



Department for
Business, Energy
& Industrial Strategy

Planned methodology changes for UK greenhouse gas emissions statistics 1990-2020

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Contents

Introduction	4
Impact of changes	5
Summary of individual changes	7
Semiconductor manufacture	7
Airborne Warning And Control System (AWACS)	7
Upstream/offshore oil and gas operations	7
Unconventional Gas (Shale gas)	9
Electric Arc Furnaces	9
Ceramics other than bricks and roofing tiles	9
Introduction of use of natural gas as a road fuel	9
Revision to DUKES wood activity data, and review of time series consistency	10
Nitrogen balance approach for sewage sludge removal from wastewater	10
Land use change activity data	10
Forestry modelling	11
Minor LULUCF revisions	11
Overall impact on emissions	13

Introduction

National Statistics on the UK's territorial greenhouse gas emissions for 1990-2020 will be published on 1st February 2022. The dataset of greenhouse gas emissions estimates is known as the UK's Greenhouse Gas Inventory. Every year, we apply methodological improvements to the way that emissions are estimated and revise the historical figures accordingly. This note sets out the main methodology changes that we have made this year, and their estimated impact on emissions. Figures presented in this report are provisional, and in addition to the UK also include emissions in the Crown Dependencies and Overseas Territories that the UK is required to report on under the United Nations Framework Convention on Climate Change (UNFCCC)¹.

The impacts of each methodology change on the 2019 totals and the 1990 baseline are given in Table 1 and the combined impact of them on each sector that we report on in Table 2. The estimated impacts are also reported as a percentage of the total emissions in last year's Greenhouse Gas Inventory. Emissions estimates are expressed in megatonnes of carbon dioxide equivalents (MtCO₂e), with emissions from each gas weighted based on its global warming potential². The '1990 baseline' is used for the UK's domestic greenhouse gas emission targets and is 1990 for carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O), and 1995 for fluorinated gases (F-gases).

Changes to the estimates can be prompted by revisions to the datasets which have been used in their compilation, for example the UK energy statistics published in the Digest of UK Energy Statistics. Changes are also made in response to internal or external reviews which highlight areas needing improvement or are required when the international reporting guidelines for greenhouse gases are revised.

These changes are applied back through the time series to 1990, to ensure that the trend in emissions from 1990 to the present is based on a consistent method. It is therefore not appropriate to compare different years' inventory submissions. 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.

¹ The Crown Dependencies are the Bailiwick of Jersey, the Bailiwick of Guernsey and the Isle of Man. Only overseas territories that are party to the UK ratification of the UNFCCC are included in these statistics, which are the Cayman Islands, Bermuda, the Falkland Islands and Gibraltar.

² The global warming potentials (GWPs) used are from Working Group 1 of the IPCC Fourth Assessment Report: Climate Change 2007 and summarised in a table published on the following page:
<https://www.gov.uk/government/publications/uk-greenhouse-gas-emissions-explanatory-notes>

Impact of changes

Table 1 shows the impact of methodological changes made this year on our emissions estimates.

Table 1 – Provisional effect of individual changes: UK, Crown Dependencies and Overseas Territories^{3,4,5,6}

Change	Reason for change	Change in emissions (MtCO ₂ e)		Impact on national total from previous inventory (%)	
		1990 baseline	2019	1990 baseline	2019
Semiconductor manufacture	Implementing recommendation from UNFCCC reviewers	~0.0	-0.1	~0.0%	~0.0%
Airborne Warning And Control System (AWACS)	New data available from Ministry of Defence	-0.1	-0.1	~0.0%	~0.0%
Upstream/offshore oil and gas operations	Review of data sources available	2.5	-0.1	0.3%	~0.0%
Unconventional Gas (Shale gas)	New research available	0.0	~0.0	0.0%	~0.0%
Electric Arc Furnaces	Review of data available from EU Emissions Trading System	0.2	~0.0	~0.0%	~0.0%
Ceramics other than bricks and roofing tiles	Implementing recommendation from UNFCCC reviewers	0.4	~0.0	~0.0%	~0.0%
Introduction of use of natural gas as a road fuel	Data now available in Digest of UK Energy Statistics (DUKES)	0.0	~0.0	0.0%	~0.0%
Revision to DUKES wood activity data, and review of time series consistency	Updated data available in DUKES	~0.0	-0.5	~0.0%	-0.1%
Nitrogen balance approach for sewage sludge removal from wastewater	Implementing recommendation from UNFCCC reviewers	~0.0	0.1	~0.0%	~0.0%
Land use change activity data	Implementing recommendation from UNFCCC reviewers	-5.3	-1.1	-0.7%	-0.4%
Forestry modelling	New datasets, improved consistency and assumptions	0.4	-0.7	~0.0%	-0.1%
Minor LULUCF revisions	New datasets available	~0.0	-0.2	~0.0%	~0.0%
TOTAL⁷		-1.9	-2.5	-0.2%	-0.6%

³ The '1990 baseline' is used for the UK's domestic greenhouse gas emission targets and consists of emissions from 1990 for all gases except fluorinated gases, for which it uses emissions values from 1995.

⁴ ~0.0 indicates where a value is non-zero but is less than either 0.05 MtCO₂e or 0.05% in magnitude. 0.0 indicates a value that has not changed.

⁵ A positive number indicates an increase on last year's emissions estimates; a negative number indicates a decrease.

⁶ All figures have been rounded to 1 decimal place.

⁷ Totals may not sum due to rounding.

Table 2 summarises the estimated impact on emissions from the methodology changes for each sector.

Table 2 – Provisional effect of changes by sector: UK, Crown Dependencies and Overseas Territories ^{8,9,10,11}

National Communication Sector	Change in emissions (MtCO ₂ e)		Impact on national total from the previous inventory (%)	
	1990 baseline	2019	1990 baseline	2019
Agriculture	0.0	0.0	0.0%	0.0%
Business	-0.1	-0.2	~0.0%	~0.0%
Energy Supply	2.5	-0.1	0.3%	~0.0%
Industrial Processes	0.5	0.1	0.1%	~0.0%
Land Use, Land Use Change and Forestry (LULUCF)	-4.9	-1.9	-0.6%	-0.4%
Public	0.0	0.0	0.0%	0.0%
Residential	~0.0	-0.5	~0.0%	-0.1%
Transport	0.0	~0.0	0.0%	~0.0%
Waste Management	~0.0	0.1	~0.0%	~0.0%
TOTAL ¹²	-1.9	-2.5	-0.2%	-0.6%

⁸ The '1990 baseline' is used for the UK's domestic greenhouse gas emission targets and consists of emissions from 1990 for all gases except fluorinated gases, for which it uses emissions values from 1995.

⁹ ~0.0 indicates where a value is non-zero but is less than either 0.05 MtCO₂e or 0.05% in magnitude. 0.0 indicates a value that has not changed.

¹⁰ A positive number indicates an increase on last year's emissions estimates; a negative number indicates a decrease.

¹¹ All figures have been rounded to 1 decimal place.

¹² Totals may not sum due to rounding.

Summary of individual changes

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

Semiconductor manufacture

Several revisions have been made to the estimates of emissions from the manufacture of semiconductors following a general review of the model parameters and assumptions that was made in consultation with UK semiconductor manufacturers and with consideration for BEIS' Excel model QA guidance. In particular:

- A flatter trend in total CO₂e for 2001-10 following a review to the approach to modelling the phasing out of CF₄ and C₂F₆
- Removing the exponential growth previously assumed for 2010 onwards
- Some changes in the relative importance of each pollutant due to revisions in some parameters in the 2019 refinement compared to the 2006 Intergovernmental Panel on Climate Change (IPCC) guidelines.

Airborne Warning And Control System (AWACS)

We have revised the estimates for sulphur hexafluoride (SF₆) emissions from AWACS using data providing a full time series of the number of active planes recently obtained from the Ministry of Defence. The previous estimate used an IPCC default emission factor, and a fixed number of planes for all years due to lack of better data. The default emission factor has been replaced by actual data for the years 2016-2020, a Ministry of Defence estimate for 2014 and 2015, and an average value based on all measured data (i.e. excluding the estimated data for 2014 and 2015) applied to all other years.

This marks a significant improvement to the accuracy and representativeness of the emissions estimates for this source and has led to a significant reduction in the estimates for all years.

Upstream/offshore oil and gas operations

We have developed new emission estimation models to make use of new and existing data sources, and to reflect some of the new IPCC methods for fugitive sources. The project has involved consultation with a number of industry, statistical and regulatory agencies, including: BEIS Offshore Petroleum Regulator for Environment and Decommissioning (OPRED), BEIS Energy Statistics, the Oil and Gas Authority (OGA), Oil and Gas UK, the Environment Agency and the Scottish Environmental Protection Agency (SEPA), and detailed analysis of:

- Environmental Emissions Monitoring System (EEMS) (fixed and mobile offshore operator-supplied data from BEIS OPRED);

- EU ETS (fixed offshore 3rd party verified operator-supplied data from BEIS OPRED, and onshore terminal data from the Environment Agency, SEPA and Natural Resources Wales);
- The Environment Agency's Pollution Inventory, SEPA's Scottish Pollutant Release Inventory, Welsh Emissions Inventory (onshore terminals operator-supplied data from environmental regulators);
- Petroleum Production Reporting System monthly returns per upstream oil and gas field (offshore and onshore operator-supplied data from OGA); this project is the first time the inventory method has been able to make use of these data.
- The first and second EU ETS National Allocation Plans, of CO₂ emissions per oil and gas installation, over 1998-2003.
- Historic editions of the Department of Trade and Industry (DTI) 'Brown Book' (Development of UK Oil and Gas Resources, available to 2004 then discontinued as a publication)
- UK oil and gas operator emissions inventory data for 1990-2003, provided by the UK Offshore Operators Association (UKOOA) to the inventory agency in February 2005.
- Digest of UK Energy Statistics (DUKES) (national energy statistics on own use of fuel, plus gas flaring and venting volume data for onshore and offshore production of oil and gas).

The project has sought to utilise the different datasets to track material production (e.g. from oil/gas field to top-side installation, to pipeline to terminal) and derive best estimates for emissions of greenhouse gases (and air quality pollutants) at each installation over the time series. Key changes have arisen from the comparisons of the National Allocation Plan data and the UKOOA 2005 dataset to revisit and overhaul the method for the early part of the time series, as well as to generate a new integrated model to automate the checking, allocations and calculation of "best" emission estimates from the combination of reporting mechanisms (notably EU ETS, EEMS and the onshore regulator Pollution Inventories). The project has also sought to address a number of minor sources for which new methodological guidance was presented in the 2019 Refinement of IPPC methods; these are generally minor fugitive emission sources from e.g. well drilling and well abandonment.

The approach to determining estimates for earlier years (i.e. in the pre-EEMS and pre-ETS period, 1990-1997) has been reviewed to improve time series consistency, drawing on the UKOOA 2005 dataset as the best available source, validated through comparison against the long-term production datasets, at the oil/gas field level, from the DTI Brown Book publications.

These revisions will have also had an indirect impact on public and business emissions in the early part of the time series where revisions to fuel use for this sector impacts fuel balance reconciliations, but it has not been possible to estimate the impact of this effect in the estimated impacts shown in this report.

Unconventional Gas (Shale gas)

A model has been produced to estimate the fugitive emissions resulting from shale gas exploration, which had not been estimated in previous inventories. With just a handful of wells drilled and completed since 2010, shale gas has been a very minor aspect of oil and gas sector activity in the UK and estimating fugitive emissions had been a lower priority than other areas of more significant uncertainty. However, to ensure the completeness of UK emissions reporting and so that the impacts of shale gas exploration and production can be better understood, research was commissioned to address this under-report and a model produced that can provide emission estimates, should the industry develop in the UK.

Electric Arc Furnaces

Through consultation with key industry operators and analysis of the EU ETS, a time series of detailed operator data has been developed allowing for more accurate emissions estimates.

Historically, emission estimates have relied on a simple method that combined annual data on total electric arc furnaces steel production with a UK industry standard emission factor per unit steel production.

In recent years the quality of greenhouse gas emissions reporting to the EU ETS has improved, and comparison between the EU ETS and greenhouse gas inventory estimates has indicated an under-report in the inventory method.

Ceramics other than bricks and roofing tiles

An estimate of CO₂ emissions from the manufacture of other ceramics has been made using British Geological Survey and EU ETS data. This is a source not previously included in the inventory, although this is a much smaller source than the brick and roof tile estimates which are currently included.

Introduction of use of natural gas as a road fuel

Natural gas use in transport has been identified separately in the Digest of UK Energy Statistics (DUKES) estimates for the first time, enabling it to be distinguished from other uses of natural gas. Therefore, we have introduced a new category in the emissions estimates for emissions from the use of natural gas in transport engines.

Note that this is a reallocation – total gas use in DUKES would have included this small component in earlier years and so CO₂ overall is likely to be unchanged. Emissions of N₂O and CH₄ will be different but as it is not possible to identify which category the gas has been reallocated from it is not possible to quantify this difference.

Revision to DUKES wood activity data, and review of time series consistency

There has been a large reduction to DUKES domestic wood activity estimates for 2008 onwards to reflect the findings of a Defra solid fuel combustion survey. Our approach to adjusting the historic time series for both domestic and industrial wood has been reviewed as a result to remove a time series adjustment to the level of activity data which is no longer necessary with the revision of the approach DUKES use.

The approach to adjusting for time series inconsistencies in energy densities of wood in DUKES has also been reviewed in consultation with Renewable Energy Statistics (RESTATS) for both domestic and industrial wood.

Nitrogen balance approach for sewage sludge removal from wastewater

We have reviewed our approach to accounting for nitrogen removed from wastewater in the form of sewage sludge. Previously to avoid double counting N₂O emissions between wastewater and emission from sewage sludge disposal we used a simple approach of deducting final emissions for other sources from wastewater emissions estimates. However, this approach did not account for the variable N₂O emission factors from these difference sources, and therefore did not well reflect actual reductions in nitrogen remaining that might result in N₂O emissions from effluent.

Now the implied nitrogen content of sewage sludge used as a fertiliser is applied to total sewage sludge removed from wastewater and incinerated, landfilled or used as a fertiliser. The total nitrogen calculated is deducted from the estimate of nitrogen in wastewater to determine the nitrogen remaining in wastewater effluent, and N₂O emission factors are applied to the remaining nitrogen.

This results in an increase in emissions for all years, particularly for later years where there is more sludge removed and less sludge disposed to waterways, and therefore more of an impact by changing the method for accounting for sludge removal.

Land use change activity data

There has been a methodological update to the land-use change activity data used in the LULUCF soils and non-forest biomass models. The new approach assimilates a wider range of land use and land-use change data sources to produce an annual time series, rather than the previous approach that used decadal rates of change based on the Countryside Survey. This has had a range of impacts to emissions across the different land types, including:

- Emissions from carbon stock change in the year of change show more annual variability and are lower than previously estimated.
- Estimates of land-use change from grassland to cropland before 2000, particularly in England, are lower than in the previous activity data set, resulting in lower carbon stock change emissions in mineral soils.
- The use of an annual time series results in a more gradual change in modelled carbon stock changes due to land-use change in mineral soil.
- Overall estimates of land-use change to grassland are lower than in the previous activity data set, resulting in smaller carbon stock change removals in mineral soils, but the direction of change varies between countries and land use transitions.
- Overall estimates of land-use change to settlement are lower than in the previous activity data set, resulting in smaller carbon stock change emissions in mineral soils.
- There are lower direct and indirect N₂O emissions from mineralisation corresponding to the lower emissions from land-use change transitions resulting in mineral soil carbon stock losses.

Forestry modelling

Small changes were made to the activity data for forest planting and wood production which included new data from the 2021 Forestry Statistics Publication. An improvement was made to the adjustment for open space within forests and estimation of forest planting data for Northern Ireland was updated to the same method as used for the rest of the UK. These changes resulted in minor changes to the forest carbon stock change and Harvested Wood Products modelled in CARBINE. A minor change was also made in the CARBINE model to improve drainage assumptions.

The deforestation activity data time series was also updated to improve consistency in assumptions for land use change following deforestation.

Minor LULUCF revisions

A number of other minor revisions were made to LULUCF models, including:

- Additional data reported by Growing Media Association was provided for peat extraction from 2014 onwards including data on volume of peat sold and sites which have ceased extraction. These new data replace interpolated values from 2014 onwards where there were data gaps due to the UK Minerals Yearbook no longer reporting peat volumes (the last year of data was 2014). This led to a small decrease in emissions from peat extraction.
- Additional peatland restoration area data supplied by Peatland Action for Scotland for 2016-2020 was used to update the activity dataset.
- Additional wildfire data for Scotland was supplied from the Fire and Rescue Service following a review of their data classification for large fires.

- Emissions from wetland drainage and rewetting of organic soils were included for the Isle of Man for the first time.

Overall impact on emissions

In total, the changes made to the methods for the 1990-2019 greenhouse gas emission statistics decrease emissions in the 1990 baseline by 1.9 MtCO_{2e} and decrease emissions in 2019 by 2.5 MtCO_{2e}. These changes are much smaller in absolute terms than the methodological changes in last year's statistics, which increased estimates of emissions in 1990 by around 16.4 MtCO_{2e} and increased estimates of emissions in 2018 by around 14.9 MtCO_{2e}. This is not an indication of the revisions to the statistics as a whole as it does not include annual variations in the UK's emitting activities, for example national fuel use. It should also be noted that these figures are not yet finalised and are subject to change.

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