Quality Assurance and Quality Control in the UK Greenhouse Gas Inventory: A Summary Note

July 2010

1. Introduction

1.1. Description and purpose of the dataset

The UK Greenhouse Gas Inventory is produced annually. The inventory is compiled using internationally accepted guidance written by the Intergovernmental Panel on Climate Change (IPCC)[1], and adopted by the UNFCCC. The inventory is updated each year, and submitted each year to the UNFCCC[2]. It is also submitted to the European Commission, where it form parts of the EU inventory.

The GHG Inventory is subject to annual reviews by an UNFCCC Expert Review Team. There are also periodic Peer Reviews and bilateral exchanges, which concentrate on specific gases, processes, sectors or sub-sectors.

1.2. Purpose of this note

This note summarises the Quality Assurance and Quality Control procedures in place to ensure the GHG Inventory meets the quality standards required for reporting under the UNFCCC and the Kyoto Protocol, and to the Commission. The QA/QC procedures are applied to each submission of the inventory.

1.3. Compilation of the UK GHG Inventory

The National Atmospheric Emissions Inventory (NAEI)[3] is the core air emissions database from which both the GHG and air quality inventories are produced. Using a common core of activity data ensures consistency in reporting across all air emissions for different reporting purposes (UNFCCC, UNECE etc). The NAEI and other related inventories are compiled and maintained by AEA, part of AEA Technology plc.

AEA perform the role of Inventory Agency and are responsible for all aspects of national inventory preparation, reporting and quality management. AEA are responsible for co-ordinating inventory-wide QA/QC activities and reporting the entire GHG inventory, but the data compilation and estimation for some source sectors are performed by other contractors:

- North Wyke Research[4] compile the agriculture sector
- The Centre for Ecology & Hydrology (CEH)[5] compile the land use, land use change and forestry sector

The UK GHG Inventory Report[6] - National Inventory Report (NIR) - provides detailed descriptions of the methodologies used to compile all the emissions estimates. The

[1] http://www.ipcc-nggip.iges.or.jp/index.html
[2] UN Framework Convention on Climate Change (UNFCCC) www.unfccc.int
[3] www.naei.org.uk
[4] http://www.northwyke.bbsrc.ac.uk/
[5] http://www.edinburgh.ceh.ac.uk/ukcarbon/

NAEI website provides copies of all reports relating to the UK's GHG Inventories, as well as UK Air Quality Inventories, which are produced using the same common database.

2. General principles of QA/QC

Quality Assurance is defined by the IPCC as a system of regular, independent reviews, including peer reviews and in-depth reviews.

Quality Control is a system to ensure regular and adequate checking

Key principals of the QA/QC plan are to maintain and enhance the following attributes of the UK GHG inventory:

- Transparency
- Consistency
- Comparability
- Completeness
- Accuracy

The QA/QC procedures used are always kept under review and almost each year new checks are added. Revisions to the time series are to be expected and this is normal inventory practice; in part these revisions are a consequence of the inventory improvement programme which is administered by the National Inventory Steering committee.

The quality of data reported via the UK GHGI and the sub-national datasets is very much dependent on the quality of input data, in particular the quality and accuracy of:

- Digest of UK Energy Statistics (DUKES) total fuel use and sectoral allocations
- Environmental regulator data (EA, SEPA, NIEA) reported in a number of databases, including the Pollution Inventory

The GHG Inventory Agency is not responsible for the full QC of the data from third parties, although it takes reasonable and considerable steps to ensure that the data received are checked, and works with the data providers to help improve the quality and transparency of their QA/QC procedures.

Example
During the course of inventory compilation, energy and emissions data for the refinery sector are provided to the Inventory Agency from several sources, including: DUKES, the EU Emissions Trading Scheme, and the UK refinery trade association, UKPIA. The Inventory Agency identified data inconsistencies between the datasets and, through consultation and analysis, determined which data source provided the most accurate representation of combustion, process and petrochemical production emissions. The Inventory Agency has agreed with DECC that the GHG Inventory may deviate from DUKES to use EU ETS data to underpin the UK refinery emissions estimate.

[6] www.naei.org.uk/reports

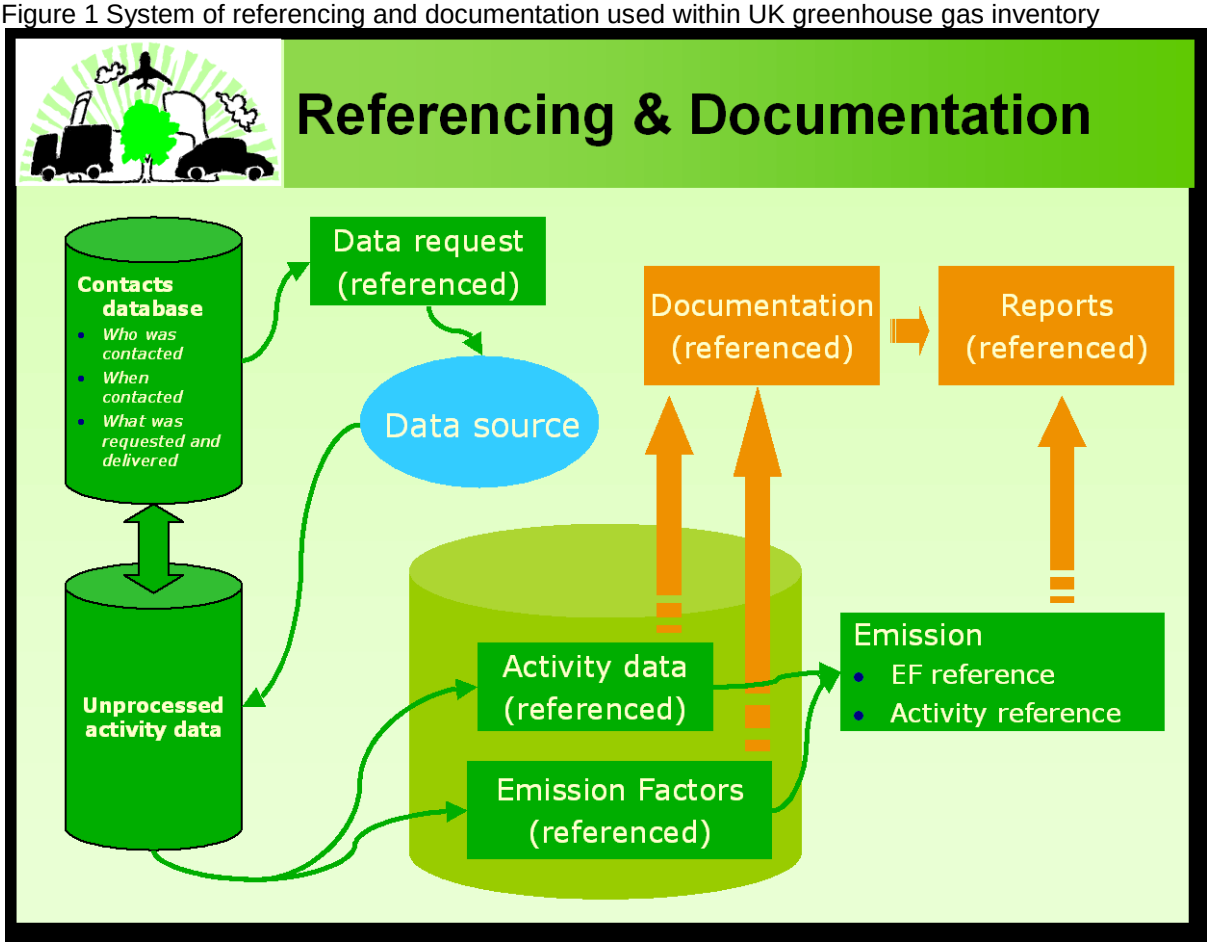
3. The QA/QC Plan

Section 1.6 of the NIR presents the general QA/QC plan for the GHG Inventory, including verification and treatment of confidentiality issues. In addition, source specific QA/QC details, and more general information, is provided in the relevant sections of the NIR.

UK emission estimates are prepared via a central database containing activity data and emission factors for all the sources necessary to construct the GHG Inventory. Numerous QA/QC procedures are built into the data processing system, including checks before data are entered, and after extraction from, the database. The QC within this system has evolved over many years, and is illustrated in Figure 1 below.

The Inventory has been subject to ISO 9000 since 1994 and is now subject to BS EN ISO 9001:2008. It is audited by Lloyds and the AEA Technology internal QA auditors. The NAEI has been audited favourably by Lloyds on three occasions in the last ten years. The emphasis of these audits was on authorisation of personnel to work on inventories, document control, data tracking and spreadsheet checking, and project management. As part of the Inventory management structure there is a nominated officer responsible for the QA/QC system – *the QA/QC Co-ordinator.* AEA is currently accredited to BS EN ISO 9001:2008, and was last audited in October 2009 by Lloyds.

Figure 1 System of referencing and documentation used within UK greenhouse gas inventory



3.1. Description of the QA/QC current system

The NAEI QA/QC system complies with the procedures outlined in Table 8.1 of the IPPC Good Practice Guidance (IPCC, 2000). An initial review of the QA/QC procedures was carried out in 2001 (Salway, 2001) and each year work continues to refine the procedures used. The system incorporates the following activities, which are carried out each year as the inventory is compiled:

Documentation

- Spreadsheets and the central database record data in such a way that source data is traceable from anywhere in the system. Version control and other key information are also recorded using a standardised system for the NAEI.
- The GHG Inventory database has an automated system that only allows data to be uploaded once it meets specified QA/QC criteria of data checking, completion and consistency.
- The NIR provides full details of GHG Inventory methodologies, which is subject to annual review by the UNFCCC.

Database

- Consistency check between IPCC and CORINAIR (air quality inventory guidelines) outputs, to ensure consistency between GHG and air quality reporting.
- Each data point is associated with key information regarding its source, etc. including an indicator for any revision from previous GHG Inventories.
- Data extracted from the NAEI database for the GHG Inventory are checked to ensure any inconsistencies are identified and rectified prior to submission.

Checking

- Spreadsheets undergo thorough checks before uploading to the NAEI database, and all source data and calculations must be clearly referenced.
- Mass balance checks are made to ensure total fuel consumptions in GHG Inventory are in accordance with official UK Energy Statistics.
- Database output comparisons between different inventory cycles enable the investigation of the effects of recalculations and help identify any data processing errors
- A final check compares emissions with those of the previous year, and a complete time-series check is also conducted for selected key sources. Any significant changes must be explained.

Recalculation

- The full time-series of emissions are recalculated if changes are made to GHG inventory methodologies, or where source data are revised or errors in previous inventories identified.

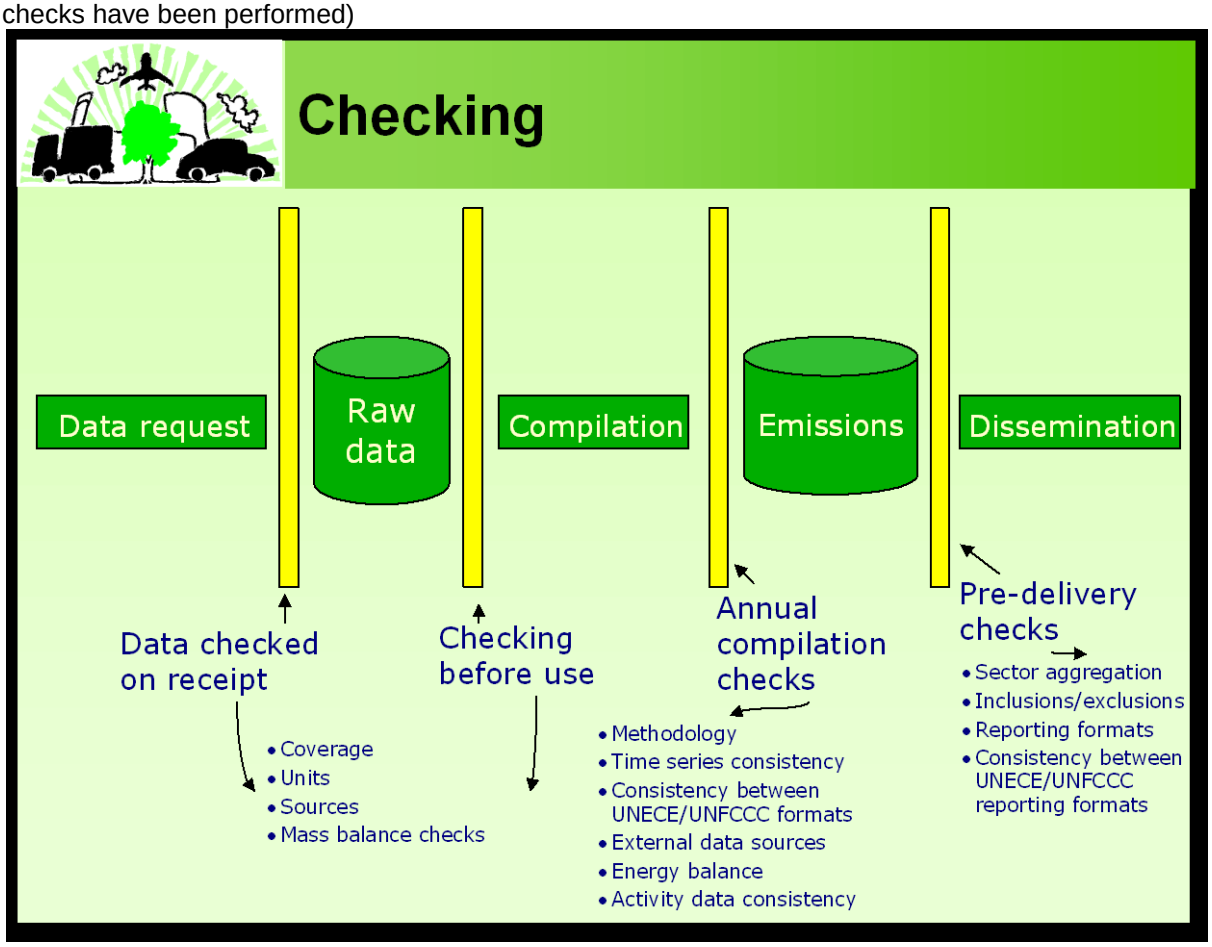
Uncertainties

- Estimates are made of the uncertainties in the estimates according to procedures set out in the IPCC guidelines.
- A ranking exercise is performed to identify key source categories and Monte-Carlo uncertainty evaluation is conducted across the inventory. The key source category analysis is important and helps prioritise the inventory improvement programme.

Archiving

- At the end of each reporting cycle, all data and files are archived electronically and on paper. Also, an annual report outlining the methodology of the inventory and data sources is produced.

Figure 2 Summary of the system of data checks used within the UK greenhouse gas inventory
(The yellow vertical bars symbolise "gates" through which data should not pass until the appropriate checks have been performed)



3.2. Compliance of National Statistical Agencies

Many of the data received by AEA come from other government departments, agencies, research establishments or consultants. Some of these organisations (e.g. DECC, North Wyke and BGS) would qualify as the *National Statistical Agencies* referred to in the Guidance. Other organisations (e.g. CEH) compile significant parts of the Inventory; data compiled by other organisations are used to compile significant parts of the inventory (e.g. the Pollution Inventory). As part of the inventory improvement programme, we are contacting these organisations and inviting them to show how their QA/QC systems comply with IPCC Good Practice Guidance.

3.3. Bilateral reviews, External Peer Review and Internal Reviews

Bilateral Reviews

In July 2008 the UK took part in a bilateral review of the agriculture inventory with experts from the French inventory team to share good practice and provide expert peer review.

External Peer Reviews
A peer review on CO_2 emissions from fossil fuel was completed in 2002 which led to an improved method for estimating emissions from domestic and international civil aviation; a review of the carbon emission factors used in the UK GHG inventory; and a review of the proportion of recycled lubricants burnt (Simmons, 2002).

A peer review on agriculture was carried out in 2005 to help improve the accuracy of the emission estimates from the agricultural sector. The review covered: the methods used to estimate agricultural emissions, including emissions from agricultural soils (N2O), manure management (N2O) and enteric fermentation (CH4); the underlying activity data and emission factors; uncertainties; and the QA/QC of the emission estimates.

UNFCCC expert review
The GHG inventory is reviewed each year by an UNFCCC Expert Review team. The review can be a centralised review, based at the UNFCCC secretariat, or less frequently an in-country review.

EU review
The European Environment Agency reviewers, on behalf of the European Commission, also review the UK's GHG estimates and parts of the NIR each year.

3.4. Capacity building and knowledge sharing

The UK actively participates in capacity building and knowledge sharing activities with other countries. Recent examples are knowledge sharing workshops with the Russian statistical agency who compile the GHG inventory for Russia, and the Sao Paolo inventory team from Brazil.

4. Verification

Verification is covered as part of the QA/QC checks and by the background research undertaken by DECC. In addition, DECC funds observations of atmospheric gases at Mace Head Atmospheric Research Station, in Ireland, which the UK Met Office model to estimate UK emissions.

5. Treatment of confidential data and information

Nearly all of the data necessary to compile the UK inventory are publicly available. The main exceptions relate to the reporting of PFC and HFC emissions from some sources, where a number of sources are aggregated for reporting purposes, and total emissions are reported as CO_2 equivalent. In a handful of cases, industrial production data are also confidential – notably adipic acid and cement production.