DEPARTMENT OF ENERGY & CLIMATE CHANGE

UK greenhouse gas emissions: quarterly statistics

Methodology summary

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1. 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 (CO_2) emissions based on energy data
2. CO_2 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 to temperature adjust emissions estimates is shown in section 3 of the report.

2. Methodology for estimating provisional emissions on a quarterly basis

2.1 CO_2 emissions based on energy data

These emissions corresponded to around 81 per cent of total UK GHG emissions in 2010. 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 CO_2 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 2010 compared to quarter one of 2011) is the same as the percentage change in energy use between these same quarters.

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 2012, *Energy Trends* covered the last quarter of 2011. The table below shows the relevant energy publications for 2012:

Publication Month	**Energy results published for 2011**	**Energy results published for 2012**
March 2012 *Energy Trends*	4th quarter 2011 provisional results; full 2011 provisional update	
June 2012 *Energy Trends*	Update to 2011 provisional results	1st quarter 2012 provisional results
July 2012 *Dukes*	Final 2011 results	
September 2012 *Energy Trends*		2nd quarter 2012 provisional results , plus update on 1st quarter 2012
December 2012 *Energy Trends*		3rd quarter 2012 provisional results; update on 1st and 2nd quarter 2012
March 2013 *Energy Trends*		4th quarter 2012 and full 2012 provisional updated.

2.2 CO_2 emissions based on non energy data

Emissions from this category corresponded to three 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 is 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.

2.3 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-CO_2 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.

3. 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.

The sectors and fuels that have been adjusted are:

- Power station – coal and gas
- Commercial – gas
- Other Business – gas
- Public – Gas
- Residential – Gas
- Residential – Oil

Non-CO_2 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 temperature for each sector and fuel from 2000 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 temperature 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 temperature with the overall long term mean (1980-2010). If the temperature is the same, then no adjustment is made; if the temperature is different, then for every degree difference, emissions are adjusted by the gradient that relates emissions to temperature.

During a calendar year, the coefficients do not vary and they are not expected to vary significantly from year to year, although we will monitor them on a regular basis.

4. 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 International Panel on Climate Change (IPCC) and which are used in international reporting tables, submitted to the 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 is available for that sector.

National Communications sector	**Quarterly data available?**	**Main activities included in the sector**
Energy supply *from power station*	Yes *Yes*	Power stations, refineries, manufactured of 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/No	Production of mineral products, chemical industry
Public	Yes	Combustion from health, education and government buildings
LULUCF	No	Converting land to cropland (and vice versa)

Emissions from the other gases, however, cannot be allocated to the different sectors, and therefore in the analysis only the total is shown.

5. Next steps

These estimates should be treated as “Experimental Official Statistics”. We would welcome any comments from users on either the estimates themselves or the underlying methodology.

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