lower than in 1990, as increased road traffic has largely offset improvements in vehicle fuel efficiency.

What you need to know about these statistics:
This publication provides the latest estimates of 1990-2019 UK territorial greenhouse gas emissions, meaning emissions that occur within the UK's borders. They are presented in carbon dioxide equivalent units (CO_2e) throughout this statistical release and cover the Kyoto "basket" of seven greenhouse 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).

We made a major methodology change to the estimates this year to better represent emissions from peatlands, which combined with other changes has led to a large upward revision to our emission estimates of between 10 and 17 $MtCO_2e$ each year from 1990 onwards compared to those published last year. Further details are given on page 30.

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Introduction

This publication provides the latest annual estimates of UK territorial greenhouse gas emissions from 1990-2019. The geographic coverage of this report is UK only unless stated otherwise. The figures in this statistical release are used as the basis for reporting against UK greenhouse gas emissions reduction targets and provide information for users on the drivers of emissions trends since 1990. Emissions are estimated following the guidance set out by the Intergovernmental Panel on Climate Change (IPCC)[1], as required for the UK's submissions to the United Nations Framework Convention on Climate Change (UNFCCC) each year.

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).

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:

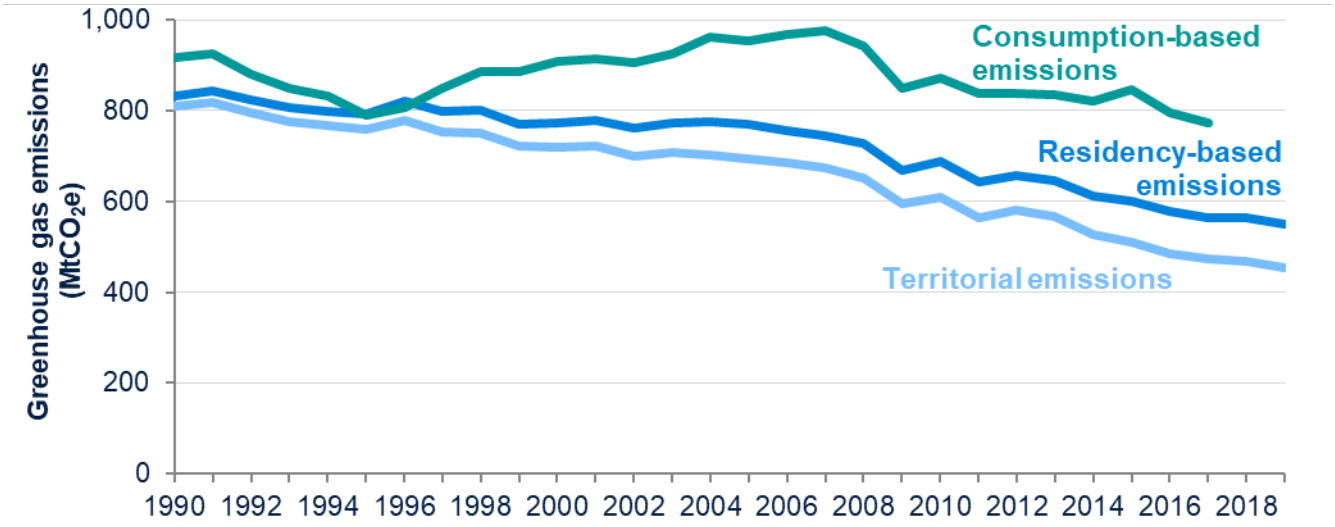
- ONS publishes emissions on a "residency" basis in the UK Environmental Accounts. The figures represent emissions caused by UK residents and businesses whether in the UK or abroad, but exclude emissions within the UK which can be attributed to overseas residents and businesses.

- 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.

Figure 1 shows how the estimates of UK territorial emissions in this publication compare to the most recent estimates of UK emissions on a residency and a consumption basis. The estimates are not directly comparable as there are differences in definitions and methodologies, for example the consumption-based estimates do not include F gases, and both the consumption-based and residency-based estimates do not incorporate the latest methodology changes made to the territorial estimates. However, this does give a good indication of the relative sizes and trends in each of these estimates and it can be seen that the UK's consumption-based emissions are considerably higher than its territorial emissions and followed a different trend over this period, peaking in 2007 and not falling as far as the territorial and residency-based estimates have since 1990.

[1] 2006 IPCC Guidelines for National Greenhouse Gas Inventories: https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html; 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (Wetlands Supplement): https://www.ipcc-nggip.iges.or.jp/public/wetlands/index.html; 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (KP Supplement): https://www.ipcc-nggip.iges.or.jp/public/kpsg/index.html

Figure 1: UK territorial, residency-based and consumption-based greenhouse gas emissions, 1990-2019



Sources: Table 1.1, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables
UK's carbon footprint 1997-2017, Defra: https://www.gov.uk/government/statistics/uks-carbon-footprint
Atmospheric emissions: greenhouse gases by industry and gas, ONS: https://www.ons.gov.uk/economy/environmentalaccounts/datasets/ukenvironmentalaccountsatmosphericemissionsgreenhousegasemissionsbyeconomicsectorandgasunitedkingdom

The estimates in this publication are based on the source of the emissions rather than where the end-user activity occurred, so for example emissions related to electricity generation are attributed to power stations, where the emissions occur, rather than homes and businesses where the electricity is used. A breakdown of UK territorial emissions by end-user sector will be published as an annex to this publication on Thursday 25 March 2021[2].

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 (GWP)[3], 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_2e).

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".

References to the 'UK Greenhouse Gas Inventory' refer to the consistent time series of emissions from 1990 to the most recent year which is updated annually and reported to the UN and the EU. The figures in these statistics are consistent with the UK's Greenhouse Gas Inventory for 1990-2019, although the inventory reported to the UN includes emissions from the UK's Crown Dependencies and certain Overseas Territories which are excluded from these statistics except where specifically stated.

[2] The Annex for 1990-2018 UK greenhouse gas emissions final figures by end-user published in March 2020 can be found here: https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-to-2018
[3] 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

Note that as part of this release the 1990-2018 emissions figures have been revised since the previous publication in February 2020, to incorporate methodological improvements and new data, and the 2019 figures have been revised from the provisional estimates published in March 2020. Details of these revisions can be found later in this statistical release.

For the purposes of reporting, greenhouse gas emissions are allocated into sectors known as National Communication (NC) sectors as follows:

Energy Supply	Emissions from electricity generation and other energy production activities such as mining, refining and manufacturing fuels. In the end-user estimates these emissions are instead assigned between the other sectors based on where the electricity/fuel is used, or to the *Exports* sector where they are used abroad.
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 *Transport* 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 *Transport* 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 *LULUCF* sector) and agricultural machinery.
Industrial processes	Emissions resulting from industrial processes, except for those associated with fuel combustion which are included in the *Business* sector.
Land use, land use change and forestry (LULUCF)	Emissions/removals of CO_2 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_2 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 *Energy Supply* sector and emissions from residential composting are included in the *Residential* sector.

2019 total greenhouse gas emissions

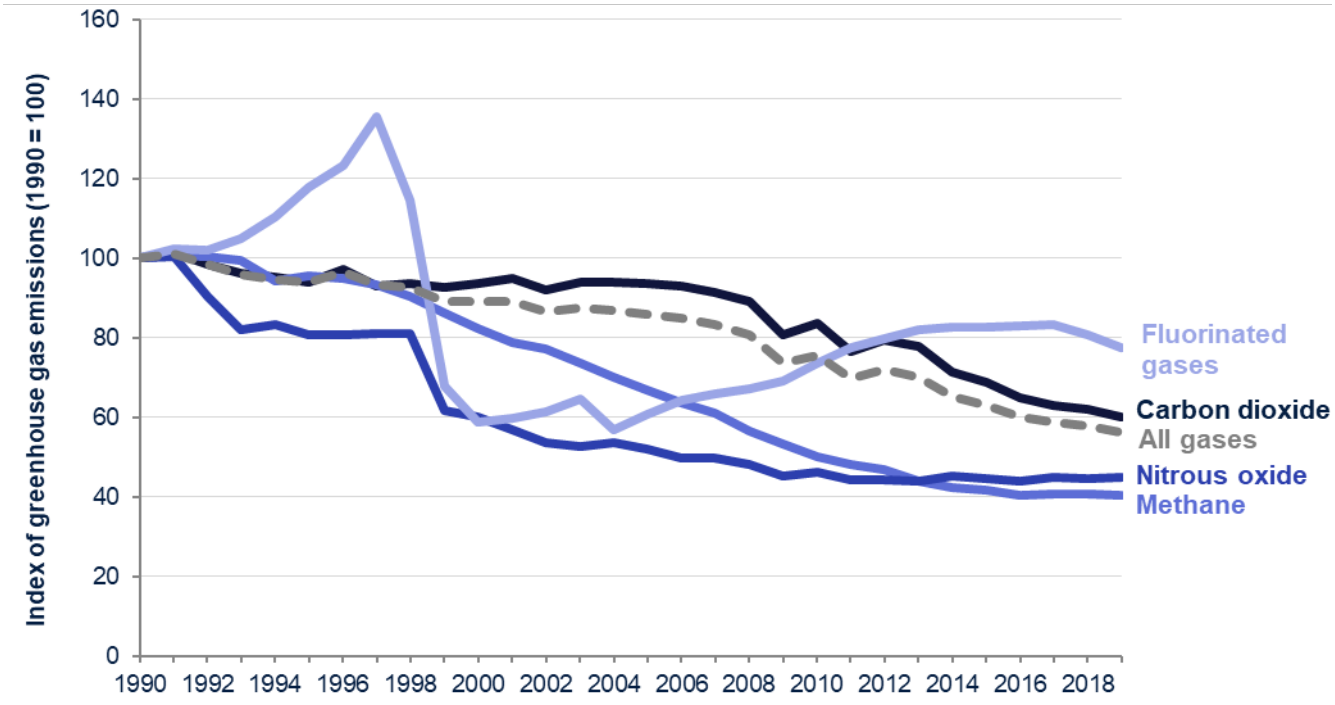
In the data tables accompanying this publication, table 1.1 shows UK greenhouse gas emissions since 1990 by gas.

In 2019, emissions in the UK of the basket of seven greenhouse gases covered by the Kyoto Protocol were estimated to be 454.8 million tonnes carbon dioxide equivalent ($MtCO_2e$), a decrease of 2.8% compared to the 2018 figure of 468.1 million tonnes. Greenhouse gas emissions in 2019 are estimated to be 43.8% lower than they were in 1990.

When broken down by gas, UK emissions are dominated by carbon dioxide, which is estimated to have accounted for about 80% of greenhouse gas emissions in the UK in 2019. Weighted by global warming potential, methane accounted for about 12% of UK emissions and nitrous oxide for about 5% of emissions in 2019. Fluorinated gases accounted for the remainder, around 3%.

Carbon dioxide has always been the dominant greenhouse gas emitted in the UK. Emissions of CO_2 have reduced by 40.0% (around 243 $MtCO_2$) since 1990 to 365.1 $MtCO_2$ in 2019, mainly due to decreases in emissions from power stations. There have been much larger proportional falls in emissions from methane (59.7% since 1990) and nitrous oxide (55.1%). Fluorinated gas (F gas) emissions are estimated to be 22.6% lower now than they were in 1990, with hydrofluorocarbons (HFCs) being the dominant F gas.

Figure 2: Index of territorial UK greenhouse gas emissions by gas, 1990-2019



Source: Table 1.1, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

UK performance against emissions reduction targets

In the data tables accompanying this publication, tables 2.1 and 2.2 show the UK's progress against domestic and international targets respectively.

Note: The carbon accounting regulations for 2019 have not yet been laid in Parliament, and so the UK's progress against the second year of the third carbon budget is not yet available. Progress will be updated in an annex to this publication on 25 March 2021.

Domestic Targets

The Climate Change Act 2008

The UK has domestic targets for reducing greenhouse gas emissions under the Climate Change Act 2008 (CCA)[4]. The CCA established a long-term legally binding framework to reduce emissions, initially committing the UK to reducing emissions by at least 80% below 1990/95 baselines by 2050. In June 2019, following the IPCC's Special Report on Global Warming of 1.5°C and advice from the independent Committee on Climate Change, the CCA was amended to commit the UK to achieving a 100% reduction in emissions (to net zero) by 2050.

The CCA also introduced carbon budgets, which set legally binding limits on the total amount of greenhouse gas emissions the UK can emit for a given five-year period[5]. The first carbon budget ran from 2008-12. In 2014, the UK confirmed that it had met the budget, with emissions 36 $MtCO_2e$ below the cap of 3,018 $MtCO_2e$[6]. The second carbon budget ran from 2013-17. In 2019, the UK confirmed that it had met the budget, with emissions 384 $MtCO_2e$ below the cap of 2,782 $MtCO_2e$[7]. A final statement for the third carbon budget, covering the period 2018-22, will be published in May 2024.

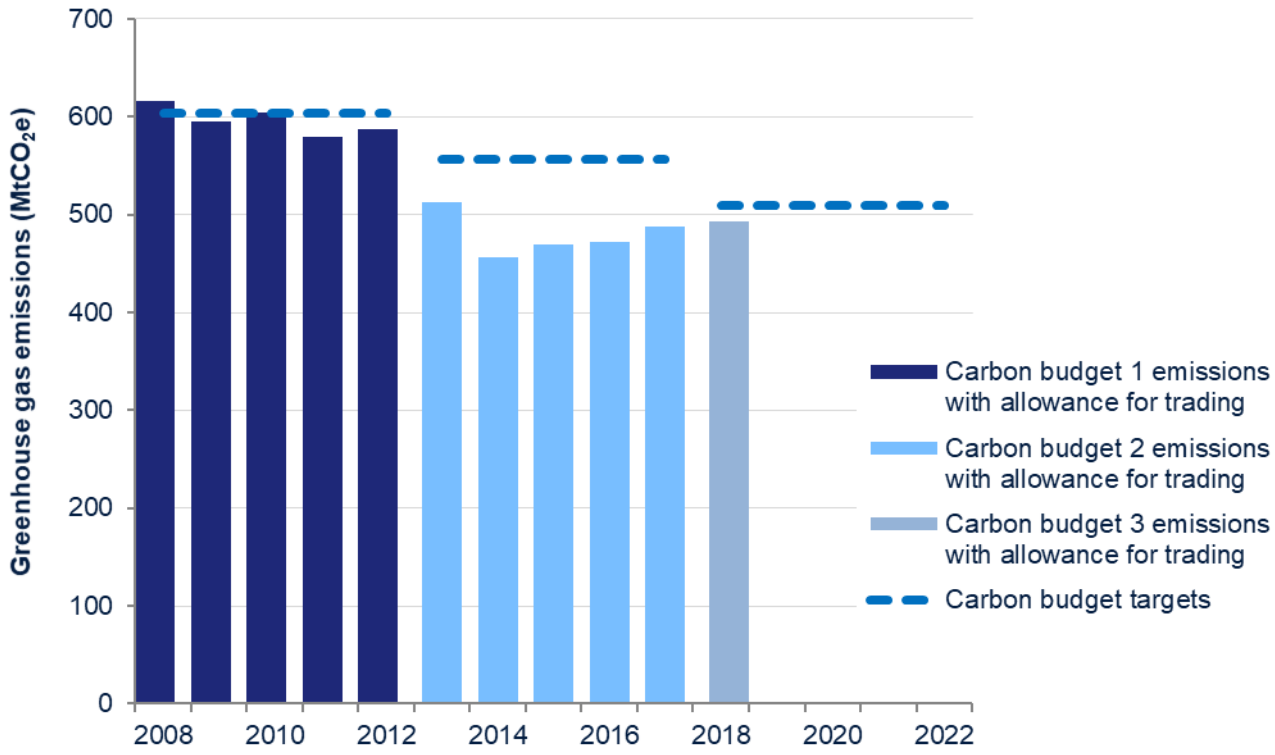
Compliance with carbon budgets is not assessed by directly comparing the budget level against UK greenhouse gas emissions. Instead, the budget level is compared to the UK's 'net carbon account'. The net carbon account is currently defined as the sum of three components:

- Emissions allowances allocated to the UK under the EU Emissions Trading System (EU ETS)[8]
- Emissions not covered by the EU ETS ('non-traded')
- Credits/debits from other international trading systems

[4] Climate Change Act 2008: http://www.legislation.gov.uk/ukpga/2008/27/contents
[5] Carbon budgets: https://www.gov.uk/guidance/carbon-budgets
[6] Final statement for the first carbon budget period: https://www.gov.uk/government/statistics/final-statement-for-the-first-carbon-budget-period
[7] Final statement for the second carbon budget period: https://www.gov.uk/government/statistics/final-statement-for-the-second-carbon-budget-period
[8] The EU Emissions Trading System (EU ETS): https://ec.europa.eu/clima/policies/ets_en

Projected performance against future carbon budgets can be found in the latest UK energy and emissions projections publication[9].

Figure 3: UK's progress towards meeting carbon budget targets ($MtCO_2e$)



Source: Table 2.1, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

Note: The carbon accounting regulations for 2019 have not yet been laid in Parliament, and so the UK's progress against the second year of the third carbon budget is not yet available. Progress will be updated in an annex to this publication on 25 March 2021.

International Targets

Pre-2020: targets under the Kyoto Protocol

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) is an international agreement.[10]

First Commitment Period (2008-2012)

The UK met its emissions reductions target for the first commitment period of the Kyoto Protocol. Under the first commitment period of the Kyoto Protocol (2008-12), the EU and its Member States, Iceland and Norway collectively made a commitment to reduce greenhouse gas emissions across the EU by 8% on 1990 levels by 2012. As part of this, the UK undertook to reduce total greenhouse gas emissions by 12.5% below base year levels over the five-year period 2008-12[11].

[9] Energy and emissions projections: https://www.gov.uk/government/collections/energy-and-emissions-projections
[10] UNFCCC page on the Kyoto Protocol: https://unfccc.int/kyoto_protocol
[11] Council Decision (2002/358/EC) of 25 April 2002: http://www.eea.europa.eu/policy-documents/council-decision-2002-358-ec

UK emissions of the basket of greenhouse gases covered by the Kyoto Protocol were an average 600.6 $MtCO_2e$ per year (exclusive of emissions trading) over the first commitment period (2008-12), 23% lower than base year emissions[12]. The UK's total emissions over the period were 372.5 $MtCO_2e$ lower than the Assigned Amount allocation (see table 2.2(a) in excel data tables).

Second Commitment Period (2013-2020)

Emission targets under the second commitment period of the Kyoto Protocol (2013-2020) are set out in the Doha Amendment.[13] These targets are translated into emission allocations called Assigned Amount Units (AAUs), as set out in each Party's 'initial report'.[14]

Joint Fulfilment with the EU

The EU had a target to reduce emissions by 20% relative to the reference year (1990) over the second commitment period. This is being fulfilled jointly with Member States and other participating countries (UK and Iceland) in accordance with Article 4 of the Kyoto Protocol. In line with this target, emissions are split into (i) 'traded sector' emissions, covered by the EU Emissions Trading System (EU ETS) which gives an overall EU-wide 'cap' on emissions from participating sectors; and (ii) 'non-traded sector' emissions, which are covered by country-level targets. Countries' emissions from the traded sector are managed centrally by the Union and are not counted towards individual targets under the Kyoto Protocol. Only emissions outside the scope of the EU ETS are counted towards individual country-level targets.

Under the terms of the Withdrawal Agreement, the UK remains committed to its shared target with the EU under the Kyoto Protocol as part of the Joint Fulfilment Agreement.

UK targets under the EU Effort Sharing Decision

The EU Effort Sharing Decision (ESD) was agreed as part of the EU's 2020 Climate and Energy package, which came into force from January 2013. Under the terms of the Withdrawal Agreement, the UK remains committed to its targets under the EU ESD due to its shared target with the EU under the Kyoto Protocol.

The ESD sets out targets for participating countries to either reduce or limit emissions by a certain percentage in the non-traded sector (i.e. covering most sectors not included in the EU ETS[15]), by 2020 from a 2005 baseline. Each country's national emission target has been translated into binding quantified Annual Emission Allocations (AEAs) for the period 2013–2020. The UK's 2020 target, based on relative GDP per capita, was to reduce emissions by 16% from 2005 levels, to be achieved through a declining limit for emissions for each year from 2013-2020[16].

In December 2020 the European Commission confirmed for each participating country their performance against ESD for 2018[17]. UK greenhouse gas emissions for 2018 under the ESD were confirmed to be 329.9 $MtCO_2e$[18], 27.4 $MtCO_2e$ below the UK's annual limit for 2018 of 357.2 $MtCO_2e$, meaning that the UK met its sixth annual target in the period. Provisional

[12] A record of UK base year emissions is published on the following page: https://www.gov.uk/government/publications/uk-greenhouse-gas-emissions-explanatory-notes
[13] https://unfccc.int/process/the-kyoto-protocol/the-doha-amendment
[14] Parties' initial reports for the second commitment period of the Kyoto Protocol: https://unfccc.int/process/transparency-and-reporting/reporting-and-review-under-the-kyoto-protocol/second-commitment-period/initial-reports
[15] ESD targets do not include emissions from LULUCF sectors.
[16] Annual emission allocations, European Commission: http://ec.europa.eu/clima/policies/effort/framework/documentation_en.htm
[17] Commission Implementing Decision (EU) 2020/1834 of 3 December 2020 on greenhouse gas emissions covered by Decision No 406/2009/EC of the European Parliament and of the Council for the year 2018 for each Member State: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2020.408.01.0003.01.ENG
[18] ESD dataset 2020, EEA website: https://www.eea.europa.eu/data-and-maps/data/esd-2

estimates indicate that greenhouse gas emissions for 2019 under the Effort Sharing Decision will also be below the annual emissions limit, by around 24.9 $MtCO_2e$. The UK is therefore on track to meet all its annual targets under the EU ESD for 2013-2019, as shown in Table 1 below and in table 2.2(c) of the excel data tables.

Table 1: Progress towards the EU Effort Sharing Decision

UK and Gibraltar, 2013-2019 — $MtCO_2e$

	2013	2014	2015	2016	2017	2018	2019(p)
Total greenhouse gas emissions excl. LULUCF and NF_3 (A)	566.5	524.0	503.5	482.8	470.5	460.3	449.2
Total verified emissions from stationary installations under the EU ETS (B)	225.3	197.9	175.9	147.4	136.8	128.9	118.6
CO_2 emissions from civil aviation (C)	1.7	1.6	1.6	1.5	1.6	1.5	1.5
Total ESD emissions (D = A - B - C)	339.5	324.4	326.0	333.9	332.1	329.9	329.1
Annual emissions allocation (E)	358.7	354.2	349.7	345.2	360.4	357.2	354.1
Difference (E - D)	**19.3**	**29.8**	**23.7**	**11.3**	**28.4**	**27.4**	**24.9**

Source: Table 2.2(c), Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

Note: 2019 ESD values are provisional until the 2022 Final ESD Review Report is published by the EU. This figure is likely to change due to changes in verified emissions under the EU ETS.

UK target under the Doha Amendment

Parties submitted 'initial reports' to facilitate the calculation of their allocated emission units permitted under their Kyoto targets.[19] The UK's initial report translates the UK's targets for the non-traded sectors into Assigned Amount Units (AAUs). [20] Particular rules for the accounting of the LULUCF sectors are used (KP-LULUCF), and some minor LULUCF sources are also excluded from accounting.[21]

As of 28 October 2020, 147 Parties have deposited their instrument of acceptance (including the UK), therefore the threshold for entry into force of the Doha Amendment has been met. These statistics contain indicative figures for the UK's progress against its targets under the Doha Amendment (see table 2.2(b) in excel data tables) which show the UK is on track to meet its target. Progress against the Kyoto target will not be finalised until the 'true-up' process, after reporting of all emissions over the commitment period has taken place.

Beyond 2020: targets under the Paris Agreement

Following the 21st Conference of the Parties (COP21) of the UNFCCC in Paris in December 2015, 195 countries committed to adopt a global climate change Agreement. The Paris Agreement entered into force on 4 November 2016 and was ratified by the UK on 18 November 2016. Parties to the Paris Agreement are required to prepare, communicate and maintain successive Nationally Determined Contributions (NDCs).

[19] 'Initial Reports' for the second commitment period of the Kyoto Protocol: https://unfccc.int/process/transparency-and-reporting/reporting-and-review-under-the-kyoto-protocol/second-commitment-period/initial-reports
[20] UK Initial Report for the second commitment period of the Kyoto Protocol: https://unfccc.int/files/national_reports/initial_reports_under_the_kyoto_protocol/second_commitment_period_2013-2020/application/zip/gbk-cp2-ir-29aug2017.zip
[21] Kyoto Protocol https://unfccc.int/sites/default/files/resource/docs/cop3/l07a01.pdf ; Decision 2/CMP.7 https://unfccc.int/resource/docs/2011/cmp7/eng/10a01.pdf; IPCC 2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol https://www.ipcc-nggip.iges.or.jp/public/kpsg/index.html

On 12 December 2020, the UK communicated its Nationally Determined Contribution (NDC) under the Paris Agreement. The NDC commits the UK to reducing economy-wide greenhouse gas emissions by at least 68% by 2030, compared to 1990 levels.[22]

Emissions Trading

Under the UNFCCC and Kyoto Protocol, three flexible mechanisms were established to provide for trading of national allowances and project-based credits by Governments and emitters. These are International Emissions Trading, the Clean Development Mechanism (CDM) and Joint Implementation (JI). In reporting emissions reductions against all of its targets, the UK needs to take account of emissions trading through these flexible mechanisms. At the present time, the scope of the UK's emissions trading does not extend beyond the European Union Emissions Trading System (EU ETS), although it should be noted that EU ETS participants may also use credits generated under CDM and JI projects, subject to certain limits, in order to comply with their obligations.

European Union Emissions Trading System (EU ETS)

The UK needs to take account of emissions trading through the EU ETS when reporting against carbon budgets. The EU ETS works by putting a limit on overall emissions from installations (e.g. power plants, industrial plants) and aviation operators on intra-EEA flights. This limit is reduced each year. Within the limit installations and aviation operators can buy and sell emission allowances as needed. This 'cap-and-trade' approach gives the flexibility needed to cut emissions in the most cost-effective way. Any installation or aviation operator within the System (except electricity generators and installations in sectors not considered to be at risk of so-called 'carbon leakage') is given an allocation of emissions allowances each year. If the installation's actual emissions are above this initial allocation for the year in question, then the installation must either purchase allowances through the System or bring forward some allowances from the following year's allocation, to cover the deficit. Conversely, installations with a surplus of emissions compared with their cap can either sell allowances or carry them over into the following year's allocation, thus providing a financial incentive to reduce emissions.

Phase I of the EU ETS covered the three-year period 2005-2007 and Phase II coincided with the first Kyoto Commitment Period (2008-12). During this period each Member State held a specific quantity of allowances based on their EU-approved National Allocation Plan (NAP). This then resulted in net "sales" or "purchases" of emissions allowances reported from UK installations depending on whether total emissions were below or above the UK's Phase II allocation[23].

Phase III of the EU ETS (2013-20) builds upon the previous two phases and has been significantly revised to make a greater contribution to tackling climate change. The system shifted away from NAPs in favour of an EU-wide cap on the number of available allowances. In addition, a greater share of the allowances are sold at auction. In the absence of a UK-specific allocation plan, a notional cap has been estimated for the purpose of calculating carbon budget

[22] UK Nationally Determined Contribution under the Paris Agreement: https://www.gov.uk/government/publications/the-uks-nationally-determined-contribution-communication-to-the-unfccc

[23] Note that a negative net value indicates that the reported emissions from UK installations in the EU ETS were below the cap, i.e. there was a net selling or withholding of units by UK installations. This means that emissions are either emitted elsewhere or emitted at a later stage, so they may not be used to offset UK emissions. The opposite occurs when reported emissions from EU ETS installations exceed the cap.

performance. Further details of this methodology are laid out in the Annual Statement of Emissions[24].

In 2012, aviation was included in the EU ETS for the first time, and aircraft operators were required to report their annual emissions and surrender an equivalent number of allowances for all flights within the European Economic Area (EEA). However, UK carbon budgets only cover domestic aviation (that is, aviation within the UK). Taking into account these changes in EU ETS, from 2013 onwards domestic aviation emissions are included in the traded sector for UK carbon budget reporting purposes. To do so requires the calculation of a separate notional cap for UK domestic aviation, covering flights within the UK only.

Net adjustments to the UK's 'net carbon account' as a result of EU ETS operations are provided in table 2.1, Final UK greenhouse gas emissions national statistics 1990-2018 Excel data tables.

[24] Annual Statement of Emissions: https://www.gov.uk/government/collections/annual-statements-of-emissions

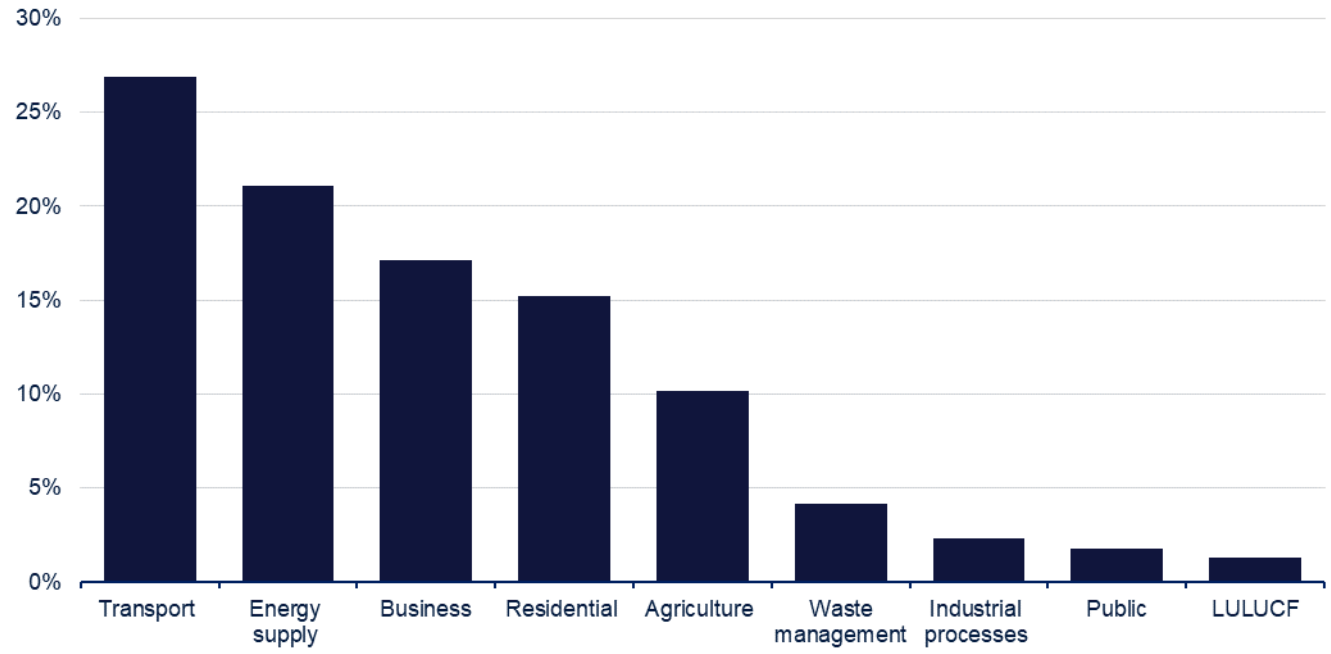
Emissions by sector

In the data tables accompanying this publication, table 1.2 shows overall UK greenhouse gas emissions since 1990 by sector and source, while tables 1.3 to 1.6 show this breakdown for each individual gas.

All the sectoral breakdowns below are defined as by source, meaning emissions are attributed to the sector that emits them directly, as opposed to where the end-user activity occurred. A breakdown of 1990-2019 UK territorial emissions by end-user sector will be published as an annex to this publication on Thursday 25 March 2021.

In 2019, 27% of net greenhouse gas emissions in the UK were estimated to be from the transport sector, 21% from energy supply, 17% from business, 15% from the residential sector and 10% from agriculture. The other 10% was attributable to the remaining sectors: waste management, industrial processes, the public sector and the land use, land use change and forestry (LULUCF) sector. The LULUCF sector includes both sinks and sources of emissions.

Figure 4: Territorial UK greenhouse gas emissions by NC sector, 2019 (%)



Source: Table 1.2, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables
Note: LULUCF is land use, land use change and forestry.

Transport

The transport sector consists of emissions from road transport, railways, domestic aviation, shipping, fishing and aircraft support vehicles. It is estimated to have been responsible for around 27% of greenhouse gas emissions in the UK in 2019, almost entirely through carbon dioxide emissions. The main source of emissions from this sector is the use of petrol and diesel in road transport. Transport emissions fell by 2% between 2018 and 2019, despite an increase in road traffic. The transport sector had historically been the second most emitting

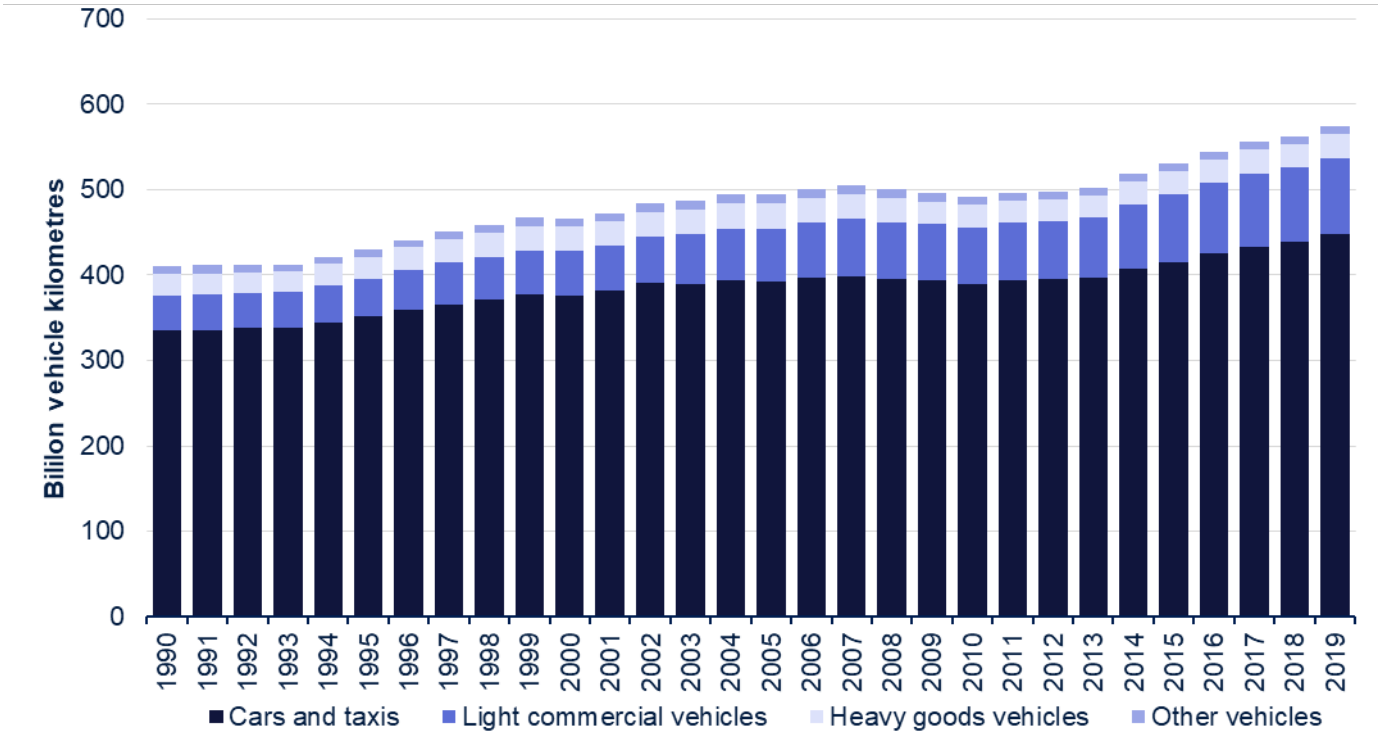
sector; however, reductions over time in what was the largest sector (energy supply) mean that since 2016 transport has been the sector with the highest emissions.

Between 1990 and 2019, there has been relatively little overall change in the level of greenhouse gas emissions from the transport sector. Between 1990 and 2007 (when emissions peaked) there was a general increasing trend, with some fluctuations year to year. After this peak, emissions declined each year until 2013, at which point this trend reversed to show small increases most years. The overall effect of these fluctuations over time means emissions are estimated to have been around 5% lower in 2019 than in 1990.

Road transport is the most significant source of emissions in this sector, in particular passenger cars; and the changes which have been seen over the period were heavily influenced by this category. Figure 5 shows how the volume of traffic on the roads has changed over time in Great Britain, which reflects the trend seen for the UK as a whole. Motor vehicle traffic volumes have generally increased throughout this period, other than a fall seen between 2007 and 2010 following the recession.

However, with lower petrol consumption outweighing an increase in diesel consumption[25] and improvements in fuel efficiency of both petrol and diesel cars[26], the volume of emissions from passenger cars has generally decreased since the mid-2000s. Although this has been partially offset by an increase in emissions from light commercial vehicles. Emissions of carbon dioxide are closely related to the amount of fuel used, whilst nitrous oxide and methane emissions are influenced more by the vehicle type and age.

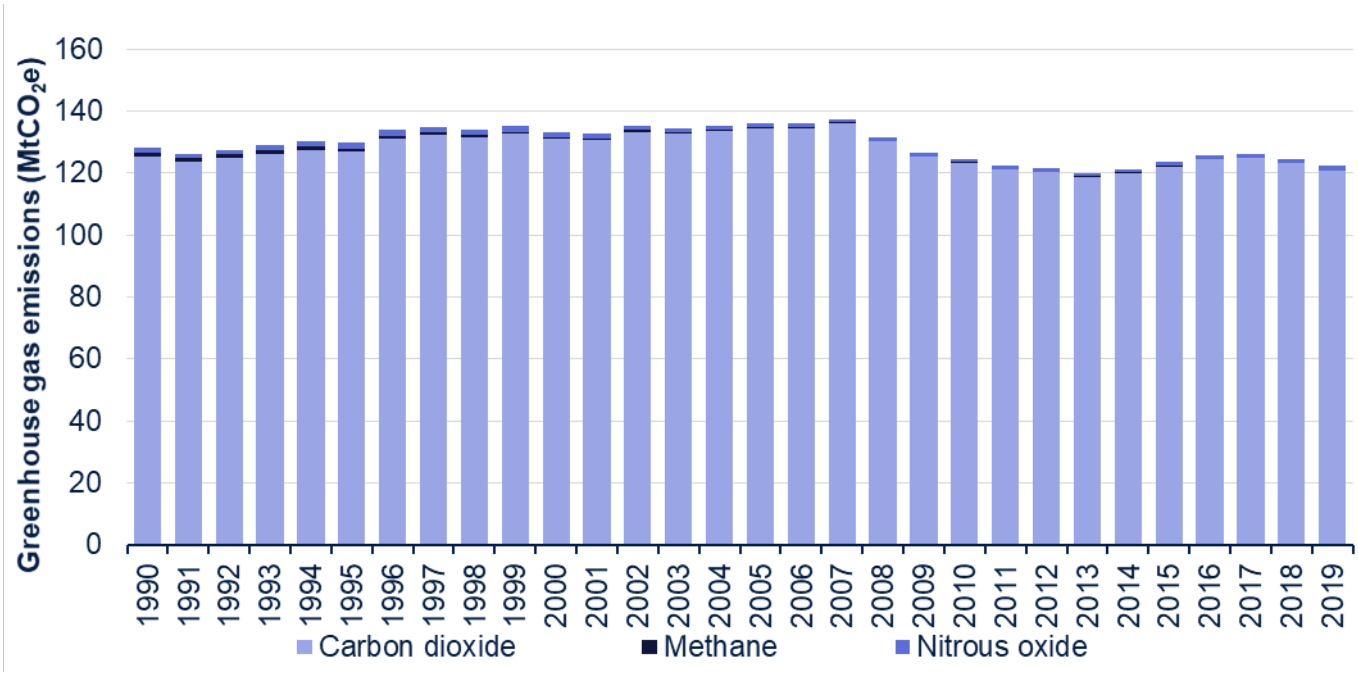
Figure 5: Motor vehicle traffic, Great Britain 1990-2019 (Billion vehicle kilometres)



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

[25] Transport Statistics Great Britain, Energy and environment (TSGB03), Table TSGB0301 (ENV0101) Petroleum consumption by transport mode and fuel type: United Kingdom from 2000: https://www.gov.uk/government/statistical-data-sets/tsgb03
[26] 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

Figure 6: Greenhouse gas emissions from transport, UK 1990-2019 ($MtCO_2e$)



Source: Tables 1.2 to 1.6, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

Energy supply

The energy supply sector consists of emissions from fuel combustion for electricity generation and other energy production sources. It is estimated to have been responsible for 21% of UK greenhouse gas emissions in 2019, with carbon dioxide being by far the most prominent gas for this sector (94%). The main source of emissions from this sector is the combustion of fuels in electricity generation from power stations.

There was an 8% fall in emissions from the energy supply sector between 2018 and 2019, meaning that between 1990 and 2019 they have reduced by 66%. This decrease has resulted mainly from changes in the mix of fuels being used for electricity generation, including the growth of renewables; together with greater efficiency resulting from improvements in technology. The energy supply sector had historically been the sector with the largest emissions. However, these reductions mean that since 2016 it has been the second largest sector (the largest being transport).

Since 1990 there has been a decline in the use of coal at power stations and an increase in the use of gas, which has a lower carbon content so results in fewer emissions. Coal use in generation reduced by 96% between 1990 and 2019[27]. Electricity generation was 3% higher in 2019 than in 1990, although it peaked in 2005 and has decreased since then[28].

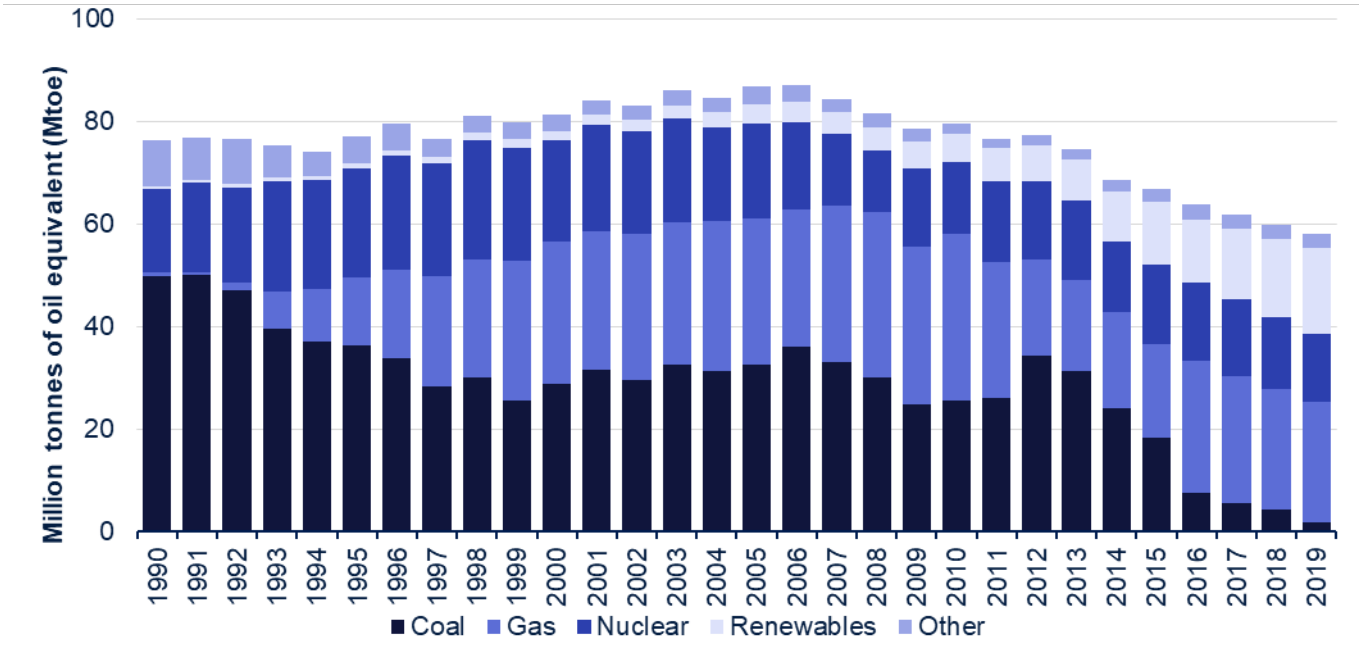
There was a 56% decrease in coal use for electricity generation between 2018 and 2019. This follows large falls in the previous three years driven by the increase in the carbon price floor in April 2015, from £9 per tonne of CO_2 to £18 per tonne of CO_2, which led to a shift away from coal towards gas[29]. In 2019 the use of gas for electricity generation remained largely

[27] Digest of United Kingdom Energy Statistics, Table 5.1.1 Fuel input for electricity generation, 1970 to 2019
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/904820/DUKES_5.1.1.xls
[28] Digest of United Kingdom Energy Statistics, Table 5.1.3 Electricity generated and supplied, 1970 to 2019
https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/904822/DUKES_5.1.3.xls
[29] Digest of United Kingdom Energy Statistics, Chapter 5 Electricity
https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

unchanged from 2018, whereas renewables saw a 9% increase. In 2019, total greenhouse gas emissions from power stations, at 58.5 $MtCO_2e$, accounted for 13% of all greenhouse gas emissions in the UK.

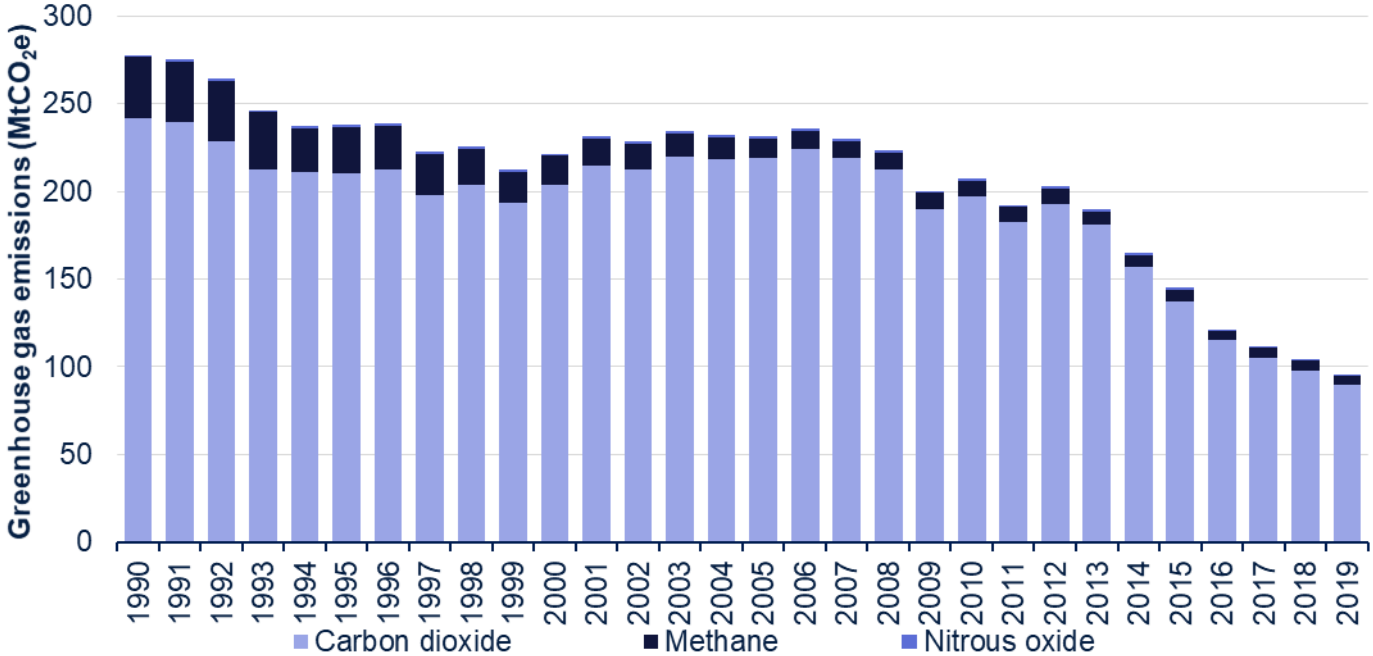
The other main factor which has noticeably contributed to the long-term decline in emissions in the energy sector has been in relation to coal mining. The production of deep-mined coal in particular has declined steadily over the period, with the last three large deep mines all closing in 2015. Emissions from coal mining and handling have fallen from 21.8 $MtCO_2e$ in 1990 to only 0.5 $MtCO_2e$ in 2019.

Figure 7: Fuel used for UK electricity generation, UK 1990-2019 (Million tonnes of oil equivalent (Mtoe))



Source: Digest of United Kingdom Energy Statistics, Table 5.1.1 Fuel input for electricity generation, 1970 to 2019
https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

Figure 8: Greenhouse gas emissions from energy supply, 1990-2019 ($MtCO_2e$)



Source: Tables 1.2 to 1.6, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

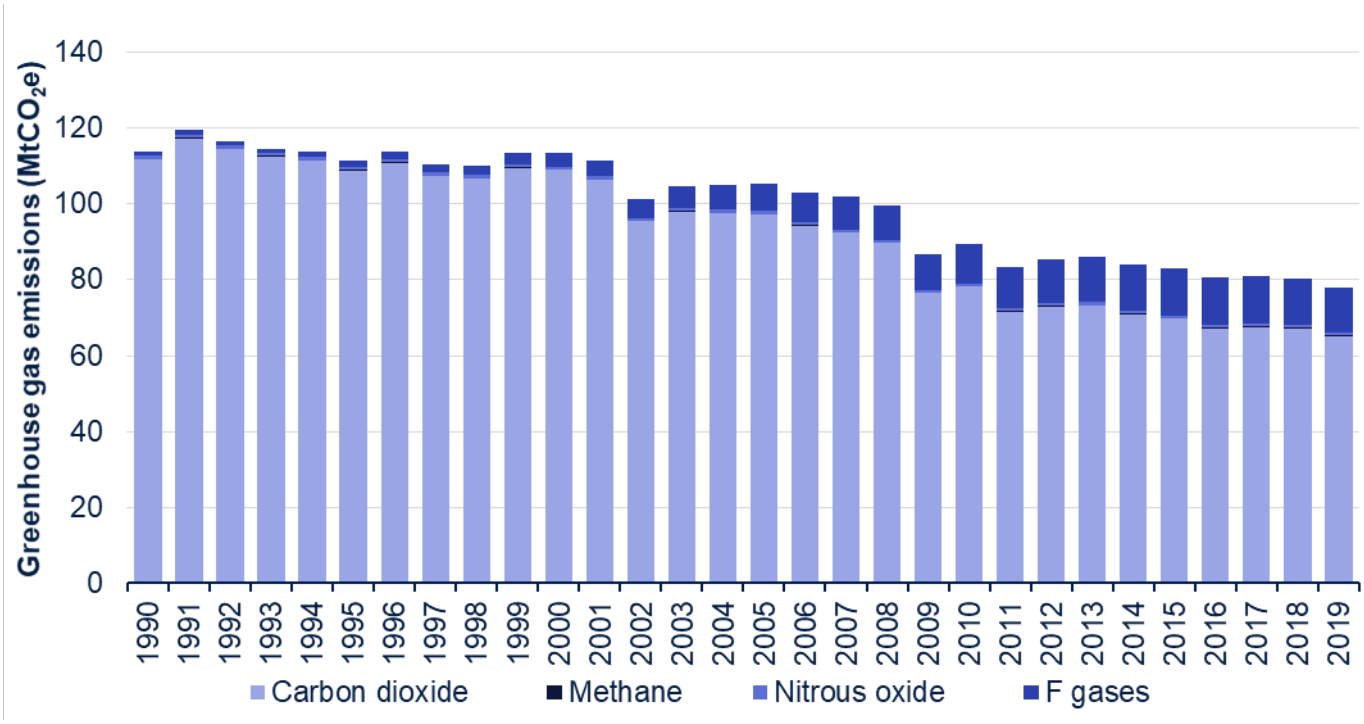
Business

The business sector consists of emissions from combustion in industrial/commercial sectors, industrial off-road machinery, and refrigeration and air conditioning. Between 2018 and 2019 there was a 3% decrease in emissions from the business sector, largely as a result of falls in emissions from industrial combustion and from refrigeration and air conditioning. It is estimated to have been responsible for 17% of greenhouse gas emissions in the UK in 2019, with carbon dioxide being the most prominent gas. Emissions from this sector primarily relate to fossil fuel combustion in industry and commerce, although emissions of F gases from the use of fluorinated compounds in certain applications, particularly refrigeration and air-conditioning, are also significant. The business sector is responsible for the majority of emissions from F gases.

In 2019, emissions from the business sector were 32% lower than 1990 emissions. Most of this decrease came between 2001 and 2009, with a significant drop in 2009 likely driven by economic factors. There has been a gradual decline in emissions in recent years. The main driver of the decrease in emissions since 1990 is a reduction in emissions from industrial combustion (including iron and steel) which has led to a 42% reduction in carbon dioxide emissions since 1990.

However, emissions from F gases have increased significantly, mainly due to an increase in emissions from refrigeration and air-conditioning as HFCs replaced ozone depleting substances which were previously used as refrigerants. This increasing trend has reversed in recent years following the introduction of the HFC phase down as part of the EU's 2014 F-Gas Regulation, and F gas emissions have fallen by 5% since 2016.

Figure 9: Greenhouse gas emissions from business, UK 1990-2019 ($MtCO_2e$)



Source: Tables 1.2 to 1.6, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

Residential

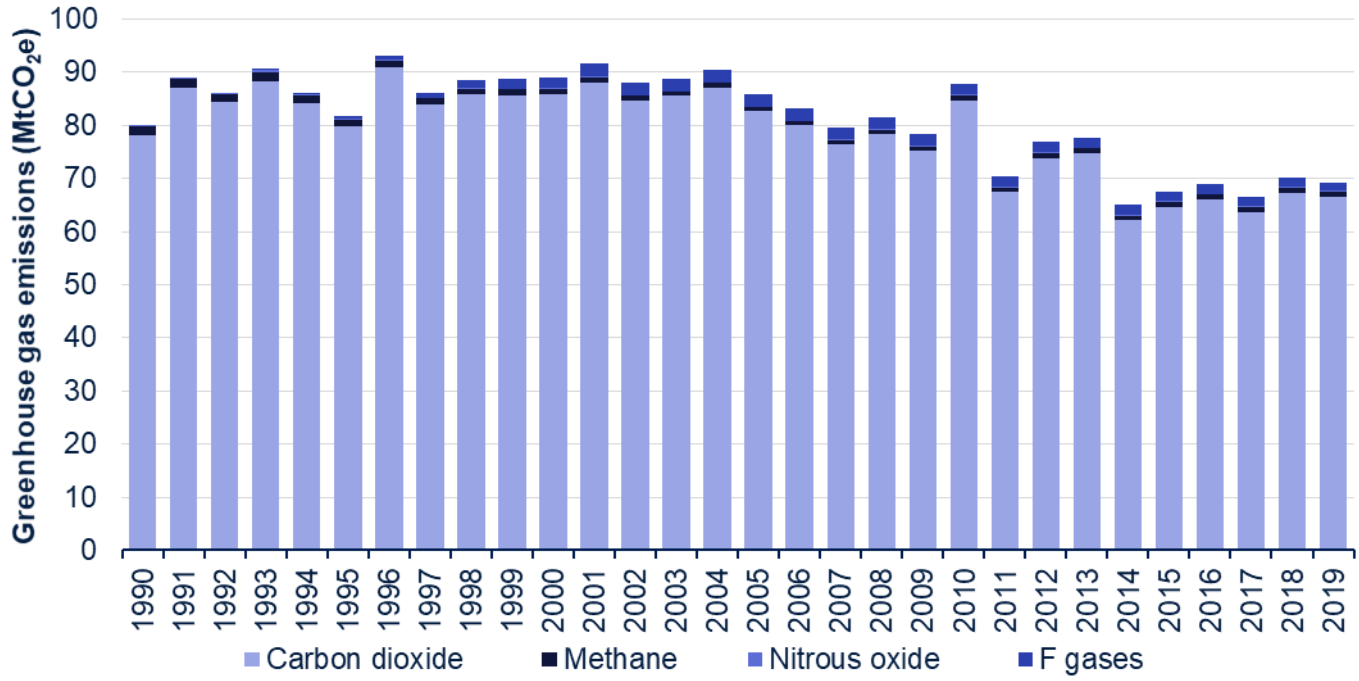
The residential sector consists of emissions from fuel combustion for heating and cooking, garden machinery, and fluorinated gases released from aerosols and metered dose inhalers. It is estimated to have been responsible for around 15% of greenhouse gas emissions in the UK in 2019, with carbon dioxide being the most prominent gas for this sector (96%). The main source of emissions from this sector is the use of natural gas for heating and cooking.

It should be noted that since these figures are estimates of emissions by source, emissions related to residential electricity use, including electricity use for heating, are attributed to power stations, and are therefore included in the energy supply sector rather than the residential sector.

Between 1990 and 2019, there has been considerable variation in greenhouse gas emissions from year to year in the residential sector. In general, carbon dioxide emissions from this sector are particularly heavily influenced by external temperatures, with colder temperatures driving higher emissions due to increased use of heating.

Temperature was the main driver of the 1% decrease in residential emissions between 2018 and 2019. The average temperature across the year was on average slightly cooler in 2019 than in 2018, but 2018 had a particularly cold February and March which meant that average temperatures increased by over 3 degrees Celsius in 2019 in these two months[30], reducing the use of natural gas for heating. Further information on the impact of external temperatures on emissions can be found later in this statistical release.

Figure 10: Greenhouse gas emissions from the residential sector, UK 1990-2019 ($MtCO_2e$)



Source: Tables 1.2 to 1.6, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

[30] Energy Trends: Weather Table ET 7.1 Average temperatures, heating degree days and deviations from the long term mean https://www.gov.uk/government/statistics/energy-trends-section-7-weather

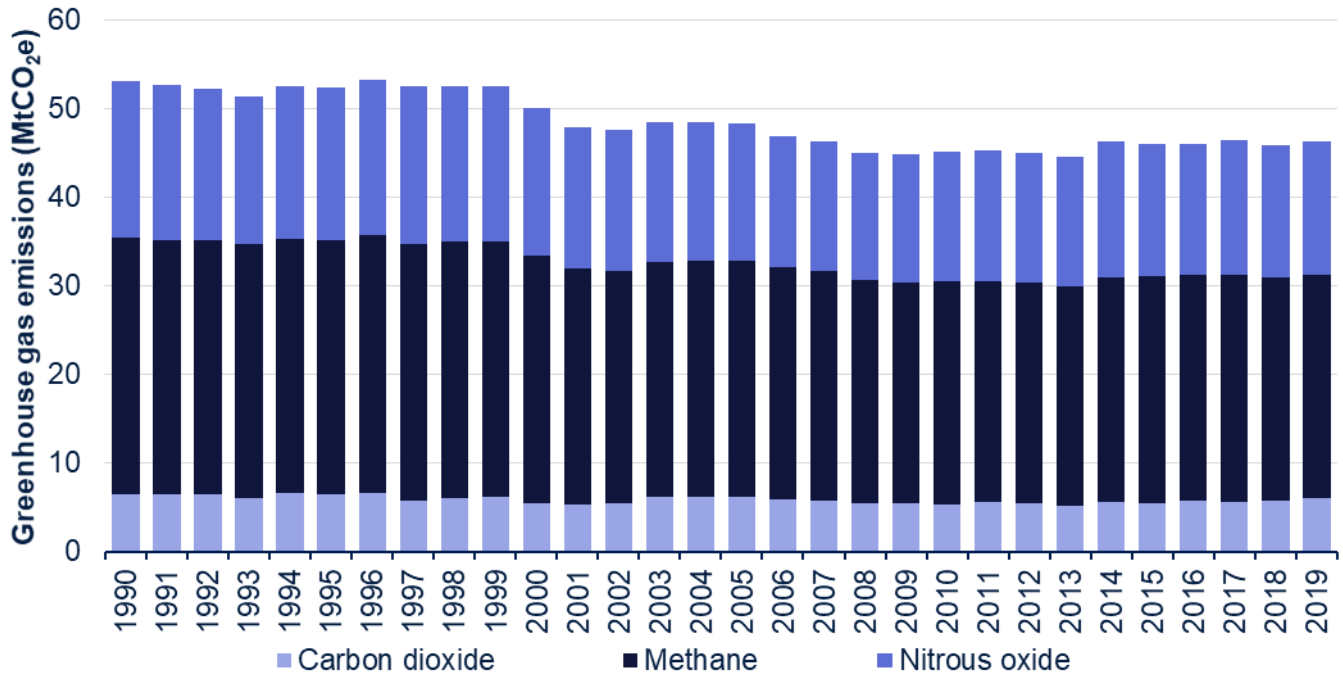
Agriculture

The agriculture sector consists of emissions from livestock, agricultural soils, stationary combustion sources and off-road machinery. It is estimated to have been responsible for 10% of greenhouse gas emissions in the UK in 2019. Emissions of methane (54%) and nitrous oxide (32%) dominate this sector. The most significant sources here are emissions of methane due to enteric fermentation from livestock, particularly cattle; and nitrous oxide emissions related to the use of fertilisers on agricultural soils.

Between 2018 and 2019 there was a 1% increase in emissions from the agriculture sector, largely due to an increase in carbon dioxide emissions from liming.

Between 1990 and 2019, greenhouse gas emissions from agriculture decreased by around 13%, with a general downward trend in emissions since the late 1990s. This was driven by a fall in animal numbers over the period, together with a decrease in synthetic fertiliser use.

Figure 11: Greenhouse gas emissions from agriculture, UK 1990-2019 ($MtCO_2e$)



Source: Tables 1.2 to 1.6, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

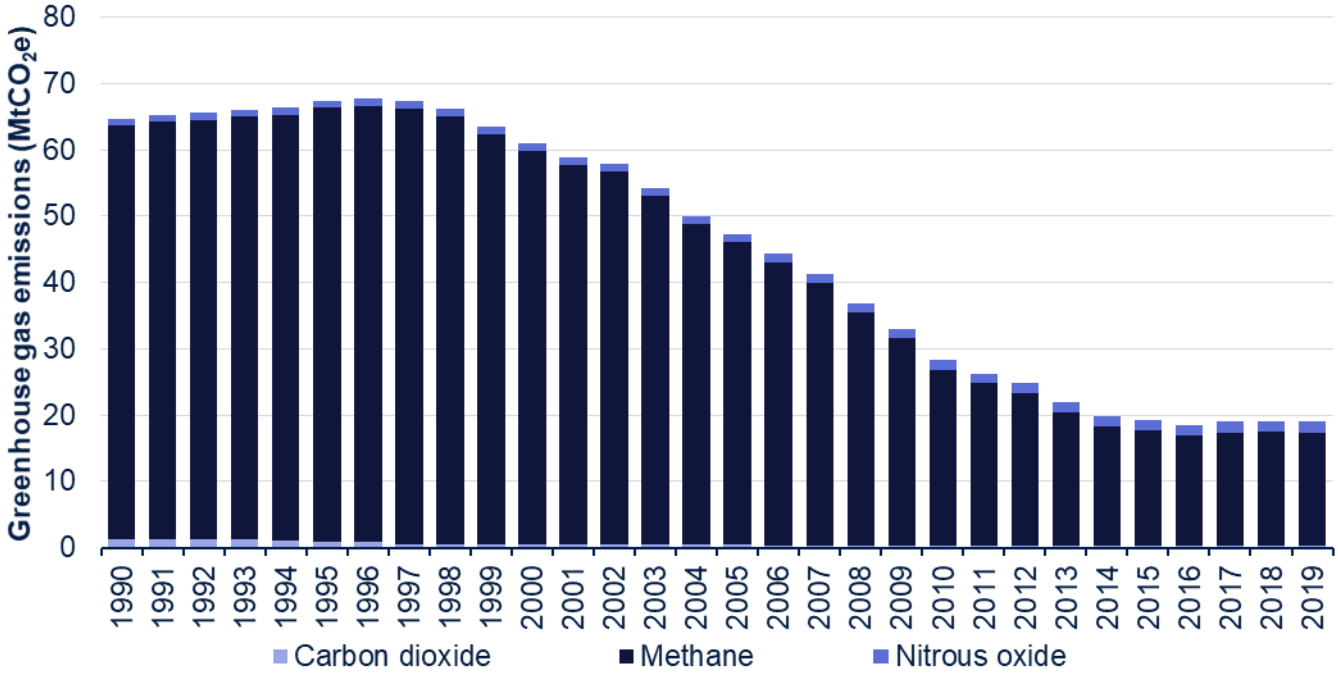
Waste management

The waste management sector consists of emissions from waste disposed of to landfill sites, waste incineration, and the treatment of waste-water. It is estimated to have been responsible for around 4% of greenhouse gas emissions in the UK in 2019, with methane being by far the most prominent gas (accounting for 90% of emissions). The vast majority of these emissions are from landfill sites.

Emissions in the waste management sector decreased by 1% between 2018 and 2019 due mainly to reduced emissions from landfill. Between 1990 and 2019, greenhouse gas emissions from the waste management sector decreased by 71%. This was due to a combination of factors, including improvements in the standards of landfilling, changes to the types of waste

going to landfill (such as reducing the amount of biodegradable waste), and an increase in the amount of landfill gas being used for energy.

Figure 12: Greenhouse gas emissions from waste management, UK 1990-2019 ($MtCO_2e$)



Source: Tables 1.2 to 1.6, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

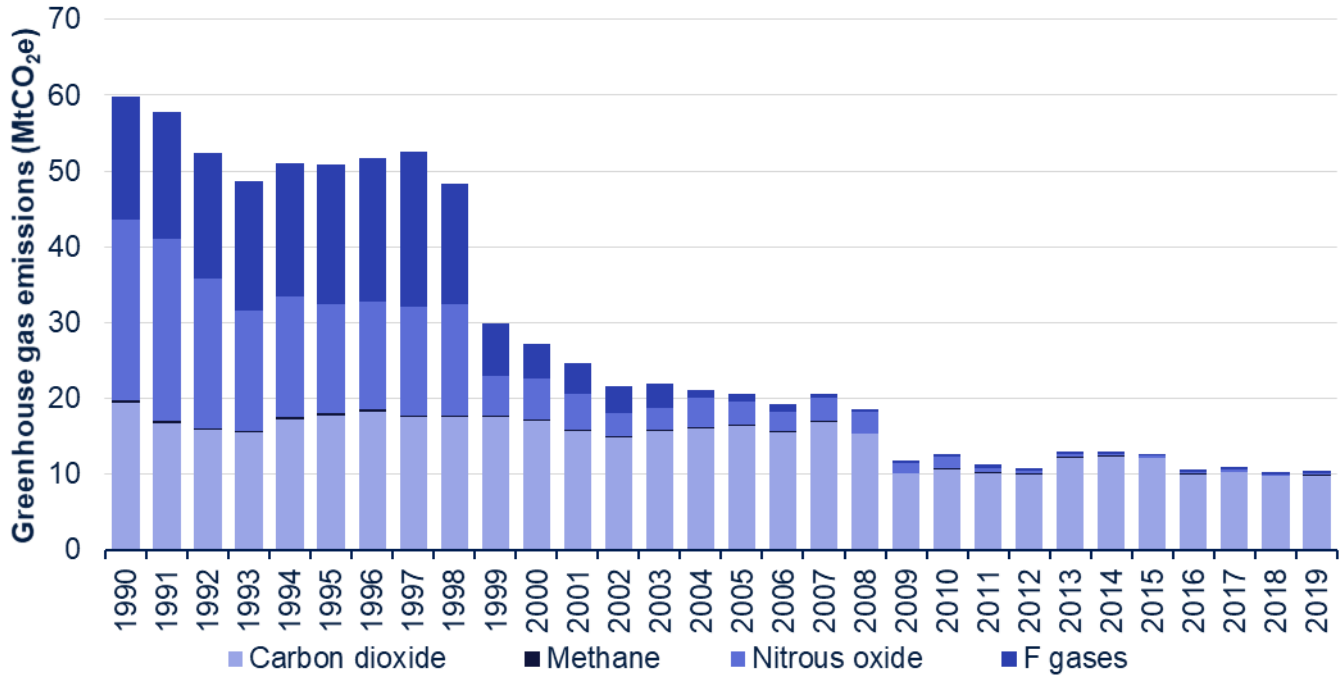
Industrial processes

The industrial processes sector consists of emissions from industry except for those associated with fuel combustion. It is estimated to have been responsible for 2% of greenhouse gas emissions in the UK in 2018, with carbon dioxide being the most prominent gas. The largest source of emissions was cement production, with other processes such as sinter, lime, and iron and steel production also contributing significantly.

Between 1990 and 2019, there was a large reduction in greenhouse gas emissions from the industrial processes sector, with an overall decrease of 83%. This was most notably due to a large reduction in emissions from adipic acid production and halocarbon production between 1998 and 1999 (combined emissions from which are now almost zero).

Emissions in the industrial processes sector increased by 2% in 2019 compared to 2018. This was mainly caused by increased emissions from the production of ammonia, cement and halocarbons.

Figure 13: Greenhouse gas emissions from industrial processes, UK 1990-2019 ($MtCO_2e$)



Source: Tables 1.2 to 1.6, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

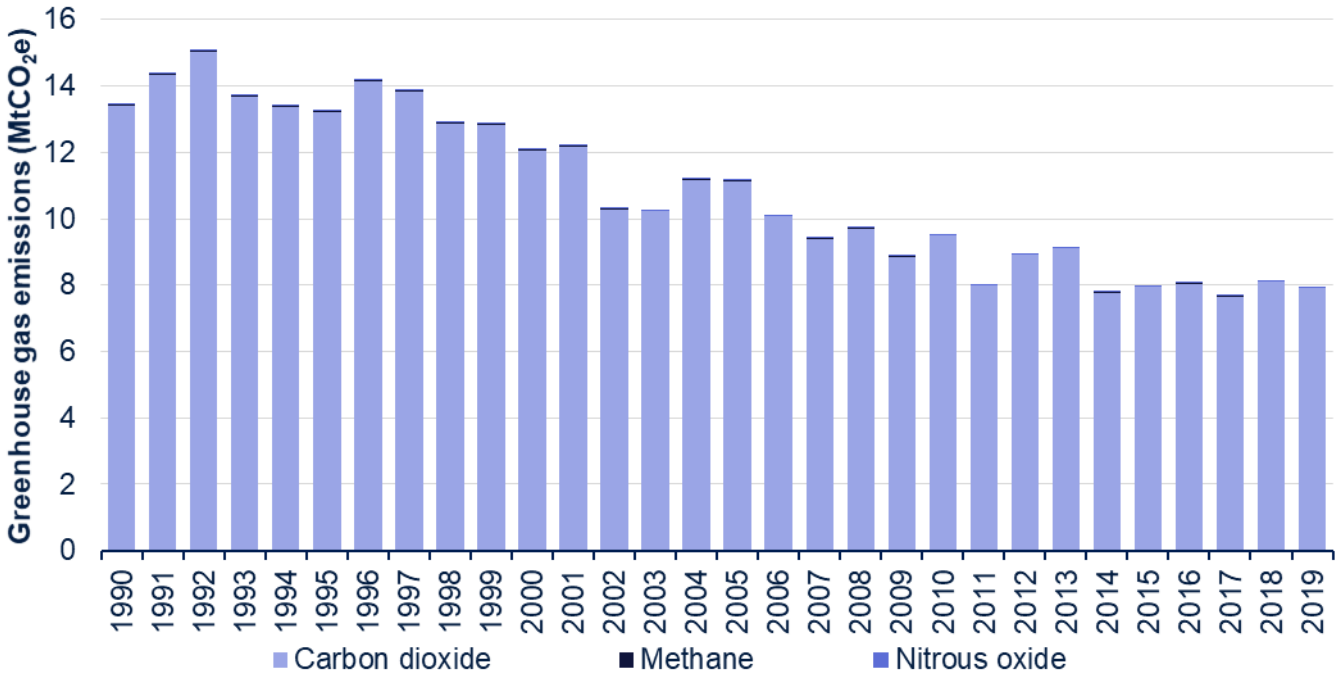
Public

The public sector consists of emissions from combustion of fuel in public sector buildings, such as schools, hospitals and offices. It is estimated to have been responsible for less than 2% of greenhouse gas emissions in the UK in 2019, with carbon dioxide making up almost all of these emissions. The main source of emissions from this sector is the use of natural gas for heating public buildings.

Between 1990 and 2019 there has been a general downward trend in greenhouse gas emissions from the public sector, which have fallen by 41% over this period. This has been driven by a change in the fuel mix, with less use of coal and oil, and more use of natural gas.

Between 2018 and 2019 emissions decreased by 3% in the public sector. As with the residential sector this is likely to be due to warmer temperatures reducing the use of gas for heating.

Figure 14: Greenhouse gas emissions from the public sector, UK 1990-2019 ($MtCO_2e$)



Source: Tables 1.2 to 1.6, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

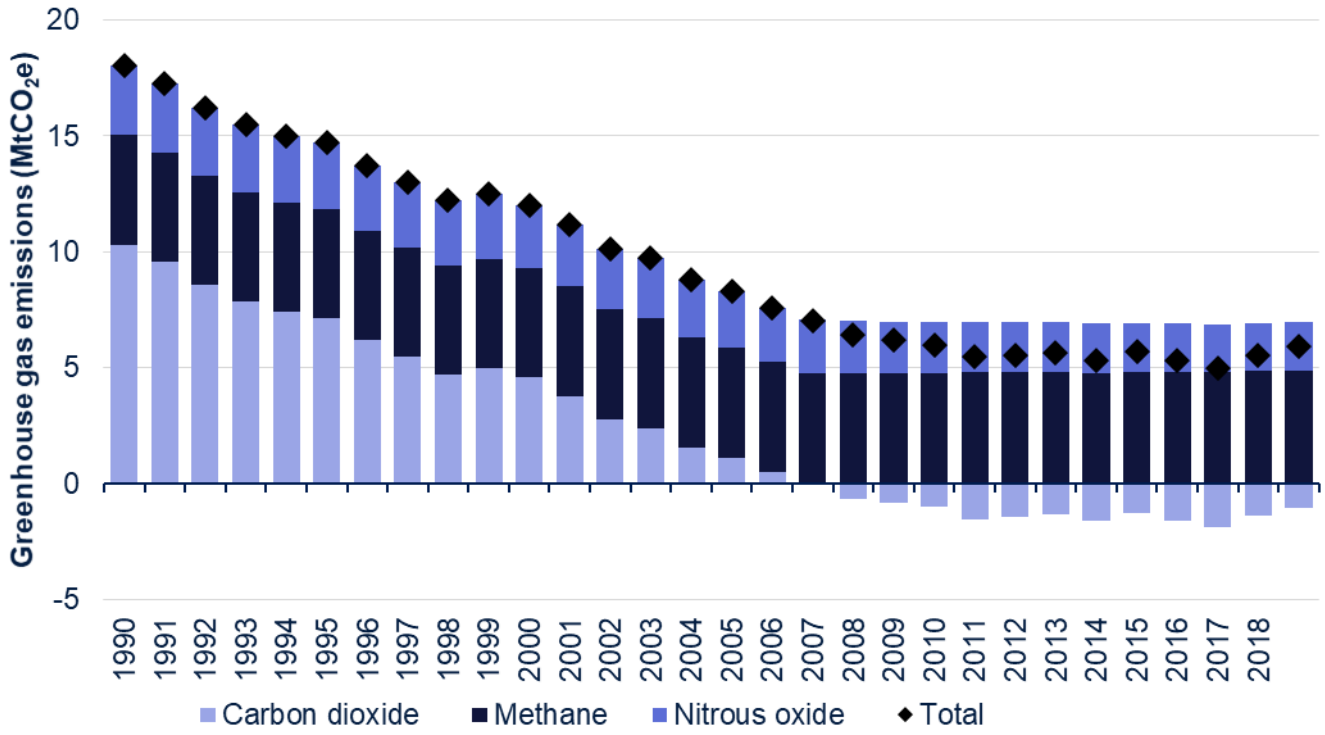
Land use, land use change and forestry (LULUCF)

The LULUCF sector consists of emissions and removals from forest land, cropland, grassland, settlements and harvested wood products. Following a major methodology change this year to better represent emissions from drained and rewetted inland organic soils (peatlands)[31], we now estimate this sector to be a net source of greenhouse gas emissions in each year from the start of the data series in 1990. Last year we estimated it to be a net sink of greenhouse gases in the UK throughout the series, meaning that it removed greenhouse gases from the atmosphere. In general, settlements and cropland are the largest sources of carbon dioxide emissions, while forest land is the dominant sink. Following the peatlands methodology change, we now estimate that grasslands have been a net source of emissions over most of the time series, before becoming a small net sink from 2013 onwards.

The LULUCF sector is estimated to have had net emissions of 5.9 $MtCO_2e$ in 2019. This has risen slightly in the last two years but is down from a total of 18.0 $MtCO_2e$ in 1990. This long-term fall has been driven by a reduction in emissions from cropland and grassland, and an increase in the sink provided by forest land, with an increasing uptake of carbon dioxide by trees as they reach maturity, in line with the historical planting pattern. There has also been some reduction in emissions since 1990 due to changes in agricultural practices.

[31] See page 30 for more information about this methodology change.

Figure 15: Greenhouse gas emissions from the LULUCF sector, UK 1990-2019 ($MtCO_2e$)



Source: Tables 1.2 to 1.6, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

International comparison

UK territorial greenhouse gas 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. Under the United Nations Framework Convention on Climate Change (UNFCCC), the UK and a number of other countries (known as the Annex I parties to the Convention[32]) report their territorial emissions each year to the UNFCCC, while other countries report theirs every few years. This allows for comparisons to be made between different countries' emission estimates following consistent approaches in line with the guidance set out by the Intergovernmental Panel on Climate Change (IPCC)[33].

Figure 16 shows the most recent territorial greenhouse gas emissions estimates reported to the UNFCCC for the UK and other members of the G20, and figure 17 shows this in terms of emissions per person in the population. To be consistent with other countries the UK emissions shown are the 2018 estimates submitted to the UNFCCC last year, so do not include the revisions to the estimates shown elsewhere in this publication. The members of the G20 account for more than 80% of world GDP and 60% of the world's population[34]. The year the data relates to for each country is shown in the charts, for Annex I countries this is 2018. As these are territorial emissions they only include emissions within a country's borders, so do not reflect any emissions resulting from the production of goods imported into a country or any international travel by its residents. The estimates shown include emissions and removals from the LULUCF sector.

Countries' emissions tend to reflect their size, with the highest emissions coming from the countries with the largest populations and land areas. China is the country with the highest greenhouse gas emissions, of around 11,200 $MtCO_2e$ in 2014 (the latest year of data available), followed by the United States, which had emissions of 5,900 $MtCO_2e$ in 2018. The European Union as whole (excluding the UK) had emissions in 2018 of 3,500 $MtCO_2e$.

When adjusted for population, Australia has the highest emissions of G20 countries of around 22 tonnes of CO_2e per person in 2018, while Canada, Saudi Arabia and the United States also each had emissions of over 17 tCO_2e per person in their latest available data. India has the lowest emissions per person in the G20, at around 2 tCO_2e per person in its latest data from 2014, although this has been increasing in recent years. The UK had emissions of around 7 tCO_2e per person in 2018. Higher emission rates can be associated with a number of factors, such as significant heavy industry, a large manufacturing sector or the use of more carbon intensive fuels such as coal for electricity generation.

[32] Annex I parties' submissions in 2020 showing greenhouse gas emissions in 2018 are available here: https://unfccc.int/ghg-inventories-annex-i-parties/2020
[33] 2006 IPCC Guidelines for National Greenhouse Gas Inventories: https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
[34] https://www.g20.org/en/il-g20.html

Figure 16: Most recent territorial greenhouse gas emissions reported to the UNFCCC: G20 countries ($MtCO_2e$)

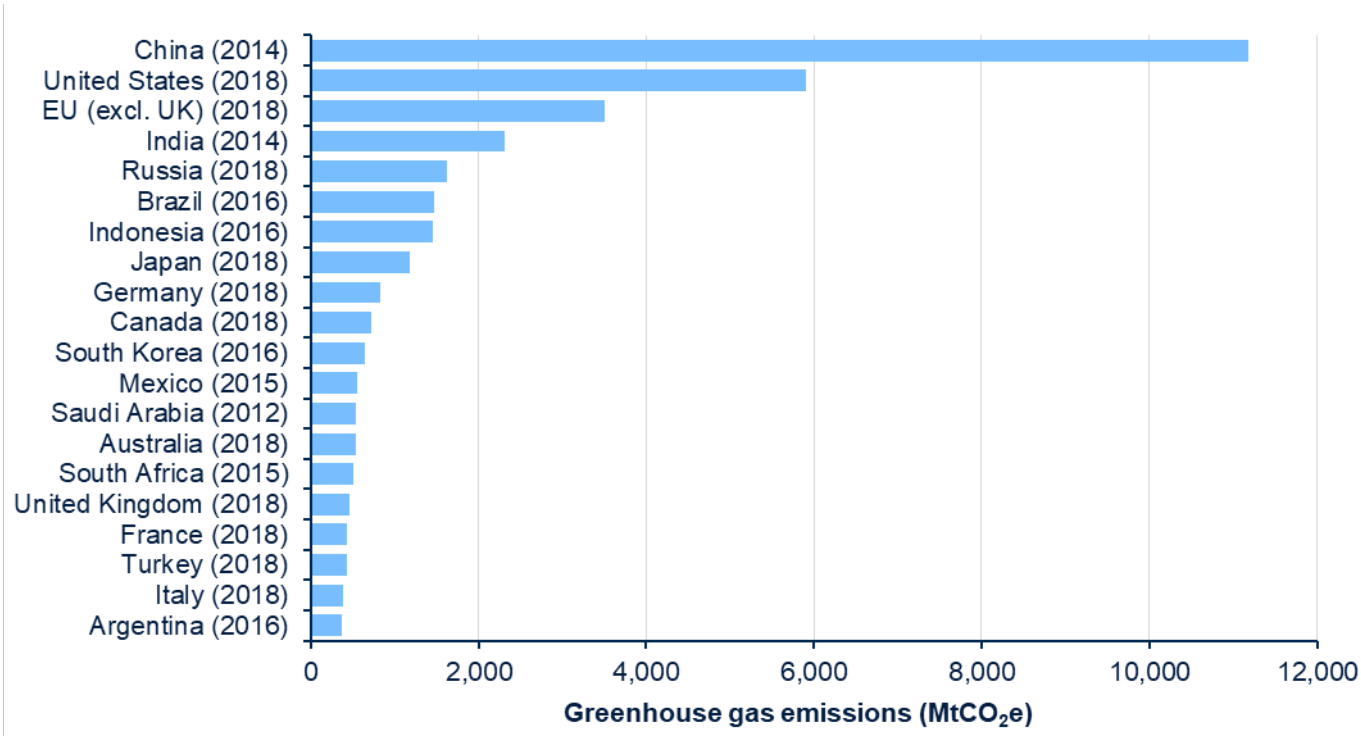
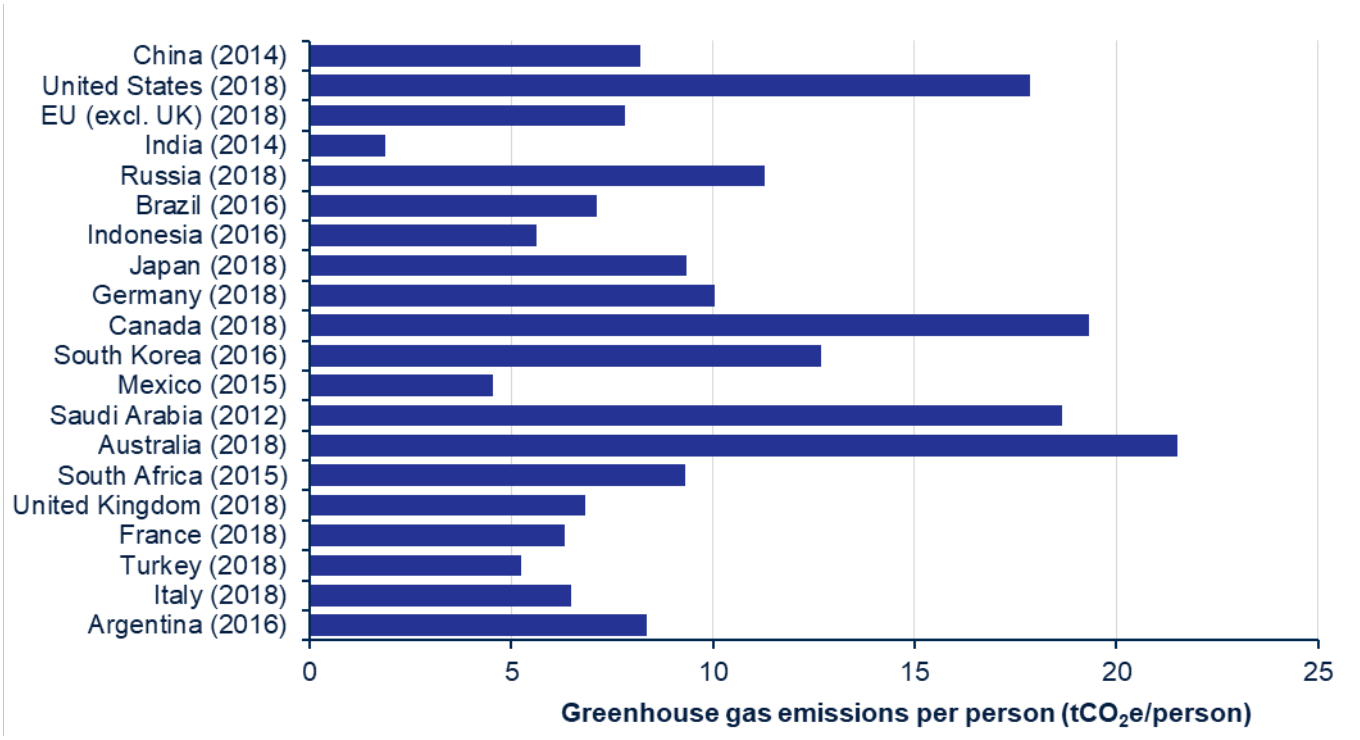


Figure 17: Territorial greenhouse gas emissions per person: G20 countries (tCO_2e)



Source: Countries' submissions to the UNFCCC

Notes:

1. The year the data relates to for each country is shown next to their name in the charts.
2. All emissions totals include emissions and removals from the LULUCF sector.
3. The UK figures include Crown Dependencies and certain Overseas Territories in line with its international reporting requirements, although they only make up around 1% of the UK emissions total.
4. The UK figures are the 2018 emissions estimates submitted to the UNFCCC in 2020 so do not incorporate the data updates and methodology changes made to the 2018 estimate in this publication.
5. The UK was a member of the EU in 2018 and included in the EU submission to the UNFCCC but has been removed from the EU figures for this comparison. The EU total includes France, Germany and Italy despite them also being shown separately.

Emissions from UK-based international aviation and shipping bunkers

In the data tables accompanying this publication, table 6.1 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[35] 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, but are reported as memo items in national greenhouse gas inventories. 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).

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 the International Civil Aviation Organization, 193 states have agreed to implement a sectoral approach to tackling international aviation emissions, in the form of a "global market-based measure" known as the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA), which does not allocate emissions to states. Under the scheme, airlines will offset their international aviation emissions covered by the scheme with reductions from other sectors, with the aim of delivering carbon-neutral growth of the sector from 2020[36].

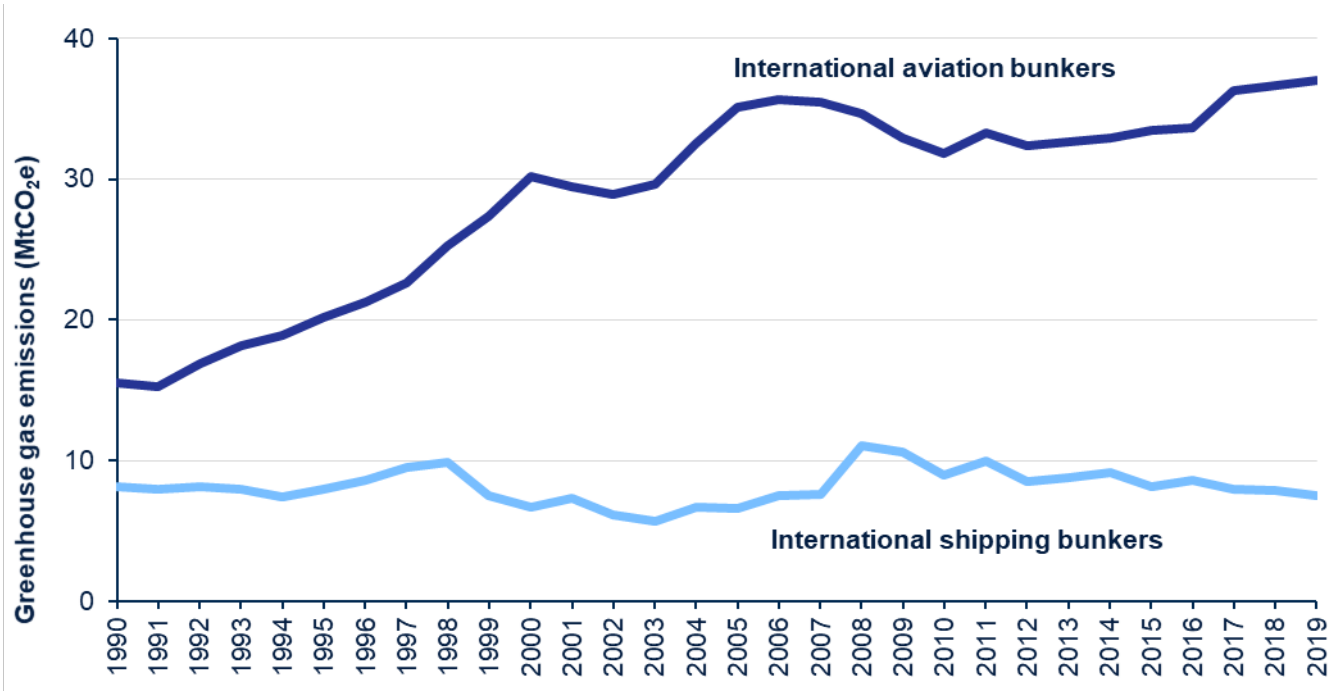
In relation to the International Maritime Organization, the 2018 Initial Strategy on Reduction of GHG Emissions from Ships[37] commits Member States to peak greenhouse gas emissions from international shipping as soon as possible and to reduce the total annual greenhouse gas emissions by at least 50% by 2050 compared to 2008 while pursuing efforts towards phasing them out as soon as possible this century.

In 2019, emissions from international aviation fuel use from UK bunkers were estimated to be 37.0 $MtCO_2e$. This was 1.0% larger than the 2018 figure. Between 1990 and 2006, when emissions reached a peak, emissions more than doubled from 15.5 $MtCO_2e$ to 35.6 $MtCO_2e$. After 2006 emissions flattened out but have risen again in the last three years to above the 2006 total. High altitude aviation has a greenhouse effect 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 7.5 $MtCO_2e$ in 2019, a decrease of 4.8% from the 2018 level. Since 1990, emissions from UK shipping bunkers have fluctuated, as can be seen in the chart below, but in recent years have been at around the same level that they were in 1990.

[35] A large container or compartment that stores fuel for ships or aircraft.
[36] https://www.icao.int/environmental-protection/CORSIA/Pages/default.aspx
[37] https://unfccc.int/sites/default/files/resource/250_IMO submission_Talanoa Dialogue_April 2018.pdf

Figure 18: Greenhouse gas emissions from UK-based international aviation and shipping bunkers, 1990-2019 ($MtCO_2e$)



Source: Table 6.1, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

Revisions from provisional estimates of greenhouse gas emissions

Provisional estimates of 2019 UK greenhouse gas and carbon dioxide emissions were published in March 2020, based on early estimates of energy consumption for the year. Differences between the provisional and final estimates arise primarily due to revisions to other statistics on which these estimates were based, use of actual data to estimate non-CO_2 emissions which are only estimated in a simplistic way in the provisional estimates, and methodological changes to the way emissions are calculated.

Typically the provisional estimates provide a better indication of emissions trends than of absolute emissions, as they do not take account of any methodological improvements that may be made to the way emissions are calculated and which can lead to revisions to the whole emissions time series from 1990 onwards. More information on revisions to the time series can be found in the next section.

It was provisionally estimated that total greenhouse gas emissions in 2019 for the UK would be 435.2 $MtCO_2e$, representing a 3.6% decrease on 2018 emissions. The final estimates show that 2019 emissions were 454.8 $MtCO_2e$, representing a 2.8% decrease on 2018 emissions. The provisional greenhouse gas emissions estimates therefore underestimated the total greenhouse gas emissions in 2019 (by 4.3%) and overestimated the percentage decrease in emissions from 2018 to 2019 (by 0.8 percentage points). The difference in the total is largely explained by the major methodology change made this year to better represent emissions from drained and rewetted inland organic soils (peatlands) consistent with the 2013 IPCC Wetlands Supplement, which is explained in the next section.

The provisional estimates are focused on carbon dioxide emissions from the energy sector, and only provided a simplistic estimate of non-CO_2 gases which assumed that the 2019 emissions for non-CO_2 gases changed from the 2018 total in line with the percentage difference between the estimates for the 2018 and 2019 of total non-CO_2 emissions in the 2018 Energy and Emissions Projections[38] published by BEIS. Focusing on carbon dioxide emissions, it was provisionally estimated that net UK carbon dioxide emissions in 2019 would be 351.5 million tonnes. The final 2019 figure of 365.1 million tonnes indicates that the provisional estimate underestimated CO_2 emissions by 3.7%. This was largely due to the new estimates for emissions from peatlands.

The provisional estimate of non-CO_2 gases was 83.7 $MtCO_2e$ and the final estimate is 89.7 $MtCO_2e$ so these emissions are 7.1% higher than reported in the provisional estimates. This was again largely due to the new estimates for emissions from peatlands.

Table 2: Comparison of 2019 provisional and final estimates

UK, 2018-2019

$MtCO_2e$

	2019 Provisional estimates	2019 Final estimates	Difference between final and provisional	Provisional 2018 to 2019 % change	Final 2018 to 2019 % change
Total CO_2	351.5	365.1	13.6	-3.9%	-3.3%
Non-CO_2 gases	83.7	89.7	5.9	-2.4%	-0.7%
All greenhouse gases	435.2	454.8	19.5	-3.6%	-2.8%

Source: Table 1.1, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables
Table 1, Provisional UK greenhouse gas emissions national statistics 2019 Excel data tables

Revisions to the UK's Greenhouse Gas Inventory

The UK Greenhouse Gas Inventory (the time series of emissions from 1990 onwards which is the basis for these statistics), is reviewed every year internally and externally (including a review by the UNFCCC), and the whole historical data series is revised where necessary to incorporate methodological improvements, changes to international reporting guidelines or new data. This takes into account revisions to the datasets which have been used in its compilation, most notably the UK energy statistics published in the Digest of UK Energy Statistics (DUKES). The methodological changes to the UK Greenhouse Gas Inventory can also impact future emissions projections. Full details of the methods used to produce the latest greenhouse gas emissions estimates will be published in the UK's National Inventory Report[39] (NIR).

These changes are applied back through the time series to 1990 in order to ensure that the trend in emissions from 1990 to the latest year is based on a consistent method. Therefore, it is not appropriate to compare the emissions time series from one year with that from another. However, the latest inventory represents a single consistent data series going back to 1990, and this therefore allows year-on-year comparisons to be made.

[38] Energy and emissions projections: https://www.gov.uk/government/collections/energy-and-emissions-projections
[39] Previous UK NIRs can be found here: http://naei.beis.gov.uk/reports/ and the latest NIR covering 1990-2019 emissions will be submitted to the UNFCCC on 15th April 2021.

The most notable methodological changes to the historical series since the 1990-2018 Greenhouse Gas Inventory was published are the large revisions to the LULUCF sector as a result of the new estimates for peatlands emissions consistent with the 2013 IPCC Wetlands Supplement. Revisions to the datasets used in producing these estimates have also led to changes across most sectors for more recent years. Details of the changes made to estimates of 1990 and 2018 emissions are given below. Revisions to other years of the time series are generally of a similar scale other than for the business sector which has seen larger decreases in the emissions estimates during the 2000s following the introduction of a new model for refrigeration, air conditioning and heat pump emissions.

Table 3: Revisions in the 2021 Greenhouse Gas Inventory, by sector

UK, 1990 and 2018

$MtCO_2e$

	1990 emissions			2018 emissions		
	2020 inventory	2021 inventory	Change	2020 inventory	2021 inventory	Change
Energy supply	278.0	278.0	~0.0	104.9	104.3	-0.7
Transport	128.1	128.1	~0.0	124.4	124.4	0.1
Business	113.8	113.8	~0.0	79.0	80.4	1.3
Residential	80.1	80.1	~0.0	69.1	70.2	1.1
Agriculture	54.0	53.1	-0.9	45.4	45.8	0.4
Waste management	66.6	64.7	-1.9	20.7	19.1	-1.5
Industrial processes	59.9	59.9	~0.0	10.2	10.2	~0.0
Public	13.5	13.5	~0.0	8.0	8.1	0.1
LULUCF	-0.1	18.0	18.2	-10.3	5.6	15.8
Total	**793.8**	**809.1**	**15.3**	**451.5**	**468.1**	**16.6**

~0.0 indicates where a value is non-zero but is less than 0.05 $MtCO_2e$ in magnitude.

Source: Table 1.2, Final UK greenhouse gas emissions national statistics 1990-2019 Data tables
Table 3, Final UK greenhouse gas emissions national statistics 1990-2018 Data tables

Within the sectors, two additional source categories have been added this year compared to the previous publication. These are summarised below.

NC category	NC Sector	Reason for change
Drainage of organic soils - grassland	LULUCF	This is a new source introduced as a result of the methodology change to estimate peatland emissions consistent with the 2013 IPCC Wetlands Supplement.
Drainage of organic soils - settlements	LULUCF	This is a new source introduced as a result of the methodology change to estimate peatland emissions consistent with the 2013 IPCC Wetlands Supplement.

Details of the methodological changes made to the emissions estimates this year are given below.

Reporting of peatlands consistent with the IPCC Wetlands Supplement

In this year's publication, a major change has been made to better represent emissions from drained and rewetted inland organic soils (peatlands) in the UK, consistent with the 2013 IPCC Wetlands Supplement[40]. The methodology applied is based on a report funded by the Department for Business, Energy, and Industrial Strategy on the "Implementation of an Emission Inventory for UK Peatlands"[41] (Evans et al. 2017). Emission factors presented in that report have been updated with additional greenhouse gas flux measurements published since 2017 and further refinements made to other assumptions, including on area changes, especially peatland restoration, following further review.

Assumptions regarding the areas of forest on peat have also been revisited to ensure consistency with the peatland maps published in the Evans et al (2017) report and available information about afforestation on peat over time.

Finally, to avoid double counting of emissions, the use of a Land-Use Change model to estimate carbon stock changes in soils has been restricted to mineral soils (both in terms of activity data and equilibrium carbon stocks) instead of using a weighted average for all soils combined.

Drained peatlands used as cropland and intensive grasslands occupy only a small fraction of the UK's peat area but have the highest greenhouse gas emissions per unit area of any land-use, with high rates of CO_2 (reported in the LULUCF sector) and N_2O emissions (reported under agriculture) as a result of deep drainage and application of fertilisers.

The largest contributions to the change in total emissions reported for the LULUCF sector occur in the cropland (+4.4 $MtCO_2e$ in 2018), and grassland (+8.2 $MtCO_2e$ in 2018) categories, which represent more than four fifths of the net increase in reported emissions. Implementation of the Wetlands Supplement into the inventory converts the LULUCF sector of the UK inventory from a net greenhouse gas sink to a net source in all years where it was a net sink. The increase in emissions reported in this sector is 15.5 $MtCO_2e$ in 2018.

This change has also led to an increase of about 0.5 $MtCO_2e$ in 2018 in the emissions reported under agriculture, as emissions of N_2O from cultivated histosols are reported there and associated activity data and emission factors have also been updated.

Industrial Wastewater Model Development

BEIS commissioned a review of the current wastewater models used to estimate greenhouse gas emissions in 2019. The previous approach, based on the 1996 IPCC Guidelines, used a single 'methane correction factor' (MCF) thought to be representative of average practice nationally, to estimate methane emissions from industrial wastewater treatment. This approach was thought likely to overestimates these emissions. As part of this project, a new industrial wastewater model was developed, replacing the previous model and aligning the approach with the 2006 IPCC Guidelines. The 2006 Guidelines include MCFs per treatment pathway (or

[40] 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands
[41] Implementation of an Emissions Inventory for UK Peatlands: https://naei.beis.gov.uk/reports/reports?report_id=980

treatment technology) and therefore offer a more refined approach than using a single, representative MCF, provided data detailing treatment pathways/technologies is available.

Analysis of the Environment Agency's Consented Discharge Database[42] identified feasible data for the proportion of wastewater treated by pathway/technology, enabling the MCF to be refined by industrial sector. The review and aggregation of production data from Eurostat's Prodcom database, combined with Tier 1 IPCC methodology wastewater generation factors allowed the calculation of total organically degradable material in wastewater from industry. The revised estimation of industrial wastewater methane emissions was calculated by combining this with the MCFs noted above.

Implementation of HFC Outlook model for estimating emissions from Refrigeration, Air Conditioning and Heat Pumps (RACHP)

We have implemented a UK-specific version of 'HFC Outlook', an RACHP model previously developed to support UN Environment Programme and European partnership for Energy and Environment (UNEP and EPEE). Hydrofluorocarbons (HFCs) are commonly used as refrigerants and can be emitted into the atmosphere if they leak out during the production, use or disposal of these systems. This model was initially developed separately to the previous UK RACHP model, so is different to that model in many ways. However, the new model has been adapted to use some UK specific data and assumptions from the previous model where appropriate. Practices in the RACHP sector are currently undergoing significant change in response to EU F-gas regulations. 'HFC Outlook', reflects the impact of these changes and includes additional features compared to the previous model. Clear differences from the previous RACHP model include:

- Modelling 35 market sub-sectors compared to 13 modelled in the previous approach.
- Introducing graduated decommissioning. This means that units of the same type are not all assumed to have the same lifetime. Instead, the lifetimes of the units are assumed to follow a distribution, with some in operation for longer or shorter times. Hence, the end of life and decommissioning of units of the same type takes place following different numbers of years in operation.
- Introducing end of life degradation, i.e., for most applications, leak rates increase for a few years leading up to the expected end of the product lifetime. This reflects the likely accumulating issues with age, and lower incentive to maintain a system that might be replaced soon.
- Introducing a graduated improvement in leak rates in response to EU F-gas regulations, where previously it was assumed that the full effect of regulation would be observed in the year of implementation.
- Utilising more up to date market understanding, particularly on the refrigerants to have been adopted in response to the increasingly stringent EU F-gas regulations, both in new systems and retrofitting of existing systems.

Note that the recalculations in very recent years and for the early time-series, including the 1990 and 2018 estimates included in Tables 1 and 2 above, are some of the smaller changes

[42] Environment Agency (2019), Consented Discharges to Controlled Waters with Conditions, Available at: https://data.gov.uk/dataset/55b8eaa8-60df-48a8-929a-060891b7a109/consented-discharges-to-controlled-waters-with-conditions

in the total time-series. For some years, particularly for 2000-2010, recalculations are expected to be up to an order of magnitude higher.

Align aerosols methodology to the IPCC default approach

Aerosol emission factors have been changed to use the 2006 IPCC default of assuming 50% of emissions occur in the year that the product is placed on the market followed by 50% in the year after being placed on the market. This is in contrast to the previous assumption that all emissions occur in the year that products are placed on the market. This change results in a smoothing of the trend in emissions and shifts the trends half a year later.

More referenceable data and assumptions, and more transparent calculation approaches have been used to make the model more in line with BEIS model quality assurance guidance. Some of the changes that have had the biggest impacts on emissions include:

- Using a value of 8% instead of 4% for the proportion of metered dose inhalers (MDIs) using HFC-227ea
- Using simple approaches to interpolate between the year that HFCs are first used for aerosols and the years for which we hold data, where previously partial data for which references were not found (during this work) was used with smaller and more specific interpolations.

Note that the recalculations for the latest year and late 1990s (including the HFC base year 1995) are the most significant due to smoothing the 2018 ban of 134a use in non-medical aerosols and a change to the interpolation used in early years respectively. Recalculations for the rest of the time-series are more muted.

Revision to lubricant activity data

The activity data for industrial lubricant use has been revised, resulting in a moderate increase in activity data and subsequent CO_2 emissions.

To ensure consistency between bottom-up estimates of lubricant consumption in the greenhouse gas inventory and in the Digest of UK Energy Statistics (DUKES), a mass balance check is performed. Lubricant consumed in engines, covering a range of industrial, aircraft, agricultural and marine applications, is reconciled against the inventory's bottom-up estimates of lubricant consumption in road engines. However, the bottom-up estimates of lubricant consumption in road engines are greater than the total amount consumed and reported in DUKES. Hence, from 2006 onwards, we are deviating from balancing against DUKES, instead using our bottom-up estimates where available and otherwise directly using DUKES' sectoral estimates. This means the total amount of lubricants consumed in engines is greater than that reported in DUKES, resulting in a recalculation.

LULUCF recalculations other than those relating to the Wetland Supplement

A series of minor changes were made to the LULUCF calculations.

- **Reformatting wildfire data:** Using data from the Fire and Rescue service Incident Response System (IRS), wildfire data has now been reformatted to calendar years to allow wildfire emissions to be calculated more accurately for the year in which the fires occurred. In the process of reformatting the data additional fires were included which had been omitted in previous inventories. This affects the emissions for biomass burning on forest land, cropland and grassland.

- **Grassland wildfires in Overseas Territories and Crown Dependencies**: The emission factor used for calculating nitrous oxide from grassland wildfires was corrected as previously the carbon monoxide factor had been used in error. This affects the emissions for biomass burning reported under grassland remaining grassland.

- **Forest Land Carbon Stock Change and Harvested Wood Products:** Small changes were made to the activity data for forest planting and wood production, resulting in minor changes to the forest carbon stock change modelled using the Forest Research CARBINE model.

- **Forest land converted to grassland and Forest land converted to Settlements for the UK:** Soil carbon stock change from deforestation is calculated using the UKCEH soil carbon stock change model. In the case of deforestation this average for the most recent decade has been updated to include the estimated deforestation in 2019. Additionally, the deforestation areas for England for 2017 & 2018 have been revised to include updated information. These changes also affect emissions of nitrous oxide from soil mineralisation and the emissions from controlled burning.

- **Peat Extraction and Wetlands converted to Grasslands:** Information on peat extraction sites was revisited when compiling this inventory and revisions were made for Wales and Northern Ireland. Wetland to Grassland conversion occurs when peat extraction sites are closed.

- **Grassland converted to Flooded Land:** The biomass carbon stock value was updated this year to use the UK specific value for shrubby grassland instead of the IPCC default value. At the same time an error with area unit conversions in the model was corrected.

- **Forest Land remaining Forest Land Carbon Stock Change and Harvested Wood Products for overseas territories and crown dependencies:** The estimation of carbon stock change in Forest Land for the Isle of Man and Guernsey was changed to use default Tier 1 IPCC methodology and emission factors, in line with reporting for the other Overseas Territories and Crown Dependencies. In addition, in Guernsey the area activity data was updated to include information from the newly available 2018 Habitat Report. This increased the Guernsey Forest remaining Forest area from 1990-2012 and reduced the area over the rest of the time series. This also reduced the Guernsey Grassland to Forest area and included Settlement to Forest areas for the first time.

Accompanying tables

The following tables are available in Excel and ODS format on the department's statistics website, alongside a CSV dataset of UK territorial greenhouse gas emissions:

UK territorial emissions

Table 1.1	Estimated territorial greenhouse gas emissions by gas, UK 1990-2019
Table 1.2	Estimated territorial greenhouse gas emissions by source category, UK 1990-2019
Table 1.3	Estimated territorial emissions of carbon dioxide (CO_2) by source category, UK 1970-2019
Table 1.4	Estimated territorial emissions of methane (CH_4) by source category, UK 1990-2019
Table 1.5	Estimated territorial emissions of nitrous oxide (N_2O) by source category, UK 1990-2019
Table 1.6	Estimated territorial emissions of fluorinated gases (F gases) by source category, UK 1990-2019
Table 1.7	Estimated territorial greenhouse gas emissions by type of fuel, UK 1990-2019 *(will be added on 25th March)*

UK territorial emissions targets

Table 2.1	UK territorial greenhouse gas emissions: progress towards the Kyoto Protocol, EU Effort Sharing Decision and UK Carbon Budget targets
Table 2.2	Estimated territorial greenhouse gas emissions for UK Carbon Budget coverage by source category, end-user category and type of fuel, UK 1990-2019

UK territorial emissions for international reporting, including Crown Dependencies & Overseas Territories

Table 3.1	Estimated territorial greenhouse gas emissions by geographical coverage and gas, UK, Crown Dependencies & Overseas Territories, 1990-2019
Table 3.2	Estimated territorial greenhouse gas emissions for the UK, Crown Dependencies and Overseas Territories by source category and type of fuel, 1990-2019
Table 3.3	Estimated territorial greenhouse gas emissions in the UK, Crown Dependencies & Overseas Territories, and totals reported to the UNFCCC and the EU, 1990-2019

Uncertainty of territorial emission estimates *(will be updated on 25th March with 2019 estimates)*

Table 4.1	Uncertainty in estimates of territorial greenhouse gas emissions by gas, UK, Crown Dependencies and Overseas Territories: 1990/2018
Table 4.2	Uncertainty in estimates of territorial greenhouse gas emissions by source sector, UK, Crown Dependencies and Overseas Territories: 1990/2018

UK territorial emissions on an end-user basis *(will be added on 25th March)*

Table 5.1	Estimated territorial greenhouse gas emissions by end user category, UK 1990-2019
Table 5.2	Estimated territorial emissions of carbon dioxide (CO_2) by end user category, UK 1970-2019
Table 5.3	Estimated territorial emissions of methane (CH_4) by end user category, UK 1990-2019
Table 5.4	Estimated territorial emissions of nitrous oxide (N_2O) by end user category, UK 1990-2019
Table 5.5	Estimated territorial emissions of fluorinated gases (F gases) by end user category, UK 1990-2019

Emissions from the use of fuels from UK international aviation and shipping bunkers (not included in UK territorial emission totals)

Table 6.1	Estimated greenhouse gas emissions arising from the use of fuels from UK international aviation and shipping bunkers, 1990-2019

Reference tables

Table 7.1	Sectoral definitions and inclusions: relationships between source categories as defined by the IPCC and the categories used in this publication
Table 7.2	Sectoral details, methodologies and data sources
Table 7.3	Fuel categories used in greenhouse gas emissions statistics *(will be added on 25th March 2021)*

Impact of including Wetlands supplement on UK emissions estimates

Table WS1	Impact of the application of methodologies for drained and rewetted inland organic soils (chapters 2 and 3) from the IPCC 2013 Wetlands Supplement on estimated territorial greenhouse gas emissions in the agriculture and land use, land use change and forestry (LULUCF) sectors, UK 1990-2019

UK territorial emissions by Standard Industrial Classification (SIC)

Tables showing emissions by Standard Industrial Classification (SIC) will be added to this publication in a separate file on 24th June 2021

Technical information

Methodology for producing greenhouse gas emissions estimates

It is impractical to directly measure emissions from every exhaust, chimney and acre of land in the UK, so greenhouse gas emission estimates are based on a series of models that estimate emissions from different sources. The source data and methods used to derive UK greenhouse gas emission estimates have been developed to be consistent with methods defined within international guidance[43]. All countries that report to the UNFCCC are required to use these estimation methods to ensure that the emissions for each country are complete and comparable.

The basic equation for estimating most sources of emissions is:

$$Emission\ Factor\ \times Activity\ Data = Emission\ Estimate$$

For example, to estimate CO_2 emissions from vehicles the activity data might be the total number of kilometres travelled by that type of vehicle and the emission factor the amount of CO_2 emitted per kilometre.

The emission factor is the emission per unit of activity. Emission factors for energy sources are either dependent on the fuel characteristics (for emissions of CO_2) or how the fuel is burned, for example the size and efficiency of equipment used. For other sources, the emission factor can be dependent on a range of parameters, such as feed characteristics for livestock or the chemical reactions taking place for industrial process emissions. Emission factors are typically derived from measurements on a number of representative sources and the resulting factor applied to all similar sources in the UK.

The UK Greenhouse Gas Inventory uses the best available data from UK and international research for each emission source. The approach used is largely defined by the availability of data and the significance of the emission source in the overall UK inventory: more detailed methods are used for the high-emitting sources, whilst simpler methods can be used for minor sources, consistent with international guidance.

For some sources, the calculation of emissions is more complicated, and therefore a model is used to estimate emissions. For example, emissions of methane from waste disposed to landfills are estimated using a model that reflects the fact that the emissions occur over a long timeframe from the initial disposal of the waste, and that emissions are affected by the level of capture and utilisation of the landfill methane produced. The CO_2 emissions and removals from land use, land use change and forestry are also modelled.

Table 7.2 in the data tables accompanying this publication summarises the methods and data sources used to estimate emissions from each source, and there are factsheets published on the NAEI website[44] that summarise the main data sources and methods used for each sector.

[43] 2006 IPCC Guidelines for National Greenhouse Gas Inventories: https://www.ipcc-nggip.iges.or.jp/public/2006gl/index.html
2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands (Wetlands Supplement): https://www.ipcc-nggip.iges.or.jp/public/wetlands/index.html
2013 Revised Supplementary Methods and Good Practice Guidance Arising from the Kyoto Protocol (KP Supplement): https://www.ipcc-nggip.iges.or.jp/public/kpsg/index.html

[44] Sector, Gas and Uncertainty Summary Factsheets: https://naei.beis.gov.uk/overview/ghg-overview

More detailed methodology information for each source can be found in the National Inventory Report submitted to the UNFCCC each year. The report for the 1990-2019 inventory will be published on 15 April 2021, so the report for the 1990-2018 inventory[45] is the most recently available at the time of this publication.

BEIS also runs a programme to monitor atmospheric concentrations of greenhouse gases, which is used to verify the emission estimates made in the Greenhouse Gas Inventory[46].

Estimating emissions on a temperature adjusted basis

BEIS publishes provisional estimates of temperature adjusted emissions[47], which give an idea of overall trends in emissions without fluctuations due to changes in external temperatures. The provisional emissions series is estimated based on UK provisional energy consumption data published by BEIS and is not as accurate as the estimates in this statistical release, which are derived from our annual Greenhouse Gas Inventory. We can compare the latest provisional unadjusted and temperature adjusted emissions with the final estimates now available.

On a temperature adjusted basis, net carbon dioxide emissions in 2018 and 2019 were estimated to be 375.5 Mt and 361.8 Mt respectively. The decrease in carbon dioxide emissions between 2018 and 2019 in the temperature adjusted figures is therefore 13.7 Mt, which is slightly less than the decrease seen in the provisional non-temperature adjusted figures, as can be seen in the table below. This suggests that the underlying change between 2018 and 2019 when adjusted for temperature would be less than the 3.3% shown.

Table 4: Comparison of provisional UK carbon dioxide emissions estimates with final estimates, 2018-2019

$MtCO_2$

	2018 CO_2 emissions (Mt)	2019 CO_2 emissions (Mt)	Absolute change (Mt)	Percentage change
Final estimates ➢ unadjusted emissions	377.7	365.1	-12.6	-3.3%
Provisional estimates ➢ unadjusted emissions	365.7	351.5	-14.2	-3.9%
Provisional estimates ➢ Temperature adjusted emissions	375.5	361.8	-13.7	-3.6%

Source: Table 1.1, Final UK greenhouse gas emissions national statistics 1990-2019 Data tables
Table 3 & 4, Provisional UK greenhouse gas emissions national statistics 2019 Excel data tables

Note: The provisional emissions estimates differ from the emissions estimates in these statistics because they were published before the 2019 figures presented were finalised.

[45] UK National Inventory Report 1990-2018: https://naei.beis.gov.uk/reports/reports?report_id=998
[46] Monitoring and verification of long term UK atmospheric measurement of greenhouse gas emissions: https://www.gov.uk/government/publications/uk-greenhouse-gas-emissions-monitoring-and-verification
[47] Provisional UK greenhouse gas emissions: https://www.gov.uk/government/collections/provisional-uk-greenhouse-gas-emissions-national-statistics

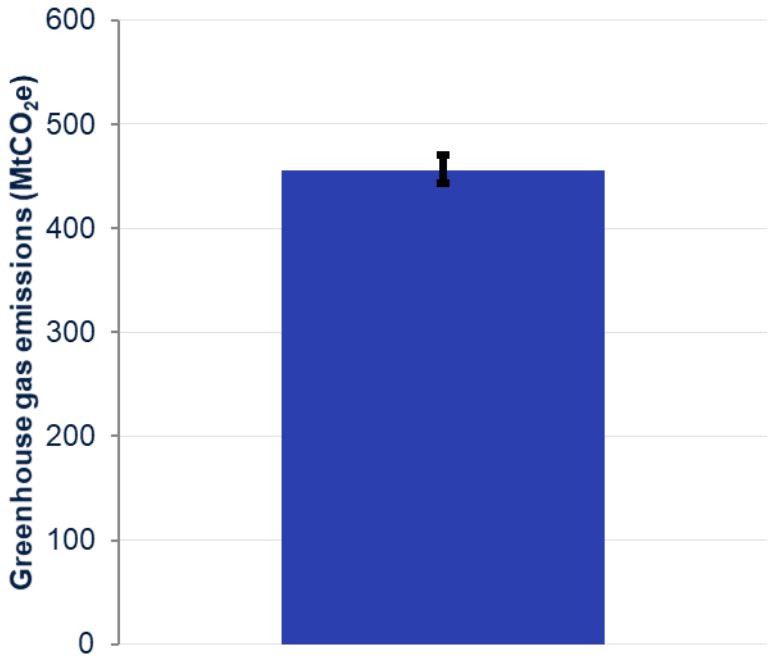
Uncertainties

In the data tables accompanying this publication, table 4.1 shows the uncertainty in the 2018 UK greenhouse gas emissions estimates by gas and table 4.2 shows it by NC sector.

Estimates of emissions have an inherent uncertainty due to uncertainty in the underlying data used to calculate the emissions, and due to uncertainty in the applicability, completeness, and application of that data. Uncertainty analysis is conducted by modelling the uncertainty in the underlying emission factors, activity data, and other variables within models; or in the overall model output. This suggests that the 95% confidence interval around the overall greenhouse gas emissions estimates is believed to be ±3%, as shown in Figure 19 (which is based on uncertainty analysis of 2018 emissions, as published in 2020). Estimates of 2019 uncertainties will be published on 25 March 2021.

The uncertainty of greenhouse gas emissions estimates varies considerably by sector. LULUCF emissions estimates are the most uncertain, followed by waste management and agriculture.

Figure 19: Illustration of uncertainty in UK greenhouse gas emissions, UK, Crown Dependencies and Overseas Territories, 2018 ($MtCO_2e$)



The error bar on this chart represents the uncertainty range (in this case, the 95% confidence interval) around the 2018 total greenhouse gas emissions central estimate.

Source: Table 4.1, Final UK greenhouse gas emissions national statistics 1990-2019 Excel data tables

Further information

Future updates to these statistics

On Thursday 25 March 2021 BEIS will publish the UK's progress against the second year of the third carbon budget and a breakdown of 1990-2019 UK territorial emissions by end-user sector and fuel, to supplement the source sector breakdown included in this publication.

On Thursday 25 March 2021 BEIS will also publish provisional estimates of UK greenhouse gas emissions for 2020. This will coincide with the publication of Energy Trends statistics, which will include estimates of 2020 UK energy consumption.

On Thursday 24 June 2021 BEIS will publish estimates of 1990-2019 UK territorial emissions by Standard Industrial Classification (SIC), to supplement the sector breakdown included in this publication.

On Thursday 24 June 2021 BEIS will also publish estimates of carbon dioxide emissions by local authority for 2019.

Final estimates of UK greenhouse gas emissions for 2020 will be published in February 2022.

Related publications

- This statistical release and the related data tables are the first release of data from the National Atmospheric Emissions Inventory (NAEI) for 1970-2019, produced for BEIS and the Devolved Administrations by Ricardo Energy & Environment. Additional results will be released as they become available. For further information on the UK Greenhouse Gas Inventory, see the NAEI website.

- The UK's National Inventory Report (NIR) for 1990-2019 will be submitted to the United Nations Framework Convention on Climate Change (UNFCCC) on 15th April 2021. The report will contain national greenhouse gas emissions estimates for 1990-2019 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.

- 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, it is important to note that trends over time are likely to be much more reliable. For more information on these uncertainties see the uncertainties factsheet on the NAEI website.

- 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 on the European Commission website.

- Under the Climate Change Act, the Annual Statement of Emissions for 2019 must be laid before Parliament and published no later than 31st March 2021. This will give details of the net UK carbon account for 2019, which is used to determine compliance with the targets and budgets under the Act.

- ONS publishes emissions on a "residence" 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.

- Detailed UK temperature data can be found on both the Met Office website and the Weather Statistics section of the gov.uk website.

- Similar results for non-greenhouse gas atmospheric pollutants are published by Defra in its statistics on Emissions of air pollutants in the UK.

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.

Uses of these statistics

The UK's territorial greenhouse gas emission estimates are used by central government departments, devolved governments and local authorities to understand emissions in the areas they are responsible for, to develop policies to reduce emissions and to set targets. They are the basis for the UK's domestic and international emissions targets and are required to be reported to the UNFCCC and EU each year.

Outside government the statistics are used by the media and the public to understand the level of greenhouse gas emissions in the UK and trends over time. They provide detailed emissions

data on gases, sectors and sub-sectors that may of interest to users (particularly academics) with a focus on a particular area of emissions. The data are also the basis of emission conversion factors that are used by companies and other organisations to report their greenhouse gas emissions.

A statement of user needs for greenhouse gas emission statistics is published at: https://www.gov.uk/government/publications/uk-greenhouse-gas-emissions-statistics-statement-on-user-needs

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: climatechange.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.
- Providing more methodological and background information about the statistics in the statistical release and including international comparisons.
- Publishing new tables showing emissions by source category for the UK, Crown Dependencies and Overseas Territories combined (the geographical coverage of UK submissions to the UNFCCC) and showing emissions in each individual Crown Dependency and Overseas Territory.

Pre-release access to statistics

Some ministers and officials receive pre-release 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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This publication is available from: https://www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics

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