



Department for
Business, Energy
& Industrial Strategy



2016 UK GREENHOUSE GAS EMISSIONS, FINAL FIGURES

Statistical Release: National Statistics



6 February 2018

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

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Executive Summary

This publication provides the latest estimates of 1990-2016 UK greenhouse gas emissions, which are presented in carbon dioxide equivalent units throughout this statistical release.

Key findings

In 2016, UK emissions of the basket of seven greenhouse gases covered by the Kyoto Protocol¹ were estimated to be 467.9 million tonnes carbon dioxide equivalent (MtCO₂e), a decrease of 5.0 per cent compared to the 2015 figure of 492.4 million tonnes.

This decrease in emissions was mainly caused by:

- Reductions in the energy supply sector, down 16.8 per cent (24.2 MtCO₂e) driven by a large decrease in power station emissions due to a change in the fuel mix for electricity generation, with less use of coal (from the conversion of a unit at the Drax plant from coal to biomass and the closure of some plants) and increased use of gas.
- A decrease of 5.4 per cent (4.6 MtCO₂e) in the business sector, driven by a reduction in emissions from fuel used in the iron and steel sector due to the closure of one of the UK's three integrated steelworks in September 2015.

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 2016. The latest figures show:

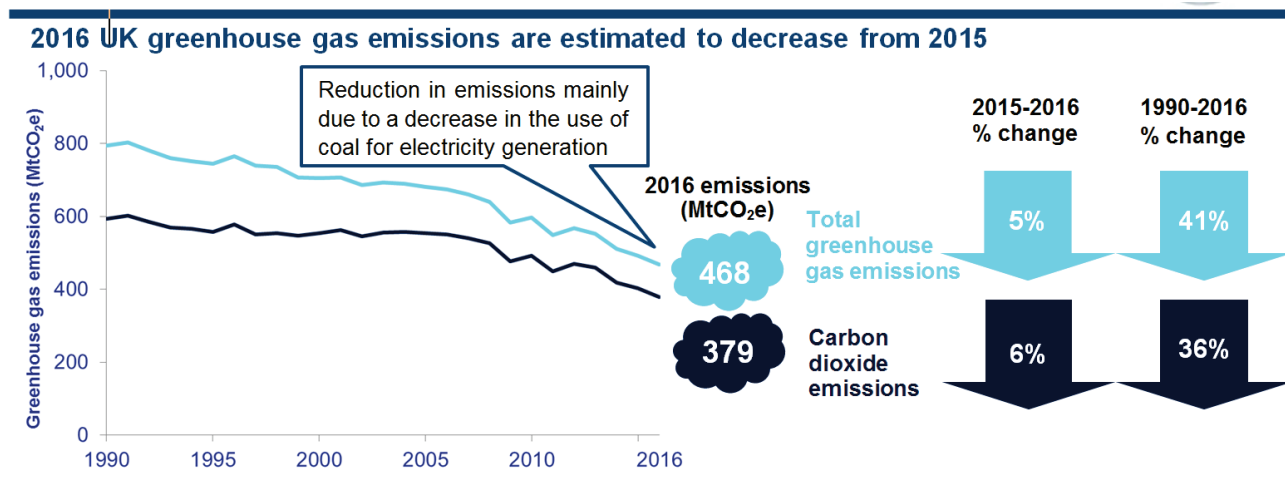
- UK net 2016 CO₂ emissions were estimated to be 378.9 million tonnes (Mt), which was around 5.9 per cent lower than the 2015 figure of 402.5 Mt. This decrease in CO₂ emissions was mainly due to the large decrease in the use of coal for electricity generation (as described above).

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 is on track to meet the second carbon budget, with annual 2013-2016 emissions that are each below the annual average emissions level of the budget period (556.4 MtCO₂e).
- UK emissions in 2016 were 41 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



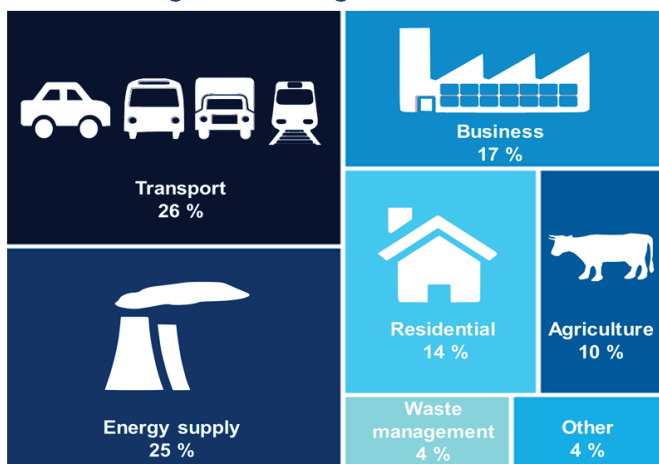
The UK is on track to meet the Second Carbon Budget

2nd Carbon Budget
(2013-17) level

2,782
MtCO₂e

The second Carbon Budget figures will not be finalised until 2019.

Transport becomes the largest emitting sector of UK 2016 greenhouse gas emissions



Other includes Public and Industrial Process sectors (the Land Use, Land Use Change and Forestry (LULUCF) sector is excluded from the sector statistics above as it acted as a net sink of emissions). Please note the percentages above do not sum to 100% due to rounding.

Energy supply and business sectors delivered the largest reductions in emissions from 2015 to 2016

	2015-2016 % change	1990-2016 % change
Energy supply	17%	57%
Waste management	5%	70%
Business	5%	29%
Other	10%	75%
Agriculture	0%	16%
LULUCF	4%	590%
Transport	2%	2%
Residential	4%	13%

LULUCF has a large decrease from 1990-2016 as emissions have gone from being a small net sink in 1990 (-2.1 MtCO₂e) to a much larger net sink of emissions in 2016 (-14.6 MtCO₂e).

Introduction

This publication provides the latest estimates of UK greenhouse gas (GHG) emissions from 1990-2016 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.

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 1990-2015 emissions figures have been revised since the previous publication in February 2017, 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 variables².

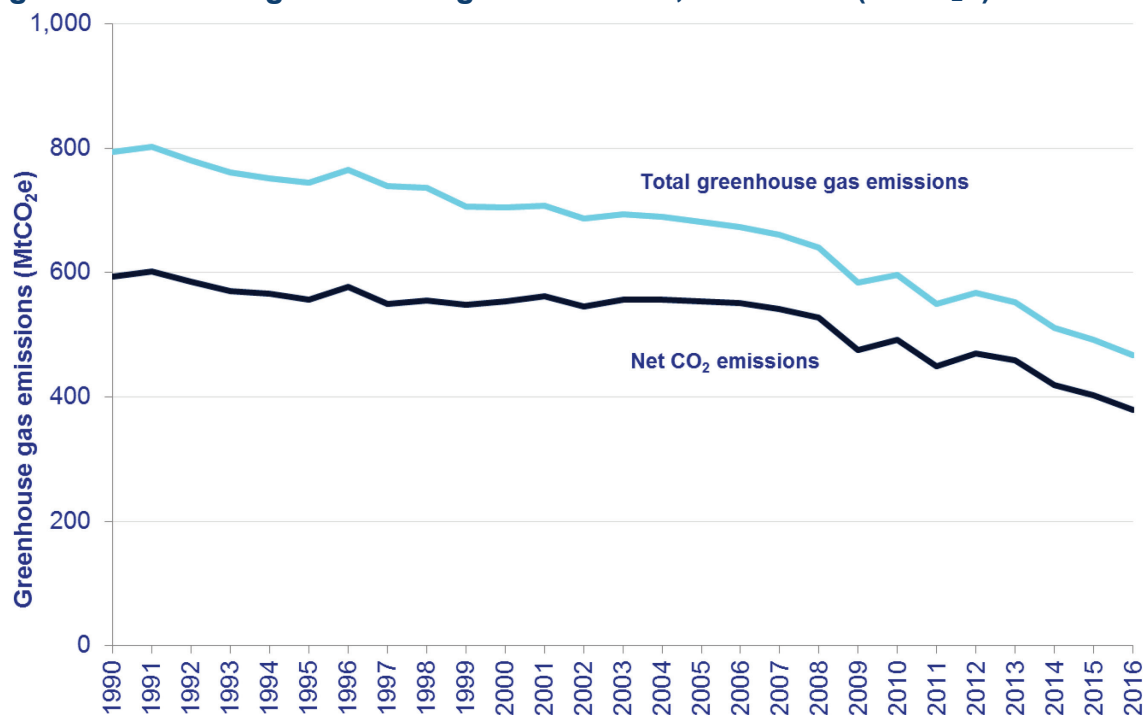
² Energy and emissions projections: <https://www.gov.uk/government/collections/energy-and-emissions-projections>

2016 total greenhouse gas emissions

In 2016, UK emissions of the basket of seven greenhouse gases covered by the Kyoto Protocol were estimated to be 467.9 million tonnes carbon dioxide equivalent (MtCO₂e), a decrease of 5.0 per cent compared to the 2015 figure of 492.4 million tonnes. Total 2016 UK greenhouse gas emissions were estimated to decrease by 41.1 per cent from 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 2016. UK net 2016 CO₂ emissions were estimated to be 378.9 million tonnes (Mt), which was around 5.9 per cent lower than the 2015 figure of 402.5 Mt. Between 1990 and 2016 UK net CO₂ emissions were estimated to decrease by 36.2 per cent.

Figure 2: Total UK greenhouse gas emissions, 1990-2016 (MtCO₂e)



Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2016 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 2008³, 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, with an interim target to reduce greenhouse gas emissions by at least 34 per cent compared to the 1990 baseline⁴ by 2020.

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 period⁴. 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.

Under the coverage of the Climate Change Act⁵, UK greenhouse gas emissions for 2016 were 467.9 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)⁶
- Emissions not covered by the EU ETS ('non-traded')
- Credits/debits from other international trading systems

In 2016 the net carbon account was 467.1 MtCO₂e. Figure 3 shows that the UK is on track to meet the second carbon budget. The net carbon account in 2016 was 0.6 per cent higher than that reported in 2015. 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 period⁷. Further information will be published in the UK's Annual Statement of Emissions for 2016, later this year⁸. Performance against all

³ Climate Change Act 2008: <http://www.legislation.gov.uk/ukpga/2008/27/contents>

⁴ Appendix 4: carbon budgets: <https://www.gov.uk/guidance/carbon-budgets>

⁵ 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).

⁶ The EU Emissions Trading System (EU ETS): https://ec.europa.eu/clima/policies/ets_en

⁷ Annex 2, Trends and Projections in the EU ETS: <https://www.eea.europa.eu/publications/trends-and-projections-EU-ETS-2017>

⁸ Annual Statements of Emissions: <https://www.gov.uk/government/collections/annual-statements-of-emissions>

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 projections publication².

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 2008-12⁹.

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 emissions¹⁰.

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.

⁹ Council Decision (2002/358/EC) of 25 April 2002: <http://www.eea.europa.eu/policy-documents/council-decision-2002-358-ec>

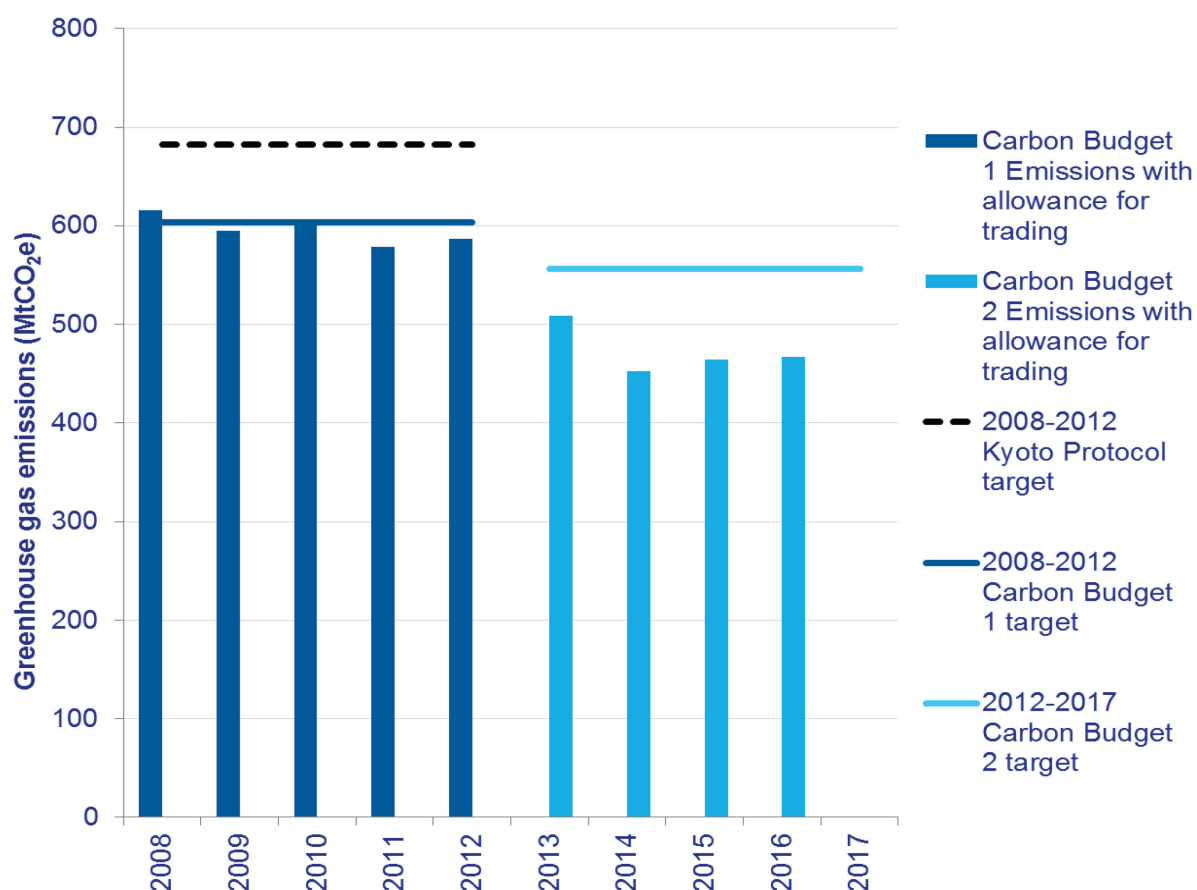
¹⁰ Record of UK base year emissions:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/345163/base_year_tables.xlsx

Beyond 2020

Following the United Nations Conference on Climate Change 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. The Nationally Determined Contributions of the EU and the Member States 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.

Figure 3: UK's progress towards meeting Kyoto Protocol and carbon budget targets (MtCO₂e)



Source: Table 9, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Note:

1. The chart shows all greenhouse gas emissions under carbon budgets coverage. These are slightly different to the emissions used to assess compliance against the Kyoto Protocol target.
2. The second Carbon Budget figures will not be finalised until end of budgetary period reporting in 2019.

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 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 2013-2020¹¹.

In December 2017 the European Commission confirmed for each Member State their performance against ESD for 2015¹². UK greenhouse gas emissions for 2015 under the ESD were confirmed to be 326.0 MtCO₂e, 23.7 MtCO₂e below the UK's annual limit for 2015 of 349.7 MtCO₂e, meaning that the UK met its third annual target in the period. Provisional estimates indicate that greenhouse gas emissions for 2016 under the Effort Sharing Decision will also be below the annual emissions limit, by around 11 MtCO₂e.

Table 1: Progress towards the EU Effort Sharing Decision

UK and Gibraltar, 2013-2016

	MtCO ₂ e			
	2013	2014	2015	2016
Total greenhouse gas emissions excl. LULUCF and NF ₃ (A)	566.5	524.0	503.5	482.8
Total verified emissions from stationary installations under the EU ETS (B)	225.3	197.9	175.9	147.4
CO ₂ emissions from civil aviation (C)	1.7	1.6	1.6	1.5
Total ESD emissions (D = A - B - C)	339.5	324.4	326.0	333.9
Annual emissions allocation (E)	358.7	354.2	349.7	345.2
Difference (E - D)	19.3	29.8	23.7	11.2

Source: Table 9, Final UK greenhouse gas emissions national statistics 1990-2016 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

¹¹ Annual emission allocations, European Commission:

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

¹² Commission Implementing Decision 2016/2132: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2017.337.01.0080.01.ENG

‘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 allocation¹³.

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 Emissions⁸.

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.

¹³ 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.

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

UK, 2008-2016

MtCO₂e

	2008	2009	2010	2011	2012		2013	2014	2015	2016
Net purchases/(sales) by UK installations	19.3	(13.5)	(7.6)	(24.9)	(14.5)		43.8	59.0	28.5	1.1
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	-	-	-	-	-		(0.2)	(0.3)	(0.3)	(0.4)
Net UK purchases/(sales)	20.2	(12.6)	(6.7)	(24.0)	(13.6)		43.6	58.7	28.2	0.7

Source: Table 9, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Note:

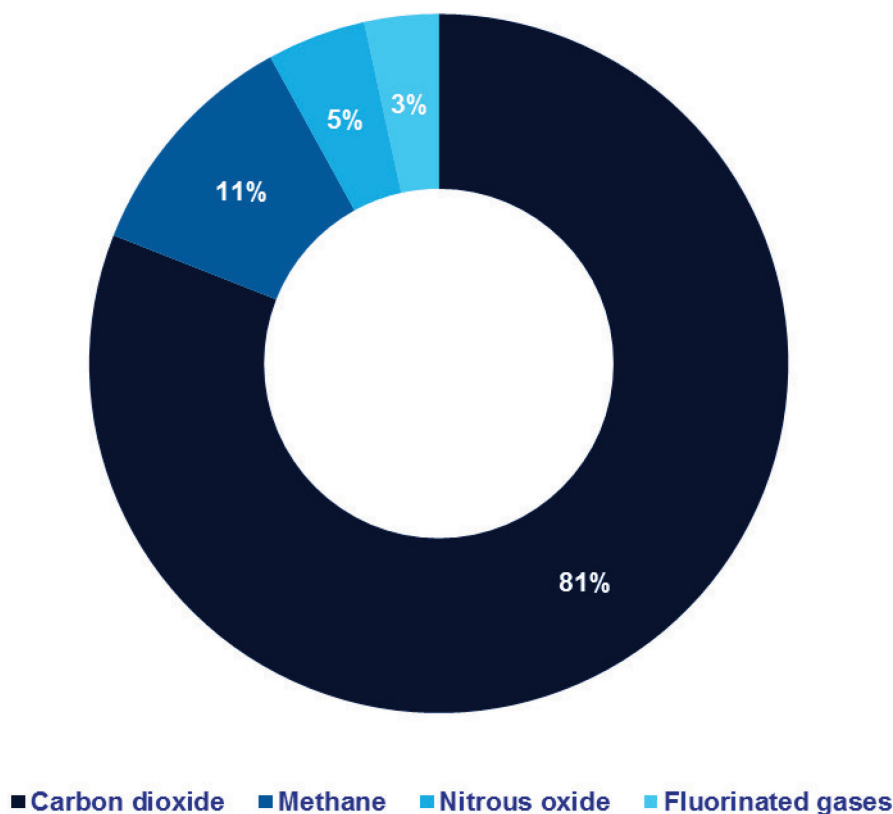
1. At the end of Phase II of the EU ETS, the UK was required to cancel all allowances which have not been either issued or auctioned by that point. As a consequence, allowances totalling 4.5 MtCO₂e were cancelled in 2012. These cancelled allowances have the effect of reducing the overall cap for the 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 for the first time 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, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulphur hexafluoride and nitrogen trifluoride. 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 accounted for about 81 per cent of the UK’s greenhouse gas emissions in 2016. Weighted by global warming potential, methane accounted for about 11 per cent of UK emissions and nitrous oxide for about 5 per cent of emissions in 2016. Fluorinated gases accounted for the remainder, around 3 per cent.

Figure 4: Greenhouse gas emissions by gas, UK, 2016 (%)



Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Carbon dioxide has always been the dominant greenhouse gas emitted in the UK. Emissions of CO₂ have reduced considerably (over 200MtCO₂) since 1990 (mainly due to

decreases in emissions from power stations and residential/industrial combustion). Emissions from methane and nitrous oxide have also decreased. Fluorinated gas (F gas) emissions are slightly 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, 1990-2016

	MtCO ₂ e						
	1990	1995	2000	2005	2010	2015	2016
Net CO ₂ emissions (emissions minus removals)	594.1	556.6	553.7	553.3	492.7	402.5	378.9
Methane (CH ₄)	133.2	126.7	109.1	87.6	64.5	51.6	51.6
Nitrous oxide (N ₂ O)	49.6	40.0	29.9	25.8	22.5	21.5	21.4
Hydrofluorocarbons (HFC)	14.4	19.1	9.8	13.1	16.4	15.9	15.2
Perfluorocarbons (PFC)	1.7	0.6	0.6	0.4	0.3	0.3	0.4
Sulphur hexafluoride (SF ₆)	1.3	1.3	1.8	1.1	0.7	0.5	0.5
Nitrogen trifluoride (NF ₃)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total greenhouse gases	794.2	744.3	705.0	681.3	597.1	492.4	467.9

Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2016 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 1990-2016 UK emissions by end-user sector and fuel type will be published on Thursday 29th March 2018¹⁴.

In 2016, 26 per cent of greenhouse gas emissions were from the transport supply sector, 25 per cent from energy supply, 17 per cent from business, 14 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 2016 so emissions were effectively negative.

Table 4: Sources of greenhouse gas emissions

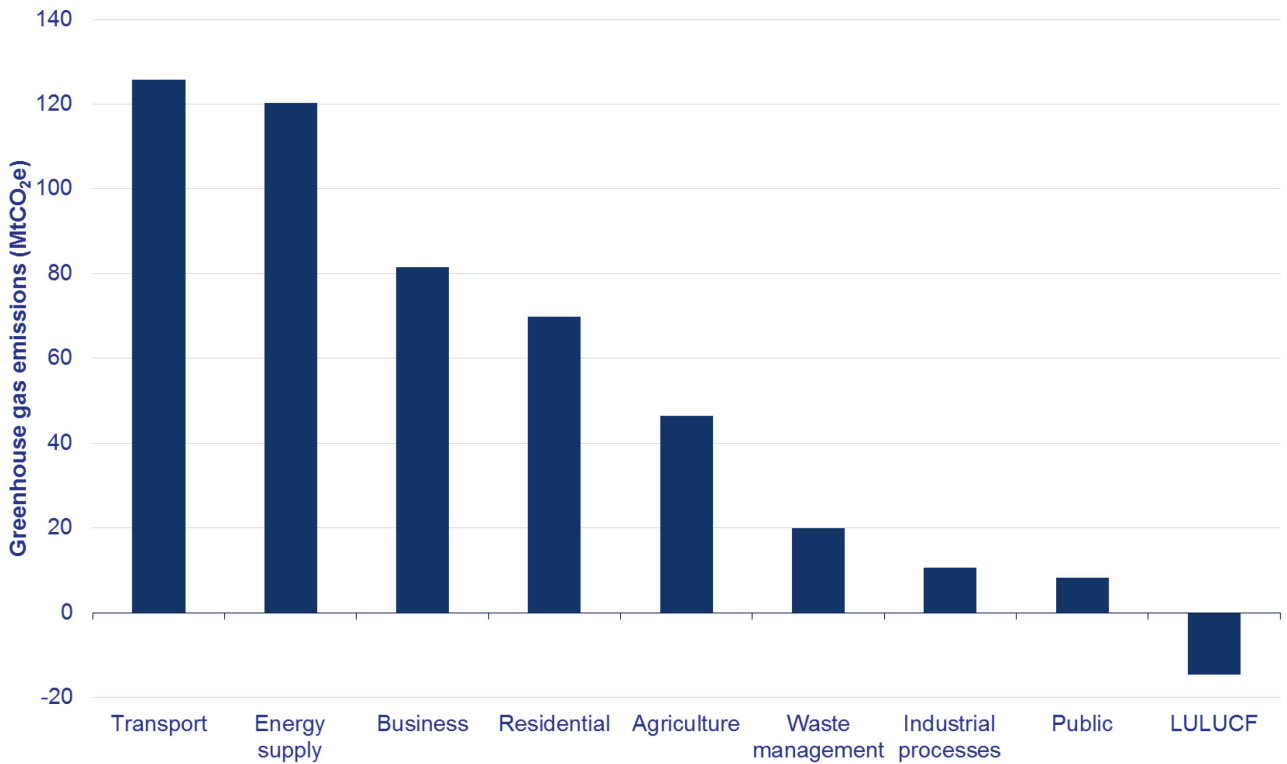
UK, 1990-2016

	MtCO ₂ e						
	1990	1995	2000	2005	2010	2015	2016
Transport	128.1	129.7	133.3	136.0	124.4	123.4	125.8
Energy supply	277.9	237.8	221.0	231.3	207.2	144.4	120.2
Business	114.7	112.5	116.2	109.7	94.7	86.2	81.5
Residential	80.2	81.7	88.7	85.7	87.5	67.4	69.8
Agriculture	55.3	54.3	51.6	49.1	45.9	46.3	46.5
Waste management	66.7	69.1	62.9	49.0	29.7	19.0	19.9
Industrial processes	59.9	50.8	27.1	20.6	12.7	12.7	10.5
Public	13.5	13.3	12.1	11.2	9.5	8.0	8.2
LULUCF	-2.1	-5.0	-7.9	-11.4	-14.4	-15.1	-14.6
Total	794.2	744.3	705.0	681.3	597.1	492.4	467.9

Source: Table 3, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

¹⁴ The Annex for 1990-2015 UK greenhouse gas emissions final figures by end-user and fuel type published in March 2017 can be found here: <https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2015>

Figure 5: Greenhouse gas emissions by source sector, UK, 2016 (MtCO₂e)



Source: Table 3, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Table 5: UK greenhouse gas emissions by gas and sector

UK, 2016

	Carbon dioxide	Methane	Nitrous oxide	F gases	Total
Transport	124.4	0.1	1.3	:	125.8
Energy supply	113.7	5.7	0.8	:	120.2
Business	66.0	0.1	1.4	14.0	81.5
Residential	67.0	0.9	0.2	1.7	69.8
Agriculture	5.5	26.3	14.6	:	46.5
Waste management	0.3	18.3	1.4	:	19.9
Industrial processes	9.9	0.1	0.3	0.3	10.5
Public	8.2	0.0	0.0	:	8.2
LULUCF	-16.0	0.0	1.4	:	-14.6
Total	378.9	51.6	21.4	16.0	467.9

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

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

Transport

The transport sector consists of emissions from domestic aviation, road transport, railways, shipping, fishing and aircraft support vehicles. It was responsible for around 26 per cent of UK greenhouse gas emissions in 2016, almost entirely through carbon dioxide emissions. The main source of emissions from this sector is the use of petrol and diesel in road transport.

Between 1990 and 2016, 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 has been a general increasing trend with some fluctuations year to year. Since this peak emissions have shown a small declining trend in every year until 2014, at which point this trend reversed to show small increases in every year. The overall effect of these fluctuations over time means emissions were around 2 per cent lower in 2016 than in 1990. The transport supply sector has historically been the second most emitting sector; however reductions over time in the largest sector (energy supply) mean that in 2016 transport became 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. Although there has been an increase in both the number of passenger vehicles¹⁵ and the vehicle kilometres travelled¹⁶, emissions from passenger cars have generally decreased since the early 2000s due to lower petrol consumption outweighing an increase in diesel consumption¹⁷ and more recently, improvements in fuel efficiency of both petrol and diesel cars¹⁸. 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.

Between 2015 and 2016 transport sector emissions increased by 2 per cent, which was mostly driven by increased emissions from passenger cars and HGVs, due to increased vehicle kilometres travelled in 2016 which resulted in a higher use of fuel.

Table 6: Transport sector emissions by gas

UK, 1990-2016

	1990	1995	2000	2005	2010	2015	2016
Carbon dioxide	125.3	126.7	130.9	134.3	123.2	122.1	124.4
Methane	1.3	0.9	0.6	0.4	0.2	0.1	0.1
Nitrous oxide	1.5	2.0	1.7	1.4	1.0	1.2	1.3
F gases	:	:	:	:	:	:	:
Total	128.1	129.7	133.3	136.0	124.4	123.4	125.8

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

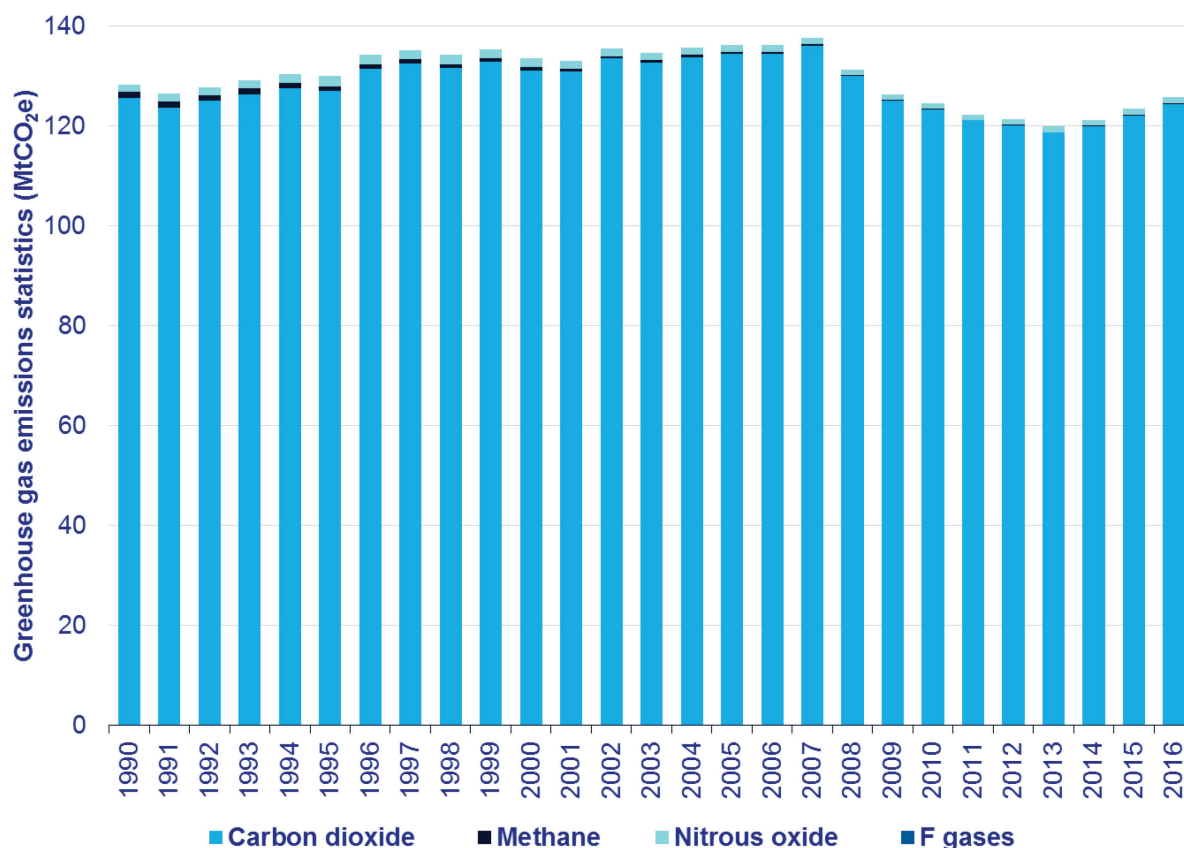
Note: A semi-colon (:) means data are not available as there are no F Gas emissions in this sector

¹⁵ Transport Statistics Great Britain, Vehicles (TSGB09), Table TSGB0901 (VEH0103) Licensed vehicles by tax class, Great Britain, annually from 1909 <https://www.gov.uk/government/statistical-data-sets/tsqb09-vehicles>

¹⁶ Transport Statistics Great Britain, Modal comparisons (TSGB01), Table TSGB0101 Passenger Transport by mode, since 1952 <https://www.gov.uk/government/statistical-data-sets/tsqb01-modal-comparisons>

¹⁷ Transport Statistics Great Britain, Energy and environment (TSGB03), Table TSGB0301 (ENV0101) Petroleum consumption by transport mode and fuel type: United Kingdom, 2000-2016 <https://www.gov.uk/government/statistical-data-sets/tsqb03>

¹⁸ Transport Statistics Great Britain, Energy and environment (TSGB03), Table TSGB0301 (ENV0103) Average new car fuel consumption: Great Britain 1997-2016 <https://www.gov.uk/government/statistical-data-sets/tsqb03>

Figure 6: Greenhouse gas emissions from transport, UK 1990-2016 (MtCO₂e)

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Energy supply

The energy supply sector consists of emissions from fuel combustion for electricity generation and other energy production sources. It was responsible for 25 per cent of UK greenhouse gas emissions in 2016, with carbon dioxide being by far the most prominent gas for this sector (95 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 2016, there was a 57 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 in 2016 it becomes the second largest sector (the largest sector in 2016 was 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 86 per cent between 1990 and 2016¹⁹. Final consumption of electricity was 9 per cent higher in 2016 than it was in 1990, although it peaked in 2005 and has decreased since then²⁰. Electricity generation in 2016 was 3 per cent lower than in 1990, again it peaked in the early 2000s and has decreased since²¹.

There was a 62 per cent decrease in coal use for electricity generation between 2015 and 2016, resulting from the conversion of a unit at the Drax plant from coal to biomass and the closure of some plants²². However, this was partially offset by a 39 per cent increase in the use of gas for electricity generation. This led to a 16.8 per cent decrease in emissions from the energy supply sector between 2015 and 2016. In 2016, total greenhouse gas emissions from power stations, at 81.6 MtCO₂e, accounted for 17 per cent of all UK greenhouse gas emissions.

The other main factor which has noticeably contributed to the long term decline in emissions 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 by 21.3 MtCO₂e since 1990 to only 0.5 MtCO₂e in 2016.

Table 7: Energy supply sector emissions by gas

UK, 1990-2016

	MtCO ₂ e						
	1990	1995	2000	2005	2010	2015	2016
Carbon dioxide	242.1	210.0	203.4	218.9	197.1	136.7	113.7
Methane	34.4	26.5	16.5	11.2	9.1	6.7	5.7
Nitrous oxide	1.4	1.3	1.2	1.2	1.0	1.0	0.8
F gases	:	:	:	:	:	:	:
Total	277.9	237.8	221.0	231.3	207.2	144.4	120.2

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

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

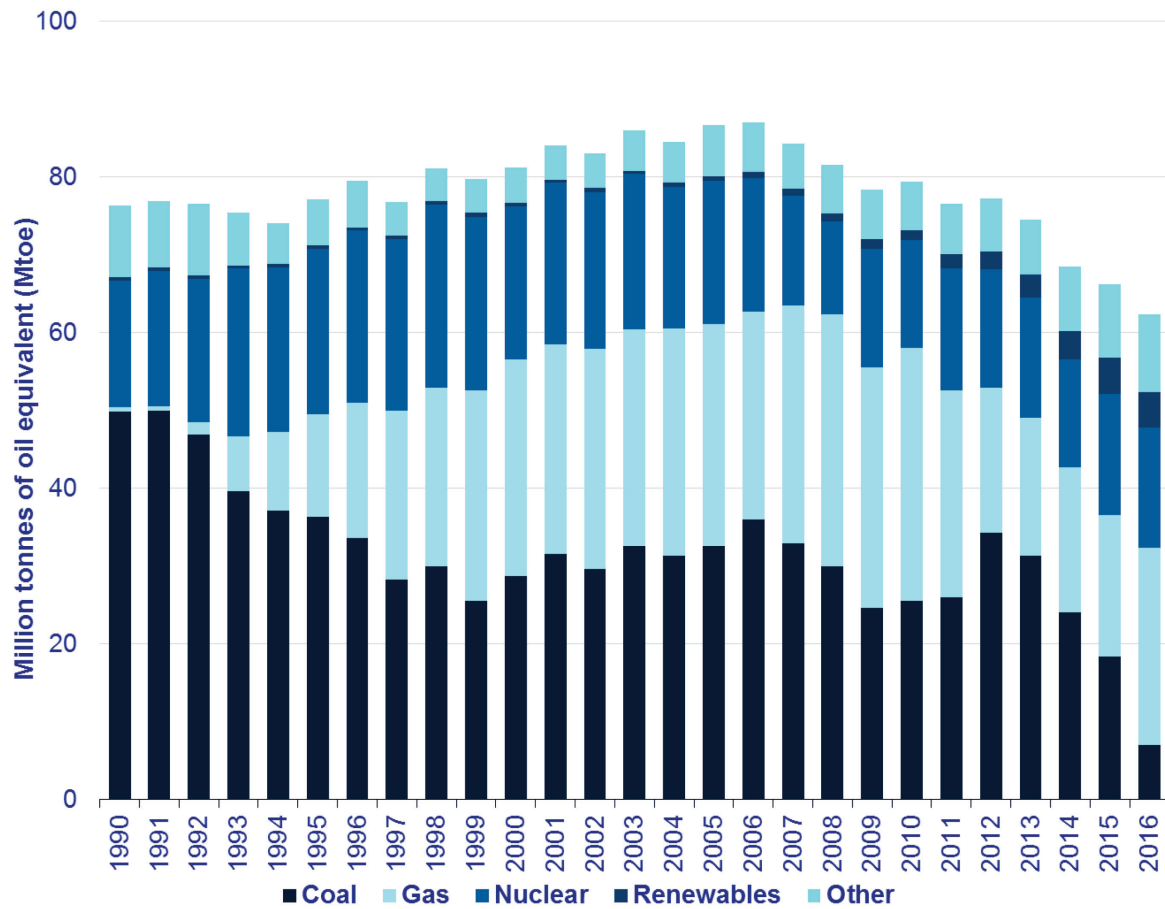
¹⁹ Digest of United Kingdom Energy Statistics, Table 5.1.1 Fuel input for electricity generation, 1970 to 2015
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/632667/DUKES_5.1.1.xls

²⁰ Digest of United Kingdom Energy Statistics, Table 5.1.2 Electricity supply, availability and consumption, 1970 to 2015
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/632668/DUKES_5.1.2.xls

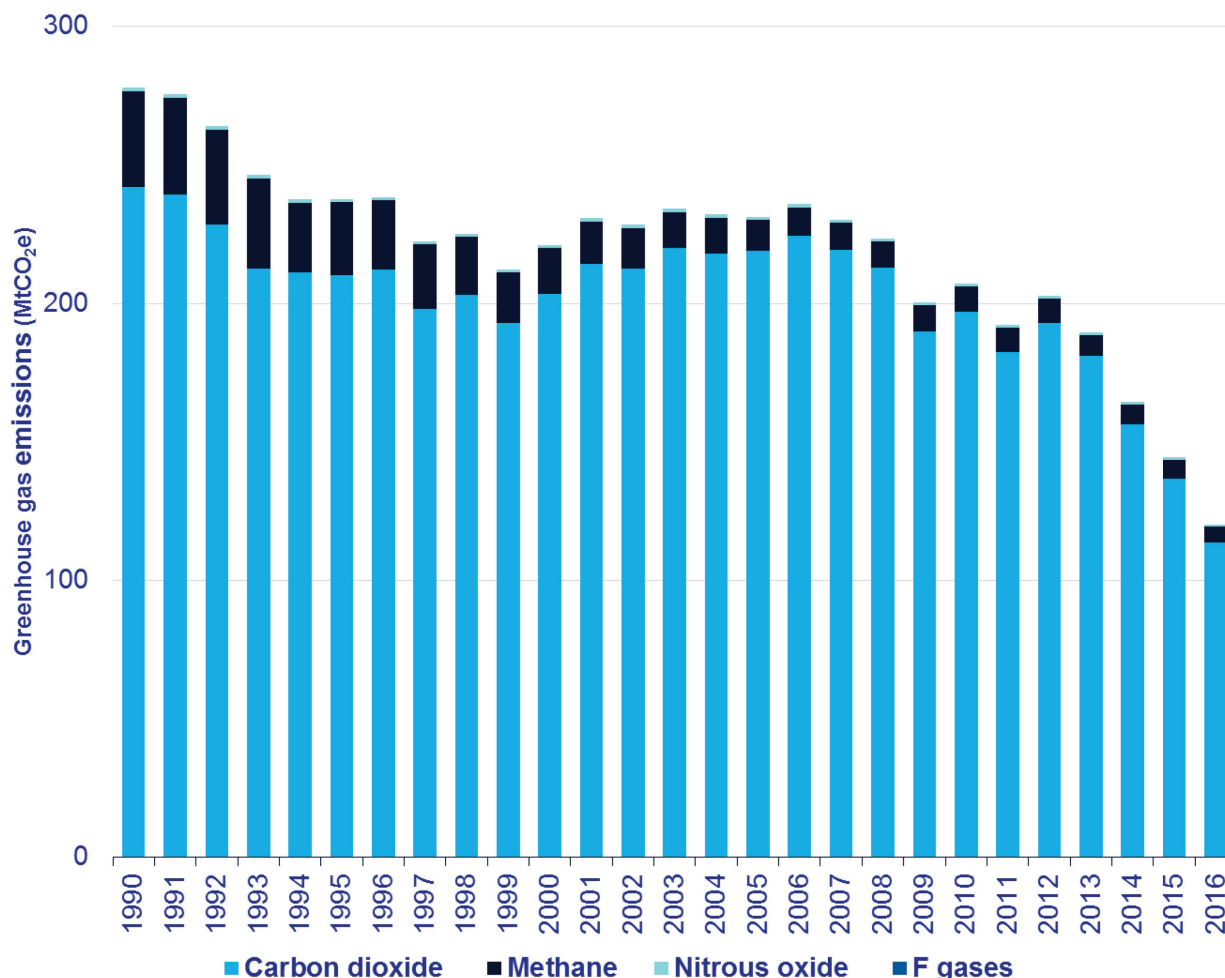
²¹ Digest of United Kingdom Energy Statistics, Table 5.1.3 Electricity generated and supplied, 1970 to 2015
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/632669/DUKES_5.1.3.xls

²² 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>

Figure 7: Fuel used for UK electricity generation, UK 1990-2016 (Million tonnes of oil equivalent (Mtoe))



Source: Digest of United Kingdom Energy Statistics, Table 5.1.1 Fuel input for electricity generation, 1970 to 2016
<https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes>

Figure 8: Greenhouse gas emissions from energy supply, 1990-2016 (MtCO₂e)

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 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 was responsible for 17 per cent of UK greenhouse gas emissions in 2016, 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 2016, emissions from the business sector were 29 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 little change in emissions since 2009. 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 has slowed in recent years, as tighter controls on emissions leakages have been introduced.

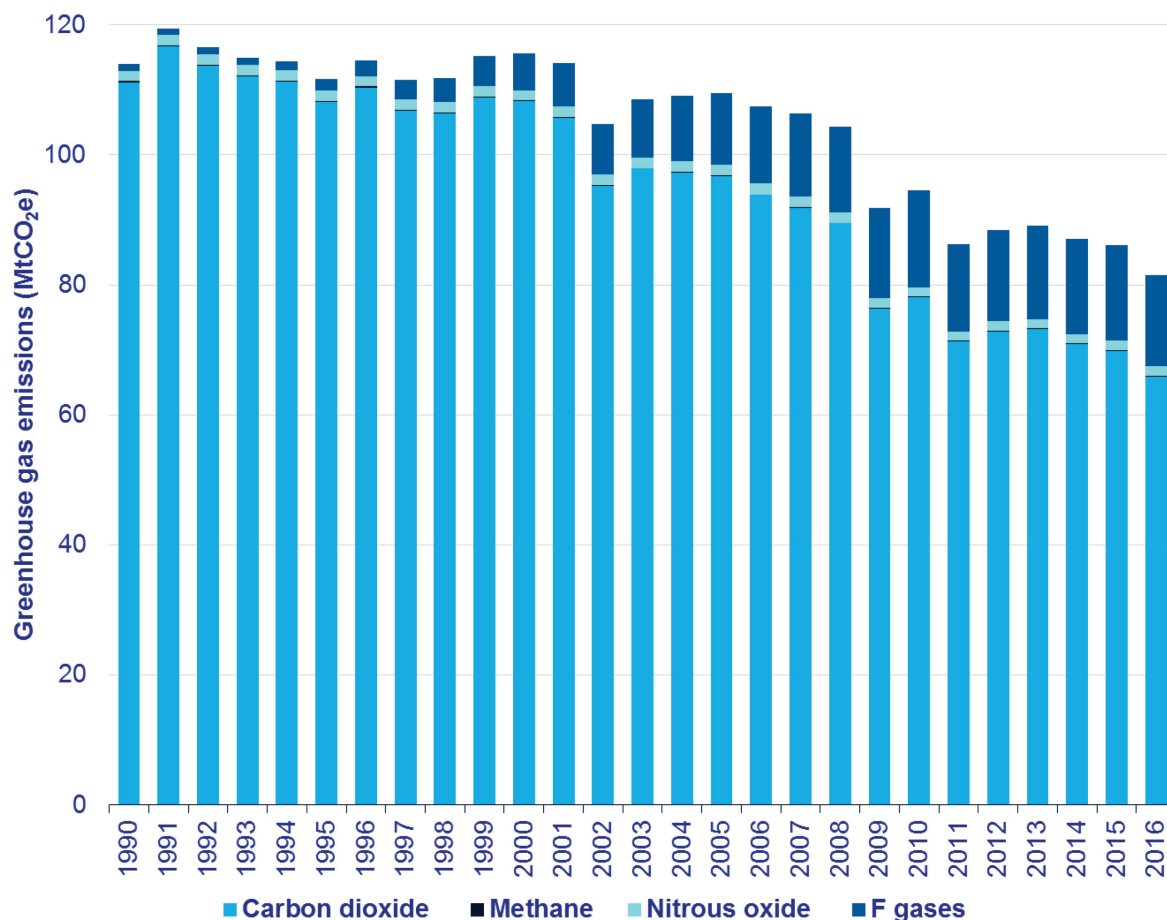
Between 2015 and 2016 there was a 5 per cent decrease in emissions from the business sector. This was largely driven by a reduction in emissions from fuel used in the iron and steel sector due to the closure of one of the UK's three integrated steelworks in September 2015.

Table 8: Business sector emissions by gas

UK, 1990-2016

	MtCO ₂ e						
	1990	1995	2000	2005	2010	2015	2016
Carbon dioxide	111.9	108.9	108.8	96.9	78.2	69.9	66.0
Methane	0.2	0.2	0.1	0.1	0.1	0.1	0.1
Nitrous oxide	1.6	1.6	1.6	1.6	1.4	1.5	1.4
F gases	1.0	1.8	5.7	11.1	14.9	14.7	14.0
Total	114.7	112.5	116.2	109.7	94.7	86.2	81.5

Source: Table 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Figure 9: Greenhouse gas emissions from business, UK 1990-2016 (MtCO₂e)

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 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 was responsible for around 14 per cent of UK greenhouse gas emissions in 2016, 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 2016, 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 increase in residential emissions between 2015 and 2016. Whilst the average temperature for both years was similar the months of November and December in 2016 were both over 3 degrees Celsius cooler on average when compared to the same months in 2015²³, which has contributed to an increase in the use of natural gas for space 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

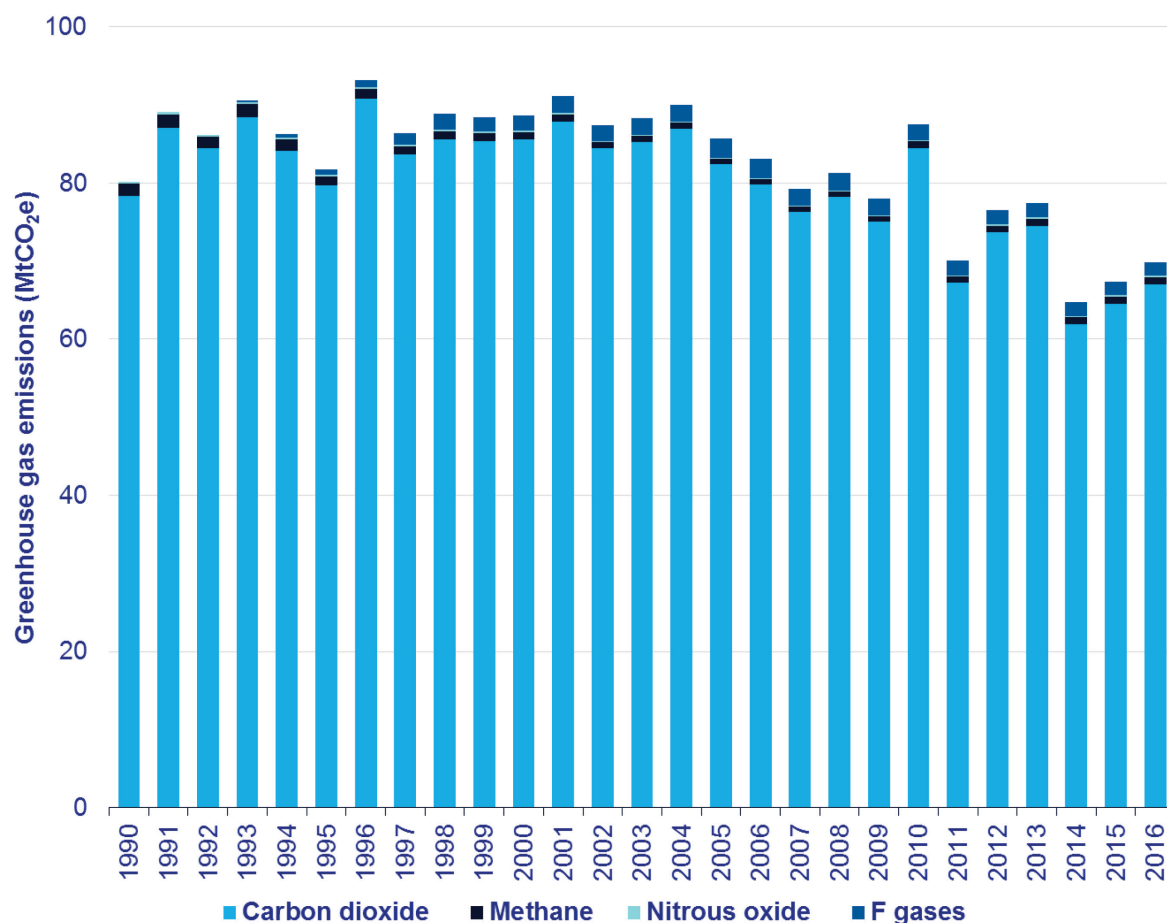
UK, 1990-2016

	MtCO ₂ e						
	1990	1995	2000	2005	2010	2015	2016
Carbon dioxide	78.4	79.7	85.6	82.5	84.5	64.5	67.0
Methane	1.5	1.1	0.9	0.6	0.9	0.9	0.9
Nitrous oxide	0.3	0.2	0.2	0.1	0.2	0.2	0.2
F gases	0.0	0.7	2.0	2.4	2.0	1.8	1.7
Total	80.2	81.7	88.7	85.7	87.5	67.4	69.8

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

²³ Energy Trends: Weather Table ET 7.1 Average temperatures 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 1990-2016 (MtCO₂e)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Agriculture

The agriculture sector consists of emissions from livestock, agricultural soils, stationary combustion sources and off-road machinery. It was responsible for 10 per cent of UK greenhouse gas emissions in 2016. Emissions of methane (57 per cent) and nitrous oxide (32 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 2016, 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 2015 and 2016 there was very little change in emissions from the agriculture sector.

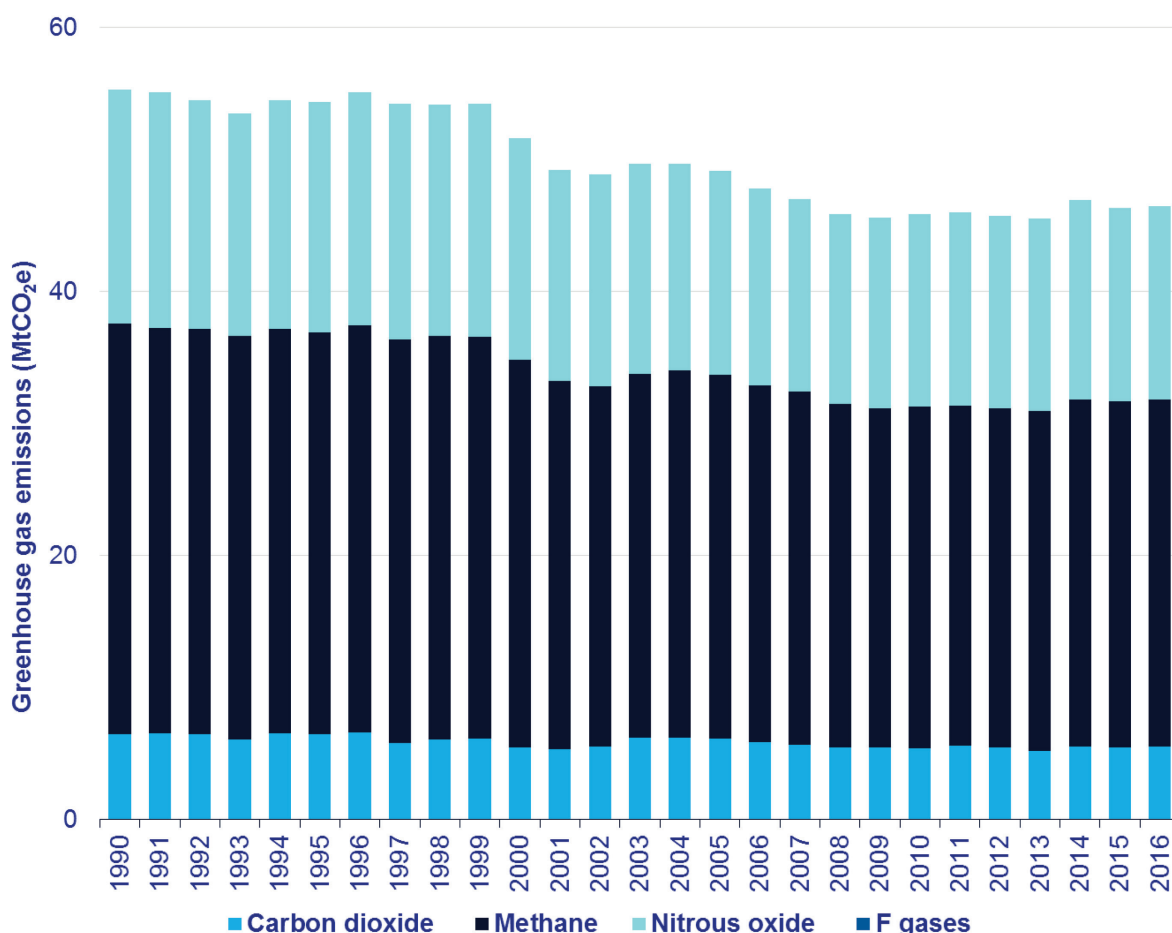
Table 10: Agriculture sector emissions by gas

UK, 1990-2016

	MtCO ₂ e						
	1990	1995	2000	2005	2010	2015	2016
Carbon dioxide	6.5	6.5	5.5	6.1	5.4	5.5	5.5
Methane	31.1	30.4	29.4	27.5	25.9	26.3	26.3
Nitrous oxide	17.8	17.4	16.8	15.5	14.6	14.6	14.6
F gases	:	:	:	:	:	:	:
Total	55.3	54.3	51.6	49.1	45.9	46.3	46.5

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

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

Figure 11: Greenhouse gas emissions from agriculture, UK 1990-2016 (MtCO₂e)

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 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 was responsible for around 4 per cent of UK greenhouse gas emissions in 2016, 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 2016, greenhouse gas emissions from the waste management sector decreased by 70 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 5 per cent between 2015 and 2016 due to increased emissions from landfilled waste.

Table 11: Waste management sector emissions by gas

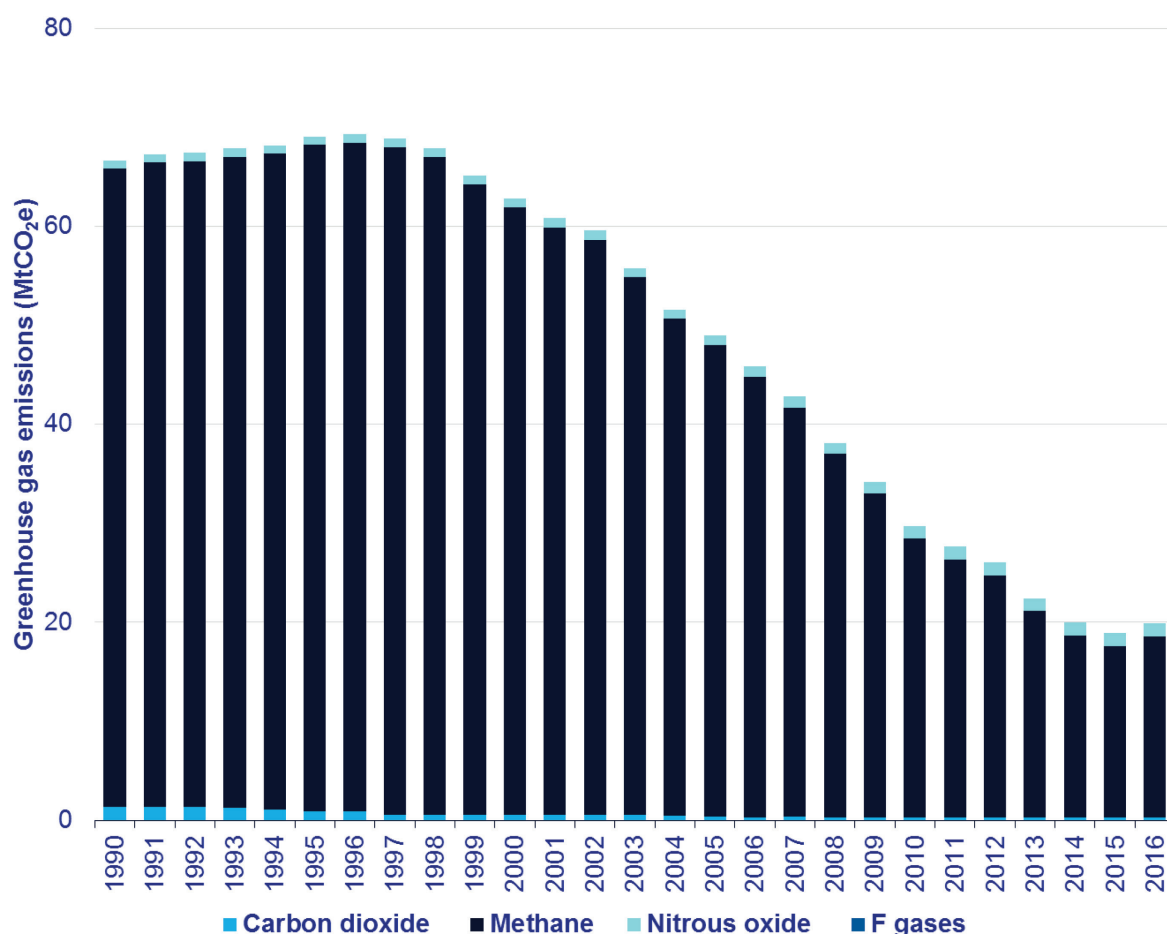
UK, 1990-2016

	MtCO ₂ e						
	1990	1995	2000	2005	2010	2015	2016
Carbon dioxide	1.4	0.9	0.5	0.4	0.3	0.3	0.3
Methane	64.5	67.3	61.4	47.6	28.2	17.4	18.3
Nitrous oxide	0.8	0.8	0.9	1.0	1.2	1.3	1.4
F gases	:	:	:	:	:	:	:
Total	66.7	69.1	62.9	49.0	29.7	19.0	19.9

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Note: A semi-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 1990-2016 (MtCO₂e)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Industrial processes

The industrial processes sector consists of emissions from industry except for those associated with fuel combustion. It was responsible for 2 per cent of UK greenhouse gas emissions in 2016, 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 2016, 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 decreased in 2016 compared to 2015 by 17 per cent. This was mainly caused by decreased emissions from sinter production due to the closure of one of the UK's three integrated steelworks in September 2015.

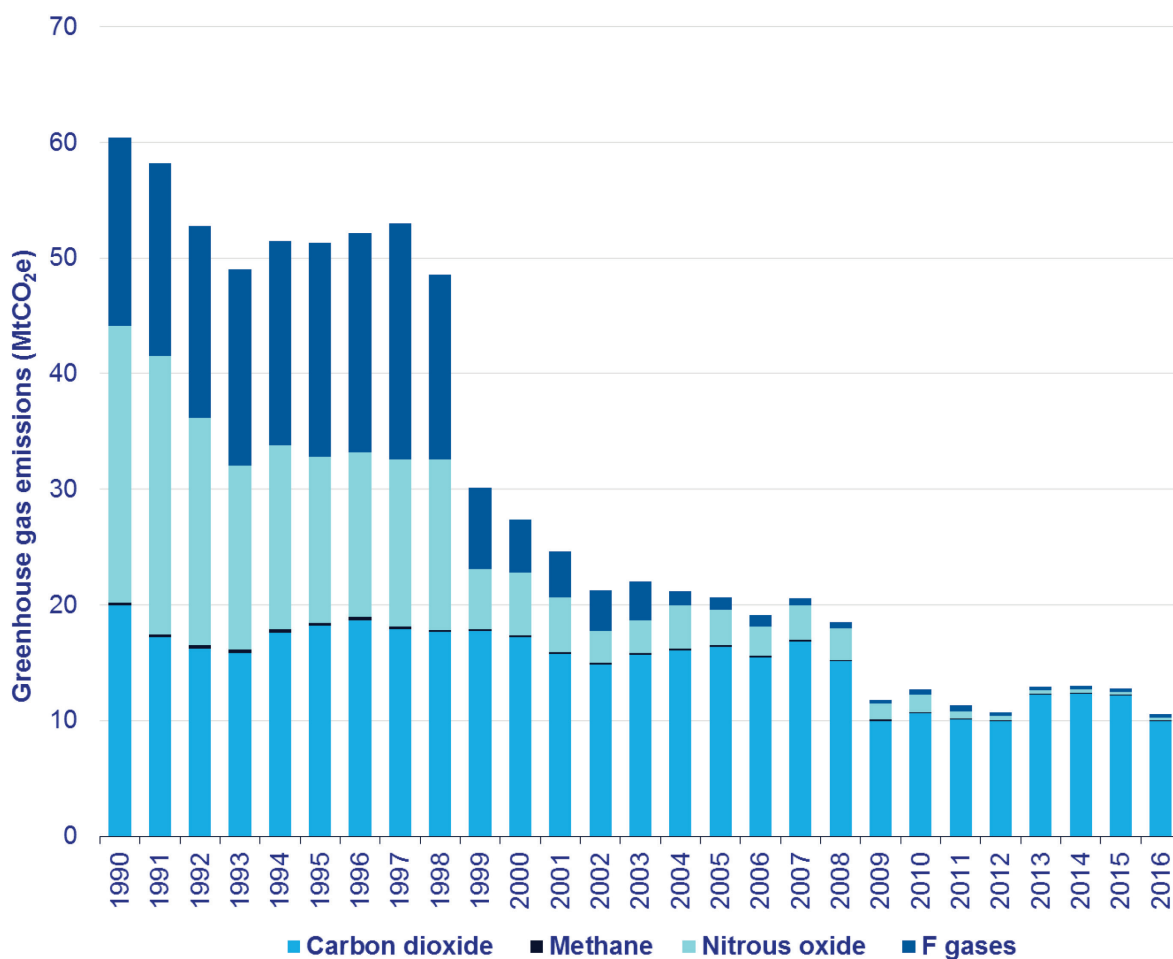
Table 12: Industrial process sector emissions by gas

UK, 1990-2016

	MtCO ₂ e						
	1990	1995	2000	2005	2010	2015	2016
Carbon dioxide	19.4	17.7	16.9	16.4	10.6	12.1	9.9
Methane	0.3	0.2	0.2	0.1	0.1	0.1	0.1
Nitrous oxide	23.9	14.4	5.4	3.1	1.5	0.3	0.3
F gases	16.3	18.5	4.6	1.0	0.5	0.3	0.3
Total	59.9	50.8	27.1	20.6	12.7	12.7	10.5

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Figure 13: Greenhouse gas emissions from industrial processes, UK 1990-2016 (MtCO₂e)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Public

The public sector consists of emissions from combustion of fuel in public sector buildings. It was responsible for less than 2 per cent of UK greenhouse gas emissions in 2016, 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 2016, there has been a general downward trend in greenhouse gas emissions from the public sector, driven by a change in the fuel mix (with less use of coal and oil, and more use of natural gas).

Between 2015 and 2016 emissions increased by 2 per cent in the public sector.

Table 13: Public sector emissions by gas

UK, 1990-2016

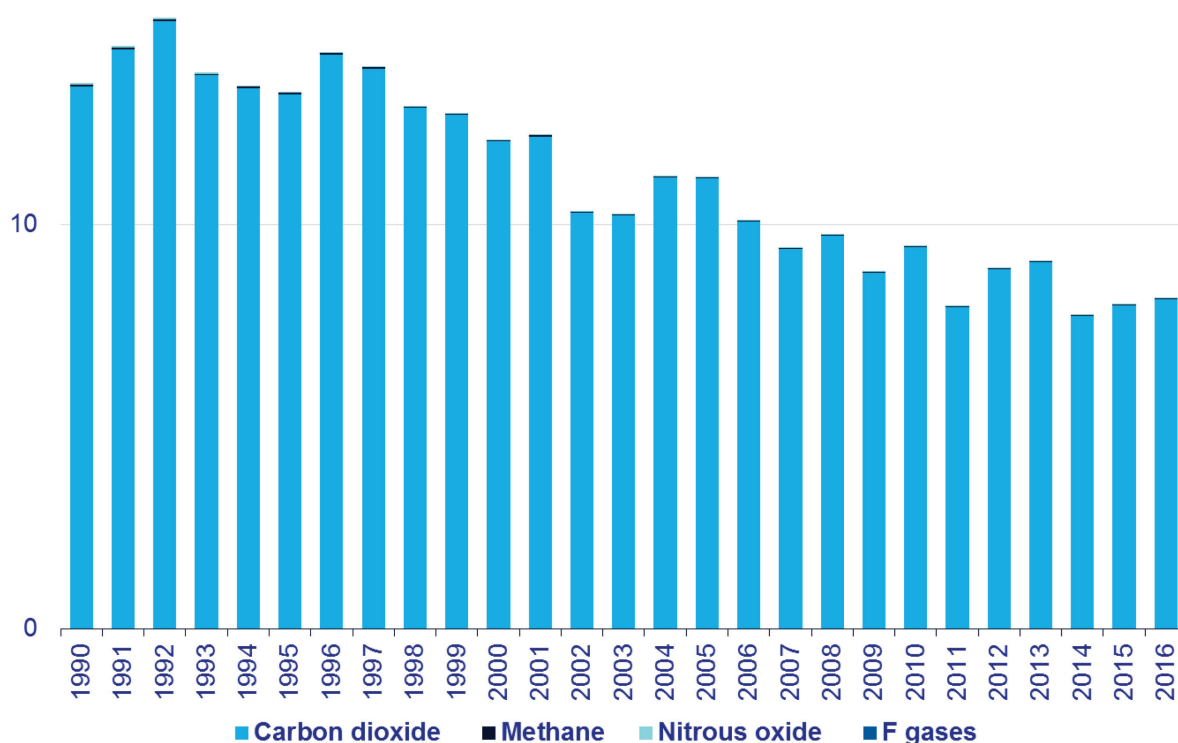
	MtCO ₂ e						
	1990	1995	2000	2005	2010	2015	2016
Carbon dioxide	13.4	13.2	12.1	11.1	9.4	8.0	8.2
Methane	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nitrous oxide	0.0	0.0	0.0	0.0	0.0	0.0	0.0
F gases	:	:	:	:	:	:	:
Total	13.5	13.3	12.1	11.2	9.5	8.0	8.2

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

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

Figure 14: Greenhouse gas emissions from the public sector, UK 1990-2016 (MtCO₂e)

20



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 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 sink²⁴ of UK greenhouse gas emissions in 2016, dominated by carbon dioxide removals. In general, land being converted to cropland is the largest source of carbon dioxide emissions, and forest land which remains as forest land is the dominant sink.

The UK has been a net sink for every year from 1990-2016 and the size of the sink in 2016 (14.6 MtCO₂e) is much larger than the size of the sink in 1990 (2.1 MtCO₂e). This has been driven by land converted to cropland and 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 2015 and 2016 there was very little change in emissions from the LULUCF sector.

Table 14: LULUCF sector emissions by gas

UK, 1990-2016

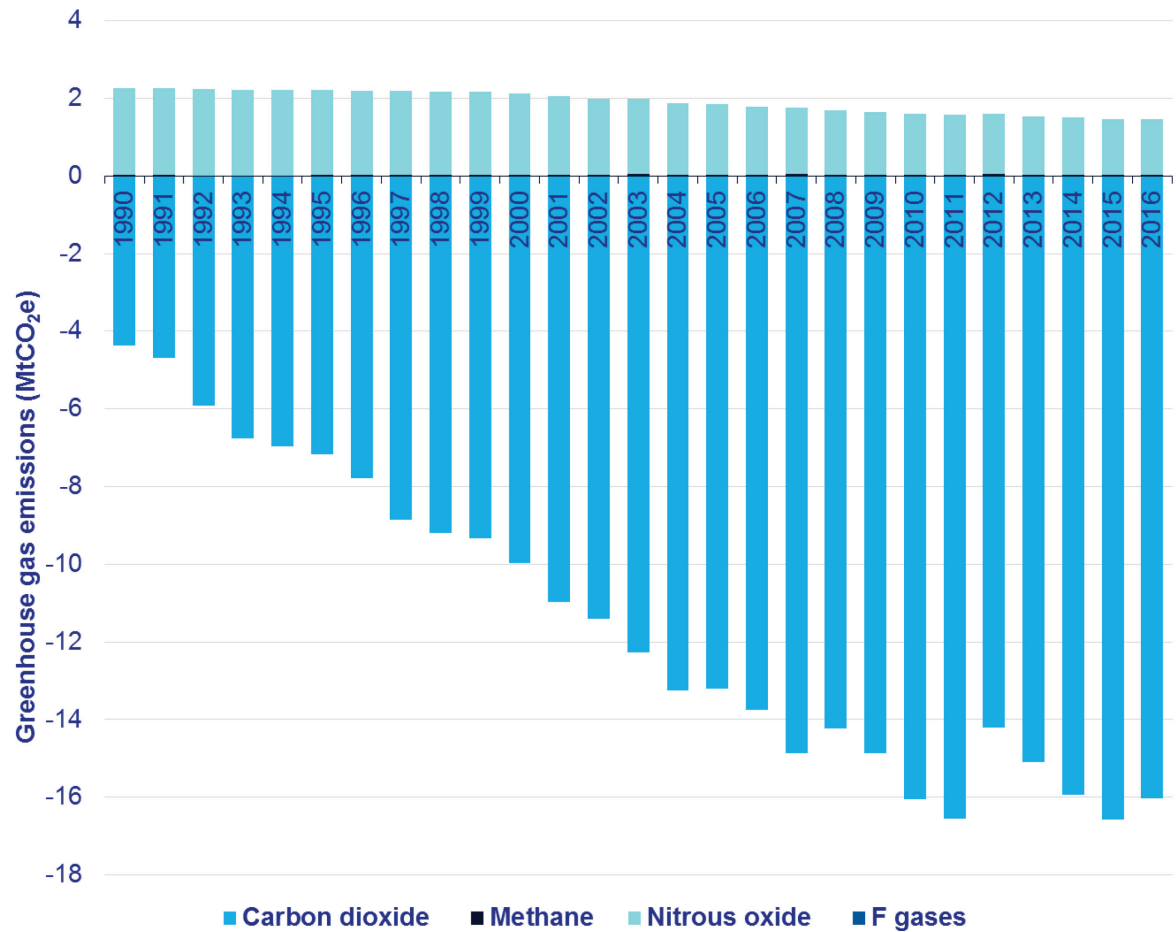
	MtCO ₂ e						
	1990	1995	2000	2005	2010	2015	2016
Carbon dioxide	-4.4	-7.2	-10.0	-13.2	-16.1	-16.6	-16.0
Methane	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nitrous oxide	2.2	2.2	2.1	1.8	1.6	1.4	1.4
F gases	:	:	:	:	:	:	:
Total	-2.1	-5.0	-7.9	-11.4	-14.4	-15.1	-14.6

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

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

²⁴ 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 1990-2016 (MtCO₂e)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Emissions from UK-based international aviation and shipping bunkers

Emissions from international aviation and shipping can be estimated from refuelling from bunkers²⁵ 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, (ICAO), 191 states have agreed to implement a sectoral approach to tackling international aviation emissions, in the form of a “global market-based measure” (GMBM), 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 2020.

In 2016, emissions from international aviation fuel use were estimated to be 34.0 MtCO₂e. This was slightly larger than the 2015 figure. Between 1990 and 2006, when emissions peaked, emissions more than doubled from 15.6 MtCO₂e to 35.7 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 8.6 MtCO₂e in 2016, a 6 per cent decrease from the 2015 level. Since 1990, emissions from UK shipping bunkers have gone up and down, as can be seen in the graph below, but in recent years have been at roughly the same level as they were in 1990.

²⁵ A large container or compartment that stores fuel for ships.

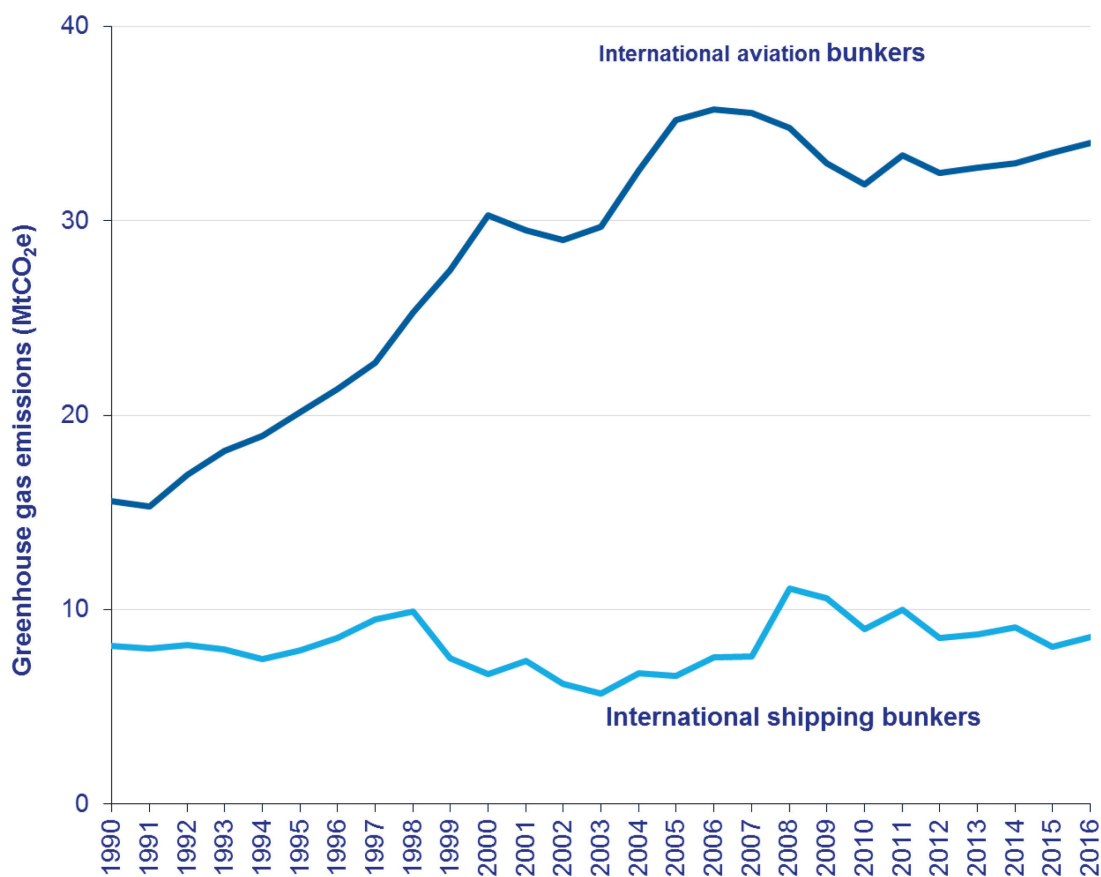
Table 15: Greenhouse gas emissions from UK-based international aviation and shipping bunkers

UK, 1990-2016

	1990	1995	2000	2005	2010	2015	2016
International aviation	15.6	20.2	30.3	35.2	31.9	33.5	34.0
International shipping	8.1	7.9	6.7	6.6	9.0	8.1	8.6
Total	23.7	28.1	37.0	41.8	40.9	41.6	42.6

Source: Table 8, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Figure 16: Greenhouse gas emissions from UK-based international aviation and shipping bunkers, 1990-2016 (MtCO₂e)



Source: Table 8, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables

Revisions from provisional estimates of greenhouse gas emissions

Provisional estimates of 2016 UK greenhouse gas and carbon dioxide emissions were published in March 2017, 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 2016 for the UK would be 466.0 million tonnes carbon dioxide equivalent, representing a 6.0 per cent decrease on 2015 emissions. The final estimates show that 2016 emissions were 467.9 million tonnes, representing a 5.0 per cent decrease on 2015 emissions. The provisional greenhouse gas emissions estimates therefore slightly underestimated total greenhouse gas emissions (by 0.4 per cent) and slightly overestimated the percentage decrease in emissions from 2015 to 2016 (by 1 percentage point).

The provisional estimates are focused on carbon dioxide emissions from the energy sector, and only provide a crude estimate of non-CO₂ gases which assumes that 2016 emissions for non-CO₂ gases are the same as emissions in 2015. Looking just at carbon dioxide emissions, it was provisionally estimated that net UK carbon dioxide emissions in 2016 would be 374.1 million tonnes. The final 2016 figure of 378.9 million tonnes therefore shows that the provisional estimate underestimated CO₂ emissions (by 1.3 per cent). The provisional estimate of non-CO₂ gases was 92 MtCO₂e (based on final 2015 emissions) and the final estimate is 89 MtCO₂e so these emissions are 3.1 per cent lower than reported in provisional estimates.

Table 16: Comparison of 2016 provisional and final estimates

UK, 2015-2016

	MtCO ₂ e				
	2016 Provisional estimates	2016 Final estimates	Difference between final and provisional	Provisional 2015 to 2016 % change	Final 2015 to 2016 % change
Total CO ₂	374.1	378.9	4.8	-7.4%	-5.9%
Total greenhouse gas emissions	466.0	467.9	1.9	-6.0%	-5.0%

Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2016 Excel data tables
Table 1, Provisional UK greenhouse gas emissions national statistics 2016 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 Report²⁶ (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 2016 Greenhouse Gas Inventory was published are revisions to the LULUCF, agriculture and transport 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.

²⁶ Previous UK NIRs can be found here: http://naei.defra.gov.uk/reports/reports?report_id=902 and the latest NIR covering 1990-2016 emissions will be submitted to the UNFCCC on 15th April 2018.

Table 17: Revisions in the 2018 greenhouse gas inventory, by sector

UK, 1990-2016

	1990 emissions			2015 emissions			MtCO ₂ e
	2017 inventory	2018 inventory	Change	2017 inventory	2018 inventory	Change	
Energy supply	277.9	277.9	0.0	144.1	144.4	0.3	
Transport	121.9	128.1	6.2	120.0	123.4	3.4	
Business	114.4	114.7	0.3	84.6	86.2	1.5	
Residential	80.1	80.2	0.0	66.3	67.4	1.1	
Agriculture	58.9	55.3	-3.6	49.1	46.3	-2.8	
Waste management	66.6	66.7	0.0	18.2	19.0	0.8	
Industrial processes	60.0	59.9	0.0	12.7	12.7	0.0	
Public	13.5	13.5	0.0	8.1	8.0	-0.1	
LULUCF	5.7	-2.1	-7.8	-7.4	-15.1	-7.7	
Total	799.0	794.2	-4.8	495.7	492.4	-3.4	

Source: Table 3, Final UK greenhouse gas emissions national statistics 1990-2016 Data tables
Table 3, Final UK greenhouse gas emissions national statistics 1990-2015 Data tables

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

Implementation of new shipping emissions model

Increased availability of high quality ship tracking data prompted a review of the previous shipping model used. The new model was developed using 2014 terrestrial automatic identification system (AIS) data supplied by the Maritime and Coastguard Agency. This carries out an emission calculation, specific to each vessel, for each point of the vessel's voyage tracked by AIS data. This method now meets and exceeds the requirements of a tier 3 methodology set out in the emissions inventory guidebook²⁷ and 2006 IPCC guidelines²⁸. Emission factors have also been updated. Emissions estimates have increased by 6.2 MtCO₂e in 1990 and 3.6 MtCO₂e in 2015.

²⁷ <https://www.eea.europa.eu/themes/air/emep-eea-air-pollutant-emission-inventory-guidebook/emep>

²⁸ <https://www.ipcc-nggip.iges.or.jp/public/2006gl/>

Changes to estimates of emissions from landfill waste

The development of Devolved administration (DA)-specific policies relating to residual waste disposal, and availability of more detailed historic data, enable us to calculate DA-specific emissions for landfill and address previous concerns with regard to the quality of some of the data used. DA-specific data has been provided by environmental regulators, allowing us to create four separate models, one for each DA. These are then aggregated to calculate national methane emissions from this sector. Overall these changes increase our estimates of landfill waste emissions by 0.9 MtCO₂e in 2015. Emissions estimates for 1990 are unaffected by this change.

Changes to estimates of emissions from harvested wood products in the UK

The UNFCCC review of the inventory identified that the proportion of harvested wood products allocated to different semi-finished products was inconsistent with FAO²⁹ data. An improvement was made to harvested wood products to change the mix of semi-finished wood products to vary over time to match the information from this data and Forest Statistics³⁰. This change decreases our estimate of emissions by 0.6 MtCO₂e in 1990 and increases our estimate by 0.8 MtCO₂e in 2015.

Changes to agriculture model as part of Defra's Smart Inventory

Changes were made as part of Defra's improvement programme to ensure that the UK inventory accurately represents the UK agricultural sector. This included a move to tier 3 approaches for estimating enteric methane emissions for all cows and sheep and methane from manure management, using UK-specific data. Other improvements included the creation of a new model which incorporates the ammonia and GHG inventories for the agriculture sector, and modelling nitrogen flow through livestock manure management in the UK. Overall, these resulted in a decrease in estimates of emissions of 3.6 MtCO₂e and 3.0 MtCO₂e in 1990 and 2015 respectively.

Changes to estimates of emissions from forest land

There have been several specific changes in this area. The largest change is to Forest remaining Forest carbon stock change due to new assumptions used in the improvement of the forest carbon (CARBINE) model and changes to deforestation areas leading to changes in carbon stock values and emissions, leading to a decrease in emissions in both 1990 and 2015. A UNFCCC recommendation also led to changes in the Grassland to Forest land stock for the UK, resulting in decreases in emissions for 1990 and 2015. More minor updates include further new assumptions for improvement of the CARBINE model and changes to the Land Use Change matrices. Overall these changes to emissions from forest land decrease estimates of emissions by around 7.1 MtCO₂e in 1990 and by around 8.3 MtCO₂e in 2015.

²⁹ Food and Agriculture Organisation of the United Nations: <http://www.fao.org/faostat/en/#home>

³⁰ Forestry Statistics: <https://www.forestry.gov.uk/forestry/infid-7aqdgc>

Other changes to emissions

There have been a number of small changes in the LULUCF sector due to UNFCCC review recommendations and improvements made by the inventory agency. New assumptions were made for settlement, cropland and grassland for improvement of the CARBINE model. The improvements also included continuous improvement for Crown Dependencies and Overseas Territories, and implementation of the UNFCCC recommendation to change the assignment of orchard area to be included in cropland instead of forestland.

There have also been minor changes across all sectors as a result of a change in data processing in the emission factor database. The change has been made as part of a wider transition towards processing inventory data in energy units, for consistency with international reporting requirements. Emission factors are now imported in the original units as presented in the literature source for the factors, and converted to NAEI units (mass units for liquid and solid fuels, megatherms for gaseous fuels) centrally in the database. This forces consistency in assumptions across pollutants, and allows variation in the timeseries where the calorific values change from year to year.

Overall impact on emissions

In total, the changes made to the methods and data for the 2018 inventory submission decrease estimates of emissions in 1990 and 2015 by around 4.8 MtCO₂e and 3.4 MtCO₂e respectively. This is not an indication of the 2018 inventory submission as a whole as it does not include annual variations in the UK's emitting activities, for example national fuel use.

UNFCCC review recommendations

The UNFCCC review recommendations (including Kyoto Protocol-Land Use, Land Use Change and Forestry (KP-LULUCF) recommendations) that have been implemented in the 2018 inventory submission covering emissions from 1990-2016 are summarised in the table below.

Table 18: UNFCCC review recommendations implemented in the 2018 inventory submission

UNFCCC review recommendations	Sector/sub-sectors impacted
Revision to the methodology for estimating horse population and manure management for horses	Agriculture: Enteric Fermentation, Manure Management

Estimating emissions on a temperature adjusted basis

BEIS publish provisional estimates of temperature adjusted emissions³¹, 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 2015 and 2016 were estimated to be 416.0 Mt and 378.2 Mt respectively. The decrease in carbon dioxide emissions between 2015 and 2016 in the temperature adjusted figures is therefore 37.7 Mt, which is more 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 2015 and 2016 when adjusted for temperature would be greater than the 5.9 per cent shown.

Table 19: Comparison of quarterly emissions estimates with final emissions estimates

UK, 2015-2016

	MtCO ₂ e			
	2015 CO ₂ emissions (Mt)	2016 CO ₂ emissions (Mt)	Absolute change (Mt)	Percentage change
Final estimates				
➤ unadjusted emissions	402.5	378.9	-23.7	-5.9%
Provisional estimates				
➤ unadjusted emissions	403.8	374.1	-29.8	-7.4%
Provisional estimates				
➤ Temperature adjusted emissions	416.0	378.2	-37.7	-9.1%

Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2016 Data tables
Table 3 & 4, Provisional UK greenhouse gas emissions national statistics 2016 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.

³¹ Provisional UK greenhouse gas emissions:
<https://www.gov.uk/government/collections/provisional-uk-greenhouse-gas-emissions-national-statistics>

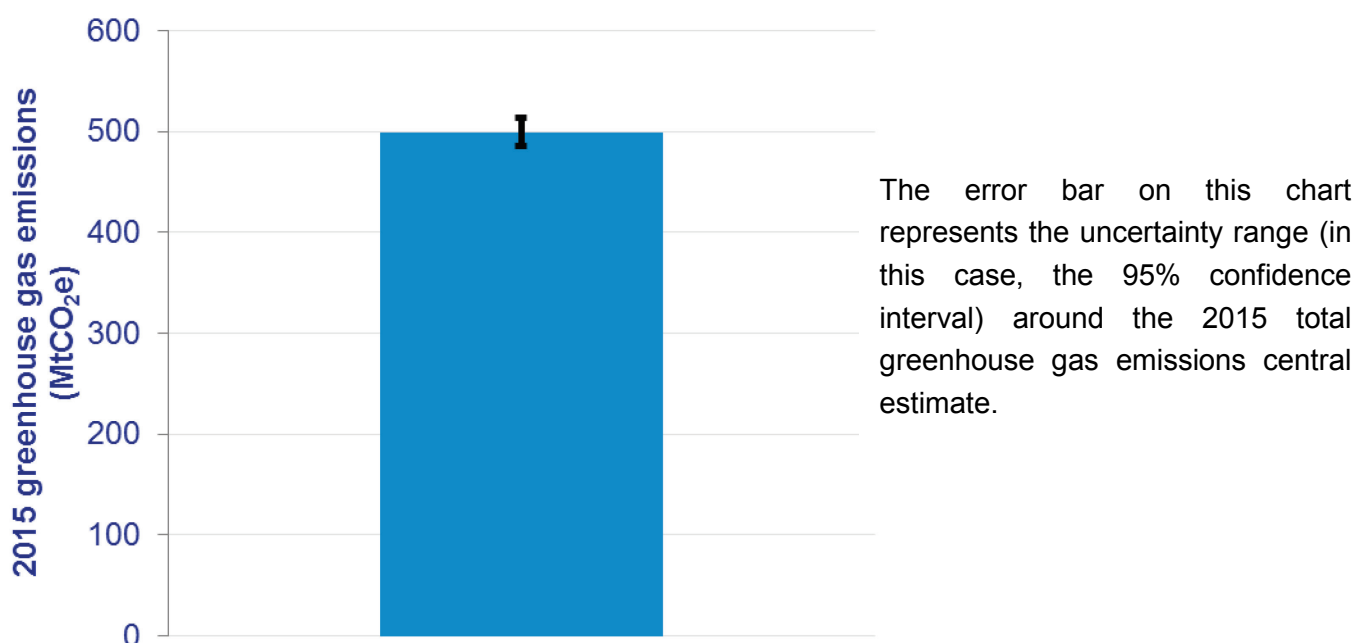
Background Information

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 2015 emissions, as published in 2017). Estimates of 2016 uncertainties will be published on March 29th 2018.

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, 2015 (MtCO₂e)



Source: Table 10, Final UK greenhouse gas emissions national statistics 1990-2016 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 (IPCC³²), 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 (MtCO₂e).

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, and excludes emissions from Crown Dependencies and Overseas Territories and emissions from Nitrogen Trifluoride (NF₃).

³² IPCC: <http://www.ipcc-nggip.iges.or.jp/public/index.html>

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 2016, although the inventory reported to the UN includes emissions from certain overseas territories which are excluded from these statistics except where specifically stated.

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 29th March 2018 BEIS will publish a breakdown of 1990-2016 UK emissions by end-user sector and fuel type, to supplement the source sector breakdown published today.

On Thursday 29th March 2018 BEIS will also publish provisional estimates of UK greenhouse gas emissions for 2017. This will coincide with the publication of Energy Trends statistics, which will include estimates of 2017 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/organisations/department-of-energy-climate-change/series/uk-greenhouse-gas-emissions>

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 1970-2016, 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 1990-2016 will be submitted to the United Nations Framework Convention on Climate Change (UNFCCC) on 15th April 2018. The report will contain national greenhouse gas emissions estimates for 1990-2016 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 2016 must be laid before Parliament and published no later than 31st March 2018. This will give details of the net UK carbon account for 2016, 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 [2017 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 were published by Defra in December 2016 [Emissions of air pollutants in the UK, 1970 to 2015](#).



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