



Department for
Business, Energy
& Industrial Strategy



2017 UK GREENHOUSE GAS EMISSIONS, FINAL FIGURES

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Executive Summary

This publication provides the latest estimates of 1990-2017 UK greenhouse gas emissions, which are presented in carbon dioxide equivalent units throughout this statistical release.

Key findings

In 2017, UK emissions of the basket of seven greenhouse gases covered by the Kyoto Protocol¹ were estimated to be 460.2 million tonnes carbon dioxide equivalent (MtCO₂e), a decrease of 2.7 per cent compared to the 2016 figure of 473.1 million tonnes. Greenhouse gas emissions in 2017 are estimated to be 42.1 per cent lower than they were in 1990.

The decrease in emissions from 2016 was mainly caused by:

- Reductions in emissions in the energy supply sector, down 7.6 per cent (9.2 MtCO₂e). 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.
- A decrease of 4.2 per cent (2.9 MtCO₂e) in the residential sector, driven by a reduction in the use of natural gas for heating due to warmer weather in the first half of 2017.

Carbon dioxide (CO₂) is the most dominant greenhouse gas from the Kyoto “basket” of greenhouse gases, accounting for 81 per cent of total UK greenhouse gas emissions in 2017. The latest figures show:

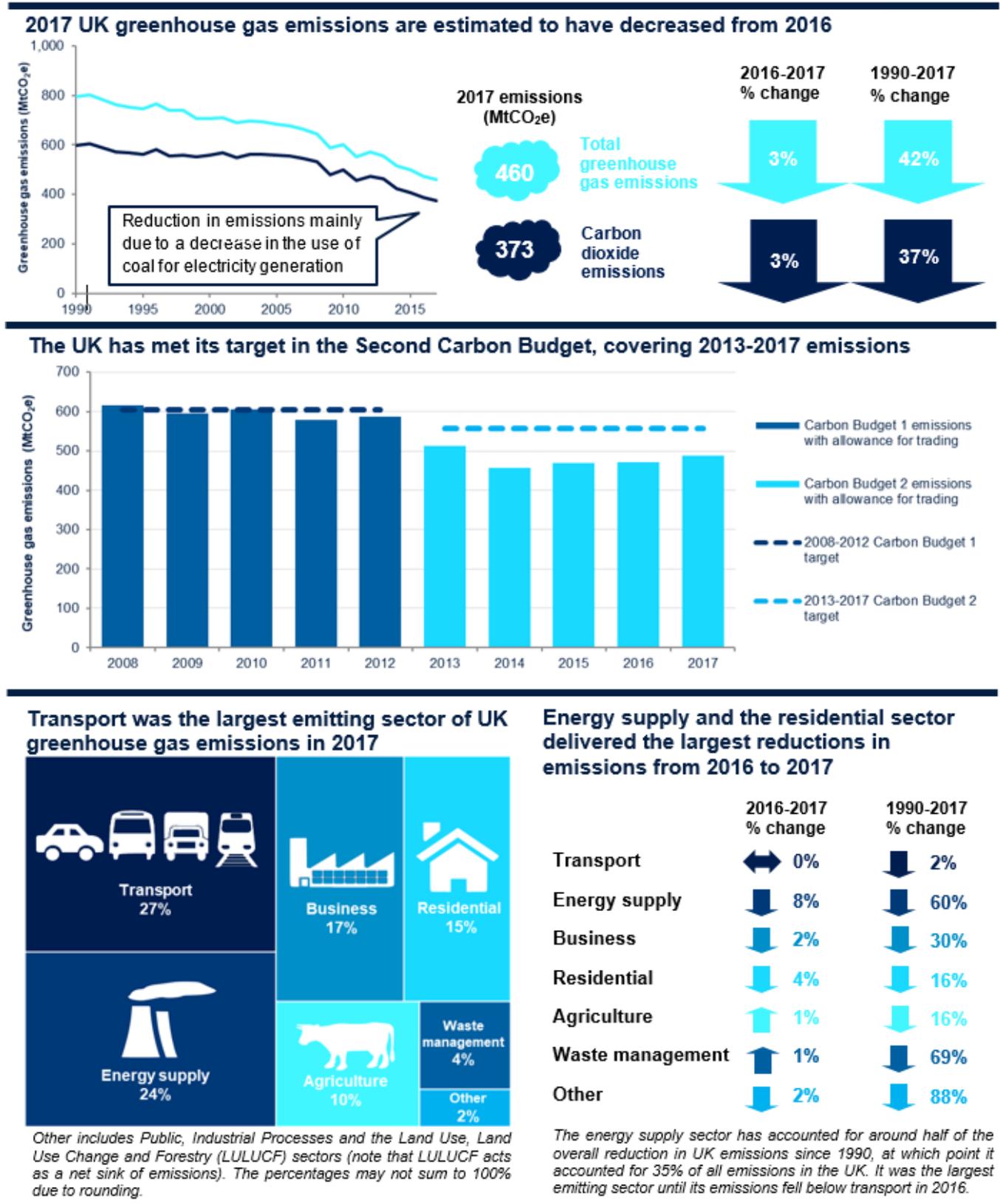
- UK net 2017 CO₂ emissions were estimated to be 373.2 million tonnes (Mt), which was 3.3 per cent lower than the 2016 figure of 385.8 Mt. This decrease in CO₂ emissions was mainly due to the large decrease in the use of coal for electricity generation (as described above).
- Between 1990 and 2017 UK net CO₂ emissions are estimated to have decreased by 37.4 per cent.

The UK has domestic targets for reducing greenhouse gas emissions under the Climate Change Act known as 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. The latest figures show:

- The UK has met the second carbon budget, with annual 2013-2017 emissions that are each below the annual average emissions level of the budget period (556.4 MtCO₂e).
- UK emissions in 2017 were 42 per cent below the 1990 base year.

¹ The basket of greenhouse gases covered by the Kyoto Protocol consists of seven gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride.

Figure 1: Summary of key findings



Introduction

This publication provides the latest estimates of UK greenhouse gas (GHG) emissions from 1990-2017 based on the source of the emissions, as opposed to where the end-user activity occurred. Emissions related to electricity generation are therefore attributed to power stations, the source of these emissions, rather than homes and businesses where electricity is used.

In accordance with international reporting and carbon trading protocols, emissions from each of the gases included in these statistics is weighted by its global warming potential (GWP)², so that total greenhouse gas emissions can be reported on a consistent basis. The GWP for each gas is defined as its warming influence relative to that of carbon dioxide. Greenhouse gas emissions are then presented in carbon dioxide equivalent units.

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

- Energy supply
- Business
- Transport
- Public
- Residential
- Agriculture
- Industrial processes
- Land use, land use change and forestry (LULUCF)
- Waste management

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.

Note that as part of this release the 1990-2016 emissions figures have been revised since the previous publication in February 2018, to incorporate methodological improvements and new data. Details of these revisions can be found later in this statistical release.

The Department for Business, Energy and Industrial Strategy (BEIS) also publish emissions projections based on assumptions of future economic growth, fossil fuel prices, electricity generation costs, UK population and other key variables³.

² Global warming potentials (GWP) of greenhouse gases used in UK emissions statistics: <https://www.gov.uk/government/publications/uk-greenhouse-gas-emissions-explanatory-notes>

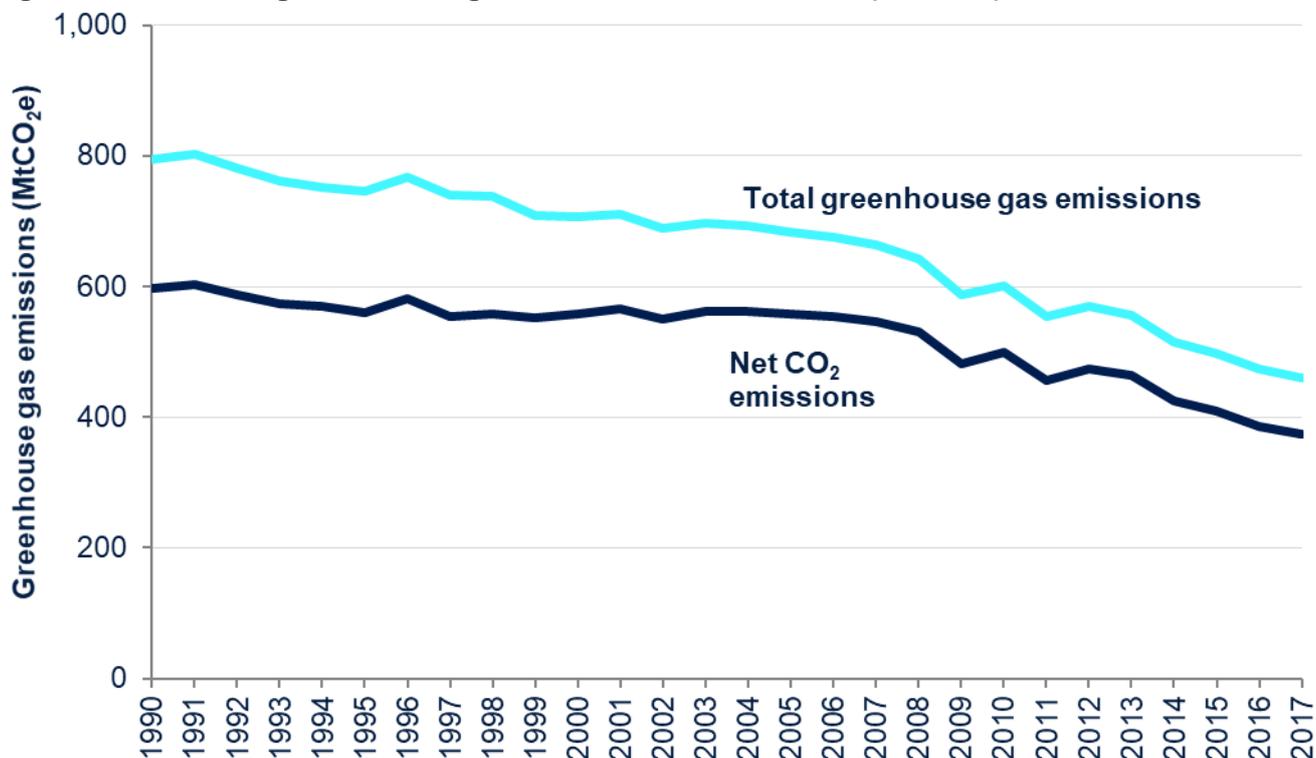
³ Energy and emissions projections: <https://www.gov.uk/government/collections/energy-and-emissions-projections>

2017 total greenhouse gas emissions

In 2017, UK emissions of the basket of seven greenhouse gases covered by the Kyoto Protocol were estimated to be 460.2 million tonnes carbon dioxide equivalent (MtCO₂e), a decrease of 2.7 per cent compared to the 2016 figure of 473.1 million tonnes. Greenhouse gas emissions in 2017 are estimated to be 42.1 per cent lower than they were in 1990.

Carbon dioxide (CO₂) is the most dominant greenhouse gas from the Kyoto “basket” of greenhouse gases, accounting for 81 per cent of total UK greenhouse gas emissions in 2017. UK net CO₂ emissions were estimated to be 373.2 million tonnes (Mt) in 2017, which is 3.3 per cent lower than the 2016 figure of 385.8 Mt. Between 1990 and 2017 UK net CO₂ emissions are estimated to have decreased by 37.4 per cent.

Figure 2: Total UK greenhouse gas emissions, 1990-2017 (MtCO₂e)



Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

UK performance against emissions reduction targets

The Climate Change Act 2008

The UK has domestic targets for reducing greenhouse gas emissions under the Climate Change Act 2008⁴, which established a long-term legally-binding framework to reduce greenhouse gas emissions, committing the UK to reducing emissions by at least 80 per cent below 1990 baselines by 2050.

To help set this trajectory, the Climate Change Act 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 period⁵. The first carbon budget ran from 2008 to 2012. In 2014, the UK confirmed that it had met the first carbon budget, with emissions 36 MtCO₂e below the cap of 3,018 MtCO₂e over the first carbon budget period. A final statement for the second carbon budget, covering the period 2013-17, will be published in May 2019 to confirm overall performance against the budget level set.

Under the coverage of the Climate Change Act⁶, UK greenhouse gas emissions for 2017 were 460.2 MtCO₂e. Compliance with carbon budgets is assessed by comparing the budget level against 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)⁷
- Emissions not covered by the EU ETS ('non-traded')
- Credits/debits from other international trading systems

In 2017 the net carbon account was 488.1 MtCO₂e. Figure 3 shows that the UK has met the second carbon budget, with emissions 383.9 MtCO₂e below the cap of 2,782 MtCO₂e over the second carbon budget period. The net carbon account in 2017 was 3.4 per cent higher than that reported in 2016. This fluctuation is due to an increase to the UK's share of allowances under the EU ETS, in line with the planned supply of allowances across the EU during the third trading period⁸. Further information will be published in the UK's Annual Statement of

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 The geographical coverage of the Climate Change Act and carbon budgets is based on the UK, excluding Crown Dependencies and Overseas Territories, and the regulations do not currently include emissions from Nitrogen Trifluoride (NF₃).

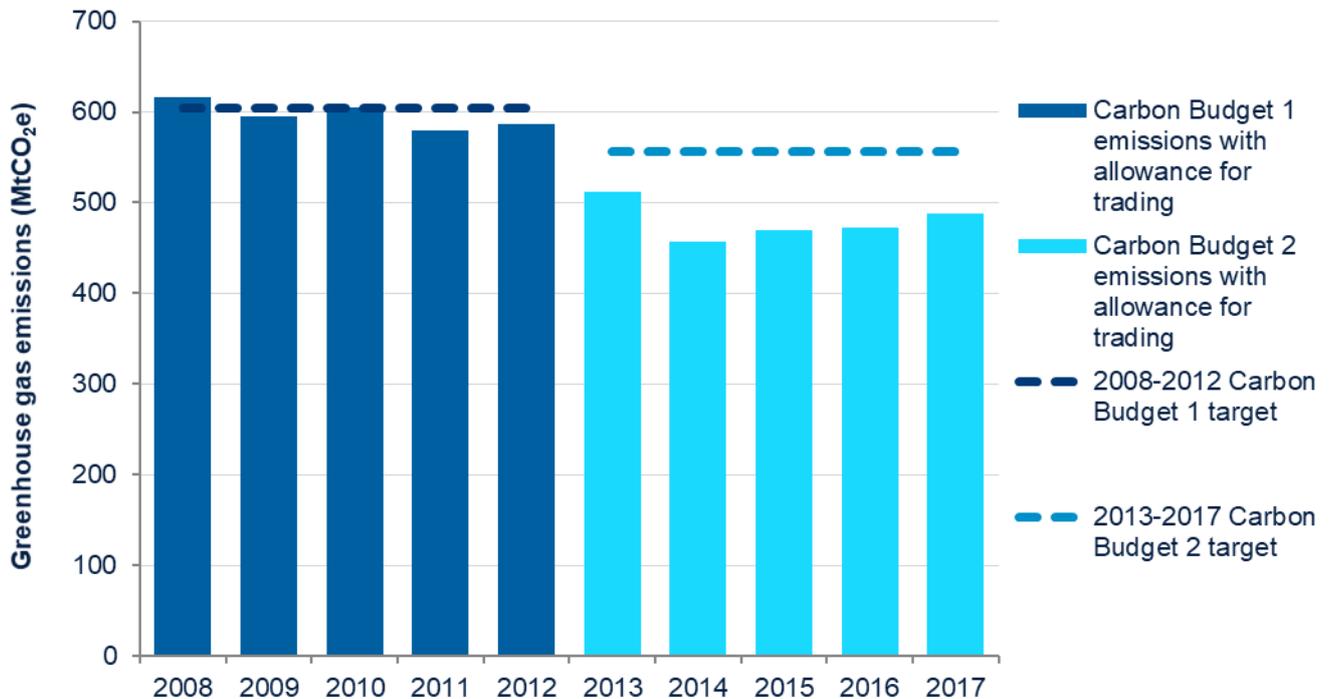
⁷ The EU Emissions Trading System (EU ETS): https://ec.europa.eu/clima/policies/ets_en

⁸ Trends and Projections in the EU ETS: <https://www.eea.europa.eu/publications/trends-and-projections-in-the>

Emissions for 2017, later this year⁹. Performance against all emissions reduction targets is presented in Excel data table 9 that accompanies this statistical release.

Projected performance against future carbon budgets can be found in the latest UK energy and emissions projections publication¹⁰.

Figure 3: UK’s progress towards meeting carbon budget targets (MtCO₂e)



Source: Table 9, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Kyoto Protocol target

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

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 per cent on 1990 levels by 2012 through the EU Emissions Trading System. As part of this, the UK undertook to reduce total greenhouse gas emissions by 12.5 per cent below base year levels over the five-year period 2008-12¹¹.

⁹ Annual Statements of Emissions: <https://www.gov.uk/government/collections/annual-statements-of-emissions>

¹⁰ Energy and emissions projections: <https://www.gov.uk/government/collections/energy-and-emissions-projections>

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 MtCO₂e per year (exclusive of emissions trading) over the first commitment period (2008-12), 23 per cent lower than base year emissions¹².

Second Commitment Period (2013-2020)

Under the second commitment period of the Kyoto Protocol (2013-2020) the EU and the Member States have a target to reduce emissions by 20 per cent relative to the reference year (1990) over the period. The commitments of the EU and the Member States, and those of Iceland, are being fulfilled jointly in accordance with Article 4 of the Kyoto Protocol. In line with this target, EU emissions are split into (i) 'traded sector' emissions, covered by the EU Emissions Trading System which gives an overall EU-wide 'cap' on emissions from participating sectors; and (ii) 'non traded sector' emissions, which are covered by Member State-level targets under the Effort Sharing Decision (ESD). The Kyoto Protocol second commitment period also covers emissions from the land use, land use change and forestry (LULUCF) sector which are not covered by the ESD.

The UK has now ratified the Doha Amendment, but it has not yet come into force. These statistics therefore do not include information on the UK's progress against its second commitment period target.

Beyond 2020

Following the 21st Conference of the Parties (COP21) of the United Nations Framework Convention on Climate Change (UNFCCC) in Paris in December 2015, 195 countries committed to adopt a global climate change Agreement. The Paris Agreement on climate change entered into force on 4 November 2016. It was ratified by the UK on 18 November 2016. At COP24 held in Katowice, Poland, in December 2018, Parties reached agreement on a rulebook to support the implementation of the Paris Agreement.

The Nationally Determined Contributions of the EU and the its Member States – the EU's central commitment under the Paris Agreement – is an at least 40 per cent domestic reduction in greenhouse gas emissions by 2030 compared to 1990 levels. This contribution will be fulfilled jointly by the EU and the Member States in accordance with EU legislation to be adopted in respect of both the emissions trading sector and the non-traded sector.

EU Effort Sharing Decision

The UK has annual greenhouse gas emissions limits under the EU Effort Sharing Decision (ESD) for the period 2013-2020. The ESD was agreed as part of the 2008 EU Climate and Energy package and came into force from January 2013. It sets out targets for EU Member States 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 Emissions Trading System), by 2020 from a 2005

¹² Record of UK base year emissions:
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/345163/base_year_tables.xlsx

baseline. The UK's 2020 target, based on relative GDP per capita, is to reduce emissions by 16 per cent from 2005 levels, to be achieved through a declining limit for emissions for each year from 2013-2020¹³.

In November 2018 the European Commission confirmed for each Member State their performance against ESD for 2016¹⁴. UK greenhouse gas emissions for 2016 under the ESD were confirmed to be 333.9 MtCO_{2e}, 11.3 MtCO_{2e} below the UK's annual limit for 2016 of 345.2 MtCO_{2e}, meaning that the UK met its fourth annual target in the period. Provisional estimates indicate that greenhouse gas emissions for 2017 under the Effort Sharing Decision will also be below the annual emissions limit, by around 29 MtCO_{2e}.

Table 1: Progress towards the EU Effort Sharing Decision

UK and Gibraltar, 2013-2017	MtCO _{2e}				
	2013	2014	2015	2016	2017
Total greenhouse gas emissions excl. LULUCF and NF ₃ (A)	566.5	524.0	503.5	482.8	470.5
Total verified emissions from stationary installations under the EU ETS (B)	225.3	197.9	175.9	147.4	137.0
CO ₂ emissions from civil aviation (C)	1.7	1.6	1.6	1.5	1.6
Total ESD emissions (D = A - B - C)	339.5	324.4	326.0	333.9	331.9
Annual emissions allocation (E)	358.7	354.2	349.7	345.2	360.4
Difference (E - D)	19.3	29.8	23.7	11.3	28.5

Source: Table 9, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

European Union Emissions Trading System (EU ETS)

The UK needs to take account of emissions trading through the European Union Emissions Trading System (EU ETS) when reporting against carbon budgets. The EU ETS works by putting a limit on overall emissions from covered installations and aviation operators on intra-EEA flights. This limit is reduced each year. Within the limit companies in Member States across the EU can buy and sell emission allowances as needed. This 'cap-and-trade' approach gives companies the flexibility they need to cut their emissions in the most cost-effective way.

Phase II of the EU ETS 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 allocation¹⁵.

¹³ Annual emission allocations, European Commission:

http://ec.europa.eu/clima/policies/effort/framework/documentation_en.htm

¹⁴ Commission Implementing Decision 2016/2132: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2017.337.01.0080.01.ENG

¹⁵ 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.

The third phase of the EU ETS (2013-20) phase builds upon the previous two phases and has been significantly revised to make a greater contribution to tackling climate change. Amongst other changes to the operating rules, the system shifted away from NAPs in favour of an EU-wide cap on the number of available allowances across Member States. In the absence of a UK-specific allocation plan, a notional cap has been estimated for the purpose of calculating carbon budget performance. Further details of this methodology are laid out in the Annual Statement of Emissions⁹.

For further information please see the section on the European Union Emissions Trading System in the background information chapter at the end of this report.

Table 2: EU ETS net trading position as reported for carbon budgets performance

UK, 2008-2017	MtCO ₂ e									
	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Net purchases/(sales) by UK installations	19.3	(13.5)	(7.6)	(24.9)	(14.5)	44.2	59.1	29.1	1.3	(27.6)
Net cancelled unallocated allowances/(sales) by UK Government ¹	0.9	0.9	0.9	0.9	0.9	-	-	-	-	-
Net UK domestic aviation emissions against aviation cap	-	-	-	-	-	(0.1)	(0.3)	(0.2)	(0.3)	(0.3)
Net UK purchases/(sales)	20.2	(12.6)	(6.7)	(24.0)	(13.6)	44.1	58.8	28.9	1.0	(27.9)

Source: Table 9, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Note:

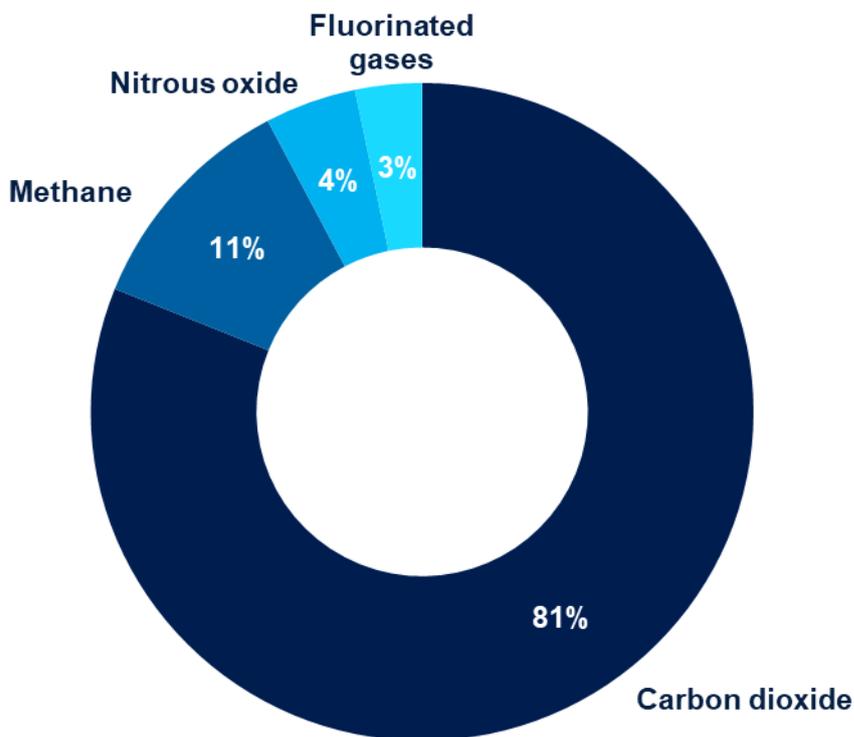
1. At the end of Phase II of the EU ETS, the UK was required to cancel all allowances which have not been either issued or auctioned by that point. As a consequence, allowances totalling 4.5 MtCO₂e were cancelled in 2012. These cancelled allowances have the effect of reducing the overall cap for the whole of Phase II. For presentational purposes, this amount has been distributed evenly over the five years 2008-2012, effectively reducing the cap by 0.9 MtCO₂e each year.
<https://www.gov.uk/government/statistics/final-statement-for-the-first-carbon-budget-period>
2. Domestic aviation emissions are included in carbon budgets accounting from 2013.
3. From 2013, the EU ETS entered its third phase, which will end in 2020. Changes to the operating rules in this period mean that Member States no longer receive a national cap as the ETS operates at installation level. Therefore a 'notional' cap is estimated for the purpose of carbon budgets accounting.

Emissions by gas

UK greenhouse gas emissions are broken down into the Kyoto “basket” of seven gases: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFC), perfluorocarbons (PFC), sulphur hexafluoride (SF₆) and nitrogen trifluoride (NF₃). The last four gases are collectively referred to as fluorinated gases or F gases.

When broken down by gas, UK emissions are dominated by carbon dioxide, which is estimated to have accounted for about 81 per cent of the UK’s greenhouse gas emissions in 2017. Weighted by global warming potential, methane accounted for about 11 per cent of UK emissions and nitrous oxide for about 4 per cent of emissions in 2017. Fluorinated gases accounted for the remainder, around 3 per cent.

Figure 4: Greenhouse gas emissions by gas, UK, 2017 (%)



Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Carbon dioxide has always been the dominant greenhouse gas emitted in the UK. Emissions of CO₂ have reduced considerably by 37 per cent (over 200MtCO₂) since 1990, mainly due to decreases in emissions from power stations and residential/industrial combustion. There have been much larger proportional falls in emissions from methane (61 per cent since 1990) and nitrous oxide (57 per cent). Fluorinated gas (F gas) emissions are estimated to be 14 per cent lower now than they were in 1990, with hydrofluorocarbons (HFCs) being the dominant F gas.

Table 3: UK greenhouse gas emissions trends by gas

UK, 1990-2017

	MtCO ₂ e							
	1990	1995	2000	2005	2010	2015	2016	2017
Net CO ₂ emissions (emissions minus removals)	596.3	560.1	558.3	557.9	498.3	408.3	385.8	373.2
Methane (CH ₄)	132.5	125.9	108.4	86.9	63.9	52.7	51.1	51.5
Nitrous oxide (N ₂ O)	48.2	38.6	28.5	24.4	21.3	20.3	20.2	20.5
Hydrofluorocarbons (HFC)	14.4	19.1	9.8	13.0	16.4	15.9	15.1	14.1
Perfluorocarbons (PFC)	1.7	0.6	0.6	0.4	0.3	0.3	0.4	0.4
Sulphur hexafluoride (SF ₆)	1.3	1.3	1.8	1.1	0.7	0.5	0.5	0.5
Nitrogen trifluoride (NF ₃)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total greenhouse gases	794.4	745.6	707.5	683.7	600.9	498.0	473.1	460.2

Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Note:

1. The entire time series is revised each year to take account of methodological improvements.
2. Emissions are reported as net emissions, including removals from the atmosphere by carbon sinks.

Emissions by sector

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 1990-2017 UK emissions by end-user sector and fuel type will be published on Thursday 28th March 2019¹⁶.

In 2017, 27 per cent of greenhouse gas emissions in the UK were estimated to be from the transport sector, 24 per cent from energy supply, 17 per cent from business, 15 per cent from the residential sector and 10 per cent from agriculture. The rest was attributable to the remaining sectors; waste management, industrial processes, and the public sector. The land use, land use change and forestry (LULUCF) sector acted as a net sink in 2017 so emissions were effectively negative.

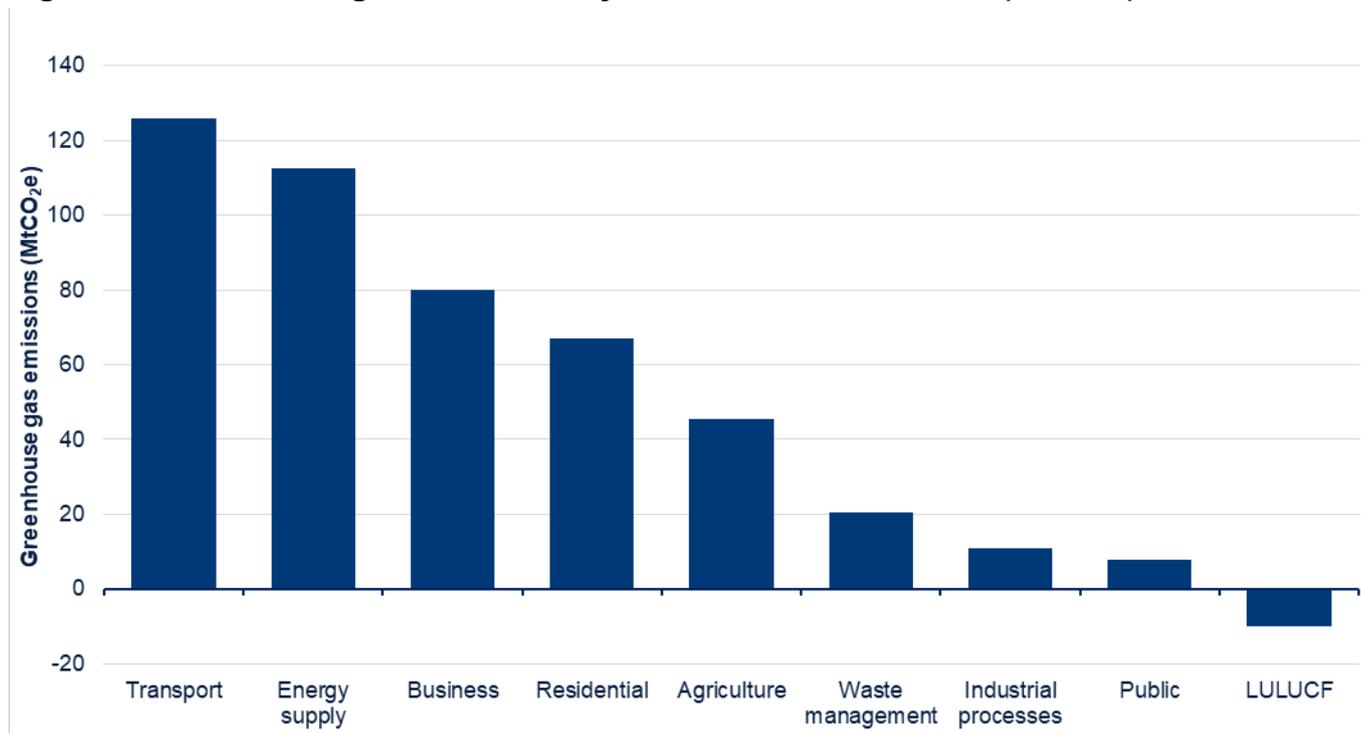
Table 4: Sources of greenhouse gas emissions

UK, 1990-2017

	MtCO ₂ e							
	1990	1995	2000	2005	2010	2015	2016	2017
Transport	128.1	129.7	133.3	136.0	124.5	123.5	125.9	125.9
Energy supply	277.9	238.0	221.6	231.5	207.4	145.3	121.8	112.6
Business	114.0	111.8	115.4	108.9	94.1	85.1	81.4	80.1
Residential	80.1	81.6	88.7	85.7	87.5	67.4	69.8	66.9
Agriculture	54.0	52.9	50.3	47.9	44.6	45.1	45.2	45.6
Waste management	66.6	69.1	62.9	49.0	29.7	20.6	20.0	20.3
Industrial processes	59.9	50.8	27.1	20.6	12.6	12.7	10.6	10.8
Public	13.5	13.3	12.1	11.2	9.5	8.0	8.2	7.8
LULUCF	0.3	-1.7	-3.9	-7.1	-9.1	-9.7	-9.8	-9.9
Total	794.4	745.6	707.5	683.7	600.9	498.0	473.1	460.2

Source: Table 3, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

¹⁶ The Annex for 1990-2016 UK greenhouse gas emissions final figures by end-user and fuel type published in March 2018 can be found here: <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2016>

Figure 5: Greenhouse gas emissions by source sector, UK, 2017 (MtCO₂e)


Source: Table 3, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Table 5: UK greenhouse gas emissions by gas and sector

UK, 2017

	MtCO ₂ e				Total
	Carbon dioxide	Methane	Nitrous oxide	F gases	
Transport	124.6	0.1	1.2	:	125.9
Energy supply	106.0	5.8	0.8	:	112.6
Business	66.1	0.2	0.9	13.0	80.1
Residential	64.1	1.0	0.2	1.6	66.9
Agriculture	5.6	25.7	14.3	:	45.6
Waste management	0.3	18.6	1.4	:	20.3
Industrial processes	10.2	0.1	0.3	0.3	10.8
Public	7.8	0.0	0.0	:	7.8
LULUCF	-11.3	0.0	1.4	:	-9.9
Total	373.2	51.5	20.5	15.0	460.2

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Note: A colon (:) means data are not available as there are no F gas emissions in these sectors

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 per cent of UK greenhouse gas emissions in 2017, 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 remained at around the same level in 2017 as they were in 2016, despite a small increase in road traffic.

Between 1990 and 2017, 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 2 per cent lower in 2017 than in 1990. The transport sector has 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 most emitting sector.

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. While there was an increase in road traffic throughout the 1990s¹⁷, traffic volumes have remained at a similar level since the early 2000s, with a small dip in the early 2010s. In combination with lower petrol consumption outweighing an increase in diesel consumption¹⁸ and, more recently, improvements in fuel efficiency of both petrol and diesel cars,¹⁹ this has led to the volume of emissions from passenger cars generally decreasing since the mid-2000s. However, this decrease has been partially offset by an increase in emissions from light duty 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.

¹⁷ Transport Statistics Great Britain, Modal comparisons (TSGB01), Table TSGB0101 Passenger transport by mode, annual from 1952
<https://www.gov.uk/government/statistical-data-sets/tsgb01-modal-comparisons>

¹⁸ 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>

¹⁹ 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>

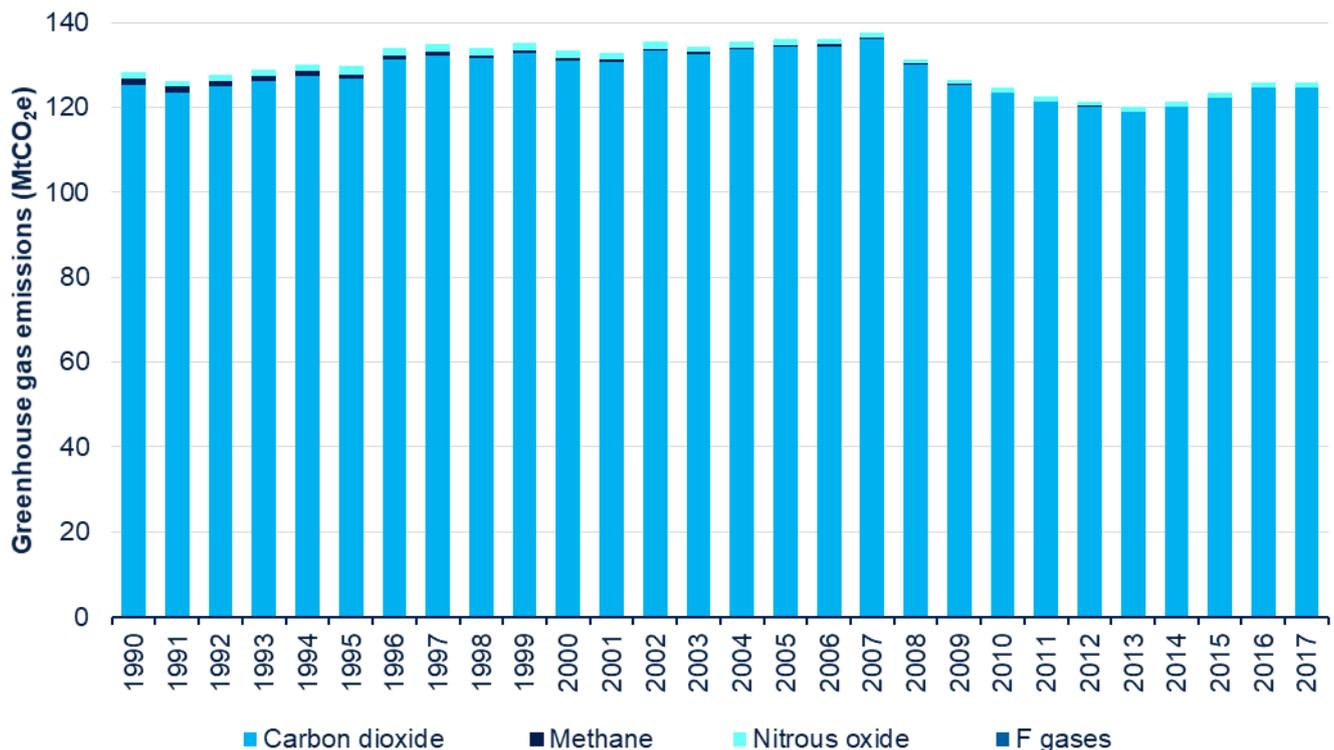
Table 6: Transport sector emissions by gas

UK, 1990-2017

	MtCO ₂ e							
	1990	1995	2000	2005	2010	2015	2016	2017
Carbon dioxide	125.4	126.8	131.0	134.3	123.4	122.2	124.6	124.6
Methane	1.3	0.9	0.6	0.4	0.2	0.1	0.1	0.1
Nitrous oxide	1.5	2.0	1.7	1.3	1.0	1.1	1.2	1.2
F gases	:	:	:	:	:	:	:	:
Total	128.1	129.7	133.3	136.0	124.5	123.5	125.9	125.9

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Note: A colon (:) means data are not available as there are no F gas emissions in this sector

Figure 6: Greenhouse gas emissions from transport, UK 1990-2017 (MtCO₂e)


Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 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 24 per cent of UK greenhouse gas emissions in 2017, with carbon dioxide being by far the most prominent gas for this sector (94 per cent). The main source of emissions from this sector is the use of natural gas and coal in electricity generation from power stations.

Between 1990 and 2017, there was a 60 per cent reduction in greenhouse gas emissions from the energy supply sector. 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 has historically been the largest emissions sector; however these reductions mean that since 2016 it has been the second largest sector (the largest sector 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. Coal use in generation reduced by 89 per cent between 1990 and 2017²⁰. Final consumption of electricity was 8 per cent higher in 2017 than it was in 1990, although it peaked in 2005 and has decreased since then²¹. Electricity generation in 2017 was also 8 per cent higher than in 1990, again it peaked in 2005 and has decreased since²².

There was a 26 per cent decrease in coal use for electricity generation between 2016 and 2017. This follows a large fall in 2016 driven by the increase in the carbon price floor in April 2015, from £9 per tonne of CO₂ to £18 per tonne of CO₂, which led to a shift away from coal towards gas²³. In 2017 there was also a fall in the use of gas for electricity generation of 4 per cent, whereas renewables saw a 13 per cent increase. This led to an overall 8 per cent decrease in emissions from the energy supply sector between 2016 and 2017. In 2017, total greenhouse gas emissions from power stations, at 73.1 MtCO₂e, accounted for 16 per cent of all UK greenhouse gas emissions.

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 MtCO₂e in 1990 to only 0.5 MtCO₂e in 2017.

²⁰ Digest of United Kingdom Energy Statistics, Table 5.1.1 Fuel input for electricity generation, 1970 to 2017

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/632667/DUKES_5.1.1.xls

²¹ Digest of United Kingdom Energy Statistics, Table 5.1.2 Electricity supply, availability and consumption, 1970 to 2017

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/632668/DUKES_5.1.2.xls

²² Digest of United Kingdom Energy Statistics, Table 5.1.3 Electricity generated and supplied, 1970 to 2017

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/632669/DUKES_5.1.3.xls

²³ 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>

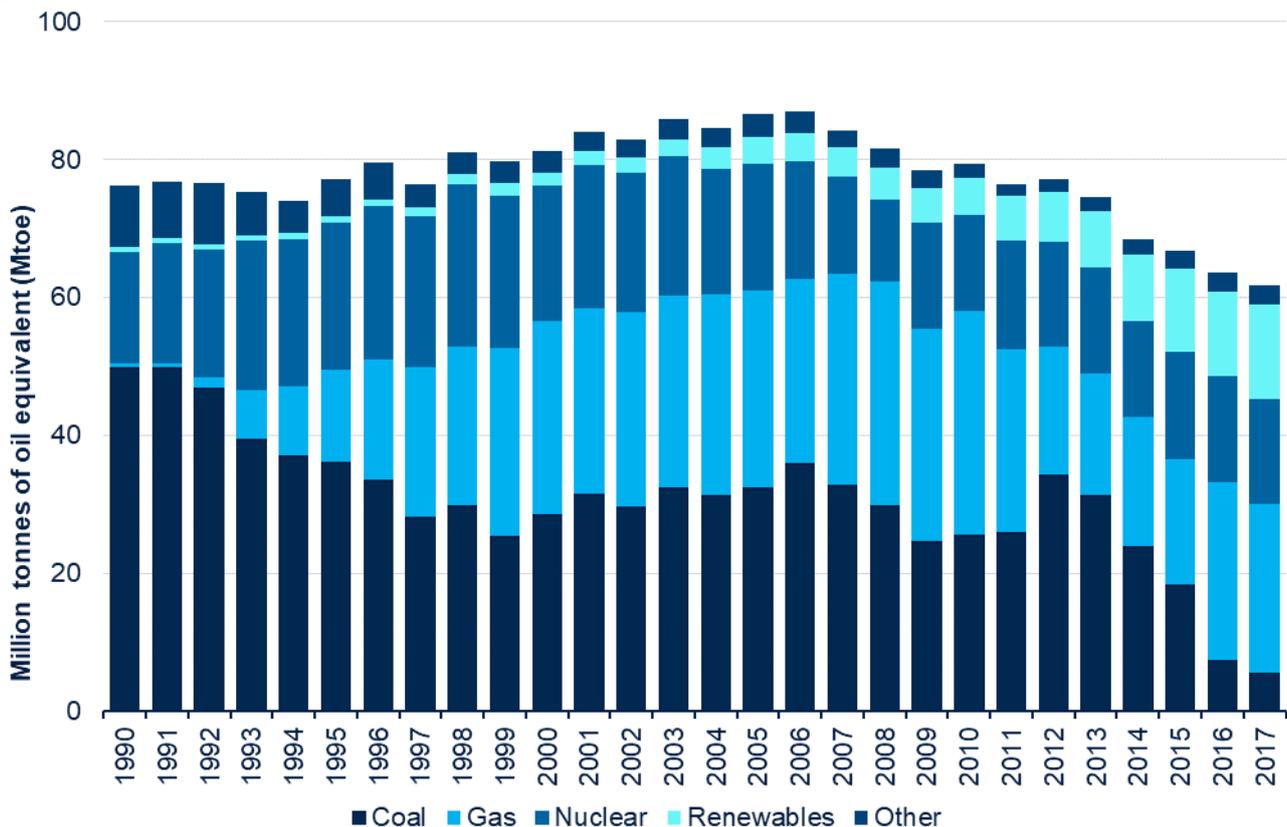
Table 7: Energy supply sector emissions by gas

UK, 1990-2017

	1990	1995	2000	2005	2010	2015	2016	2017
Carbon dioxide	242.1	210.3	204.0	219.1	197.3	137.6	115.2	106.0
Methane	34.4	26.5	16.5	11.2	9.1	6.7	5.8	5.8
Nitrous oxide	1.4	1.3	1.2	1.2	1.0	1.0	0.8	0.8
F gases	:	:	:	:	:	:	:	:
Total	277.9	238.0	221.6	231.5	207.4	145.3	121.8	112.6

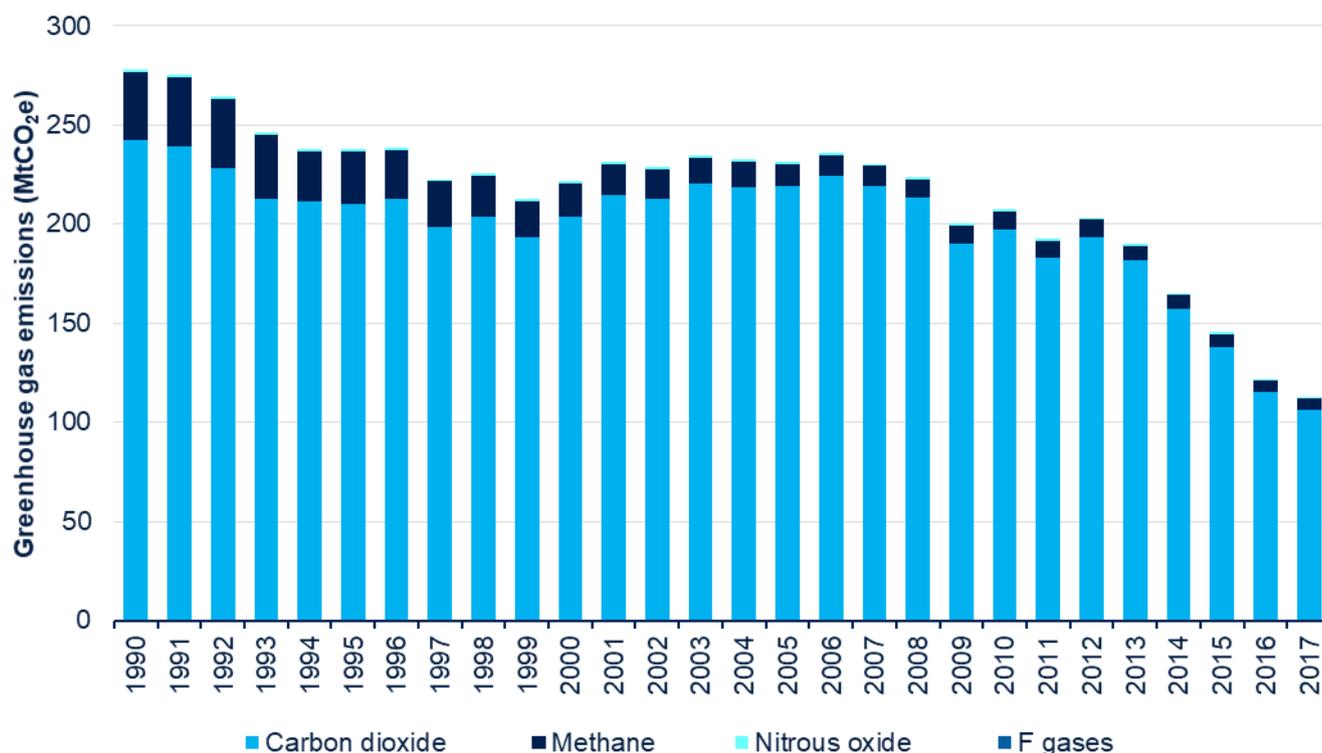
Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Note: A colon (:) means data are not available as there are no F gas emissions in this sector

Figure 7: Fuel used for UK electricity generation, UK 1990-2017 (Million tonnes of oil equivalent (Mtoe))


Source: Digest of United Kingdom Energy Statistics, Table 5.1.1 Fuel input for electricity generation, 1970 to 2017

<https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes>

Figure 8: Greenhouse gas emissions from energy supply, 1990-2017 (MtCO₂e)

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 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. It is estimated to have been responsible for 17 per cent of UK greenhouse gas emissions in 2017, 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 2017, emissions from the business sector were 30 per cent 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 41 per cent 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 slowed in recent years and in the last two years has reversed, as tighter controls on emissions leakages have been introduced.

Between 2016 and 2017 there was a 2 per cent decrease in emissions from the business sector, with the largest reduction in emissions being from commercial refrigeration as a result of the HFC phase down.

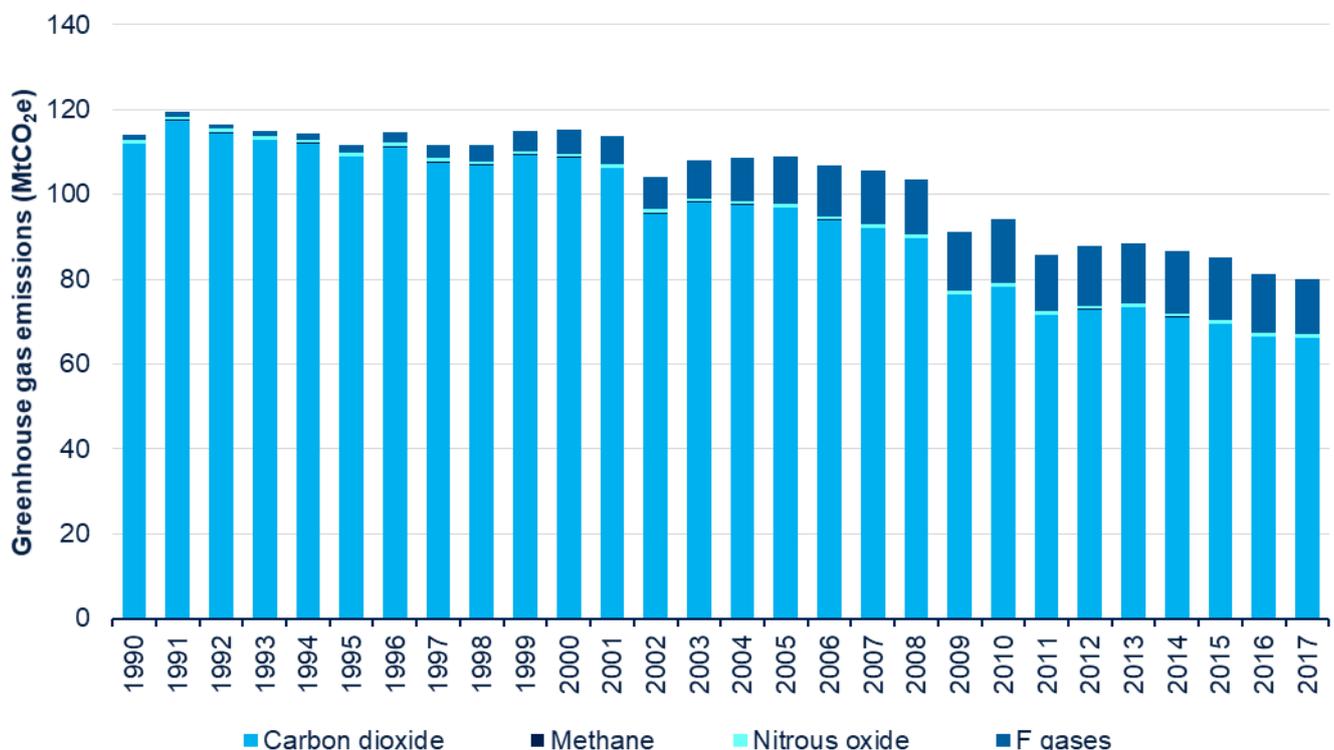
Table 8: Business sector emissions by gas

UK, 1990-2017

	1990	1995	2000	2005	2010	2015	2016	2017
Carbon dioxide	111.9	108.9	108.7	96.9	78.2	69.5	66.4	66.1
Methane	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2
Nitrous oxide	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.9
F gases	1.0	1.8	5.7	11.1	14.9	14.6	14.0	13.0
Total	114.0	111.8	115.4	108.9	94.1	85.1	81.4	80.1

Source: Table 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Figure 9: Greenhouse gas emissions from business, UK 1990-2017 (MtCO₂e)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 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 per cent of UK greenhouse gas emissions in 2017, with carbon dioxide being the most prominent gas for this sector (96 per cent). 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 2017, 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.

Temperature was the main driver of the 4 per cent reduction in residential emissions between 2016 and 2017. The average temperature across the year was on average 0.3 degrees Celsius higher in 2017 than in 2016, and in particular was on average 1.7 degrees higher between February and April²⁴, 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.

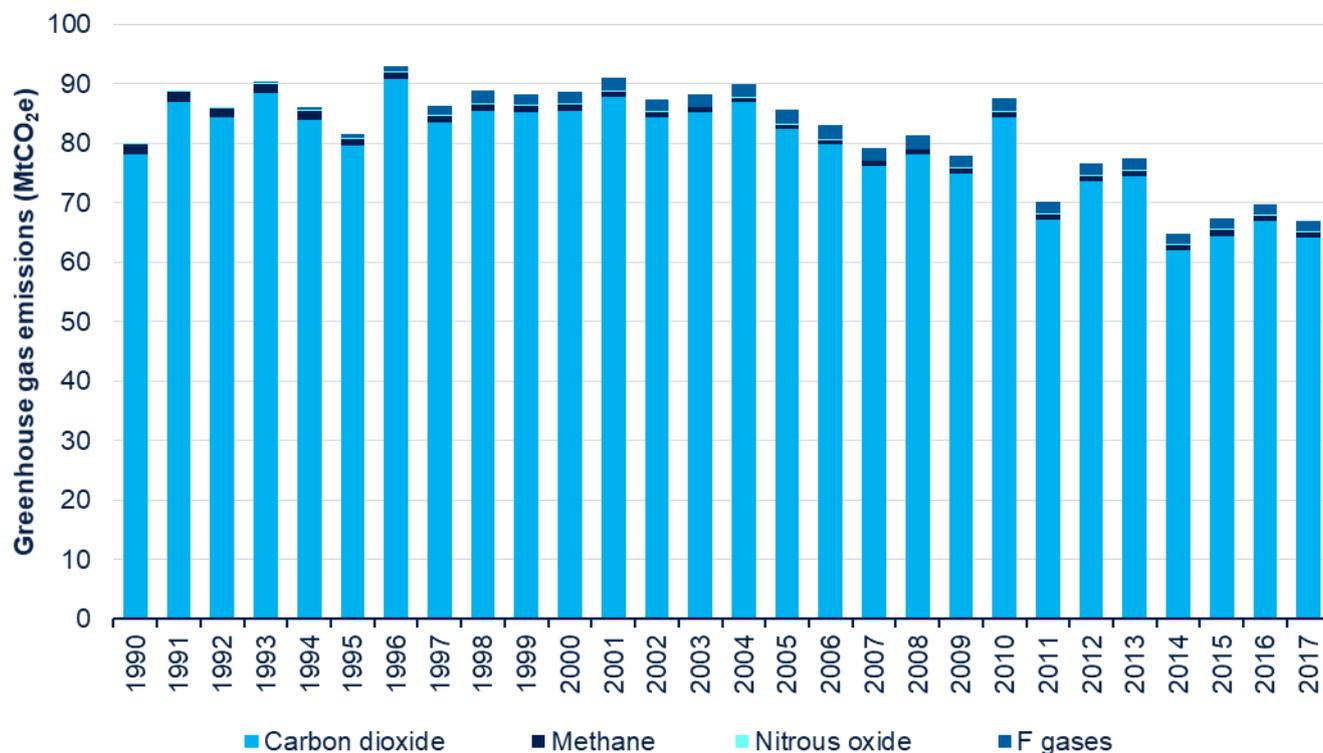
Table 9: Residential sector emissions by gas

UK, 1990-2017

	MtCO ₂ e							
	1990	1995	2000	2005	2010	2015	2016	2017
Carbon dioxide	78.3	79.6	85.6	82.5	84.5	64.5	66.9	64.1
Methane	1.5	1.1	1.0	0.7	0.9	0.9	1.0	1.0
Nitrous oxide	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
F gases	0.0	0.7	2.0	2.4	2.0	1.8	1.7	1.6
Total	80.1	81.6	88.7	85.7	87.5	67.4	69.8	66.9

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

²⁴ Energy Trends: Weather Table ET 7.1 Average temperatures, heating degree days and deviations from the long term mean https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/585958/ET_7.1.xls

Figure 10: Greenhouse gas emissions from the residential sector, UK 1990-2017 (MtCO₂e)

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

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 per cent of UK greenhouse gas emissions in 2017. Emissions of methane (56 per cent) and nitrous oxide (31 per cent) 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 1990 and 2017, greenhouse gas emissions from agriculture decreased by around 16 per cent, 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.

Between 2016 and 2017 there was a 1 per cent increase in emissions from the agriculture sector.

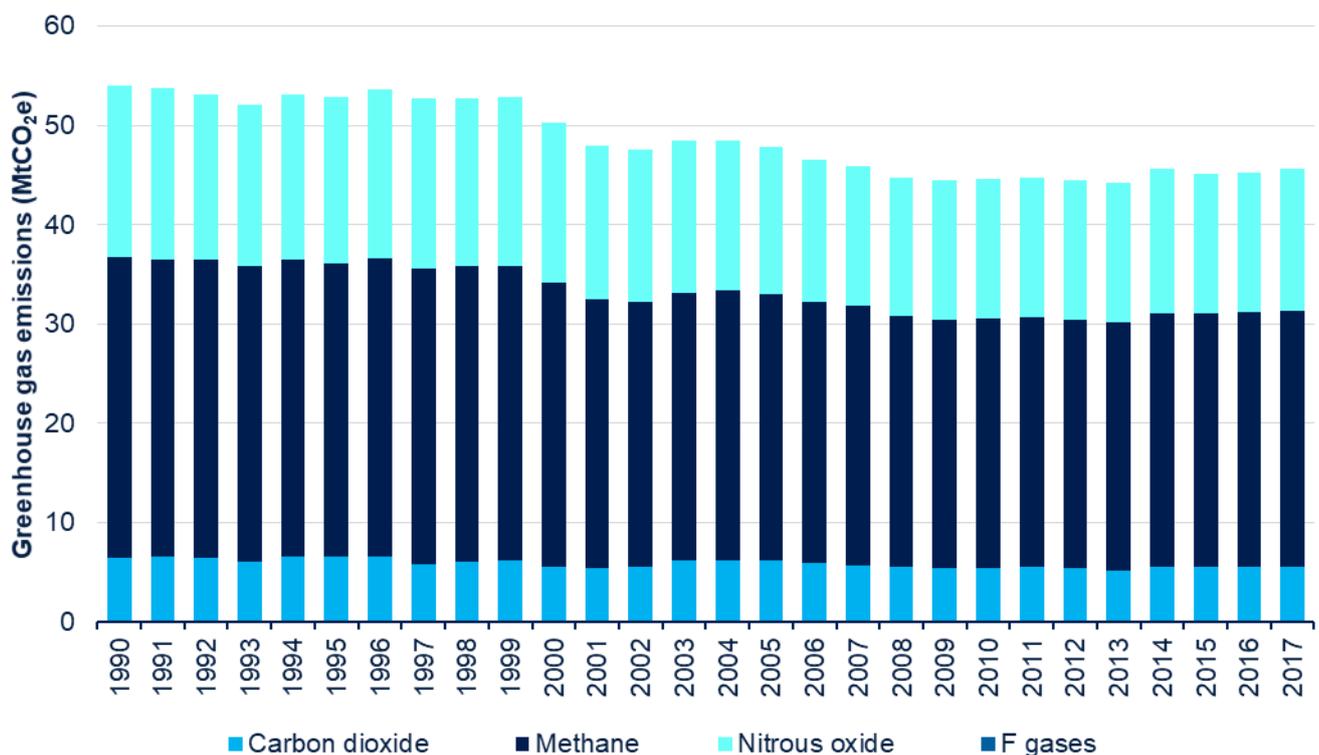
Table 10: Agriculture sector emissions by gas

UK, 1990-2017

	1990	1995	2000	2005	2010	2015	2016	2017
Carbon dioxide	6.5	6.5	5.5	6.1	5.4	5.5	5.5	5.6
Methane	30.3	29.6	28.7	26.8	25.2	25.6	25.6	25.7
Nitrous oxide	17.2	16.8	16.2	14.9	14.0	14.1	14.1	14.3
F gases	:	:	:	:	:	:	:	:
Total	54.0	52.9	50.3	47.9	44.6	45.1	45.2	45.6

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Note: A colon (:) means data are not available as there are no F gas emissions in this sector

Figure 11: Greenhouse gas emissions from agriculture, UK 1990-2017 (MtCO₂e)


Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 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 per cent of UK greenhouse gas emissions in 2017, with methane being by far the most prominent gas (accounting for 92 per cent of emissions). The vast majority of these emissions are from landfill sites.

Between 1990 and 2017, greenhouse gas emissions from the waste management sector decreased by 69 per cent. 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.

Emissions in the waste management sector rose by 1 per cent between 2016 and 2017 due mainly to increased emissions from landfill and waste-water handling.

Table 11: Waste management sector emissions by gas

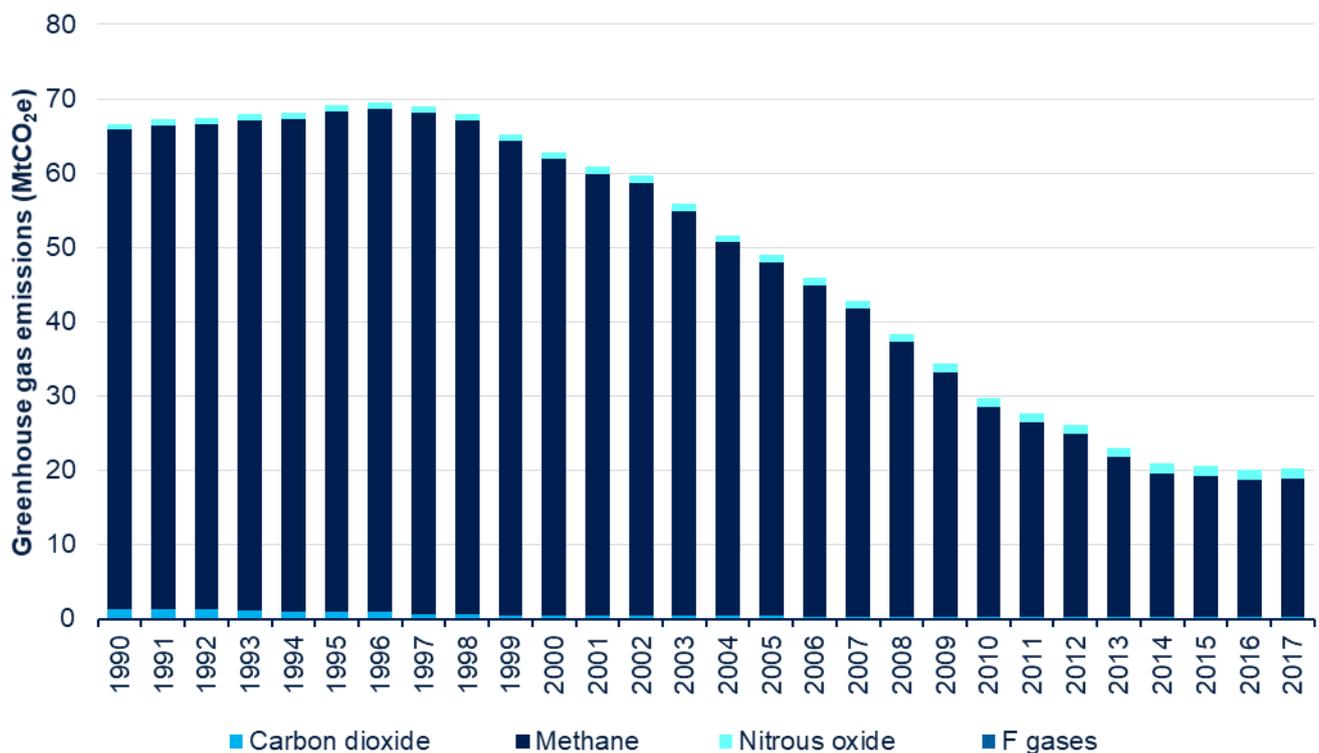
UK, 1990-2017

	MtCO ₂ e							
	1990	1995	2000	2005	2010	2015	2016	2017
Carbon dioxide	1.3	1.0	0.5	0.4	0.3	0.2	0.3	0.3
Methane	64.5	67.3	61.4	47.6	28.2	19.0	18.4	18.6
Nitrous oxide	0.8	0.8	0.9	1.0	1.2	1.4	1.4	1.4
F gases	:	:	:	:	:	:	:	:
Total	66.6	69.1	62.9	49.0	29.7	20.6	20.0	20.3

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Note: A colon (:) means data are not available as there are no F gas emissions in this sector

Figure 12: Greenhouse gas emissions from waste management, UK 1990-2017 (MtCO₂e)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 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 per cent of UK greenhouse gas emissions in 2017, 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 2017, there was a large reduction in greenhouse gas emissions from the industrial process sector, with an overall decrease of 82 per cent. 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 in 2017 compared to 2016 by 2 per cent. This was mainly caused by increased emissions from the use of gas in the production of ammonia and of iron and steel.

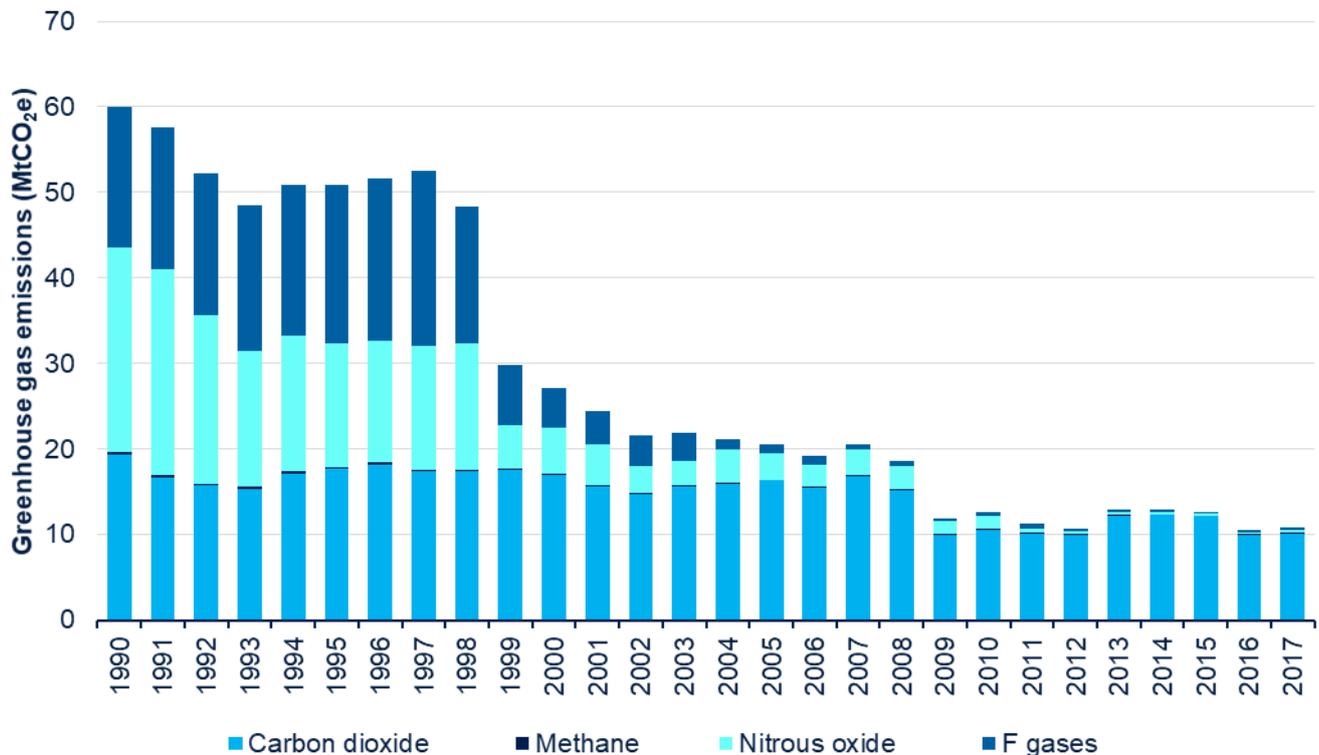
Table 12: Industrial process sector emissions by gas

UK, 1990-2017

	MtCO ₂ e							
	1990	1995	2000	2005	2010	2015	2016	2017
Carbon dioxide	19.4	17.7	16.9	16.3	10.6	12.1	10.0	10.2
Methane	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Nitrous oxide	23.9	14.4	5.4	3.1	1.5	0.3	0.3	0.3
F gases	16.3	18.5	4.6	1.0	0.4	0.3	0.3	0.3
Total	59.9	50.8	27.1	20.6	12.6	12.7	10.6	10.8

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Figure 13: Greenhouse gas emissions from industrial processes, UK 1990-2017 (MtCO₂e)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Public

The public sector consists of emissions from combustion of fuel in public sector buildings. It is estimated to have been responsible for less than 2 per cent of UK greenhouse gas emissions in 2017, 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 2017 there has been a general downward trend in greenhouse gas emissions from the public sector, which have fallen by 42 per cent 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 2016 and 2017 emissions decreased by 4 per cent 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.

Table 13: Public sector emissions by gas

UK, 1990-2017

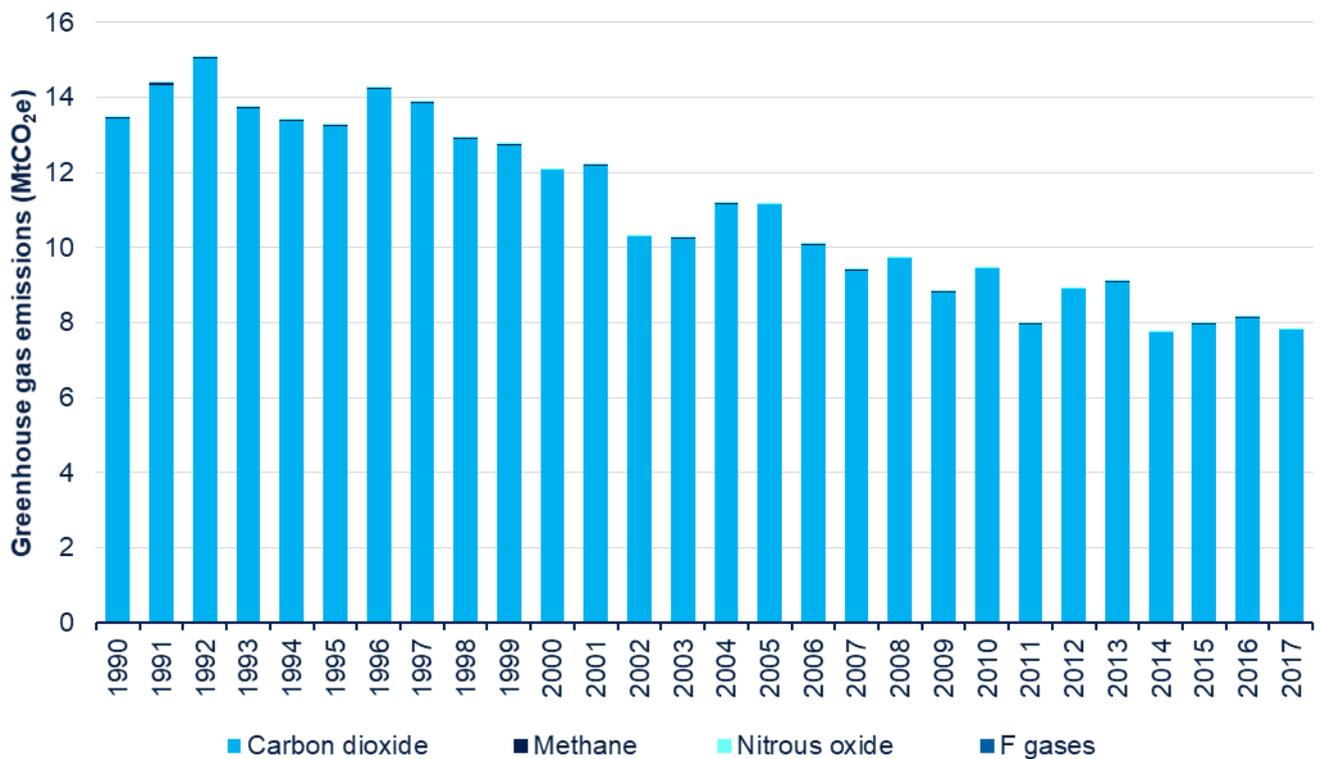
	MtCO ₂ e							
	1990	1995	2000	2005	2010	2015	2016	2017
Carbon dioxide	13.4	13.2	12.1	11.1	9.4	7.9	8.1	7.8
Methane	~0.0	~0.0	~0.0	~0.0	~0.0	~0.0	~0.0	~0.0
Nitrous oxide	~0.0	~0.0	~0.0	~0.0	~0.0	~0.0	~0.0	~0.0
F gases	:	:	:	:	:	:	:	:
Total	13.5	13.3	12.1	11.2	9.5	8.0	8.2	7.8

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Note: A colon (:) means data are not available as there are no F gas emissions in this sector.

~0.0 indicates where a value is non-zero but is less than 0.05 MtCO₂ in magnitude.

Figure 14: Greenhouse gas emissions from the public sector, UK 1990-2017 (MtCO₂e)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 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. It acted as a net sink²⁵ of UK greenhouse gas emissions in 2017, dominated by carbon dioxide removals. In general, cropland is the largest source of carbon dioxide emissions, and forest land is the dominant sink.

In the UK the LULUCF sector is estimated to have gone from a small net emitter of greenhouse gases in 1990 (0.3 MtCO_{2e}) to a net sink in every year from 1991-2017, with the estimated size of the sink in 2017 being 9.9 MtCO_{2e}. This has been driven by a reduction in emissions from land being converted to cropland 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 less intensive agricultural practices.

Between 2016 and 2017 there was a 1 per cent increase in the size of the net sink provided by the LULUCF sector.

Table 14: LULUCF sector emissions by gas

UK, 1990-2017

	MtCO _{2e}							
	1990	1995	2000	2005	2010	2015	2016	2017
Carbon dioxide	-2.0	-3.9	-6.0	-8.9	-10.7	-11.2	-11.3	-11.3
Methane	~0.0	~0.0	~0.0	~0.0	~0.0	~0.0	~0.0	~0.0
Nitrous oxide	2.3	2.2	2.1	1.8	1.6	1.4	1.4	1.4
F gases	:	:	:	:	:	:	:	:
Total	0.3	-1.7	-3.9	-7.1	-9.1	-9.7	-9.8	-9.9

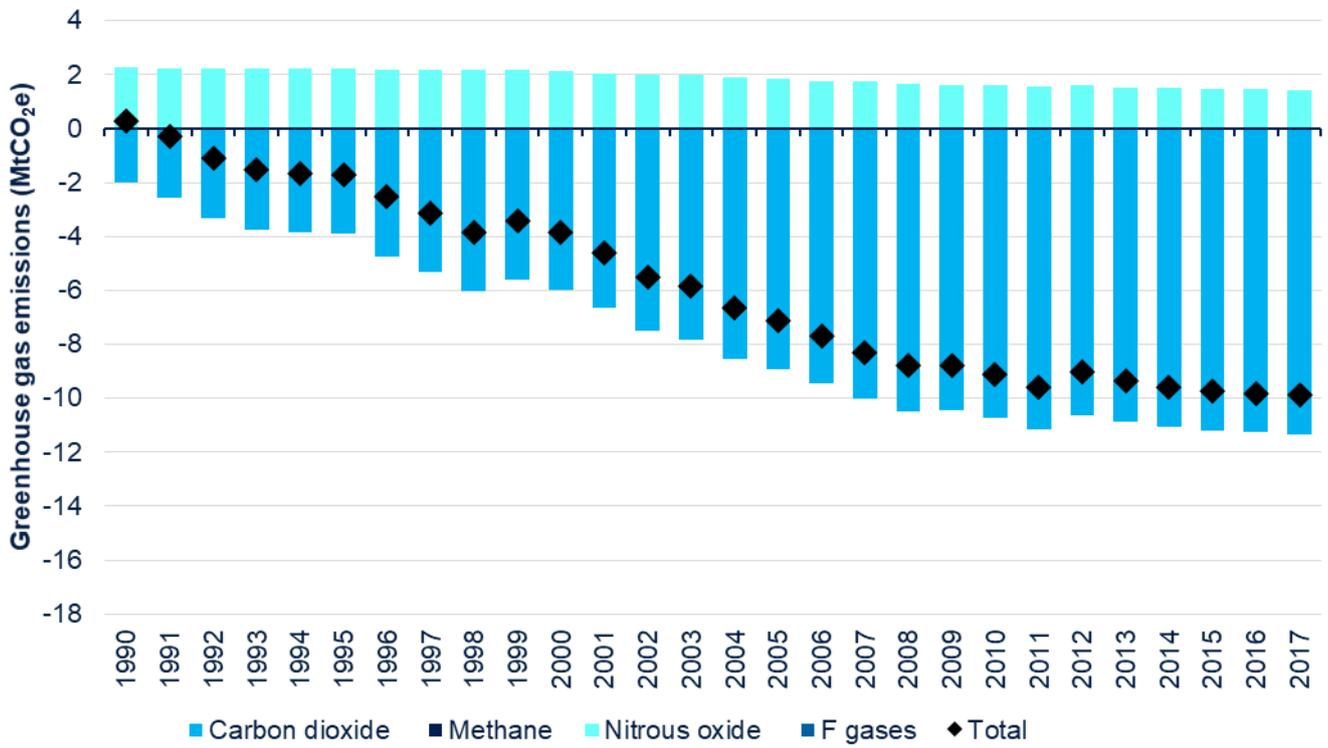
Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Note: A colon (:) means data are not available as there are no F gas emissions in this sector

~0.0 indicates where a value is non-zero but is less than 0.05 MtCO₂ in magnitude.

²⁵ 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”.

Figure 15: Greenhouse gas emissions from the LULUCF sector, UK 1990-2017 (MtCO₂e)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Emissions from UK-based international aviation and shipping bunkers

Emissions from international aviation and shipping can be estimated from refuelling from bunkers²⁶ 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 Organisation (ICAO) and International Maritime Organisation (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 Organisation, 191 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 with reductions from other sectors, with the aim of delivering carbon-neutral growth of the sector from 2020²⁷.

In 2017, emissions from international aviation fuel use were estimated to be 35.0 MtCO₂e. This was 4 per cent larger than the 2016 figure. Between 1990 and 2006, when emissions peaked, emissions more than doubled from 15.5 MtCO₂e to 35.6 MtCO₂e. Since 2006 emissions have flattened out. 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 7.8 MtCO₂e in 2017, a 9 per cent decrease from the 2016 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.

²⁶ A large container or compartment that stores fuel for ships.

²⁷ <https://www.icao.int/environmental-protection/CORSIA/Pages/default.aspx>

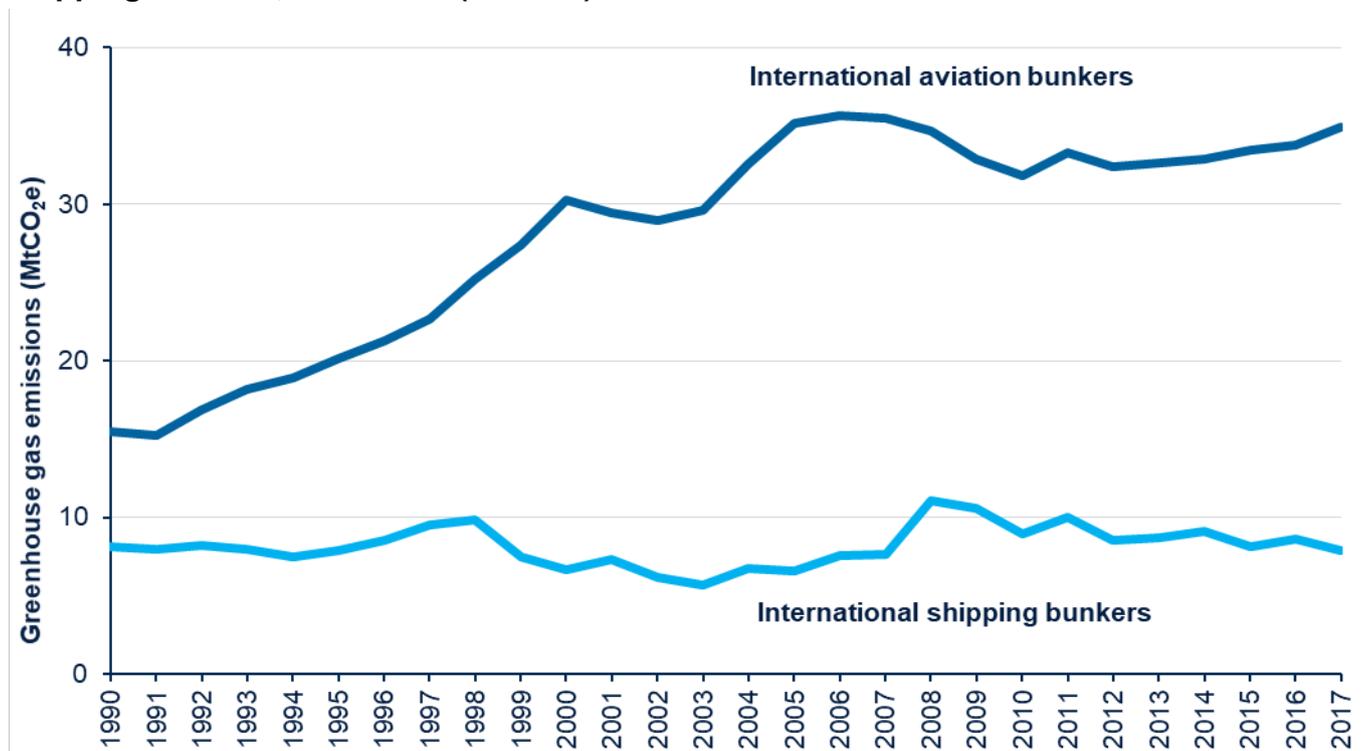
Table 15: Greenhouse gas emissions from UK-based international aviation and shipping bunkers

UK, 1990-2017

	1990	1995	2000	2005	2010	2015	2016	2017
International aviation	15.5	20.1	30.2	35.1	31.8	33.5	33.7	35.0
International shipping	8.1	7.9	6.7	6.6	9.0	8.1	8.6	7.8
Total	23.7	28.0	36.9	41.7	40.8	41.6	42.3	42.8

Source: Table 8, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Figure 16: Greenhouse gas emissions from UK-based international aviation and shipping bunkers, 1990-2017 (MtCO₂e)



Source: Table 8, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Revisions from provisional estimates of greenhouse gas emissions

Provisional estimates of 2017 UK greenhouse gas and carbon dioxide emissions were published in March 2018, 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-CO₂ emissions which are only crudely estimated 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 2017 for the UK would be 455.9 million tonnes carbon dioxide equivalent, representing a 2.6 per cent decrease on 2016 emissions. The final estimates show that 2017 emissions were 460.2 million tonnes, representing a 2.7 per cent decrease on 2016 emissions. The provisional greenhouse gas emissions estimates therefore slightly underestimated total greenhouse gas emissions (by 0.9 per cent) and slightly underestimated the percentage decrease in emissions from 2016 to 2017 (by 0.2 percentage point).

The provisional estimates are focused on carbon dioxide emissions from the energy sector, and only provided a crude estimate of non-CO₂ gases which assumed that 2017 emissions for non-CO₂ gases were the same as emissions in 2016. Looking just at carbon dioxide emissions, it was provisionally estimated that net UK carbon dioxide emissions in 2017 would be 366.9 million tonnes. The final 2017 figure of 373.2 million tonnes therefore shows that the provisional estimate underestimated CO₂ emissions by 1.7 per cent.

The provisional estimate of non-CO₂ gases was 89.0 MtCO₂e (based on final 2016 emissions) and the final estimate is 87.0 MtCO₂e so these emissions are 2.3 per cent lower than reported in the provisional estimates. This was largely due to methodological changes, as the final 2017 non-CO₂ figure represents a 0.3 per cent decrease on 2016 emissions.

Table 16: Comparison of 2017 provisional and final estimates

UK, 2016-2017

	MtCO ₂ e				
	2017 Provisional estimates	2017 Final estimates	Difference between final and provisional	Provisional 2016 to 2017 % change	Final 2016 to 2017 % change
Total CO ₂	366.9	373.2	6.3	-3.2%	-3.3%
Total greenhouse gas emissions	455.9	460.2	4.3	-2.6%	-2.7%

Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables
 Table 1, Provisional UK greenhouse gas emissions national statistics 2017 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 United Nations Framework Convention on Climate Change (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 Report²⁸ (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.

The most notable changes to the historical series since the 2018 Greenhouse Gas Inventory was published are revisions to the LULUCF and agriculture sectors.

Details of the changes made to estimates of 1990 and 2016 emissions are given below. Revisions to other years of the time series are of a similar scale.

²⁸ Previous UK NIRs can be found here: <http://naei.beis.gov.uk/reports/> and the latest NIR covering 1990-2017 emissions will be submitted to the UNFCCC on 15th April 2019.

Table 17: Revisions in the 2019 greenhouse gas inventory, by sector

UK, 1990 and 2016

	1990 emissions			2016 emissions			MtCO ₂ e
	2018	2019	Change	2018	2019	Change	
	inventory	inventory		inventory	inventory		
Energy supply	277.9	277.9	~0.0	120.2	121.8	1.6	
Transport	128.1	128.1	~0.0	125.8	125.9	0.2	
Business	114.7	114.0	-0.7	81.5	81.4	-0.2	
Residential	80.2	80.1	-0.1	69.8	69.8	~0.0	
Agriculture	55.3	54.0	-1.3	46.5	45.2	-1.3	
Waste management	66.7	66.6	-0.1	19.9	20.0	0.1	
Industrial processes	59.9	59.9	~0.0	10.5	10.6	~0.0	
Public	13.5	13.5	~0.0	8.2	8.2	~0.0	
LULUCF	-2.1	0.3	2.4	-14.6	-9.8	4.8	
Total	794.2	794.4	0.2	467.9	473.1	5.2	

~0.0 indicates where a value is non-zero but is less than either 0.05 MtCO₂ in magnitude.

Source: Table 3, Final UK greenhouse gas emissions national statistics 1990-2017 Data tables

Table 3, Final UK greenhouse gas emissions national statistics 1990-2016 Data tables

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

Change in fossil-carbon factors used for Municipal Solid Waste (MSW)

Previously, a UK-specific set of emission factors for MSW were used. These were derived using a limited set of UK-specific waste composition data. However, the factors were very uncertain as UK data only covered the period 1990-2011. Factors for later years were assumed to be equal to the figure for 2011.

Given the increasing uncertainty associated with the UK-specific data, the emissions factors have been updated to use the Intergovernmental Panel on Climate Change (IPCC) 2006 inventory guidelines' default values. This has resulted in more conservative estimates and ensures consistency with the inventory's methodology for estimating the biogenic carbon content of MSW. This is because the old approach applied emission factors to the sum of biodegradable and non-biodegradable wastes in the UK energy statistics whereas the new approach applies factors to just the non-biodegradable wastes. The ratio of non-biodegradable to biodegradable waste in the energy statistics is quite different in different years so the impact of the new methodology also changes from year to year.

Adjustments to Forest Land inventory processes

As part of the process of generating the greenhouse gas emissions inventory for Forest Land, a program called "Reconcile" is used to take information from the forest inventories for the private sector forest and the public forest estate and assigns the forest areas to either afforestation or restocking.

Parameters are optimised to achieve a volume production forecast from CARBINE, a land use model, that matches as closely as possible the published wood production statistics. In

previous greenhouse gas inventory forecasts this was done manually. The process has now been automated and some adjustments made to the parameters used in the model as a result.

Landfill methane corrections

A correction was applied to misreported methane flaring data for England and Wales for the years 2008 to 2016 inclusive, provided by the Environment Agency. The misreport involved presenting data in incorrect units for 2015, and misallocating gas between flaring and combustion in engines. This impacted the volume of methane calculated as being emitted from landfill in England and Wales between 2008 and 2016.

Additionally, in 2016 the quantity of waste landfilled in Northern Ireland was estimated as data were not available from the Northern Ireland Environment Agency (NIEA) in time for the compilation of the National Atmospheric Emissions Inventory (NAEI). During compilation of the 2017 inventory, 2016 data was obtained from NIEA and consequently waste estimates and CH₄ emissions were recalculated.

Implementation of biofuels carbon factors research

Biofuel carbon factors have been reviewed, including reassessing the fossil content of mixed fossil/biogenic fuels. This includes:

- Fossil carbon factors for FAME (Fatty Acid Methyl Ester, which comprises most biodiesels), which was previously assumed to be 100% biogenic;
- Fossil carbon factors for bio-MTBE, which is a minor road fuel not previously included in the NAEI; and,
- Revised fossil carbon factors for natural gas to account for the increasing contribution of biogas injected into the national grid.

These changes to fossil carbon factors affect most emissions sectors. Biogenic carbon emissions are accounted for via LULUCF carbon stock balances rather than at the point of emission, so revisions to the biogenic carbon factors will not impact the national total.

Updated agriculture data

There have been no specific changes to the methodology this year. There were some revisions to activity data, including decreasing the 2016 value for urea fertiliser use. Minor error corrections throughout the inventory have resulted in a small decrease to the estimate of total GHG emission from UK agriculture across the time series by 1.7% and 1.9% for 1990 and 2016 respectively.

Update to EMEP/EEA Guidebook N₂O emission factors

The N₂O emissions factor for inland waterways using gas oil and diesel has been changed to align with the latest version of the European Monitoring and Evaluation Programme/European Environment Agency (EMEP/EEA) Guidebook. The factors for diesel-fuelled machinery were reduced by a factor of 10 in the latest 2016 Guidebook, compared with the 2005 version.

In addition, the factor used for shipping was increased by a factor of 1.9 to bring it in line with the N₂O factors currently used for coastal shipping engines using gas oil, and the factors for

diesel-fuelled machinery were reduced by a factor of 10. This brings the factors more in line with factors used for other types of diesel machinery (e.g. rail).

Correction of error in recording of deadwood in forests

A double-counting of carbon in litter due to turnover and harvest was identified. Deadwood had previously been counted in both felled and restocked stands; e.g. carbon for deciduous foliage could enter the litter pool as both turnover at senescence and as residue from harvest. This had exaggerated the size of the sink provided by LULUCF and has since been corrected. As a result, the estimate of the size of the LULUCF sink has reduced by 3.5 Mt in 2016.

Other model upgrades

There have been a range of other minor changes made to the estimates, predominantly to the LULUCF models. A large range of minor improvements have been made including updates to the average living biomass densities for cropland and grassland, updates to the average forest biomass densities used in estimating wildfire and controlled burning emissions and changes to the way land is modelled in overseas territories and crown dependencies. Estimates of the amount of nitrous oxide used for recreational purposes have also now been included in the NAEI for the first time.

Overall impact on emissions

In total, the changes made to the methods and data for the 2019 inventory submission increase estimates of emissions in 1990 and 2016 by around 0.2 MtCO_{2e} and 3.8 MtCO_{2e} respectively. This is not an indication of the 2019 inventory submission as a whole as it does not include annual variations in the UK's emitting activities, for example national fuel use.

Estimating emissions on a temperature adjusted basis

BEIS publish provisional estimates of temperature adjusted emissions²⁹, 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 2016 and 2017 were estimated to be 384.6 Mt and 374.8 Mt respectively. The decrease in carbon dioxide emissions between 2016 and 2017 in the temperature adjusted figures is therefore 9.9 Mt, which is slightly less than the decrease seen in the non-temperature adjusted figures (as can be seen in the table below). This suggests that the underlying change between 2016 and 2017 when adjusted for temperature would be less than the 3.3 per cent shown.

Table 18: Comparison of provisional emissions estimates with final emissions estimates
UK, 2016-2017

	MtCO ₂ e			
	2016 CO ₂ emissions (Mt)	2017 CO ₂ emissions (Mt)	Absolute change (Mt)	Percentage change
Final estimates				
➤ unadjusted emissions	385.8	373.2	-12.6	-3.3%
Provisional estimates				
➤ unadjusted emissions	378.9	366.9	-12.0	-3.2%
Provisional estimates				
➤ Temperature adjusted emissions	384.6	374.8	-9.9	-2.6%

Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2017 Data tables
Table 3 & 4, Provisional UK greenhouse gas emissions national statistics 2017 Excel data tables

Note: The provisional emissions estimates differ from the emissions estimates in these statistics because they were published before the 2017 figures presented were finalised.

²⁹ Provisional UK greenhouse gas emissions:

<https://www.gov.uk/government/collections/provisional-uk-greenhouse-gas-emissions-national-statistics>

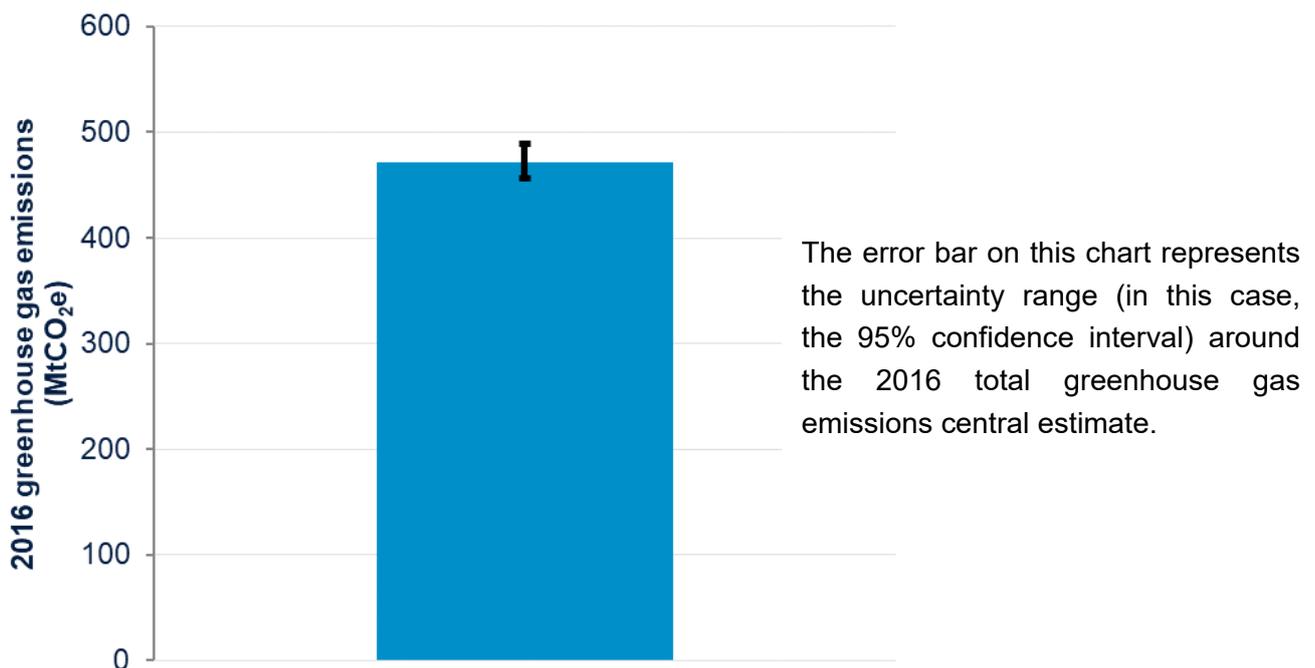
Background Information

Uncertainties

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. Uncertainty in greenhouse gas emissions estimates is believed to be within 3 per cent, as shown in Figure 17 (which is based on uncertainty analysis of 2016 emissions, as published in 2018). Estimates of 2017 uncertainties will be published on 28th March 2019.

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 17: Illustration of uncertainty in UK greenhouse gas emissions, UK, Crown Dependencies and Overseas Territories, 2016 (MtCO_{2e})



Source: Table 10, Final UK greenhouse gas emissions national statistics 1990-2017 Excel data tables

Coverage of emissions reporting

The emissions reported in this statistical release are defined as by source, meaning emissions are attributed to the sector that emits them directly. These high-level sectors are made up of a number of more detailed sectors, which follow the definitions set out by the Intergovernmental

Panel on Climate Change (IPCC³⁰), and which are used in international reporting tables that are submitted to the United Nations Framework Convention on Climate Change (UNFCCC) every year.

The basket of greenhouse gases covered by the Kyoto Protocol consists of seven gases: carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride. The last four gases are collectively referred to as fluorinated gases or F gases. In accordance with international reporting and carbon trading protocols, each of these gases is weighted by its global warming potential (GWP), so that total greenhouse gas emissions can be reported on a consistent basis. The GWP for each gas is defined as its warming influence relative to that of carbon dioxide. Greenhouse gas emissions are then presented in carbon dioxide equivalent units.

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

Unless otherwise stated, any figures included in this release represent emissions from within the UK (excluding its Crown Dependencies: Jersey, Guernsey, and the Isle of Man) and are expressed in millions of tonnes of carbon dioxide equivalent (MtCO_{2e}).

Reporting of greenhouse gas emissions under the Kyoto Protocol is based on emissions in the UK, its Crown Dependencies (Bailiwick of Jersey, Bailiwick of Guernsey, Isle of Man), and those Overseas Territories (Cayman Islands, Falkland Islands and Gibraltar) that are provisionally party to the UK ratification of the Kyoto Protocol for the second commitment period. This includes emissions from all direct flights and shipping between the UK and these Territories. The Kyoto Protocol also uses a narrower definition of carbon sinks than that applied for domestic UK carbon dioxide reporting, which therefore results in a slightly different emissions total.

Reporting of greenhouse gas emissions for the UK’s Carbon Budgets only includes emissions within the UK, excluding emissions from Crown Dependencies and Overseas Territories and emissions from Nitrogen Trifluoride (NF₃).

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 2017, although the inventory reported to the UN includes emissions from certain overseas territories which are excluded from these statistics except where specifically stated.

³⁰ IPCC: <https://www.ipcc.ch/reports/>

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.

The EU ETS operates as a *cap and trade* system, which means that there is a finite limit of allowances in the System (i.e. the cap). Currently, any installation or aviation operator within the System in the EU (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, so as to cover the deficit. Conversely, installations with a surplus of emissions compared with their cap are allowed to either sell allowances or carry them over into the following year's allocation, thus providing a financial incentive to reduce emissions.

The System is now in Phase III, which will cover the eight year period 2013-2020. Phase III has seen changes to some of the parameters of the system, but there has been no change to the ultimate cap and trade basis of the EU ETS. Final results of the net ETS position are currently available for each year of Phase I, which covered the three year period 2005-2007, and also for each year of Phase II, which covered the period 2008-2012. For UK carbon budget reporting purposes, a notional UK cap must be estimated for each year between 2013 and 2020.

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.

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.

Future updates to emissions estimates

On Thursday 28th March 2019 BEIS will publish a breakdown of 1990-2017 UK emissions by end-user sector and fuel type, to supplement the source sector breakdown published today.

On Thursday 28th March 2019 BEIS will also publish provisional estimates of UK greenhouse gas emissions for 2018. This will coincide with the publication of Energy Trends statistics, which will include estimates of 2018 UK energy consumption.

Further information

Further information on UK greenhouse gas emissions statistics, including Excel tables with additional data on UK emissions, can be found on the Gov.uk website at:

<https://www.gov.uk/government/collections/uk-greenhouse-gas-emissions-statistics>

Background notes

1. A full set of data tables can be accessed via the [Final UK greenhouse gas emissions national statistics](#) pages of the Gov.uk website.
2. This statistical release and the related data tables are the first release of data from the National Atmospheric Emissions Inventory (NAEI) for 1970-2017, 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](#).
3. The UK's National Inventory Report (NIR) for 1990-2017 will be submitted to the United Nations Framework Convention on Climate Change (UNFCCC) on 15th April 2019. The report will contain national greenhouse gas emissions estimates for 1990-2017 and descriptions of the methods used to produce the estimates. Previous reports can be found on the [NAEI website](#).
4. The [background quality report](#) provides a summary of quality issues relating to statistics on UK greenhouse gas (GHG) emissions.
5. 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.
6. Further information about the Kyoto Protocol can be found on the [UNFCCC's website](#).
7. Further details of the European Union Emissions Trading System can be found at the [EU ETS section of the Gov.uk website](#).
8. 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 Gov.uk website.
9. Under the Climate Change Act, the Annual Statement of Emissions for 2017 must be laid before Parliament and published no later than 31st March 2019. This will give details of the

net UK carbon account for 2017, which is used to determine compliance with the targets and budgets under the Act.

10. The latest UK energy statistics, including revisions to earlier years' data, can be found in the [2018 Digest of UK Energy Statistics](#).
11. Detailed UK temperature data can be found on both the [Met Office website](#) and the [Weather Statistics section of the Gov.uk website](#).
12. When emissions are measured on this basis, UK emissions account for less than 2 per cent of the global total, based on a range of estimates produced by the UN, the IEA, the World Resources Institute and the EIA, amongst others.
13. Similar results for non-greenhouse gas atmospheric pollutants are published by Defra in its statistics on [Emissions of air pollutants in the UK](#).
14. 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.

This publication is available from: <https://www.gov.uk/government/collections/final-uk-greenhouse-gas-emissions-national-statistics>

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