



Department
of Energy &
Climate Change

UK greenhouse gas quarterly emissions statistics

Methodology summary

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Introduction

DECC currently publishes annual provisional figures for all greenhouse gas (GHG) emissions at the end of March, 3 months after the end of the year of reference, while final emissions estimates are published 13 months after the end of the year of reference.

Generally, for the purpose of estimating provisional emissions figures, GHG emissions are classified into 3 main categories:

1. Carbon dioxide (CO₂) emissions based on energy data
2. CO₂ emissions based on non-energy data
3. Other greenhouse gas emissions

Depending on which of these categories they belong to, emissions can be estimated using different methodologies. Some of these estimates can be updated more frequently than annually, for example on a quarterly basis, because they are based on energy data which is available at more regular intervals during the year.

The purpose of this report is to outline the methodology that has been adopted in calculating quarterly emissions estimates using provisional inland energy consumption statistics which are published in DECC's quarterly energy publication [Energy Trends](#). The methodology to estimate annual provisional emissions is also shown, as it is the starting point for the calculation of quarterly emissions. The methodology for temperature adjusting emissions estimates is shown in section 3 of the report.

Methodology review 2014

Background

Up until Q1 2014, the UK quarterly greenhouse emissions statistics were published as “Experimental statistics”, meaning that they were new statistics undergoing evaluation¹. In 2014, a detailed methodological review was undertaken, including an invitation for users to feedback on the statistics, their use, and the methodology. As a result of the review, some changes to the methodology have been implemented, and these specific changes are detailed below. Following the review, the statistics have been rebadged from “Experimental statistics” to “Official statistics”.

Methodology review

The methodology used to produce the statistics was reviewed in detail, focusing on the following areas:

- Detailed review of the relationship between emissions and energy data for different sectors and fuels
- The impact of revisions to energy and inventory data on estimates
- Temperature correction and the relationship between temperature and emissions
- Users and user feedback
- Presentation and dissemination

Summary of changes

As a result of the review of emissions data categorisation, some small changes were made to the broader fuel type to which some emissions data was allocated, in order to bring it in line with the underlying energy data classifications.

The temperature correction methodology was amended to use heating degree days rather than degrees Celsius to correct for changes in temperature. Heating degree days had a better model fit with emissions data than degrees Celsius. The regression outputs can be found at the end of this document.

Some changes were made to the presentation of the publication following feedback from users and in line with best practice. These include the publication of emissions data for individual quarters (in addition to annual totals) in the accompanying data tables, more information on revisions and the impact of these, and clarification of some commentary.

¹ <http://www.statisticsauthority.gov.uk/assessment/code-of-practice/index.html>

Indicative differences as a result of methodological changes

The table below shows indicative differences between the previously used methodology and the revised methodology. The figures in the table are based on estimates for the year to Q2 2014, on both an actual, and temperature adjusted basis.

Sector	Actual emissions estimates		Temperature adjusted emissions estimates	
	Difference	Difference as %	Difference	Difference as %
Energy Supply	-2.1	-1.3%	-1.4	-0.8%
Business	-0.1	-0.1%	0.2	0.2%
Transport	0.0	0.0%	0.0	0.0%
Public	0.0	0.0%	0.1	0.9%
Residential	-0.1	-0.1%	1.0	1.4%
Other sectors	0.0	0.0%	0.0	0.0%
Total CO₂	-2.3	-0.5%	-0.2	0.0%

Methodology for estimating provisional emissions on a quarterly basis

CO₂ emissions based on energy data

These emissions corresponded to around 82 per cent of total UK GHG emissions in 2012. Provisional estimates for this category are primarily based on change in energy use between the latest two years. The sectors that are included in this category includes: power stations, other energy supply, industrial, domestic, commercial and transport.

Annual methodology:

It is assumed that the percentage change in CO₂ emissions between the latest two years is the same as the percentage change in energy use for a particular activity and fuel for the latest two years. The underlying energy dataset is published in *Energy Trends*.

Quarterly methodology:

This same approach is used to estimate quarterly emissions, using *Energy Trends* as the underlying data source. Therefore, it is assumed that the percentage change in carbon dioxide emissions between the same quarter of two consecutive years (for example quarter one of 2012 compared to quarter one of 2013) is the same as the percentage change in energy use between these same quarters.

Annual emissions are divided into quarters based on data in *Energy Trends*, assuming that the proportion of the total annual energy use for a particular quarter corresponds to the proportion of total annual emissions.

Source data availability:

The underlying energy data are available on a quarterly basis in *Energy Trends*. These data are made available with a three month lag; for example, in March 2014, *Energy Trends* covered the last quarter of 2013. The table below shows the relevant energy publications for 2014:

Publication Month	Energy results published for 2013	Energy results published for 2014
March 2014 <i>Energy Trends</i>	4 th quarter 2013 provisional results; full 2013 provisional results	
June 2014 <i>Energy</i>	Update to 2013 provisional	1 st quarter 2014

<i>Trends</i>	results	provisional results
July 2014 <i>Digest of United Kingdom energy statistics</i>	Final 2013 results	
September 2014 <i>Energy Trends</i>		2 nd quarter 2014 provisional results , plus update on 1 st quarter 2014
December 2014 <i>Energy Trends</i>		3 rd quarter 2014 provisional results; plus update on 1 st and 2 nd quarter 2014
March 2015 <i>Energy Trends</i>		4 th quarter 2014 provisional results; full 2014 provisional results.

CO₂ emissions based on non energy data

Emissions from this category corresponded to 3 per cent of total UK GHG emissions in 2010. They cover sectors that are not linked to energy activities, where energy data might not be available or the quality of the data are unreliable, such as agriculture, waste and Land Use Land Use Change and Forestry (LULUCF).

Annual methodology:

Provisional emissions estimates from this category are based on the assumption that emissions from these sectors have not changed since the previous year.

Quarterly methodology:

It is assumed that quarterly emissions from this category have not changed compared to emissions in the corresponding quarter of the previous year. A quarterly breakdown of the annual emissions estimates is not available; it is therefore assumed that emissions are equally distributed across the four quarters of the year.

Source data availability:

Emissions within this category are estimated annually based on the latest GHG Inventory.

Other greenhouse gases

In reporting progress towards domestic and international targets, the UK includes estimates of five other greenhouse gases in addition to carbon dioxide; methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphur hexafluoride. These corresponded to 16 per cent of total UK greenhouse gas emissions in 2010.

Annual methodology:

Provisional emissions estimates for these gases are based on the assumption that the trend in emissions will be half way between “no change” on the latest year and a repeat of the trend over recent years.

Quarterly methodology:

Because of the lack of availability of underlying quarterly data sources for activities related to non-CO₂ gases, emissions from these gases are assumed to be the same during each quarter, based on the latest available published annual estimates.

Source data availability:

Emissions within this category can be estimated only annually, based on the latest GHG Inventory.

Temperature adjustment methodology

To smooth the effect of particularly colder/warmer than average weather, when there might be a higher/lower than average consumption of fuel due to external temperatures, carbon dioxide emissions have been temperature adjusted. The adjustment has been applied for the period September to April in every year, and only for some specific sectors and fuels. From October 2014, heating degree days have been used to temperature adjust emissions². In previous publications, degrees Celsius were used for temperature correction.

The sectors and fuels that have been adjusted are:

- Power station – coal and gas
- Miscellaneous industrial/commercial combustion – gas
- Business – gas
- Public – Gas
- Residential – Gas
- Residential – Oil

Non-CO₂ emissions have not been temperature adjusted.

To decide whether emissions in a sector should be temperature adjusted or not, and if so by how much, the following procedure has been followed:

1. Establish the regression between quarterly emissions and quarterly average heating degree days for each sector and fuel from 2002 to the latest year for which a final inventory is available.
2. Identify the coefficient of determination R^2 . This is a statistic which gives some information about the goodness of fit of a model; it measures how well the regression line approximates the real data points. Its range is between 0 and +1; if the R^2 is exactly 1 then the regression line perfectly fits the data, while if its value is close to 0, then heating degree days and emissions cannot be modeled with a simple linear regression model.
3. Conduct a statistical test on the coefficient of each individual regression. If the coefficient is statistically significant different from zero, and the R^2 is significantly high, then emissions for that sector and fuel are adjusted, otherwise they will stay the same.
4. Adjust emissions for a particular sector and fuel by comparing quarterly heating degree days with the overall long term mean (1981-2010). If the average number of heating degree days is the same, then no adjustment is made; if the average number of heating degree days is different, then for every degree difference, emissions are adjusted by the gradient that relates emissions to heating degree days.

The coefficients are updated each quarter to take into account any revisions to energy data, although they are not expected to vary significantly.

² <https://www.gov.uk/government/statistics/energy-trends-section-7-weather>

Illustrative heating degree day and degrees Celsius regression coefficients for temperature corrected sectors and fuels³

Sector	Fuel	Heating Degree Days		Degrees Celsius	
		Coefficients	R ²	Coefficients	R ²
Power station	Coal+gas	1.5186	0.6823	-1.3208	0.6747
Commercial	Gas	0.2283	0.7936	-0.2102	0.7614
Other business	Gas	0.5397	0.6301	-0.5010	0.5929
Public	Gas	0.2125	0.9125	-0.1895	0.9097
Residential	Gas	2.3755	0.9480	-2.1339	0.9428
Residential	Oil	0.2161	0.8616	-0.1793	0.8234

³ Regression coefficients of quarterly final inventory data (2002 to 2012) and heating degree days, calculated in Q2 2014.

Presentation of the data

4.1 Emissions by source and end-user

Quarterly estimates of carbon dioxide emissions are presented on a “by source” basis. This means that they are attributed to the sector that emits them directly. This is different from emissions by “end-user”, where emissions are allocated in accordance to where the end-user activity has occurred.

For example, all carbon dioxide emissions produced by a power station are allocated to the power station when reporting on a by source basis. However when applying the end-user method, these emissions are reallocated to the users of this electricity, such as domestic homes or large industrial users.

4.2 National Communication sectors

For the purposes of reporting, carbon dioxide emissions are allocated into National Communication (NC) sectors. These are a small number of broad, high-level sectors, and are as follows: energy supply, business, transport, public, residential, agriculture, industrial processes, LULUCF and waste management.

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 \(IPCC\)](#) and which are used in international reporting tables, submitted to the United Nations Framework Convention on Climate Change (UNFCCC) every year. It should be noted that to estimate quarterly emissions, the same methodology is applied to all these IPCC low level sectors.

The table below summarises the main activities for each of the National Communication sectors and shows if underlying quarterly data are available for that sector.

National Communications sector	Quarterly data available?	Main activities included in the sector
Energy supply <i>from power stations</i>	Yes Yes	Power stations, refineries, manufactured solid fuels
Transport	Yes	Road transport, domestic aviation, railways
Business	Yes	Industrial combustion, refrigeration, air conditioning
Residential	Yes	Combustion, aerosol and non-aerosol products

Agriculture	No	Enteric fermentation, manure management, miscellaneous combustion
Waste management	No	Waste disposal, waste incineration
Industrial process	Yes	Production of mineral products, chemical industry
Public	Yes	Combustion from health, education and government buildings
LULUCF	No	Converting land to cropland (and vice versa)

1. The underlying energy activity data provide a basis to estimate the change in emissions. There is not an exact mapping between energy data and emissions NC categories, and activity data may contain some activities relating to non-carbon greenhouse gases.

Provisional estimates of the sector breakdown for non-CO₂ gases are not produced.

4.2 International reporting guidelines

The methodology used to produce the annual and quarterly provisional emissions estimates does not yet take into account the global warming potentials recommended in the IPCC Fourth Assessment Report⁴, or the 2006 IPCC Guidelines⁵. The annual provisional figures, published in March 2015, and subsequent quarterly publications, will take these into account.

⁴ http://www.ipcc.ch/publications_and_data/publications_ipcc_fourth_assessment_report_synthesis_report.htm

⁵ <http://www.ipcc-nggip.iges.or.jp/public/2006gl/>

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