Department for Business, Energy & Industrial Strategy

2015 UK GREENHOUSE GAS EMISSIONS, FINAL FIGURES

Statistical Release: National Statistics

7 February 2017

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

Contents

Executive Summary

This publication provides the latest estimates of 1990-2015 UK greenhouse gas emissions which are presented in carbon dioxide equivalent units throughout this statistical release.

Key findings

In 2015, UK emissions of the basket of seven greenhouse gases covered by the Kyoto Protocol[1] were estimated to be 495.7 million tonnes carbon dioxide equivalent ($MtCO_2e$), a decrease of 3.8 per cent compared to the 2014 figure of 515.1 million tonnes.

This decrease in emissions was mainly caused by:

- Reductions in the energy supply sector, down 12.3 per cent (20.1 $MtCO_2e$) driven by a large decrease in power station emissions due to a change in the fuel mix for electricity generation, with a decrease in the use of coal and more use of nuclear and renewables.
- A decrease of 2.6 per cent (2.3 $MtCO_2e$) 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.
- A reduction of 7.1 per cent (1.4 $MtCO_2e$) in the waste management sector, due to decreased emissions from landfilled waste.

Carbon dioxide (CO_2) 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 2015.

The latest figures show:

- UK net 2015 CO_2 emissions were estimated to be 403.8 million tonnes (Mt), which was around 4.1 per cent lower than the 2014 figure of 421.2 Mt. This decrease in CO_2 emissions was mainly due to the large decrease in the use of coal for electricity generation (as described above).

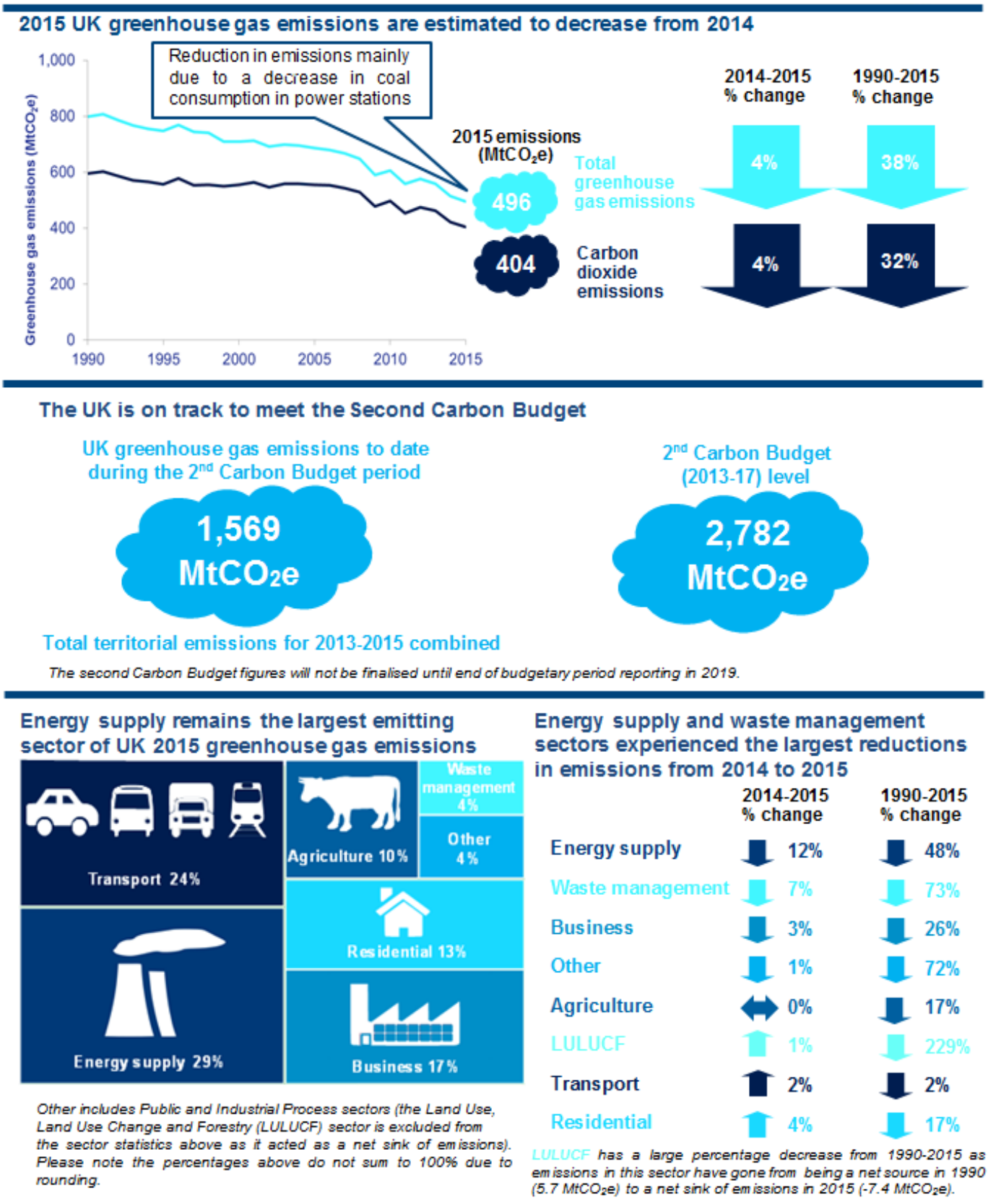
The UK has domestic targets for reducing greenhouse gas emissions under the Climate Change Act known as carbon budgets, which set legally-binding limits on the total amount of greenhouse gas emissions the UK can emit for a given five-year period.

[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.

The latest figures show:

- The UK is on track to meet the second carbon budget, with annual 2013-2015 emissions that are each below the annual average emissions level of the budget period (556.4 $MtCO_2e$).
- UK emissions in 2015 were 38 per cent below the 1990 base year.

Figure 1: Summary of key findings



Introduction

This publication provides the latest estimates of UK greenhouse gas (GHG) emissions from 1990-2015 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 1990-2014 emissions figures have been revised since the previous publication in February 2016, to incorporate methodological improvements and new data. Details of these revisions can be found later in this statistical release.

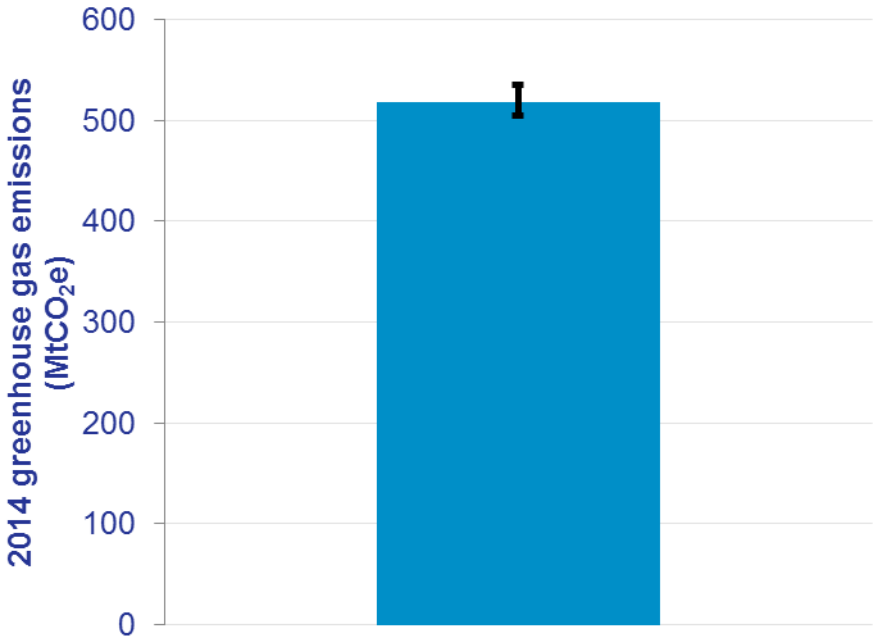
The Department for Business, Energy and Industrial Strategy (BEIS) also publish emissions projections based on assumptions of future economic growth, fossil fuel prices, electricity generation costs, UK population and other key variables[2].

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

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 around 3 per cent, as shown in Figure 2 (which is based on uncertainty analysis of 2014 emissions, as published in 2016). Estimates of 2015 uncertainties will be published on March 30th 2017.

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 2: Illustration of uncertainty in UK greenhouse gas emissions, UK, Crown Dependencies and Overseas Territories, 2014 ($MtCO_2e$)



The error bar on this chart represents the uncertainty range (in this case, the 95% confidence interval) around the 2014 total greenhouse gas emissions central estimate.

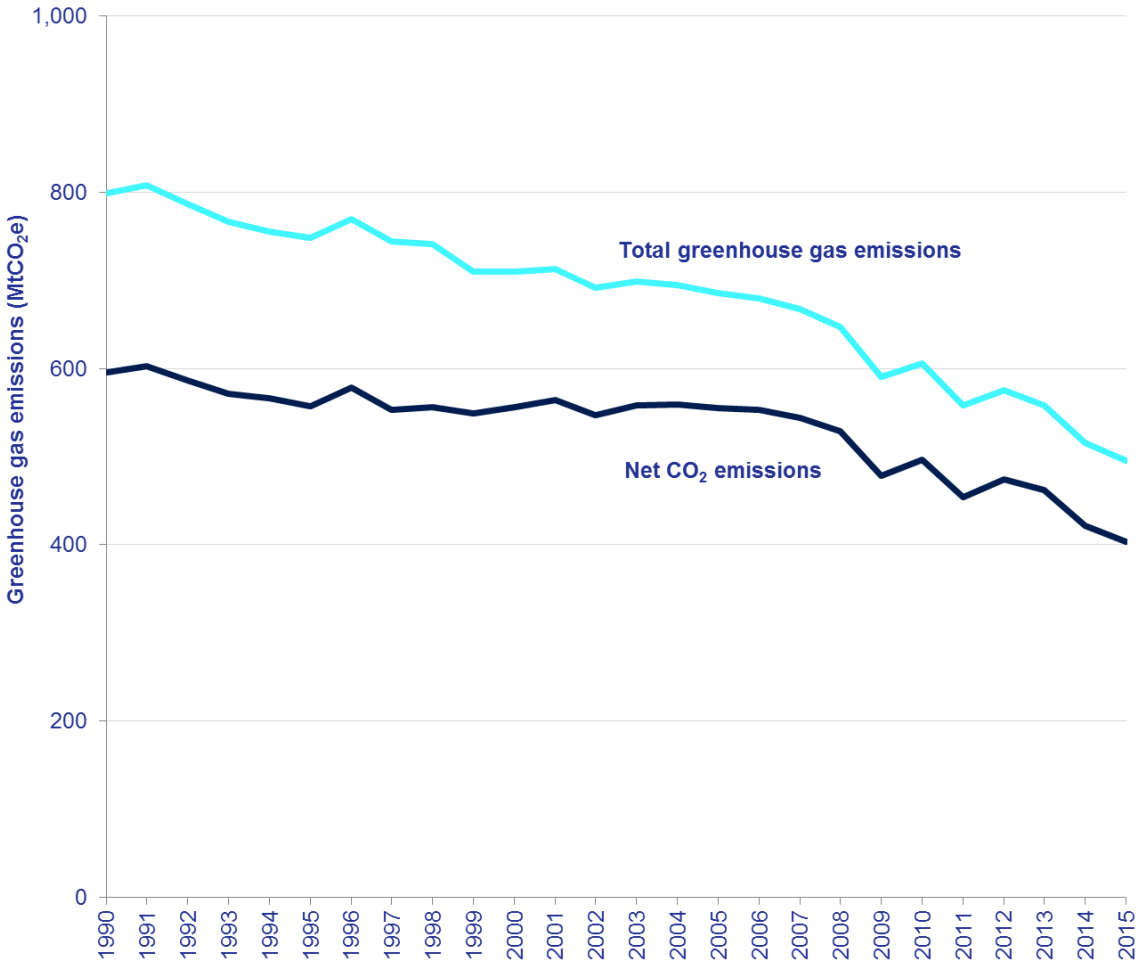
Source: Table 10, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

2015 total greenhouse gas emissions

In 2015, UK emissions of the basket of seven greenhouse gases covered by the Kyoto Protocol were estimated to be 495.7 million tonnes carbon dioxide equivalent ($MtCO_2e$), a decrease of 3.8 per cent compared to the 2014 figure of 515.1 million tonnes. Total 2015 UK greenhouse gas emissions were estimated to decrease by 38.0 per cent from 1990.

Carbon dioxide (CO_2) 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 2015. UK net 2015 CO_2 emissions were estimated to be 403.8 million tonnes (Mt), which was around 4.1 per cent lower than the 2014 figure of 421.2 Mt. Between 1990 and 2015 UK net CO_2 emissions were estimated to decrease by 32.2 per cent.

Figure 3: Total UK greenhouse gas emissions, 1990-2015 ($MtCO_2e$)



Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2015 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 2008[3], 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 baseline[4] 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 period[4]. 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 $MtCO_2e$ below the cap of 3,018 $MtCO_2e$ over the first carbon budget period.

Under the geographical coverage of the Climate Change Act[5], UK greenhouse gas emissions for 2015 were 495.7 $MtCO_2e$. 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), emissions not covered by the EU ETS ('non-traded'), and any credits/debits from other international trading systems. In 2015 the net carbon account was 467.5 $MtCO_2e$. Figure 4 shows that the emissions reported under the net carbon account for years 2013 to 2015 were below the annual average of the second carbon budget, indicating that the UK is on track to meet this target. The net carbon account in 2015 was 2 per cent higher than that reported in 2014. This fluctuation is due to an increase in 'non-traded' emissions in 2015 (including those in the transport and residential sectors) and 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 period[6]. Further information will be published in the UK's Annual Statement of

[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 (NF_3).
[6] Annex 2, Trends and Projections in the EU ETS: http://www.eea.europa.eu/publications/trends-and-projections-EU-ETS-2016

Emissions for 2015, later this year[7]. Performance against all emissions reduction targets is presented in Excel data table 9 that accompanies this statistical release.

The latest UK projections[2] show that the UK is on track to meet the second (2013-2017) and third carbon budget (2018-2022). For the fourth carbon budget (2023-2027), UK emissions are projected to be greater than the cap set by the budget. In June 2016, the Government set the level for the fifth carbon budget (2028-2032) at 1,725 $MtCO_2e$.

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), EU and its Member States collectively made a commitment to reduce greenhouse gas emissions across the EU by 8 per cent on 1990 levels by 2012. 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 2008-12[8].

UK emissions of the basket of greenhouse gases covered by the Kyoto Protocol were an average 600.6 $MtCO_2e$ per year (exclusive of emissions trading) over the first commitment period (2008-12), 23 per cent lower than base year emissions[9].

Second Commitment Period (2013-2020)

Under the second commitment period the EU and the Member States have a collective target to reduce its emissions by 20 per cent relative to base year levels over the period. 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.

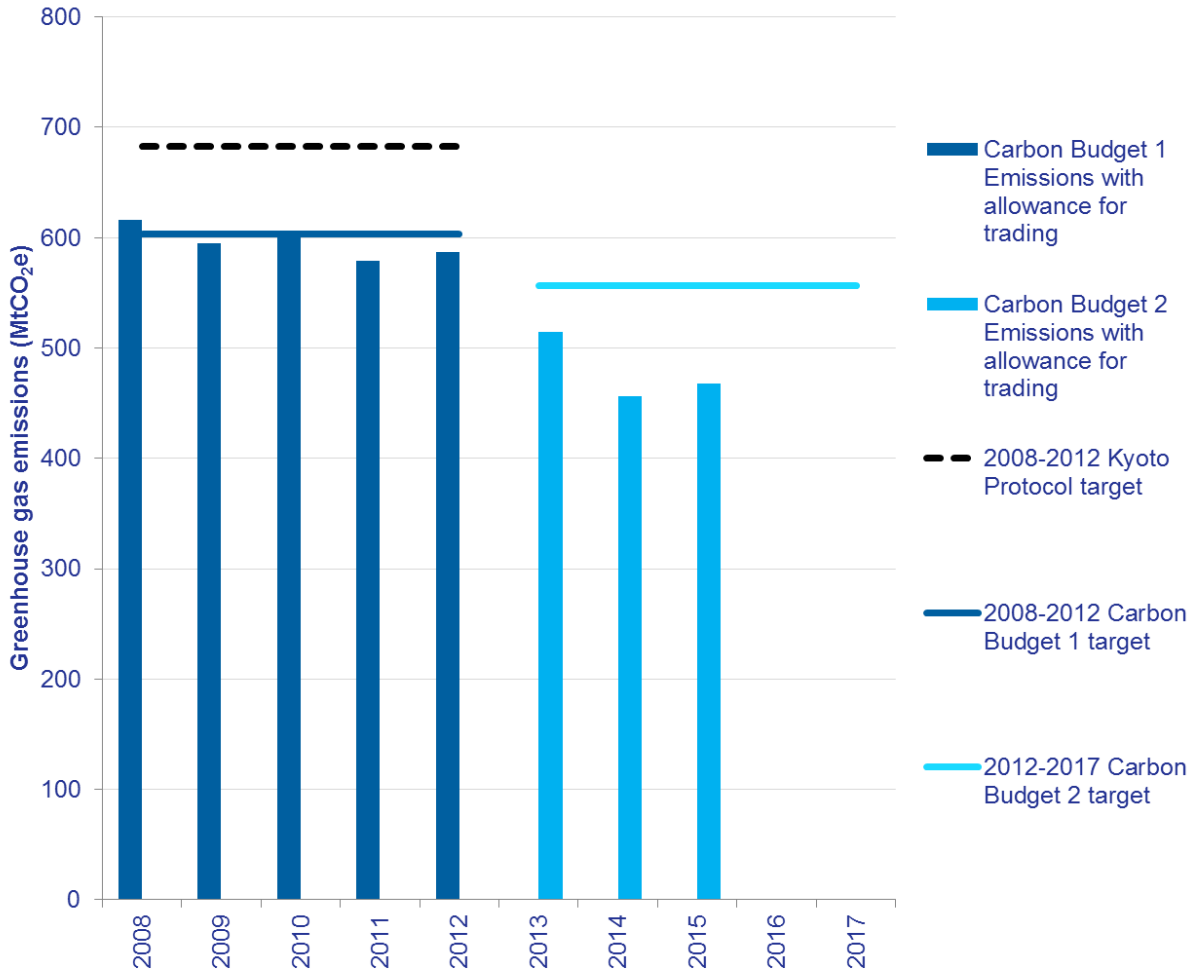
As ratification of the Kyoto Protocol is not yet complete and exact details of the UK's target for the second commitment period are still being finalised, these statistics do not include information on the UK's progress against its second commitment period target.

[7] Annual Statements of Emissions: https://www.gov.uk/government/collections/annual-statements-of-emissions
[8] Council Decision (2002/358/EC) of 25 April 2002: http://www.eea.europa.eu/policy-documents/council-decision-2002-358-ec
[9] Record of UK base year emissions: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/345163/base_year_tables.xlsx

Beyond 2020

At 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 entered into force on 4 November 2016. It was ratified by the UK on 18 November 2016, during the United Nations Conference on Climate Change in Marrakesh. The EU and its Member States are committed to a target of at least a 40 per cent domestic reduction in greenhouse gas emissions by 2030 compared to 1990 levels. The contribution of each EU Member State to this overall target will be set out in EU legislation (the Effort Sharing Regulation) which is currently being negotiated.

Figure 4: UK's progress towards meeting Kyoto Protocol and carbon budget targets ($MtCO_2e$)



Source: Table 9, Final UK greenhouse gas emissions national statistics 1990-2015 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 2013-2020[10].

In December 2016 the European Commission confirmed for each Member State their performance against ESD for years 2013 and 2014[11]. UK greenhouse gas emissions for 2013 under the ESD were confirmed to be 339.5 $MtCO_2e$, 19.3 $MtCO_2e$ below the UK's annual limit for 2013 of 358.7 $MtCO_2e$, meaning that the UK met its first annual target. The same review process confirmed that 2014 emissions under the ESD would be 324.4 $MtCO_2e$, 29.8 $MtCO_2e$ below the UK's annual limit for 2014. Provisional estimates indicate that greenhouse gas emissions for 2015 under the Effort Sharing Decision will also be below the annual emissions limit, by around 24 $MtCO_2e$.

Table 1: Progress towards the EU Effort Sharing Decision

UK and Gibraltar, 2013-2015 — $MtCO_2e$

	2013[1]	2014[1]	2015
Total greenhouse gas emissions excl. LULUCF and NF_3 (A)	566.5	524.0	503.5
Total verified emissions from stationary installations under the EU ETS (B)	225.3	197.9	175.8
CO_2 emissions from civil aviation (C)	1.7	1.6	1.6
Total ESD emissions (D = A - B - C)	339.5	324.4	326.1
Annual emissions allocation (E)	358.7	354.2	349.7
Difference (E - D)	**19.3**	**29.8**	**23.6**

Source: Table 9, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Note:

1. Performance for years 2013 and 2014 have been adjusted following an EU comprehensive review of inventories. Results of this review are published on the European Commission website (see documentation tab): http://ec.europa.eu/clima/policies/effort/implementation_en

[10] Annual emission allocations, European Commission: http://ec.europa.eu/clima/policies/effort/framework/documentation_en.htm

[11] Commission Implementing Decision 2016/2132: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2016.331.01.0009.01.ENG&toc=OJ:L:2016:331:TOC

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 allocation[12].

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 Emissions[7].

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.

[12] 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

UK, 2008-2015

$MtCO_2e$

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

Source: Table 9, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Note:

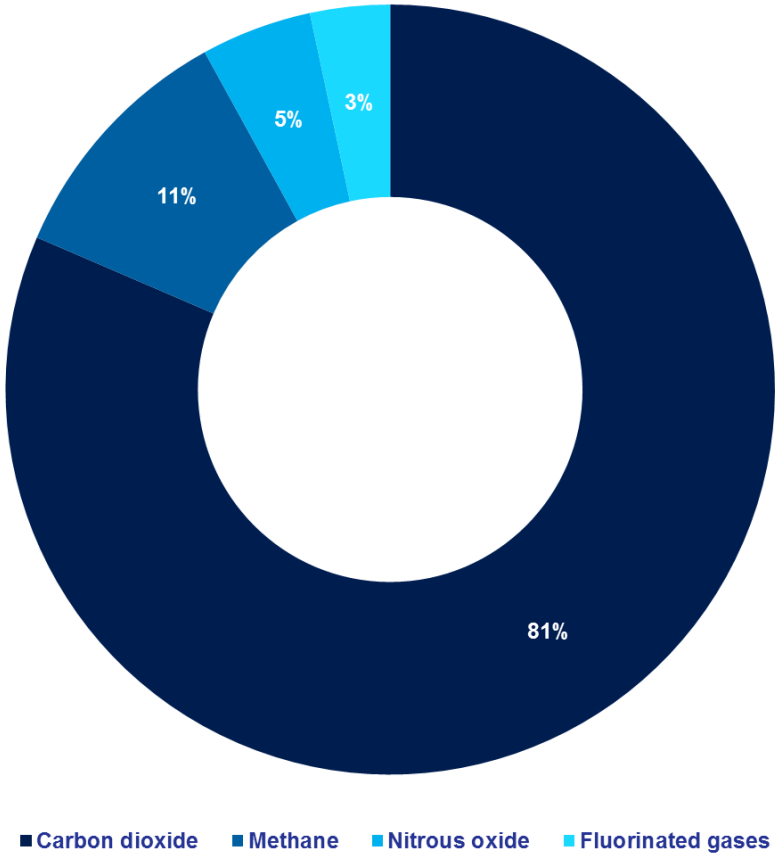
1. At the end of Phase II of the EU ETS, the UK was required to cancel all allowances which have not been either issued or auctioned by that point. As a consequence, allowances totalling 4.5 $MtCO_2e$ were cancelled in 2012. These cancelled allowances have the effect of reducing the overall cap for the 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 $MtCO_2e$ 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 2015. 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 2015. Fluorinated gases accounted for the remainder, around 3 per cent.

Figure 5: Greenhouse gas emissions by gas, UK, 2015 (%)



Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Carbon dioxide has always been the dominant greenhouse gas emitted in the UK. Emissions of CO_2 have reduced considerably 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, 1990-2015

$MtCO_2e$

	1990	1995	2000	2005	2010	2014	2015
Net CO_2 emissions (emissions minus removals)	595.7	557.5	555.7	555.2	496.7	421.2	403.8
Methane (CH_4)	134.8	128.3	110.5	88.9	67.8	54.0	52.2
Nitrous oxide (N_2O)	51.2	41.7	31.3	27.1	24.0	23.3	23.1
Hydrofluorocarbons (HFC)	14.4	19.1	9.8	13.1	16.4	15.8	15.8
Perfluorocarbons (PFC)	1.7	0.6	0.6	0.4	0.3	0.3	0.3
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	**799.0**	**748.5**	**709.7**	**685.8**	**605.9**	**515.1**	**495.7**

Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2015 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 1990-2015 UK emissions by end-user sector and fuel type will be published on Thursday 30th March 2017[13].

In 2015, 29 per cent of greenhouse gas emissions were from the energy supply sector, 24 per cent from transport, 17 per cent from business, 13 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 2015 so emissions were effectively negative.

Table 4: Sources of greenhouse gas emissions

UK, 1990-2015

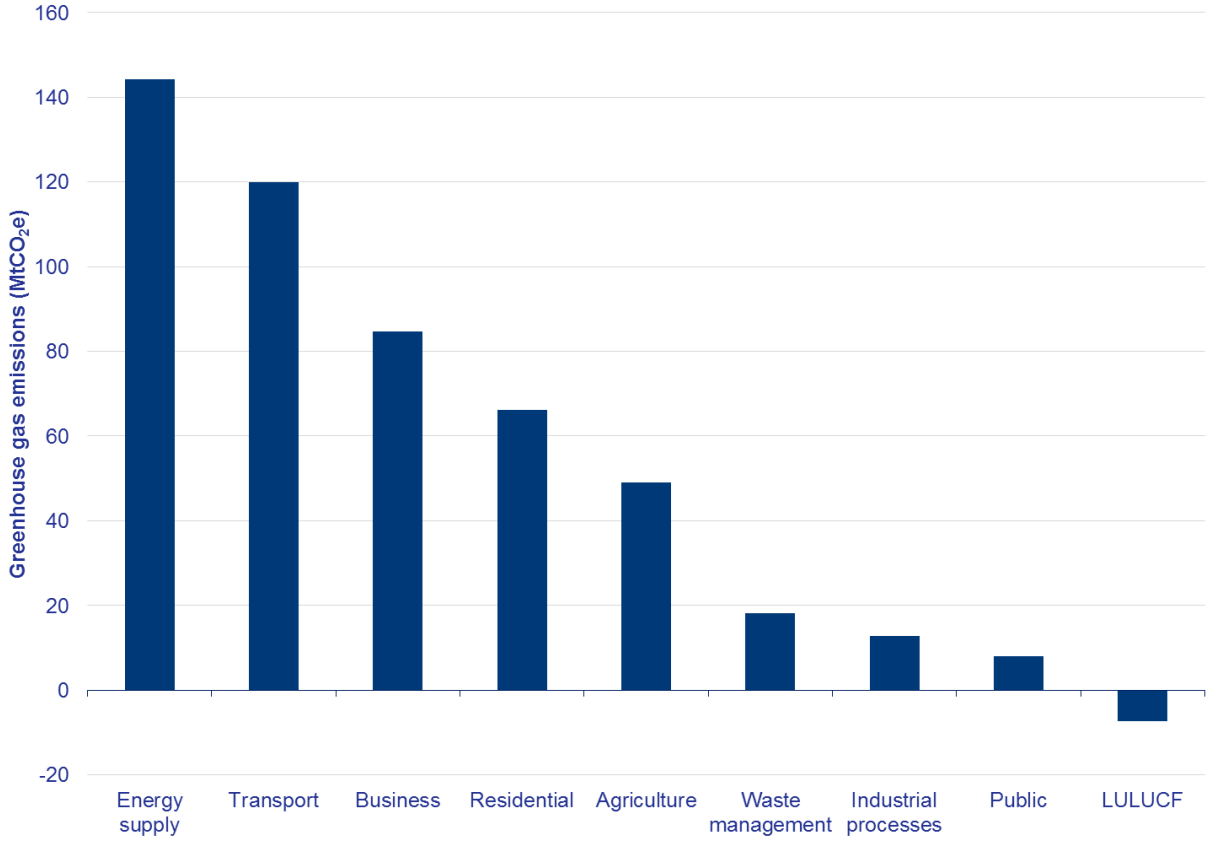
$MtCO_2e$

	1990	1995	2000	2005	2010	2014	2015
Energy supply	277.9	237.8	220.9	231.0	206.7	164.3	144.1
Transport	121.9	122.2	126.7	130.4	120.1	117.8	120.0
Business	114.4	112.2	116.2	109.8	94.8	86.9	84.6
Residential	80.1	81.7	88.7	85.7	87.5	63.8	66.3
Agriculture	58.9	58.3	54.8	51.1	48.6	49.1	49.1
Waste management	66.6	69.0	62.7	49.2	31.7	19.5	18.2
Industrial processes	60.0	50.9	27.1	20.6	12.7	13.0	12.7
Public	13.5	13.3	12.1	11.2	9.7	8.1	8.1
LULUCF	5.7	3.1	0.5	-3.2	-5.8	-7.4	-7.4
Total	**799.0**	**748.5**	**709.7**	**685.8**	**605.9**	**515.1**	**495.7**

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

[13] The Annex for 1990-2014 UK greenhouse gas emissions final figures by end-user and fuel type published in March 2016 can be found here: https://www.gov.uk/government/statistics/final-uk-greenhouse-gas-emissions-national-statistics-1990-2014

Figure 6: Greenhouse gas emissions by source sector, UK, 2015 ($MtCO_2e$)



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

Table 5: UK greenhouse gas emissions by gas and sector

UK, 2015

$MtCO_2e$

	Carbon dioxide	Methane	Nitrous oxide	F gases	Total
Energy supply	136.4	6.7	1.0	0.0	144.1
Transport	118.8	0.1	1.1	0.0	120.0
Business	68.6	0.1	1.3	14.6	84.6
Residential	63.4	0.9	0.2	1.8	66.3
Agriculture	5.2	27.7	16.3	0.0	49.1
Waste management	0.3	16.5	1.4	0.0	18.2
Industrial processes	12.1	0.1	0.3	0.3	12.7
Public	8.1	0.0	0.0	0.0	8.1
LULUCF	-8.9	0.0	1.5	0.0	-7.4
Total	**403.8**	**52.2**	**23.1**	**16.6**	**495.7**

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 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 29 per cent of UK greenhouse gas emissions in 2015, with carbon dioxide being by far the most prominent gas for this sector. The main source of emissions from this sector is the use of coal and natural gas in electricity generation from power stations.

Between 1990 and 2015, there was a 48 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.

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 63 per cent between 1990 and 2015[14]. Final consumption of electricity was 9 per cent higher

[14] 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/541289/DUKES_5.1.1.xls

in 2015 than it was in 1990, although it peaked in 2005 and has decreased since then[15]. Electricity generation in 2015 was 2 per cent lower than in 1990, again it peaked in the early 2000s and has decreased since[16].

There was a 24 per cent decrease in coal use for electricity generation between 2014 and 2015, resulting from the conversion of a unit at the Drax plant from coal to biomass and the temporary closure of some plants[17]. There was increased use of nuclear and renewables for electricity generation (12 per cent and 29 per cent increases respectively). This led to a 12.3 per cent decrease in emissions from the energy supply sector between 2014 and 2015. In 2015, total greenhouse gas emissions from power stations, at 103.8 $MtCO_2e$, accounted for 21 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. Emissions from coal mining and handling have fallen by 20.4 $MtCO_2e$ since 1990 to only 1.4 $MtCO_2e$ in 2015.

Table 6: Energy supply sector emissions by gas

UK, 1990-2015

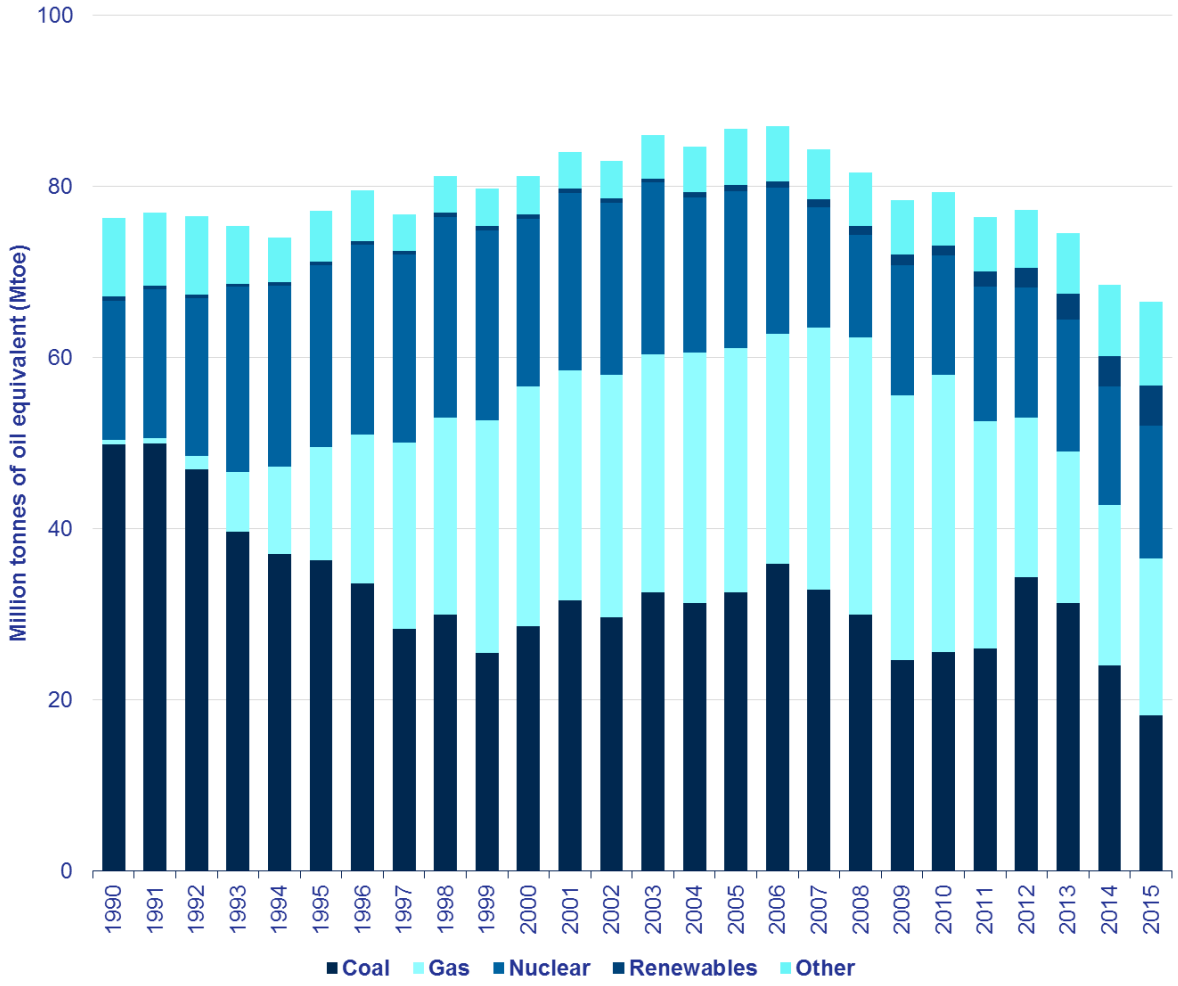
$MtCO_2e$

	1990	1995	2000	2005	2010	2014	2015
Carbon dioxide	242.1	210.0	203.3	218.7	196.6	156.0	136.4
Methane	34.4	26.5	16.4	11.1	9.1	7.2	6.7
Nitrous oxide	1.4	1.3	1.1	1.2	1.0	1.0	1.0
F gases	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**277.9**	**237.8**	**220.9**	**231.0**	**206.7**	**164.3**	**144.1**

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

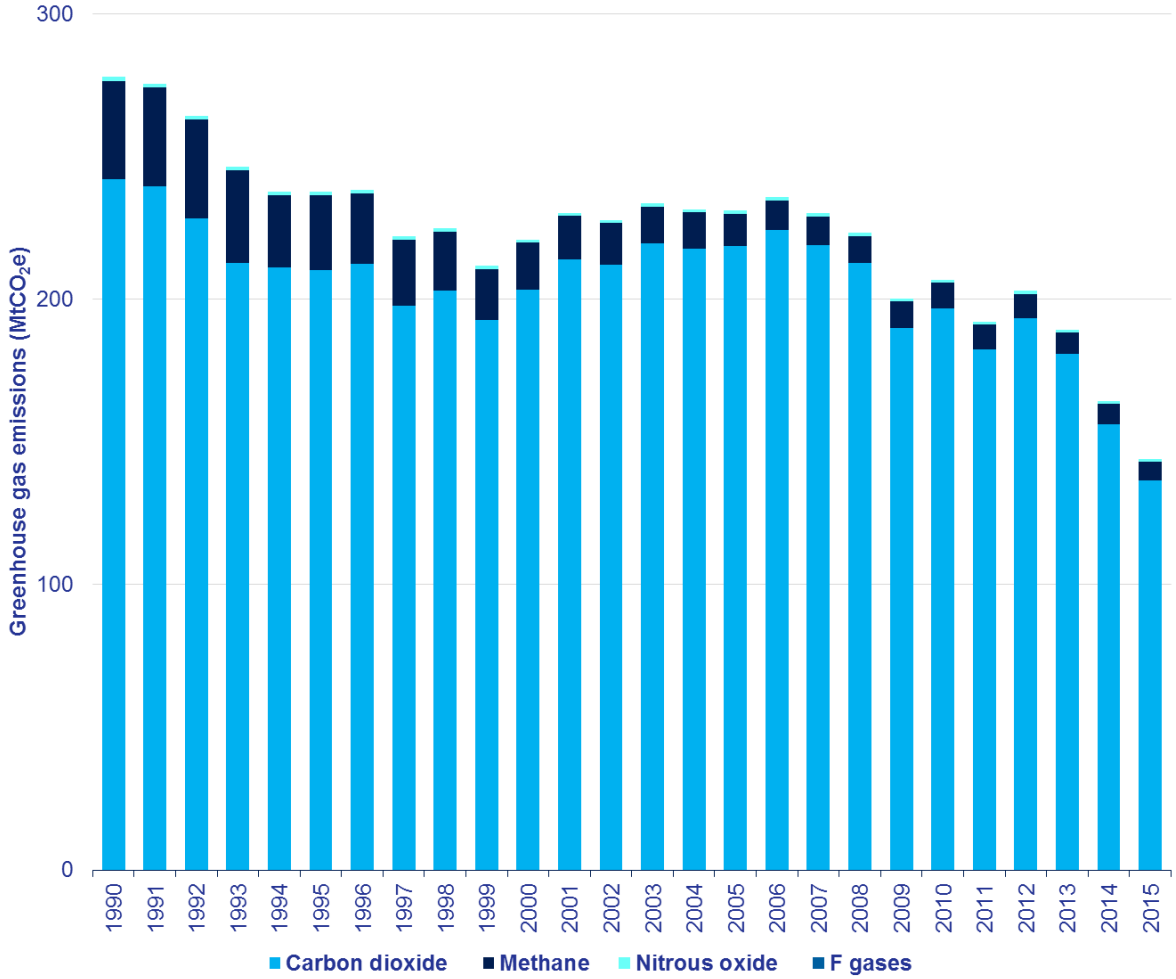
[15] Digest of United Kingdom Energy Statistics, Table 5.1.2 Electricity supply, availability and consumption, 1970 to 2015
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/541290/DUKES_5.1.2.xls
[16] Digest of United Kingdom Energy Statistics, Table 5.1.3 Electricity generated and supplied, 1970 to 2015
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/541291/DUKES_5.1.3.xls
[17] 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 1990-2015 (Million tonnes of oil equivalent (Mtoe))



Source: Digest of United Kingdom Energy Statistics, Table 5.1.1 Fuel input for electricity generation, 1970 to 2015
https://www.gov.uk/government/statistics/electricity-chapter-5-digest-of-united-kingdom-energy-statistics-dukes

Figure 8: Greenhouse gas emissions from energy supply, 1990-2015 ($MtCO_2e$)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Transport

The transport sector consists of emissions from domestic aviation, road transport, railways, shipping, fishing and aircraft support vehicles. It was responsible for around 24 per cent of UK greenhouse gas emissions in 2015, 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 2015, there has been relatively little overall change in the level of greenhouse gas emissions from the transport sector (emissions were around 2 per cent lower in 2015 than in 1990). Emissions increased slightly up to 2007 and have declined slightly since then.

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 vehicles[18] and the vehicle kilometres travelled[19], emissions from passenger cars have generally decreased since the early 2000s due to lower petrol consumption outweighing an increase in diesel consumption[20] and more recently, improvements in fuel efficiency of both petrol and diesel cars[21]. 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 2014 and 2015 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 2015 which resulted in a higher use of fuel.

Table 7: Transport sector emissions by gas

UK, 1990-2015

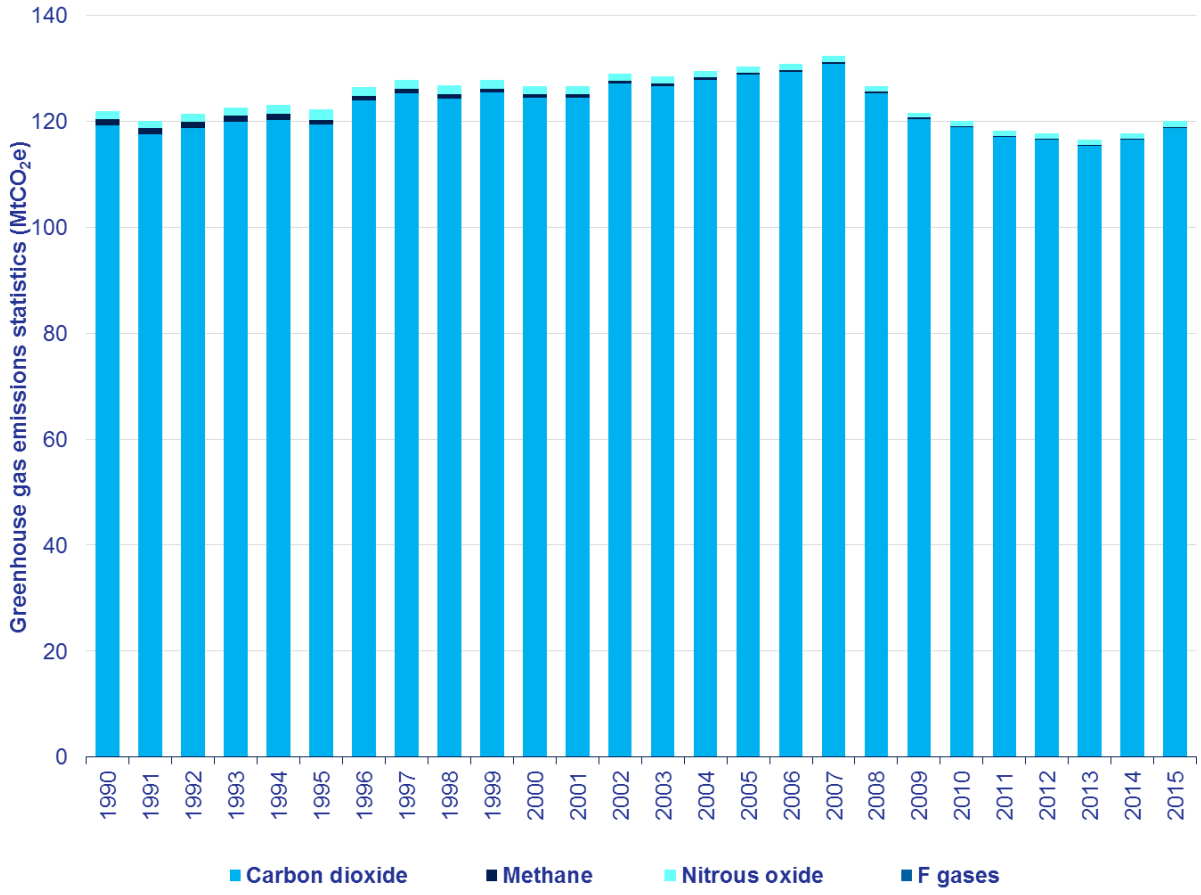
$MtCO_2e$

	1990	1995	2000	2005	2010	2014	2015
Carbon dioxide	119.2	119.4	124.5	128.8	119.0	116.6	118.8
Methane	1.2	0.9	0.6	0.4	0.2	0.1	0.1
Nitrous oxide	1.4	1.9	1.6	1.3	1.0	1.1	1.1
F gases	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**121.9**	**122.2**	**126.7**	**130.4**	**120.1**	**117.8**	**120.0**

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

[18] 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/tsgb09-vehicles
[19] Transport Statistics Great Britain, Modal comparisons (TSGB01), Table TSGB0101 Passenger Transport by mode, since 1952 https://www.gov.uk/government/statistical-data-sets/tsgb01-modal-comparisons
[20] Transport Statistics Great Britain, Energy and environment (TSGB03), Table TSGB0301 (ENV0101) Petroleum consumption by transport mode and fuel type: United Kingdom, 2000-2015 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/482684/env0101.xls
[21] Transport Statistics Great Britain, Energy and environment (TSGB03), Table TSGB0301 (ENV0103) Average new car fuel consumption: Great Britain 1997-2015 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/482686/env0103.xls

Figure 9: Greenhouse gas emissions from transport, UK 1990-2015 ($MtCO_2e$)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 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 2015, 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.

2015 emissions from the business sector were 26 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 39 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 replacing other, 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 2014 and 2015 there was a 3 per cent decrease in emissions from the business sector, 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

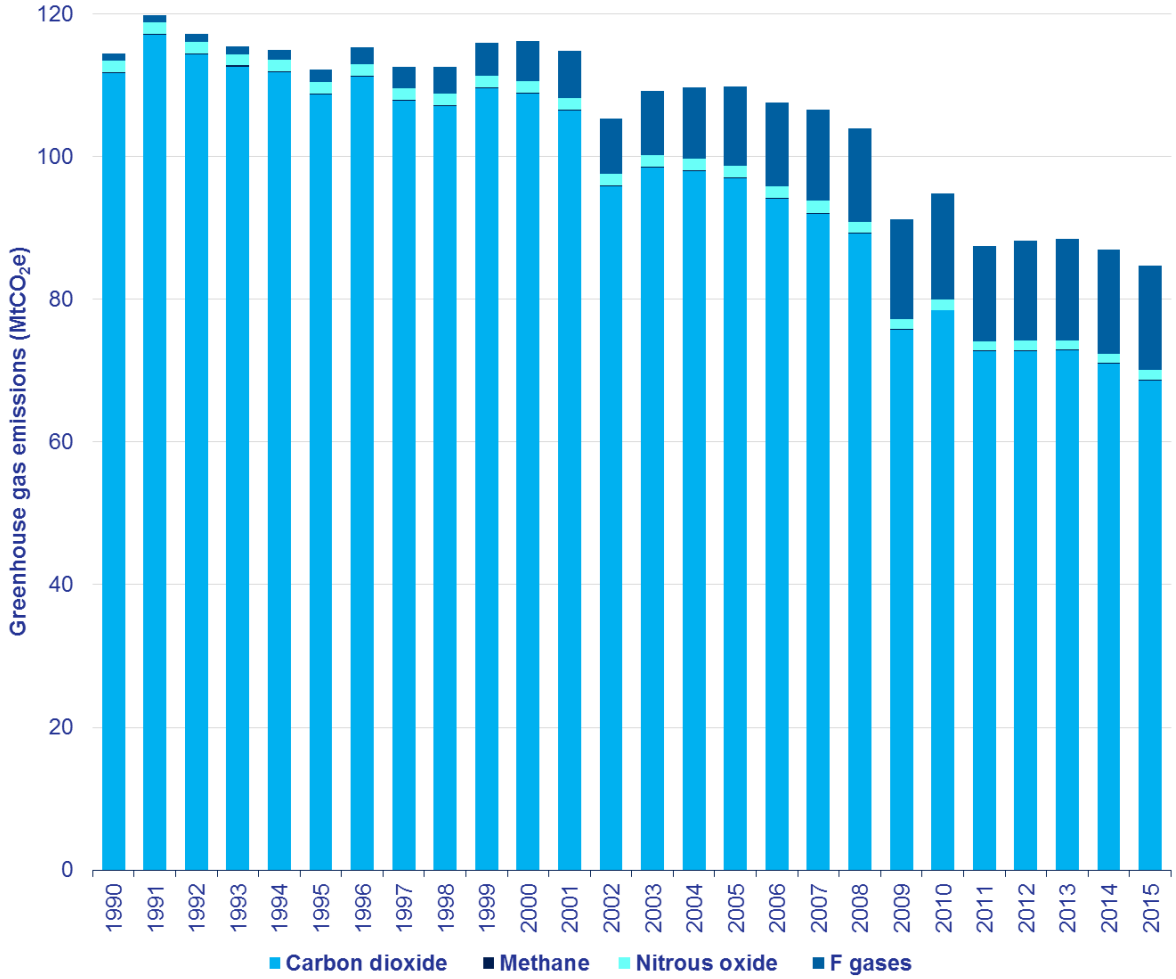
UK, 1990-2015

$MtCO_2e$

	1990	1995	2000	2005	2010	2014	2015
Carbon dioxide	111.6	108.7	108.8	96.9	78.4	70.9	68.6
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	1.3	1.3
F gases	1.0	1.8	5.7	11.0	14.9	14.5	14.6
Total	**114.4**	**112.2**	**116.2**	**109.8**	**94.8**	**86.9**	**84.6**

Source: Table 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Figure 10: Greenhouse gas emissions from business, UK 1990-2015 ($MtCO_2e$)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 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 13 per cent of UK greenhouse gas emissions in 2015, with carbon dioxide being the most prominent gas for this sector. The main source of emissions from this sector is the use of natural gas for heating and cooking. Emissions of F gases in this sector are related to the use of aerosols and metered dose inhalers.

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 2015, 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 2014 and 2015, with 2015 being a cooler year than 2014. 2015 was 0.6 degrees Celsius cooler on average than 2014, despite average temperatures in the fourth quarter of 2015 being the warmest for the fourth quarter since 1970[22]. In particular the first quarter of 2015 was on average 1.3 degrees cooler than the first quarter of 2014[23], 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, 1990-2015

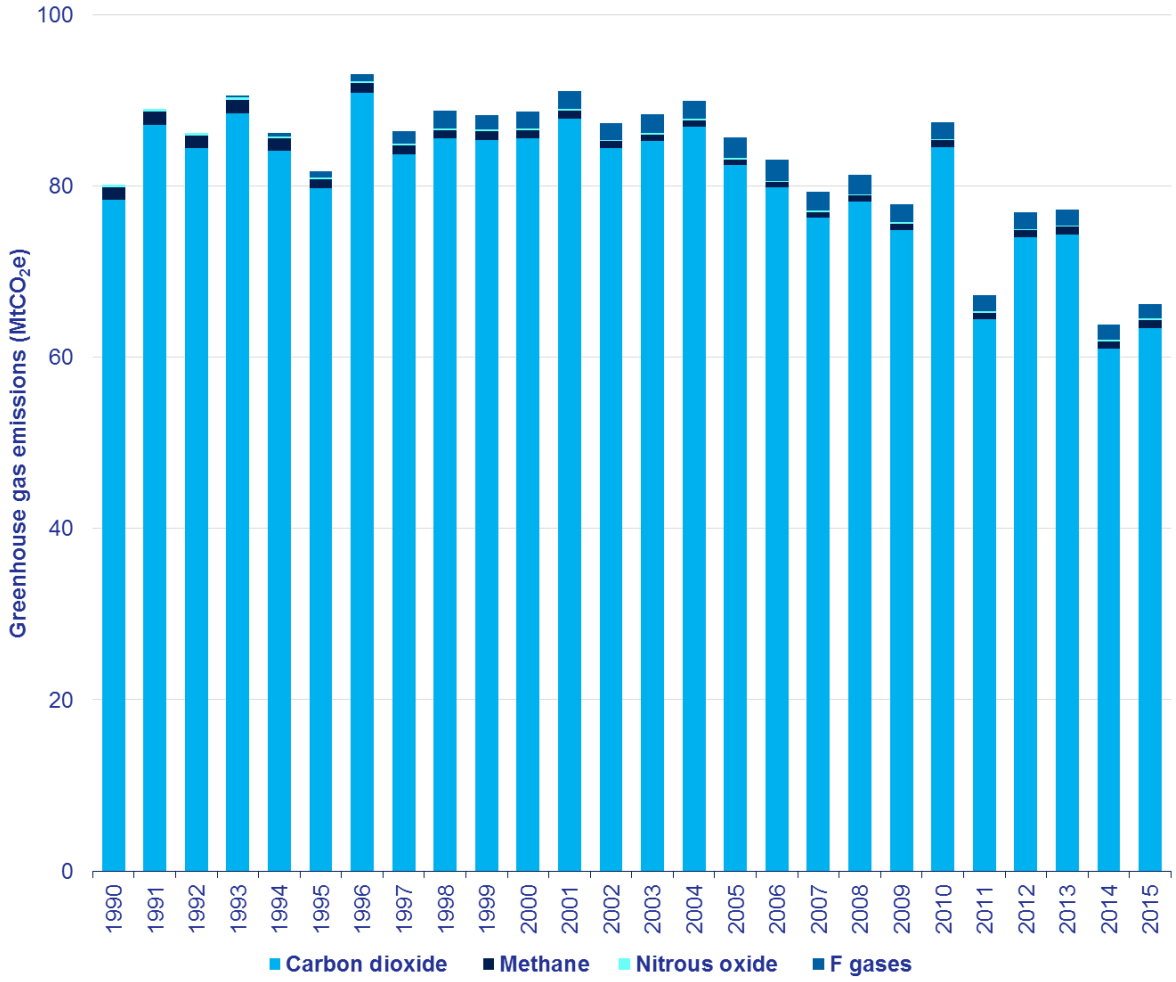
$MtCO_2e$

	1990	1995	2000	2005	2010	2014	2015
Carbon dioxide	78.4	79.7	85.6	82.5	84.5	61.0	63.4
Methane	1.5	1.1	0.9	0.6	0.8	0.8	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	1.8
Total	**80.1**	**81.7**	**88.7**	**85.7**	**87.5**	**63.8**	**66.3**

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

[22] Weather: Digest of United Kingdom energy statistics (DUKES)
https://www.gov.uk/government/statistics/weather-digest-of-united-kingdom-energy-statistics-dukes
[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 11: Greenhouse gas emissions from the residential sector, UK 1990-2015 ($MtCO_2e$)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 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 2015. Emissions of methane (56 per cent) and nitrous oxide (33 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 2015, greenhouse gas emissions from agriculture decreased by around 17 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 2014 and 2015 there was very little change in emissions from the agriculture sector.

Table 10: Agriculture sector emissions by gas

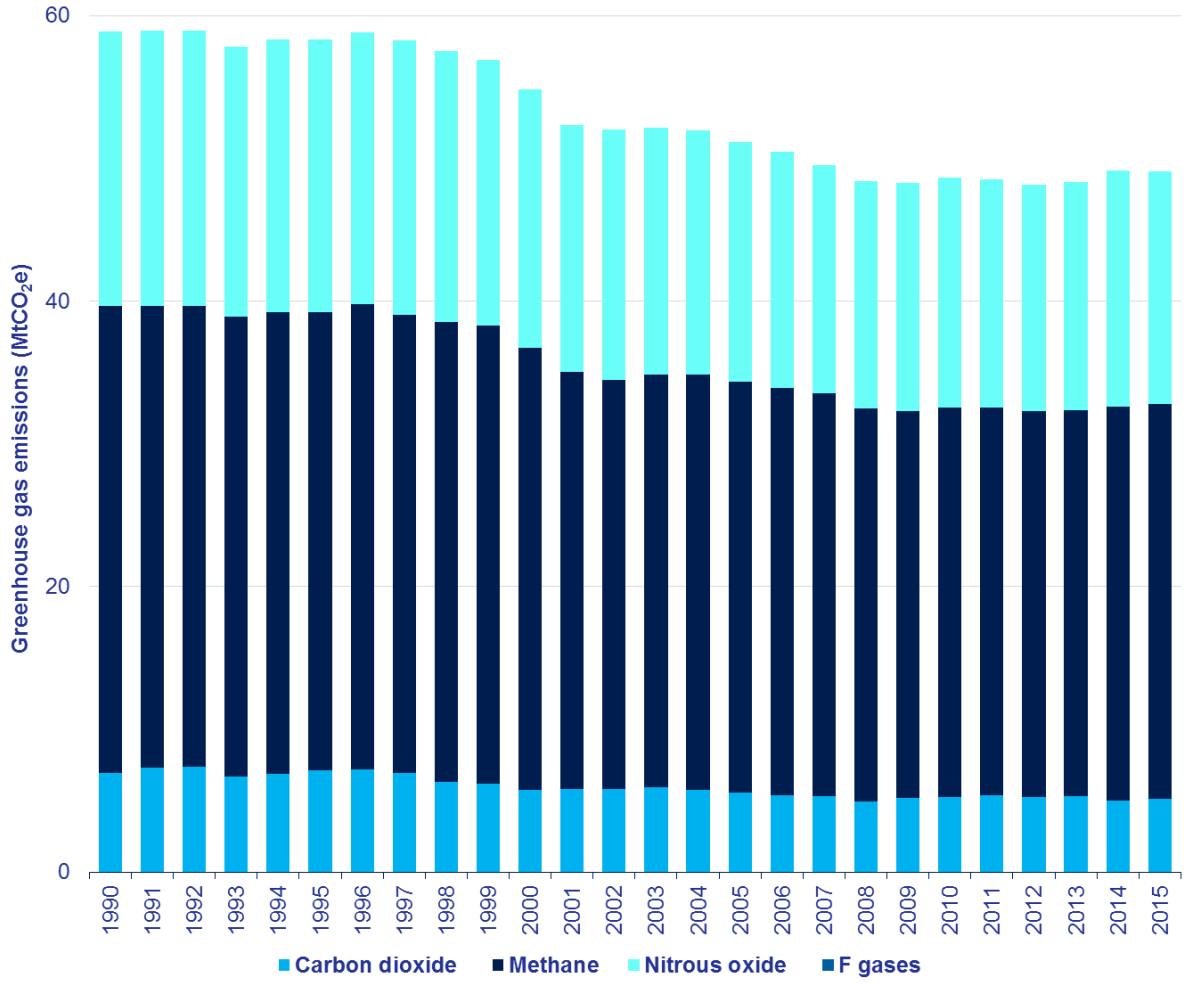
UK, 1990-2015

$MtCO_2e$

	1990	1995	2000	2005	2010	2014	2015
Carbon dioxide	7.0	7.1	5.7	5.6	5.2	5.0	5.2
Methane	32.7	32.1	31.0	28.8	27.3	27.6	27.7
Nitrous oxide	19.2	19.1	18.1	16.8	16.1	16.5	16.3
F gases	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**58.9**	**58.3**	**54.8**	**51.1**	**48.6**	**49.1**	**49.1**

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Figure 12: Greenhouse gas emissions from agriculture, UK 1990-2015 ($MtCO_2e$)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 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 2015, with methane being by far the most prominent gas (accounting for 91 per cent of emissions). The vast majority of these emissions are from landfill sites.

Between 1990 and 2015, greenhouse gas emissions from the waste management sector decreased by 73 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 fell by 7 per cent between 2014 and 2015 due to decreased emissions from landfilled waste.

Table 11: Waste management sector emissions by gas

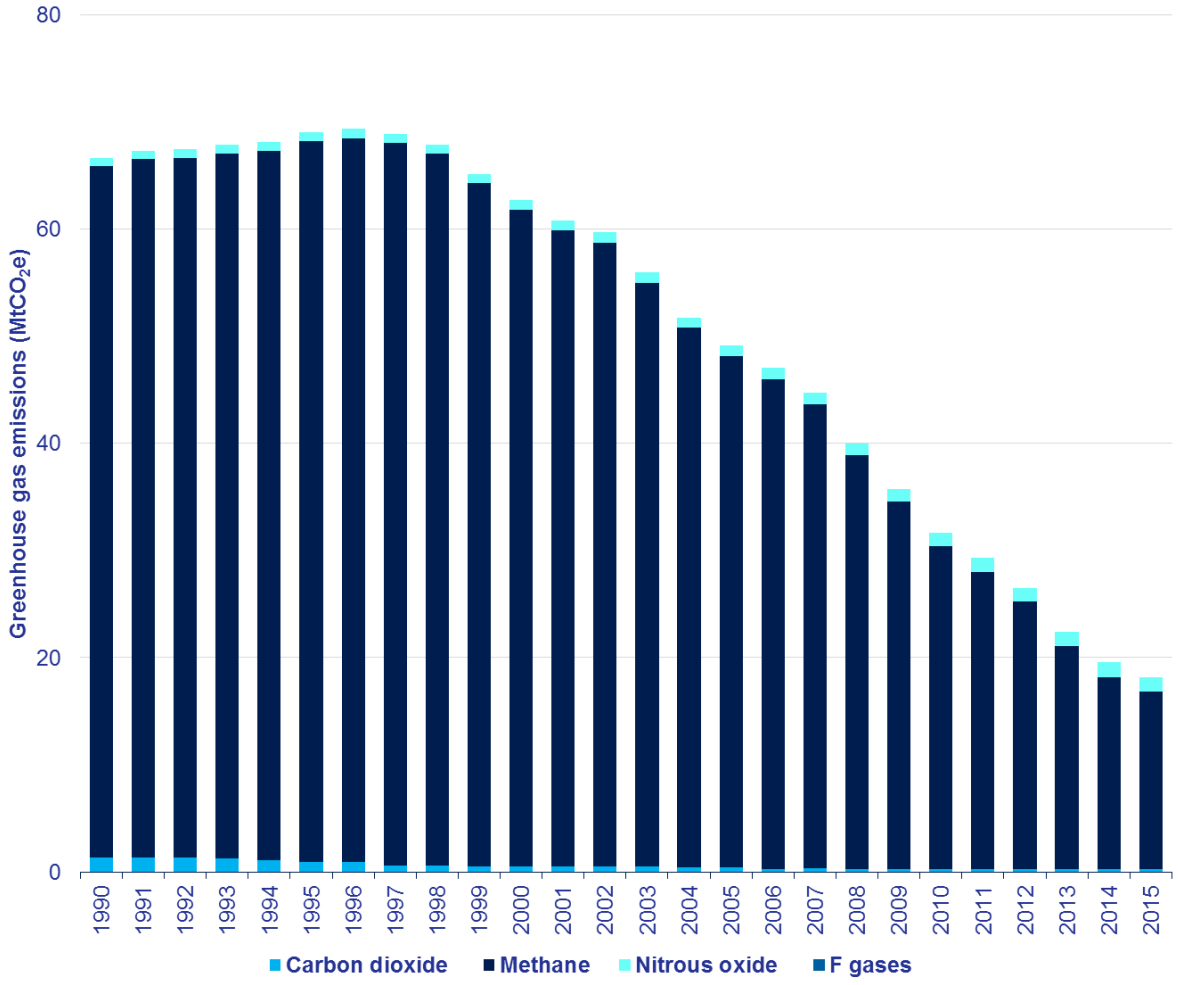
UK, 1990-2015

$MtCO_2e$

	1990	1995	2000	2005	2010	2014	2015
Carbon dioxide	1.3	0.9	0.5	0.4	0.3	0.3	0.3
Methane	64.5	67.3	61.3	47.7	30.1	17.9	16.5
Nitrous oxide	0.8	0.8	0.9	1.0	1.2	1.4	1.4
F gases	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**66.6**	**69.0**	**62.7**	**49.2**	**31.7**	**19.5**	**18.2**

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Figure 13: Greenhouse gas emissions from waste management, UK 1990-2015 ($MtCO_2e$)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 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 3 per cent of UK greenhouse gas emissions in 2015, with carbon dioxide being the most prominent gas. The largest source of emissions is cement production, with other processes such as sinter, lime, and iron and steel production also contributing significantly.

Between 1990 and 2015, there was a large reduction in greenhouse gas emissions from the industrial process sector, with an overall decrease of 79 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 2015 compared to 2014 by 2 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

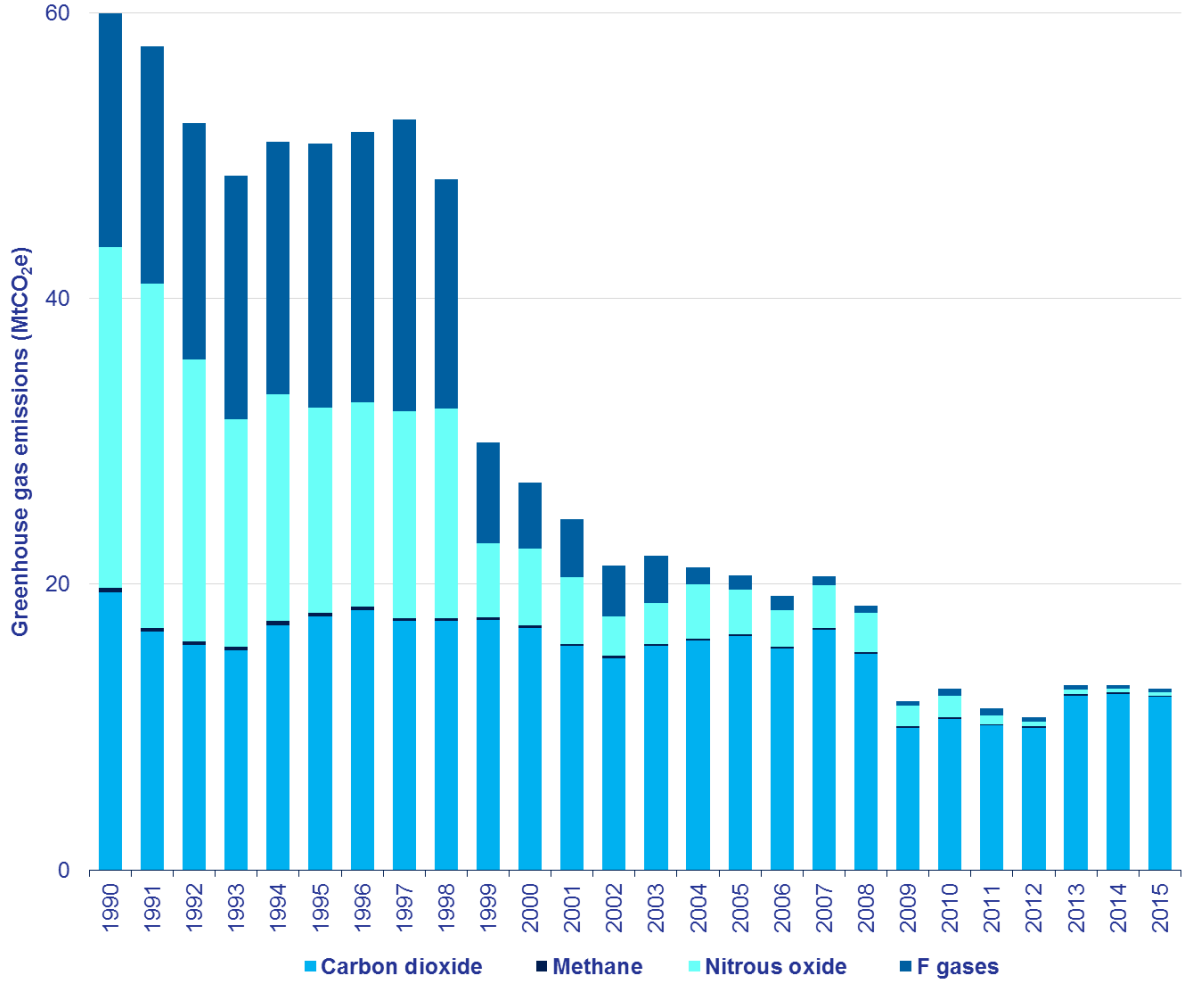
UK, 1990-2015

$MtCO_2e$

	1990	1995	2000	2005	2010	2014	2015
Carbon dioxide	19.4	17.7	17.0	16.4	10.6	12.3	12.1
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	**60.0**	**50.9**	**27.1**	**20.6**	**12.7**	**13.0**	**12.7**

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Figure 14: Greenhouse gas emissions from industrial processes, UK 1990-2015 ($MtCO_2e$)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 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 2015, 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 2015, 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 2014 and 2015 emissions decreased by less than 1 per cent in the public sector.

Table 13: Public sector emissions by gas

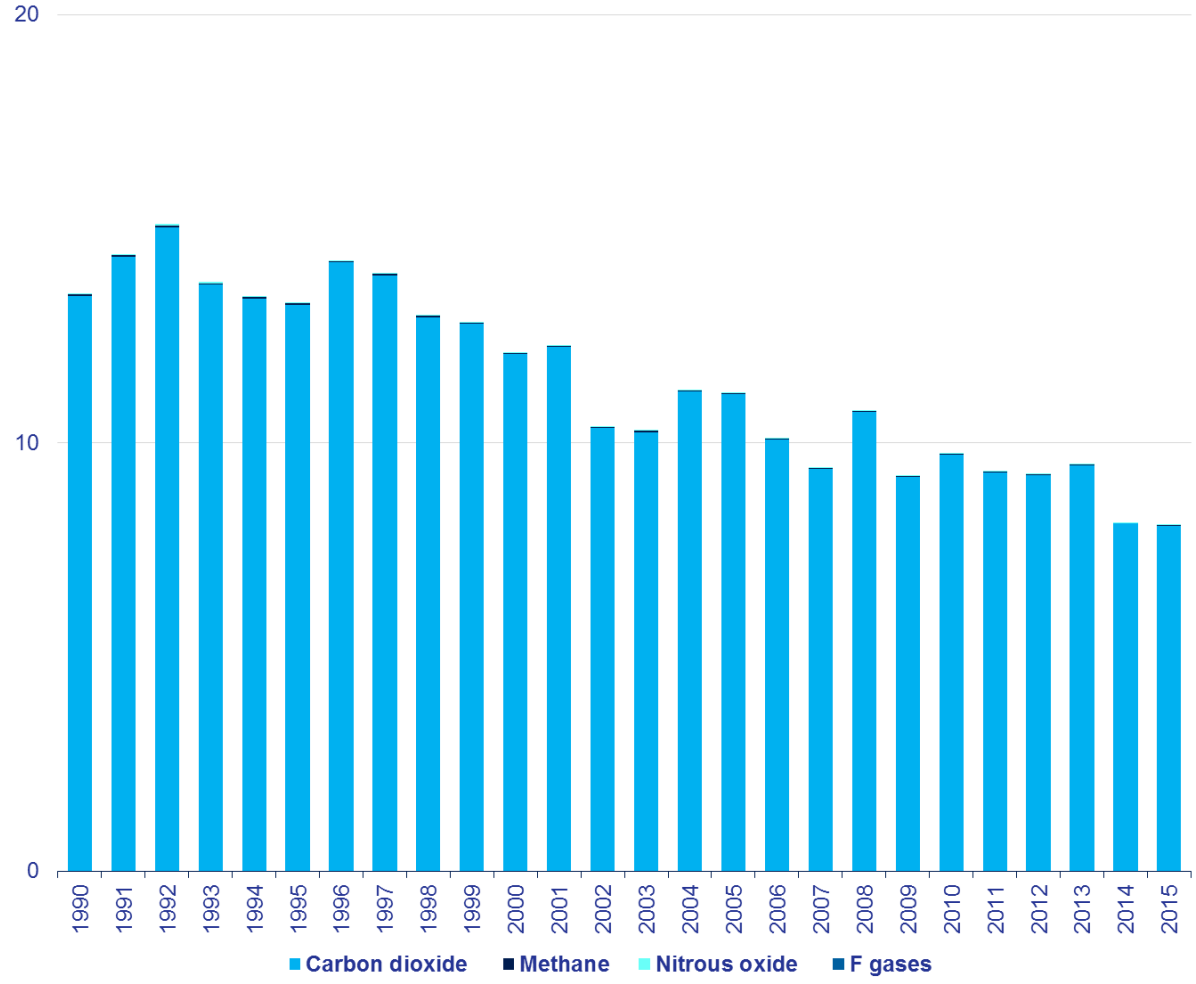
UK, 1990-2015

$MtCO_2e$

	1990	1995	2000	2005	2010	2014	2015
Carbon dioxide	13.4	13.2	12.1	11.1	9.7	8.1	8.1
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	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**13.5**	**13.3**	**12.1**	**11.2**	**9.7**	**8.1**	**8.1**

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Figure 15: Greenhouse gas emissions from the public sector, UK 1990-2015 ($MtCO_2e$)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Land use, land use change and forestry (LULUCF)

The LULUCF sector consists of emissions from forest land, cropland, grassland, settlements and harvested wood products. It acted as a net sink of UK greenhouse gas emissions in 2015, dominated by carbon dioxide emissions. 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.

Between 1990 and 2015, the UK has gone from being a net source of LULUCF emissions to a net sink 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.

LULUCF emissions slightly increased in 2015 compared to 2014 by 0.1 $MtCO_2e$. This was mainly due to an increase in emissions from forest land remaining forest land offset by a decrease in emissions from harvested wood products.

Table 14: LULUCF sector emissions by gas

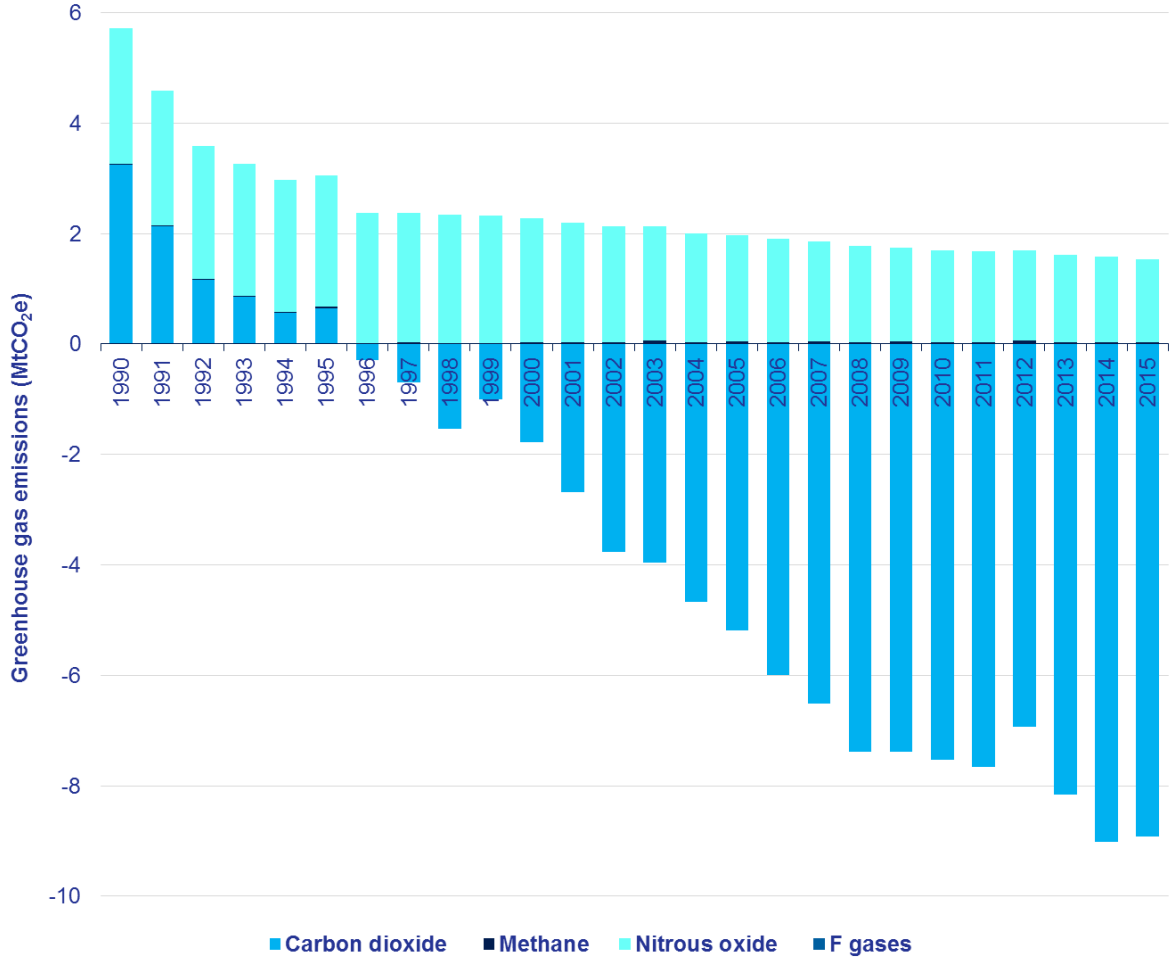
UK, 1990-2015

$MtCO_2e$

	1990	1995	2000	2005	2010	2014	2015
Carbon dioxide	3.2	0.6	-1.8	-5.2	-7.5	-9.0	-8.9
Methane	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nitrous oxide	2.5	2.4	2.2	1.9	1.7	1.6	1.5
F gases	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**5.7**	**3.1**	**0.5**	**-3.2**	**-5.8**	**-7.4**	**-7.4**

Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Figure 16: Greenhouse gas emissions from the LULUCF sector, UK 1990-2015 ($MtCO_2e$)



Source: Tables 3 to 7, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Emissions from UK-based international aviation and shipping bunkers

Emissions from international aviation and shipping can be estimated from refuelling from bunkers[24] 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 2015, emissions from international aviation fuel use were estimated to be 33.3 $MtCO_2e$. This was slightly larger than the 2014 figure. Between 1990 and 2006, when emissions peaked, emissions more than doubled from 15.4 $MtCO_2e$ to 35.5 $MtCO_2e$. 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 7.4 $MtCO_2e$ in 2015, a 16 per cent decrease from the 2014 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.

[24] A large container or compartment that stores fuel for ships.

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

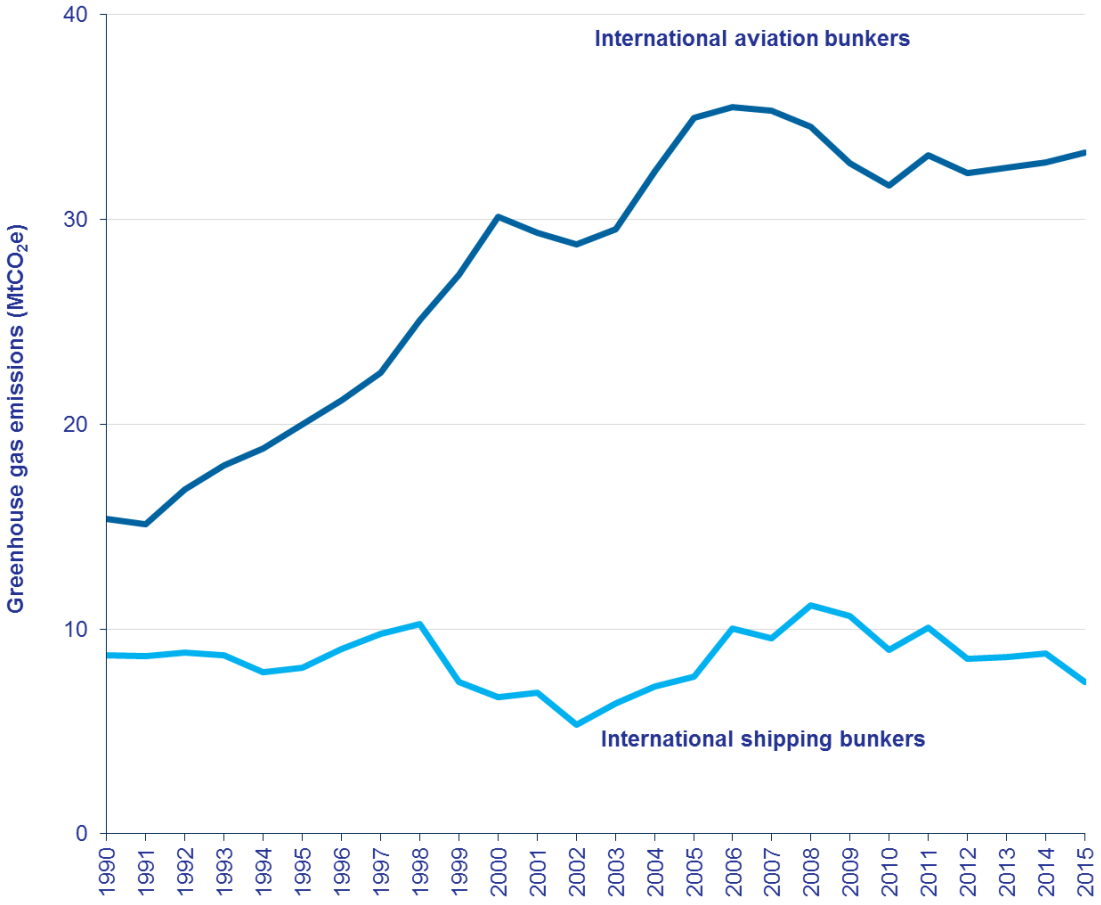
UK, 1990-2015

$MtCO_2e$

	1990	1995	2000	2005	2010	2014	2015
International aviation	15.4	20.0	30.1	35.0	31.6	32.8	33.3
International shipping	8.7	8.1	6.7	7.7	9.0	8.8	7.4
Total	**24.1**	**28.1**	**36.8**	**42.6**	**40.7**	**41.6**	**40.7**

Source: Table 8, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Figure 17: Greenhouse gas emissions from UK-based international aviation and shipping bunkers, 1990-2015 ($MtCO_2e$)



Source: Table 8, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables

Revisions from provisional estimates of greenhouse gas emissions

Provisional estimates of 2015 UK greenhouse gas and carbon dioxide emissions were published in March 2016, based on early estimates of energy consumption for the year. Differences between the provisional and final estimates arise primarily due to revisions to other statistics on which these estimates were based, use of actual data to estimate non-CO_2 emissions which are only 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 2015 for the UK would be 497.2 million tonnes carbon dioxide equivalent, a 3.4 per cent decrease on 2014 emissions. The final estimate of 2015 emissions is 495.7 million tonnes, 0.3 per cent lower than the provisional estimate and representing a 3.8 per cent decrease on 2014 emissions. The 2015 provisional greenhouse gas emissions estimates therefore slightly underestimated the decrease in emissions that is seen in the 2015 final greenhouse gas emissions.

The provisional estimates are focused on carbon dioxide emissions from the energy sector, and only provide a crude estimate of non-CO_2 gases which assumes that 2015 emissions for non-CO_2 gases are the same as emissions in 2014. Looking just at carbon dioxide emissions, it was provisionally estimated that net UK carbon dioxide emissions in 2015 would be 404.7 million tonnes. The final 2015 figure of 403.8 million tonnes is 0.2 per cent lower than the provisional estimate. The provisional CO_2 emissions estimates therefore very slightly underestimated (at a smaller magnitude than total greenhouse gas emissions estimates) the decrease in CO_2 emissions that is seen in the 2015 final CO_2 emissions.

Table 16: Comparison of 2015 provisional and final estimates

UK, 2014-2015

$MtCO_2e$

	2015 Provisional estimates	2015 Final estimates	Difference between final and provisional	Provisional 2014 to 2015 % change	Final 2014 to 2015 % change
Total CO_2	404.7	403.8	-0.9	-4.1%	-4.1%
Total greenhouse gas emissions	497.2	495.7	-1.4	-3.4%	-3.8%

Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2015 Excel data tables
Table 1, Provisional UK greenhouse gas emissions national statistics 2015 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 Report[25] (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, business and waste management sectors.

Details of the changes made to estimates of 1990 and 2014 emissions are given below. Revisions to other years of the time series are of a similar scale.

[25] Previous UK NIRs can be found here: http://naei.defra.gov.uk/reports/reports?report_id=902 and the latest NIR covering 1990-2015 emissions will be submitted to the UNFCCC on 15th April 2017.

Table 17: Revisions in the 2017 greenhouse gas inventory, by sector

UK, 1990-2014

$MtCO_2e$

	1990 emissions			2014 emissions		
	2016 inventory	2017 inventory	Change	2016 inventory	2017 inventory	Change
Energy supply	277.9	277.9	0.0	163.8	164.3	0.5
Transport	121.9	121.9	0.0	117.9	117.8	-0.1
Business	115.4	114.4	-1.0	88.5	86.9	-1.6
Residential	80.1	80.1	0.0	64.2	63.8	-0.4
Agriculture	58.7	58.9	0.2	49.1	49.1	0.1
Waste management	68.8	66.6	-2.1	18.8	19.5	0.7
Industrial processes	60.0	60.0	-0.1	13.0	13.0	0.0
Public	13.5	13.5	0.0	8.1	8.1	0.0
LULUCF	0.3	5.7	5.4	-9.0	-7.4	1.5
Total	**796.6**	**799.0**	**2.4**	**514.4**	**515.1**	**0.7**

Source: Table 3, Final UK greenhouse gas emissions national statistics 1990-2015 Data tables
Table 3, Final UK greenhouse gas emissions national statistics 1990-2014 Data tables

Changes to estimates of emissions from harvested wood products

A UNFCCC review recommendation to include more detailed forest area data for the UK has had knock on effects for emissions from harvested wood products. Improvements to forest land activity data, in particular improved alignment with annual wood production statistics, are estimated to decrease harvested wood products emissions by 0.2 $MtCO_2e$ in 1990 and 0.4 $MtCO_2e$ in 2014.

Changes to ammonia and methanol feedstocks

The 2006 IPCC guidelines indicated emissions from the manufacture of petrochemicals such as methanol should be reported in Industrial Processes and Product Use (IPPU). The changes mainly occur over the period from 1990 to 2001 when the UK produced methanol. These changes are estimated to decrease emissions in the Business sector and increase emissions in the Industrial Processes sector in 1990. Overall the changes to ammonia and methanol feedstocks are estimated to decrease emissions by around 0.7 $MtCO_2e$ in 1990 and emissions are expected to remain unchanged for 2014.

Changes to estimates of emissions from grassland

There have been several specific changes in this area. The largest change is due to using a new methodology for calculating biomass carbon stock change from hedges as a result of grassland management, which is estimated to decrease emissions in 1990 and slightly increase emissions in 2014. More minor updates include the correction of an error in the application of a conversion factor, inclusion of more detailed forest data using the National

Forest Inventory, using updated activity data including changes to wildfire areas and revised peat extraction areas. Overall these changes to grassland are estimated to decrease emissions by around 1 $MtCO_2e$ in 1990 and increase emissions by around 0.2 $MtCO_2e$ in 2014.

New data for commercial and industrial waste in landfill and change of decay rates

A new dataset from HM Revenue & Customs (HMRC) has been used which gives detail on inert wastes for 2008-2014 that was previously not available and makes the landfill model more complete. Due to the large increase in the percentage of methane captured from landfill following the use of this dataset, the country specific decay rate has been changed to the default IPCC decay rate. Emissions are estimated to decrease by around 2 $MtCO_2e$ in 1990 and increase by 0.2 $MtCO_2e$ in 2014.

Changes to estimates of emissions from forest land

There have been several specific changes in this area. The largest change is due to a UNFCCC review recommendation to include more detailed forest area data and improved forest soil carbon stock change modelling for "Land converted to Forest Carbon stock change for the UK" which is estimated to increase emissions in 1990 and 2014. The emission source "Land converted to Forest Land Direct N_2O Emissions from Mineralisation" is also reported for the first time in this inventory which is estimated to slightly increase emissions in 1990 and 2014. More minor updates include the correction of an error in the application of a conversion factor, inclusion of more detailed forest data using the National Forest Inventory, using updated activity data including changes to wildfire areas and inclusion of an improved soil sub-model in the forest carbon model (CARBINE). Overall these changes to emissions from forest land are estimated to increase emissions by around 6 $MtCO_2e$ in 1990 and by around 1 $MtCO_2e$ in 2014.

Other changes to emissions

The time series for estimates of emissions from fluorinated gas use in aerosols have been revised in the Business sector to reflect new data from the British Aerosol Manufacturers' Association (BAMA) for 2009-2012 and BAMA industry insight on market behaviours in reaction to the new EU F gas regulations from 2012 to 2020. This has decreased Business 2014 emissions by a small amount.

Activity data for non-agricultural anaerobic digestion has been updated and rationalised between the greenhouse gas and ammonia inventories. UNFCCC review recommendations requested that nitrous oxide emissions from wastewater decomposition were recalculated to account for two new parameters. Additionally it was requested that the UK revises its approach to emissions from solvent use of HFCs and to review the lubricants emissions estimates. These changes have resulted in a slight increase of waste management sector emissions in 1990 and 2014.

There have been other minor changes in the LULUCF sector including continuous improvement updates to activity data in emissions from croplands and wetlands, inclusion of more detailed forest data for cropland and settlement emissions, correction of an error in the application of a conversion factor in emissions from croplands and settlements and inclusion of a new emissions source in the inventory for emissions from indirect nitrous oxide. These minor changes have increased LULUCF sector emissions by less than 1 $MtCO_2e$ in both 1990 and 2014.

Overall impact on emissions

In total, the changes made to the methods and data for the 2017 inventory submission have led to an increase in 2014 emissions by around 1 $MtCO_2e$ and an increase in 1990 emissions by around 2 $MtCO_2e$.

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 2017 inventory submission covering emissions from 1990-2015 are summarised in the table below.

Table 18: UNFCCC review recommendations implemented in the 2017 inventory submission

UNFCCC review recommendations	Sector/sub-sectors impacted
Include more detailed forest area data	• LULUCF: Forest remaining forest biomass burning (wildfires) • LULUCF: Forest land drainage • LULUCF: Land converted to cropland carbon stock change • LULUCF: Land converted to cropland biomass burning (controlled burning) • LULUCF: Land converted to grassland carbon stock change • LULUCF: Land converted to grassland biomass burning (controlled burning) • LULUCF: Land converted to settlement carbon stock change • LULUCF: Land converted to settlement biomass burning (controlled burning) • KP-LULUCF: Afforestation and Reforestation biomass burning (wildfires) • KP-LULUCF: Forest Management biomass burning (wildfires) • KP-LULUCF: Deforestation carbon stock change • KP-LULUCF: Deforestation biomass burning (controlled burning) • KP-LULUCF: Harvested Wood Products

Include more detailed forest area data and improved forest soil carbon stock change modelling	• LULUCF: Forest remaining forest carbon stock change • LULUCF: Land converted to forest carbon stock change • KP-LULUCF: Afforestation and Reforestation carbon stock change • KP-LULUCF: Forest Management carbon stock change
Include more detailed forest area data and correction of a previous error	• LULUCF: Forest land fertilisation • KP-LULUCF: Afforestation and Reforestation fertilisation
Include emissions from indirect N_2O – reported for the first time in the UK Greenhouse Gas Inventory	• LULUCF: Indirect emissions for the UK, Overseas Territories & Crown Dependencies • KP: Afforestation and Reforestation indirect emissions • KP-LULUCF: Deforestation indirect emissions • KP-LULUCF: Forest Management indirect emissions • KP-LULUCF: Cropland Management indirect emissions • KP-LULUCF: Grazing Land Management indirect emissions
Include more detailed forest area data and report harvested wood product production data and factors used to convert product data to carbon	• LULUCF: Harvested wood products
Include emissions from historic land use change and organic soil drainage in KP reporting	• KP-LULUCF: Cropland Management carbon stock change • KP-LULUCF: Cropland Management emissions from drainage • KP-LULUCF: Grazing Land Management carbon stock change • KP-LULUCF: Grazing Land Management emissions from drainage
Include Cropland Management and Grazing Land Management KP activities for the Overseas Territories and Crown Dependencies	• KP-LULUCF: Cropland Management carbon stock change • KP-LULUCF: Grazing Land Management carbon stock change
Recalculation of emissions of N_2O from waste water decomposition to include two new parameters	• Waste management: Waste water handling
Emissions from lubricant used for energy purposes will be re-allocated from non-energy use to sectors for reporting energy use	• Agriculture, Business and Transport (IPCC sectors 2D1, 1A3biv and 1A2gviii are impacted)

Estimating emissions on a temperature adjusted basis

BEIS publish provisional estimates of temperature adjusted emissions[26], 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 provisional inland 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 2014 and 2015 were estimated to be 440.0 Mt and 414.9 Mt respectively. The decrease in carbon dioxide emissions between 2014 and 2015 in the temperature adjusted figures is therefore 25.1 Mt, which is more than the decrease seen in the non-temperature adjusted figures (as can be seen in the table below).

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

UK, 2014-2015

$MtCO_2e$

	2014 CO_2 emissions (Mt)	2015 CO_2 emissions (Mt)	Absolute change (Mt)	Percentage change
Final estimates ➢ unadjusted emissions	421.2	403.8	-17.4	-4.1%
Quarterly estimates ➢ unadjusted emissions	422.0	402.8	-19.2	-4.6%
Quarterly estimates ➢ Temperature adjusted emissions	440.0	414.9	-25.1	-5.7%

Source: Table 1, Final UK greenhouse gas emissions national statistics 1990-2015 Data tables
Table 1 & 2, Quarterly provisional emissions September 2016 Data tables

Note: The non-adjusted emissions estimates from the quarterly figures differ from the emissions estimates in these statistics because the quarterly statistics were published before the 2017 inventory figures presented here were finalised.

[26] Provisional UK greenhouse gas emissions:
https://www.gov.uk/government/collections/provisional-uk-greenhouse-gas-emissions-national-statistics
UK greenhouse gas emissions quarterly official statistics (the final publication of these statistics was published on 29 September 2016):
https://www.gov.uk/government/collections/uk-greenhouse-gas-emissions-quarterly-official-statistics

Background Information

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 (IPCC[27]), 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, 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.

[27] IPCC: http://www.ipcc-nggip.iges.or.jp/public/index.html

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 (NF_3).

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 2015, 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 from, to and 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 30th March 2017 BEIS will publish a breakdown of 1990-2015 UK emissions by end-user sector and fuel type, to supplement the source sector breakdown published today.

On Thursday 30th March 2017 BEIS will also publish provisional estimates of UK greenhouse gas emissions for 2016. This will coincide with the publication of Energy Trends statistics, which will include estimates of 2016 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 1970-2015, 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 1990-2015 will be submitted to the United Nations Framework Convention on Climate Change (UNFCCC) on 15th April 2017. The report will contain national greenhouse gas emissions estimates for 1990-2015 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 2015 must be laid before Parliament and published no later than 31st March 2017. This will give details of the net UK carbon account for 2015, 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 2016 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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