

**QA/QC of outside agencies in the
Greenhouse Gas Emission Inventory.**

Update of the background information in the Netherlands
National System.

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The updated document was made in co-operation with NL Agency acting as National Inventory Entity (NIE) and the involved outside agencies. The following officials contributed to this document: Mrs Ellen Brinksma (Netherlands Statistics), Mr Andre Bannink (Wageningen UR Livestock Research), Mr Olaf van Hunnik (NL Agency; Waste Management Administration) and Mr Bram ten Cate (Wageningen UR, Alterra/WOT N&M-unit).

Abstract

QA/QC of outside agencies in the Greenhouse Gas Emission Inventory.

Resulting from the obligations under the Kyoto Protocol a description of the quality assurance and quality control (QA/QC) of outside agencies must be added in the national system for the inventory of greenhouse gas emissions. This report is an update of the 2006 QA/QC descriptions and serves as a background document to the National System for greenhouse gasses. It describes for each outside agency in the inventory the QA/QC on there individual contribution and calculations of greenhouse gas emissions.

Keywords:

QA/QC, outside agency, national system, pollutant release and transfer register, greenhouse gas emissions

Rapport in het kort

QA/QC van 'outside agencies' in de broeikasgasemissie-inventarisatie.

Voortvloeiende uit de verplichtingen onder het Kyoto protocol moet in het nationale systeem voor de inventarisatie van de broeikasgasemissies beschreven worden hoe de organisaties die emissies aanleveren, en niet onder de directe invloed van de kwaliteitscontrole en kwaliteit zorg van de emissieregistratie vallen (zogenaamde outside agencies), omgaan met hun kwaliteitscontrole en kwaliteitsborging (QA/QC). Dit rapport is een actualisatie van de in 2006 geïnventariseerde beschrijvingen en dient als achtergronddocument bij het Nationaal Systeem voor de inventarisatie van broeikasgasemissies. In dit rapport wordt per outside agency een beschrijving gegeven van de kwaliteitszorg en kwaliteitsborging die de organisaties toepassen op hun bijdrage aan de inventarisatie en berekening van de broeikasgasemissies.

Trefwoorden:

QA/QC, Nationaal systeem, broeikasgasemissie, outside agencies

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Summary

As a result of the obligations under the Kyoto Protocol a description of the quality assurance and quality control (QA/QC) of outside agencies must be added described in the national system for the inventory of greenhouse gas emissions.

In the Netherlands almost all national system and inventory related actions are directly contracted by ministry of Infrastructure and Environment (IenM) to the Emission Registrations project coordinated by the national Institute for Public Health and the Environment (RIVM), and NL Agency as acting NIE. However also data is prepared and processed under other arrangements. The Netherlands national system has several of these so called outside agencies. These are:

- Statistics Netherlands (CBS);
- Alterra of the Wageningen University & Research centre;
- NL Agency Waste Management Administration;
- Wageningen UR Livestock Research.

Underlying report is an update of the 2006 QA/QC descriptions of the outside agencies and serves as a background document to the National System for greenhouse gasses. This report describes for each outside agency in the inventory the QA/QC on there individual contribution and calculations of greenhouse gas emissions.

1 Quality assurance and quality control of outside agencies

The UNFCCC and IPCC guidelines provide guidance for QA/QC activities related to greenhouse gas inventories and National System. The guidelines also separately distinguish potential involvement of outside agencies in emission estimates. In the Netherlands almost all national system and inventory related actions are directly contracted by ministry of Infrastructure and Environment (IenM) to the Emission Registrations project coordinated by the national Institute for Public Health and the Environment (RIVM), and NL Agency as acting National Inventory Entity (NIE). Quality issues are part of the contract from the Ministry (IenM). RIVM (PRTR) and NL Agency (NIE) are therefore not considered as outside agencies.

The greenhouse gas inventory is based on the national Pollutant Release and Transfer Register (PRTR) as part of the ER-project. The general process of inventory preparation has existed many years. The ER-project is organised as a project with an annual cycle.

Annex 1 lists briefly how, in accordance with the table 8.1. of the IPCC Good Practice Guidance, the main QC activities (Tier 1) in the Netherlands National System are being dealt with. The mentioned organisations though not under direct contract, participate in the ER project (through covenants) and thus are subject to these general checks for the emission estimation process. As part of the overall national system, they are also subject to the other QA/QC activities that are implemented in accordance with the QA/QC programme.

In the national system also data are supplied and processed under arrangements that are not specifically IenM-related. The institutes that supply these data are therefore for the national system considered as outside agencies. They involve:

- data from Statistics Netherlands (CBS);
- data on LULUCF through Alterra of the Wageningen University & Research centre;
- data on waste through the NL Agency Waste Management Administration;
- data on enteric methane emission in dairy cows through the Wageningen UR Livestock Research.

This report describes for each outside agency separately how the relevant QA/QC arrangements in these organisations are taken care of.

2 Quality control and quality assurance at Statistics Netherlands

2.1 Introduction

This paragraph describes the quality assurance and quality control activities of CBS¹, Statistics Netherlands, that are related to estimates of greenhouse gas emissions and sinks. The information is based on available information and reports from CBS. CBS has a long standing history of involvement in the Netherlands system of emission monitoring. Its involvement includes:

- the production of statistical data that are a basis for greenhouse gas emission estimates;
- participation in the process of emission estimates in the ER, the Netherlands Emission Monitoring system. In 2004 this involvement was renewed and updated through a covenant [ER-CBS, 2004, Internal document in Dutch];
- participation in advisory bodies for the improvement of the national system under the Kyoto Protocol, inter alia the Advisory Committee for the National Inventory Entity (NIE).

Through this involvement CBS has a proper understanding of the UNFCCC guidelines, including the requirements with regard to QA/QC.

This paragraph describes the main aspects of QA/QC at CBS. CBS does not have an overall certification for quality control, but does have internal guidelines and self-assessments, as well as guidelines from Eurostat and the aforementioned UNFCCC. This paragraph focuses on those aspects that impact the greenhouse gas inventory.

2.2 The organisation²

CBS is responsible for collecting, processing and publishing statistics targeting a wide variety of groups, including the general public, policymakers and scientists. In addition to its responsibility for (official) national statistics, Statistics Netherlands also has the task of producing European statistics (under Eurostat legislation). The legal basis for Statistics Netherlands and its work is the Act of 20 November 2003 governing the central bureau of statistics (Statistics Netherlands).

The information Statistics Netherlands publishes incorporates a multitude of societal aspects, from macro-economic indicators such as economic growth and consumer prices, to the incomes of individual people and households. Statistics Netherlands' statistical programmes (the long-term statistical programme and the annual work programme) are set by the Central Commission for Statistics. This is an independent commission that watches over the independence, impartiality, relevance, quality and continuity of the statistical programme. The Director-General decides autonomously which methods to use to make these statistics, and whether or not to publish results.

Statistics Netherlands aims to reduce the administrative burden for companies and the public as much as possible. To this end it aims to use existing

¹ Centraal Bureau voor de Statistiek

² The information in this section is taken from www.cbs.nl, Statistics Netherlands, Voorburg/Heerlen, 2004.

administrative registrations of both government and government-funded organisations whenever possible. By law, this information is available to Statistics Netherlands free of charge. Only if this information does not suffice, does Statistics conduct supplementary surveys among companies and private persons. Companies are usually obliged by law to supply information to Statistics Netherlands and can be forced to cooperate under certain circumstances; Statistics Netherlands may use sanctions such as administrative fines. For its part Statistics Netherlands is obliged to keep all individual data confidential. As an exception data sharing with Eurostat, national statistical institutes in EU member states, Dutch Central Bank and academic researchers is allowed under certain restructures.

On 3 January 2004, Statistics Netherlands became an autonomous agency (in Dutch ZBO) with legal personality. There is no longer a hierarchical relationship between the Minister of Economic Affairs and the organisation. However, the minister is responsible for setting up and maintaining a system for the provision of government statistical information; in other words the minister is politically responsible for legislation and budget, for the creation of conditions for an independent and public production of high quality and reliable statistics. The costs of tasks and activities undertaken to put this legislation into practice are accountable to the government's budget.

The CBS activities that have a direct relation with greenhouse gas emission estimates are carried out in the two departments that are working respectively on:

- the elaboration of energy balances [Taakgroep Energie]³;
- the elaboration of environmental statistics [Taakgroep Milieu]⁴.

The latter group includes the manure management related emissions data.

2.3 General QA/QC policy

Introduction of a quality management model

The general policy with regard to QA/QC is outlined among others in a Quality declaration of Statistics Netherlands (CBS, 2011). The Statistics Netherlands quality declaration was approved by the Board of directors on 28 April 2008. The declaration has been adapted on 1 February 2011 to the new formulation of 'Statistics Netherlands' mission. Statistics Netherlands complies with the official national regulations that apply to information held by government authorities. In the longer term Statistics Netherlands has opted for a model based on the model of the European Foundation for Quality Management, focusing on both the output and on the total process (primary processes, supporting processes and management processes). This choice for EFQM puts Statistics Netherlands in line with Eurostat and the statistical offices of various other countries.

CBS does not have an quality certification (as of 2010), but maintains in its overall policy the aim of continuous learning and improving. Many QA/QC related activities and procedures are implemented. This paragraph describes in the following sections the main elements, grouped into four categories:

- quality control;
- quality assurance;
- documentation and archiving;
- evaluation and improvement.

⁶ Group leader as per 1 December 2010: Mrs Ellen Brinksma

⁵ Group leader as per 1 December 2010: Mr Hendrik Jan Dijkerman

CBS will, after its reorganisation by 1-1-2012, again have a corporate quality department (TBC).

Data protection

A specific issue for CBS is confidentiality. CBS in its strategy paper states that maximum attention must be paid to data security and the protection of individual identities. The 1996 Law on the central bureau of and central commission for statistics contains stringent stipulations in the area of confidentiality of data. Security is an area of continuing concern. In the publication of survey results, is ensured that no figures can be traced back to individual persons, households, companies or institutions. When databases are linked, too, very strict conditions are in place to protect individual identities. Statistics Netherlands collaborates closely with the national privacy authority in this respect, and has a solid reputation. As it uses state-of-the art data protection techniques, Statistics Netherlands is the place par excellence where databases with sensitive information can be matched and linked safely, exclusively for statistical purposes. In practice risk analyses are used as a supporting tool.

2.4 Quality control

CBS fully participates in all arrangements under the Emission Registration process, though not as formal subcontractor, but through a covenant between MNP (from onward 2010 RIVM) and CBS. This implies that the QA/QC, related to greenhouse gas emissions, is fully integrated in the QA/QC of the ER. The checks applied on the annual greenhouse gas emission estimates are therefore part of the QC checks as elaborated in the QC Tier 1 and (where applicable) QC Tier 2 checks of the ER project. The table on QC checks (see annex 2), illustrates this.

For a proper understanding below, in addition, also more general aspects of the quality control at CBS are described:

Transparency

Through a bottom up process, CBS has described many of its key processes. These include the greenhouse gas related processes [CBS, 2005-1 and CBS 2005-2 on respectively transport and combustion installations, internal documents of CBS, in Dutch]. These process descriptions include data suppliers, methods, process, flow chart, tasks, and responsibilities.

Input data QC and continuity

CBS uses input data from its own questionnaires. Where data are acquired from third parties, data requirements are usually defined in Service Level Agreements. The SLA's generally define frequency, format and contents. In the past more use was made of covenants and gentlemen agreements.

A shift is anticipated from use of energy data provided through questionnaires amongst companies to use of energy data from energy suppliers. CBS will assure a confrontation and comparison of the methods to ensure that this shift does not lead to inconsistencies in time series.

QC checks

Quality checks are performed as part of the routine activities of elaborating the statistics. These include plausibility checks (e.g. for the energy balance process at entering data from questionnaires and during checks of the statistical results thereof), checks with data from earlier years on outliers, checks on errors (partially automated through indication of large differences with previous data)

and where easily possible comparison of two data sources. The latter e.g. applies to comparing data from questionnaires with those from company environmental reports. The table in annex 1 provides more information on the QC checks.

Important cross checks and feed back on quality come from the cross checks that are carried out by CBS on e.g.:

- cross checking questionnaire data with data from company environmental reports;
- cross checking energy balance data by confronting information on energy production side with information on energy use side.

Uncertainties

Uncertainties are usually assessed through expert judgements. The uncertainties estimates for greenhouse gas emissions are fully part of the ER process and are described in the applicable documents and procedures of the National System.

2.5 Quality assurance

Checks against other data

See under quality control. In addition CBS supplies annual data on energy through a 'joint questionnaire' to Eurostat, IEA (International Energy Agency) and UN ECE. These organisations therefore are supplied with consistent information. Since definitions may differ however, that output data (after processing by these international organisations) may differ to some extent. As yet there are no standard quality reports under these international obligations; however work is in progress to improve the legal basis for this reporting.

The data are validated and checked by these organisations, mainly by comparing with previous year data. In case of unexplainable differences CBS is asked for further explanations. These processes provide important input on quality.

Audits

CBS has used internal audits as tools for QA. The last years there have been few. It is anticipated that this tool will be used more intensively the next years and that a cycle of a number of years may be applied (yet to be established). Audits in CBS cover both processes and substance. External audits may occasionally be implemented (by peers from other countries), usually referring to methodological aspects.

2.6 Documentation and archiving

Relevant documentation and data base versions are logged and archived. The period for storage of basic hard copy raw data (e.g. returned filled in forms from questionnaires) are stored often 5 years, sometimes longer. Electronic databases are usually stored longer. All emission related databases are available back to at least 1990. The relevant electronic data bases that underpin the energy balances are available at least back to 1995 and most even to 1990 in the CBS BOS (data storage) system.

2.7 Evaluation and improvement

CBS has as general policy, continuous learning and improvement.

3 Quality control and quality assurance at NL Agency Waste Management Department

3.1 Introduction

This paragraph describes the quality assurance and quality control activities of NL Agency, Waste Management Department, that are related to estimates of greenhouse gas emissions from waste related activities⁵. It focuses on those aspects that have impact on the greenhouse gas inventory and describes only the main aspects.

The information is based on available information and reports from and discussions with NL Agency, Waste Management Department.

3.2 The organisation

NL Agency is an agency of the Dutch Ministry of Economic Affairs, Agriculture and Innovation. Focussing on sustainability, innovation, international business and cooperation. NL Agency is the number one contact point for businesses, knowledge institutions and government bodies. One single contact point for information, advice, financing, networking and regulatory matters. One single contact point for a quicker and better service.

Nationally, NL Agency carries out programmes for various Dutch ministries. Since 1 January 2005 the "waste programme" started. Since then many of the tasks in the policy field of waste for the Ministry of Infrastructure and the Environment or its predecessor have been carried out within one organisation⁶. The Waste Management Department implements programmes and national and international regulations relating to waste. It also advises on the preparation and evaluation of waste policy. The Waste Management Department is the central point for authorities and companies looking for knowledge, permits and expert advice.

One of the tasks of the Waste Management Department is the monitoring of waste and waste related aspects, such as emissions. In accordance with the Waste Management Plan of the Ministry of Infrastructure and the Environment the Waste Management Department is the central point for the coordination of the collecting, analysing and presenting of these results and figures. This is done in cooperation with other organisations as the CBS (Statistics Netherlands).

The required activities for the estimations of greenhouse gas emissions from the waste sector (by the Waste Management Department) are agreed upon by a cooperation covenant between the RIVM and NL Agency. On a yearly base the emissions from composting/digesting of separated collected organic waste of households, incinerating in municipal solid waste incinerators and land filling are produced. The relevant agreements from the covenant are also described in the ER implementation plan [RIVM/MNP, 2005] and the ER strategy [RIVM, 2010].

3.3 General QA/QC policy

The Waste Management Department participates in all arrangements under the Emission Registration process (ER), though not as a formal subcontractor, but as

⁵ As composting/digesting, incineration and land filling.

⁶ Before that the different tasks were carried out by different organisations.

stated through a covenant between RIVM and the Waste Management Department. This implies that the QA/QC, related to greenhouse gas emissions, is fully integrated in the QA/QC of the ER.

3.4 **Quality control**

The checks applied on the annual greenhouse gas emissions estimates are therefore part of the QC checks as elaborated in the QC Tier 1 and (where applicable) QC Tier 2 checks of the ER project. The table on QC checks at the end of this annex further details this for composting, land filling and incinerating. This table should be seen as additional to the general overview, described in Annex 1 of this document.

For a proper understanding below, in addition, also more general aspects of the quality control at the Waste Management Department are described.

Transparency

All the monitoring activities, the collection, analysing and reporting, of the Waste Management Department are yearly published in different documents for the public. These descriptions contain also the methods and detailed information of the different tasks.

Input data QC and continuity

The Waste Management Department uses input data for the greenhouse gas emissions from waste related activities from different questionnaires and analyses. These questionnaires have a long term history (mostly back to 1990, some even further back), on a yearly basis. The most important questionnaires are done by the Waste Management Department themselves, according to the agreements with the Ministry of Infrastructure and the Environment.

QC checks

Quality checks are performed as part of the routine monitoring activities. These include plausibility checks, checks with data from earlier years on outliers, checks on errors and where possible comparison with other data sources. For the checks as part of the ER process, see inter alia Annex 1.

Uncertainties

Uncertainties are usually assessed through expert judgements. The uncertainty estimates for greenhouse gas emissions are fully part of the ER process and are described in the applicable documents and procedures of the National System.

3.5 **Quality assurance**

In addition to being fully subject to the emission estimation activities under the ER, including all the QA activities under the National System (see annual QA/QC programmes and work plans), the Waste Management Department is also responsible for the different waste reporting obligations for the Netherlands towards the European Union. These obligations have a frequency of yearly to once every three years (for all these three years). Different parties within Europe (e.g. Eurostat or the European Environmental Agency) collect these reports and check the information on the quality, consistency and plausibility.

3.6 **Documentation and archiving**

Relevant documentation and database versions are logged and archived. The period for storage of basic hard copy raw data (e.g. returned filled in forms from questionnaires) are stored often 5 years, sometimes longer. Electronic databases are usually stored longer. All emission related databases and tools are available back to at least 1990.

3.7 Evaluation and improvement

As mentioned, the Waste Management Department is full participant of the ER process and subject to the annual evaluation and improvement cycle of the National System.

4 Quality control and quality assurance at Alterra

4.1 Introduction

Alterra is the research institute for our green living environment. Alterra is part of Wageningen University & Research centre and offers a combination of practical and scientific research in a multitude of disciplines related to the green world around us and the sustainable use of our living environment: knowledge of water, nature, biodiversity, climate, landscape, forest, ecology, environment, soil, landscape and spatial planning, geo-information, remote sensing, flora and fauna, urban green, man and society etc.

Alterra's research is organised in five centres: Soil Science, Water and Climate, Geo-Information, Landscape en Ecosystem Studies. Over four hundred researchers are employed. The centres are supported in their work by staff departments in marketing, communications, human resource management, financial en facility services.

This paragraph describes the quality assurance and quality control activities of Alterra that are relevant to the work on estimates of greenhouse gas emissions and sinks. The information is based on available documentation and reports from Alterra and on discussions of RIVM, PBL and NL Agency with Alterra in 2005 and 2010.

Alterra has a long standing history of involvement in the Dutch system of emission monitoring. Its involvement includes the annual production of data that are a basis for greenhouse gas emission estimates for agricultural soils and for LULUCF. Alterra fully participates in the process of emission estimates in the ER, the Netherlands Emission Monitoring system, notably in the Taskforce on Agriculture and Land Use.

The participation of Alterra in emission estimates is formally arranged through two channels:

- the activities for the ER are part of the Statutory Research Tasks Unit for Nature & the Environment (in Dutch: WOT N&M⁷) commissioned to Alterra by the Ministry of Economic Affairs, Agriculture and Innovation. Alterra carries out a project with the aim to collect, process and report data on carbon in forests and soils as a result of (changes in) land use and forestry, in conformity with the agreed upon monitoring protocols. Alterra also supports the calculation of emission data on nitrous oxide emissions from agricultural soils;
- In addition specific supporting research activities for relevant parties carried out under consultancy contracts. Examples in recent years include studies on improvement of estimating emissions related to the development of a national LULUCF monitoring system in the Netherlands [Alterra reports 774, 903, 1035-1, 1035-2 and 1035-3, 1035-6, 1035-7, 1217, 1916].

⁷ WOT ("Wettelijke onderzoekstaken") concerns research for the Ministry of Economic Affairs, Agriculture and Innovation (EL&I) that is a consequence of requirements, resulting from national and international legislation. EL&I determines aim, scope and contents of the research. For these tasks EL&I concludes long term agreements with Wageningen UR (including Alterra).

As part of its work, Alterra also participates in advisory bodies for the improvement of the national system under the Kyoto Protocol, inter alia a special project group on LULUCF issues, that advises the Ministry of Economic Affairs, Agriculture and Innovation on LULUCF issues. Also its experts are involved in EU Monitoring Mechanism workshops on LULUCF and agricultural soil issues and participate in the IPCC processes to develop Good Practice Guidance on relevant issues and the IPCC assessment reports. Through these activities, Alterra has a thorough understanding of the UNFCCC guidelines including the requirements with regard to QA/QC.

4.2 General

Alterra has implemented a certified Quality Management System, according to the standard ISO 9001:2008. It identifies our organizational structure, policy and procedures, functional responsibilities of our management and staff and the lines of authority. Processes for planning, implementing, documenting, and assessing Alterra's activities are described in our Quality manual entitled "Kwaliteitshandboek Alterra", which is available to all personnel via our corporate intranet site.

One of Alterra's core values is our social responsibility to minimize negative environmental issues in its overall performance. The care for the environment is secured in a environmental management system, which is certified according to the standard ISO 14001:2004.

4.3 Quality organisation

At relevant levels personnel responsible for the correct implementation of the quality system are identified and responsibilities are described.

At management level the Management Director is assigned to ensure that the quality system is implemented, maintained and improved. Assistance is given by the Quality Assurance Manager (QAM) who has direct and unimpeded access to the Management Director and Heads of Departments. The QAM is responsible for developing the quality policy for Alterra and coordinating quality related issues between Alterra's Departments. The Heads of Departments are responsible for implementing, maintaining and improving the Alterra quality system at their Departments. A Department Quality Coordinator (DQC) at every Department assists the Head of Department in maintaining and improving the quality system at their Department.

Coordination of quality control is organized in the Quality Team (QT), which is chaired by the Management Director and with as members all DQC's and the QAM.

Internal audits are planned, carried out and reported in the Alterra Auditing Team, which is led by the QAM. The auditors are trained for their job by an external bureau.

4.4 Quality documents

Alterra's quality management system is described in "Kwaliteitshandboek Alterra". This handbook is available in electronic form on Alterra's web for all employees. Procedures were developed for the sixteen management processes and more detailed work instructions in accordance with ISO 9001:2008.

For research projects to be carried out in compliance with OECD regulations for Good Laboratory Practices, specific procedures have been described, which are an integral part of Alterra's quality system.

The ISO-quality assurance certificate also covers a quality management system for models and data. The system has been developed by a DLO-task force, led by Alterra in 2004 and was implemented and certified at Alterra in 2004/2005. The ISO quality assurance system includes guidelines and regulations for the quality control of concept publications. .

4.5 Quality audits

The internal auditing system is established to check whether applied quality activities comply with the agreed quality system and contribute to the quality objectives. Audit results are reported to the Heads of Departments and Management Director and are used by the Head of Departments for improvement of the quality system.

4.6 Quality assurance Certificates and Accreditations

Alterra's Quality Management and Assurance System fulfils the requirements of several international standards for quality systems (see table). Audit results are reported to the Heads of Departments and Management Director and are used by the Heads of Departments for improvement of the quality system.

Quality assurance Certificates and Accreditations

Quality certificate	Applies to	Issued by	Valid until
ISO 9001:2008	Alterra	TNO Certification	December 17, 2012
ISO 14001:2004	Alterra	TNO Certification	October 25, 2012
GLP Endorsement of compliance	CWK, team ERA	Food and Consumer Product Safety Authority	No end date
RVA NEN-ISO/IEC 17025	CB, team CBLB	Dutch Accreditation Council	29 May 2010

Alterra is committed to the continual development of the Quality Management System wherein all processes are assessed by a separate, but objective organization, for the verification of adequate process control and for objective reporting of quality to management.

4.7 Quality control in research projects

Quality measures are relevant for research projects to guarantee product quality for the customer. The measures consist of *general* and *project specific* measures.

Important *general* quality measures in research projects are:

- Use of a standard format for project description;
- Use of a standard electronic tool for calculating project costs;
- The principle that the project manager is responsible for quality control in research projects;
- The principle that the project manager is responsible for communication with customers about: project definition, applied methodology, research progress, research results, reporting and project evaluation.

The *project* manager is responsible for selection and implementation of *additional* and *project specific* quality control measures in research projects, e.g.:

- Selection of an appropriate research team (approval by Head of Department);

- Choice of appropriate methods and models;
- Planning of an internal or external scientific reviewing panel;
- Planning of an external audit.

Besides the internal and formal quality assurance systems mentioned above, there are several external and/or informal mechanisms that contribute to the quality of our output:

- Concepts of peer-reviewed publications are subject to external screening by experts in the relevant field;
- Stimulation of co-authorships with a joint responsibility for the publication;
- Participation of Alterra staff in Graduate Schools of Wageningen University, accredited by the Royal Netherlands Academy of Sciences;
- An active role in the development and application of international standards for certain fields of research.

4.8 General QA/QC issues WOT unit for Nature & the Environment (additions)

The WOT unit for Nature & the Environment at Wageningen UR has its own quality management handbook. It uses, where possible, the Alterra quality management system [Alterra, 2010]. Forms and procedures of that system are applicable also for the WOT unit, unless other or additional procedures are mentioned in the additional quality handbook for the WOT unit itself [WOT, 2010].

4.9 Quality control WOT unit

In addition for the WOT unit quality classes have been defined:
For reports and studies, two peer experts should review the draft. Afterwards also editorial aspects are checked.

5 Quality control and quality assurance at Wageningen UR Livestock Research

5.1 Introduction

This annex describes the quality control and quality assurance activities of (Wageningen UR Livestock Research) in relation to the protocol for estimation of emission factor for enteric methane from dairy cows (not other cattle, not other ruminant species). The protocol includes the use of a dynamic, mechanistic model of enteric fermentation, applied as a Tier 3 approach, which delivers these results for the ER. The methodology is described in reports and peer-reviewed papers on microbial activity and end-products of fermentation in the rumen and large intestine in dairy cattle (Dijkstra et al., 1992; Mills et al., 2001; Bannink et al., 2008; Bannink, 2010; Bannink et al., 2011). Wageningen UR Livestock Research has a long standing history of mathematical modelling of fermentative and digestive processes in the digestive tract of ruminants and in predicting the extent and site of feed digestion, microbial synthesis including methanogenesis, digestion and nutrient absorption and excretion with urine and faeces. Wageningen UR Livestock Research works in close collaboration with the chair group of Animal Nutrition of Wageningen University who initiated and delivered most of this modelling work, in close cooperation with foreign scientists.

Involvement of Wageningen UR Livestock Research in the ER includes:

- the calculation of enteric methane emission in dairy cows based on statistical data delivered by CBS (QA/QC responsibility with CBS) by following a Tier 3 approach;
- giving advise with the amendment of protocols;
- application of the Tier 3 to evaluate nutritional measures and policy options affecting enteric methane;
- responsibility for QA/QC with use of the Tier 3, and as the developer of the Tier 3 communicate its applicability, its limitations and its operative aspects.

In addition, Wageningen UR Livestock Research is responsible for:

- development, evaluation and application of the Tier 3 methodology for enteric methane in dairy cows;
- responsible for the scientific quality of the Tier 3 and publication of results obtained with the Tier 3, in co-authorship with chair group Animal Nutrition of Wageningen University, in peer-reviewed papers in ranked scientific journals.

5.2 The organisation

The CBS is responsible for collecting, processing and publishing statistics on the composition of dairy cow rations, the chemical composition and feeding value of dietary components, and on feed intake and milk yield. These statistics are delivered strictly to scientists at Wageningen UR Livestock Research who have (demonstrably) the expertise to use the Tier 3 and who are familiar with construction and scientific background of the Tier 3, with its applicability and evaluations, and with its limitations.

The Wageningen UR Livestock Research activities that have a direct relation with the research activities on digestive processes in ruminants as well as mathematical modelling in two departments at Wageningen UR:

- the Animal Nutrition Group of Wageningen UR Livestock Research; this group is located in Lelystad and primarily responsible for conducting the

calculations and for delivery of emission factors and related background information for the NIR;

- the chair group of Animal Nutrition of Wageningen University; this group is located in Wageningen and collaborates closely with the group in Lelystad on experimental as well as modelling research projects related to digestive and fermentative processes in the digestive tract of dairy cows.

5.3 General QA/QC issues

Wageningen UR Livestock Research is an institute within the legal entity 'Stichting Dienst Landbouwkundig Onderzoek', a foundation (*'stichting'*) incorporated under the laws of The Netherlands, with registered office at Wageningen. Wageningen UR Livestock has a certified ISO 9001:2008 quality system.

5.4 Quality control

All relevant processes have been described in the Quality Manual of Wageningen UR Livestock Research 2010. Wageningen UR Livestock Research has a thorough system of audits that may lead to recommended improvements. The implementation of agreed upon resulting actions is controlled by a quality manager. Procedures are in place for continuous improvement.

5.5 Quality assurance

Wageningen UR Livestock Research uses various types of audits:

- annual audits by the certifier, as required under its certification process;
- audits by a visitation committee of international scientist. Once every four year such a (peer) committee carries out a general audit from a scientific point of view;
- internal audits, that involve both the primary processes and supporting processes. The focus of these audits is determined by the management.

5.6 Documentation and archiving

Detailed procedures are in place of document management. On each project the relevant documents are archived in the project file.

5.7 Evaluation and improvement

Evaluations or potential improvements of the Tier 3 methodology for enteric methane emission in dairy cows, or of the interpretation of the results generated, are shared with the agency responsible for the ER and archived by the latter.

Quality aspects within Wageningen UR Livestock Research will be addresses according to the internal Quality Manual which was described above.

5.8 Quality control

Wageningen UR Livestock Research participates in the ER process as an outside agency delivering estimates of enteric methane emission in dairy cows. Results are delivered and discussed with PBL or RIVM as the agency that is primarily responsible for archiving the results delivered, and for archiving discussions related to data checks and quality control and assurance. The Wageningen UR Livestock Research is primarily responsible for archiving the Tier 3 methodology applied, the model inputs used, the calculation results delivered and documented. Communication and evaluation of the Tier 3 methodology itself is preferably achieved by peer-reviewed papers in ranked scientific journals including a co-author of the chair group of Animal Nutrition of Wageningen University.

All other aspects of QA/QC, related to greenhouse gas emissions, are handled by the agency responsible for the ER or with other outside agencies such as the

CBS. This means that the initiative and documentation of checks on the annual enteric methane emission by dairy cows delivered by Wageningen UR Livestock Research is therefore subject to the QC checks elaborated in the ER. Wageningen UR Livestock Research only handles QC/QA aspects specifically related to application of the Tier 3 methodology for enteric methane in dairy cows. According to standard procedures, the QC/QA aspects of other Tier 1 and Tier 2 are excluded from the Wageningen UR Livestock Research, unless specific requests are made.

For a proper understanding, some further aspects of the QC are described below:

Transparency

The activities and methodology used by Wageningen UR Livestock Research in relation to the ER have been documented in a background document (Bannink, 2011). In addition the Tier 3 methodology for estimation of enteric methane emission in dairy cows has been described in peer-reviewed papers in ranked scientific journals. The Tier 3 methodology including the related ER results and an analysis of uncertainty of estimates has been recently been accepted for publication in a peer-reviewed journal (Bannink et al., 2011). For documentation of the model formulation and the input requirements, the reader is referred to the basic modelling work published by Dijkstra et al. (1992), Mills et al. (2001) and Bannink et al. (2008, 2010). All data delivered by CBS, the calculation routines to generate model input for the Tier 3 and the Tier 3 method itself have been documented and remain unchanged, unless discussed and evaluated together with CBS and the agency handling the ER.

The ER handling agency is responsible for archiving discussions, notes and decisions on options for improvement and changes in methodology in relation to the Tier 3 methodology. Since the Tier 3 methodology was introduced in 2005, there have been no changes in the formulation of the model applied in the Tier 3 methodology.

Input data QC and continuity

The CBS delivers data to Wageningen UR Livestock Research according to a standardized protocol (evaluated by the WUM) and in a standardized format. These data are required to generate model inputs. Data are delivered yearly according to the frequency of the ER, unless there are specific requests for use of the Tier 3 methodology in addition to the Wageningen UR Livestock Research task for the ER.

QC checks

Quality checks of data delivered by CBS to Wageningen UR Livestock Research are primarily performed in the WUM. These checks include plausibility checks, checks with data from earlier years on outliers and checks on potential errors. The table in annex 1 provides more information on the QC checks performed by CBS and the specific role of Wageningen UR Livestock Research.

Uncertainties

Uncertainty of estimates of enteric methane in dairy cows have been established by Wageningen UR Livestock Research (Bannink, 2010; Bannink et al., 2011) through expert judgement of uncertainty associated with model inputs (based on data delivered by CBS) and uncertainty associated with improper model parameters or an improper model formulation.

Model protection with respect to the Tier 3 for enteric methane in dairy cows

Within Wageningen UR Livestock Research the control and assurance of quality with respect to the results delivered to the ER, or amendments of the methodology used in the ER, is strictly limited to scientists of Wageningen UR Livestock Research or of the chair group of Animal Nutrition of Wageningen University who are familiar with the development, construction and application of the Tier 3 methodology. The model is protected in that sense that only these particular scientists have actual access to the Tier 3 and the modelling software required to run the Tier 3, to evaluate it, and to improve it.

Data protection in relation to the Tier 3 for enteric methane in dairy cows

All data they received from CBS are treated as confidential information in principle, as far as have not appeared in publicly available reports. The latter may involve publications from CBS, Wageningen UR Livestock Research or the ER itself. The primary responsibility for QC/QA with respect to the data lies with CBS and data are evaluated by a Working Group on Unifying Manure and excretion data (WUM). Discussions in the WUM and decisions following from this are communicated with Wageningen UR Livestock Research. The CBS is initiating and documenting discussions on the national statistics of dairy cows' nutrition and performance within the WUM.

5.9 Quality assurance

Checks with other data

These checks are primarily the responsibility of the agency responsible for the data delivery for the ER.

Wageningen UR Livestock Research is responsible for the scientific quality of the Tier 3 methodology for enteric methane emission in dairy cows. This involves a process of model evaluation in cooperation with experts in high-ranking science groups abroad (University of Reading, Reading, UK; University of Guelph, Guelph, CA; University of California, Davis, US). This also includes evaluation of the model against independent methane measurements in dairy cows.

Audits

The Tier 3 calculations by Wageningen UR Livestock Research are reviewed by the agency responsible for the ER, and are shared with colleagues within Wageningen UR Livestock Research or the chair group of Animal Nutrition of Wageningen University, who are familiar with the Tier 3 methodology.

An outside audit by Wageningen UR will be organized in 2011 on the Tier 3 methodology. Scientists will be consulted who are qualified for the task of auditing models that are used for monitoring purposes.

Since the introduction of the Tier 3 in 2005 there have been no amendments to the model which would require an additional or further audit. Because the role of Wageningen UR Livestock Research is rather limited to converting CBS data into model inputs, and to calculate emission factors for enteric methane in dairy cows, other types of audits (e.g. on the data received, or on the handling of the results generated by Wageningen UR Livestock Research) rely with the agency handling the ER or the outside-agency delivering data to Wageningen UR Livestock Research.

5.10 Documentation and archiving

Relevant documentation and data bases are logged and archived in separate directories for every single registration year, including all input data derived from CBS, including the results obtained, and including an analysis of trends which allows for a check on consistency and logic of results.

This information is shared with colleagues from the chair group of Animal Nutrition of Wageningen University not directly involved with ER task, but informed on Tier 3 methodology and enteric methane emission in dairy cows, and who hence can be considered the most experienced independent reviewers.

The model used in the Tier 3 methodology remained unchanged since introduction in 2005 and has been archived as such.

5.11 Evaluation and improvement

Wageningen UR Livestock Research is continuously involved with experimental work on digestive processes and enteric methane emission in dairy cattle, as well as with the modelling of these processes by dynamic, mechanistic modelling techniques.

Observational data generated by Wageningen UR Livestock Research itself, or published in literature, will be used to evaluate the accuracy of methane predictions by the Tier 3 approach, and to evaluate the potential of improvement of predictions.

Work with the Tier 3 method is shared with international research groups who closely collaborate with Wageningen UR Livestock Research on ruminant nutrition and enteric fermentation. Preferably, such collaborative work will be published in peer-reviewed papers.

Relevant documentation

- Alterra, 2010, Kwaliteitshandboek Alterra Edition september 2010
- Bannink, A., M.W. van Schijndel and J. Dijkstra (2011) A model of enteric fermentation in dairy cows to estimate methane emission for the Dutch National Inventory Report using a Tier 3 approach. *Animal Feed Science & Technology* (in press).
- Bannink, A. (2010) Methane emissions from enteric fermentation by dairy cows, 1990-2008. Background document on the calculation method and uncertainty analysis for the Dutch National Inventory Report on Greenhouse Gas emissions. WOT report Wageningen UR, Wageningen, NL. pp 58 (in press).
- Bannink, A., M.C.J. Smits, E. Kebreab, J.A.N. Mills, J.L. Ellis, A. Klop, J. France & J. Dijkstra (2010) Simulating the effects of grassland management and grass ensiling on methane emission from lactating cows. *Journal of Agricultural Science (Cambridge)* 148, 55-72.
- Bannink, A., J. France, S. López, W.J.J. Gerrits, E. Kebreab, S. Tamminga & J. Dijkstra (2008) Modelling the implication of feeding strategy on rumen fermentation and functioning of the rumen wall. *Animal Feed Science & Technology* 143, 3-26.
- CBS 2005-1 BSV Luchtverontreiniging Transport, 2005-10-28, Internal document CBS, in Dutch
- CBS 2005-2: BSV Luchtverontreiniging Vuurhaarden 2005-10-05, Internal document CBS, in Dutch
- CBS 2005-3: BSV NEH, 2005-11-15, Internal document CBS, in Dutch
- CBS, 2011, Statistics Netherlands quality declaration. 1 february 2011, CBS.
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- Groot, W.J.M. de, R. Visschers, E. Kiestra, P.J. Kuikman & G.J. Nabuurs (2005) Nationaal systeem voor de rapportage van voorraad en veranderingen in bodem-C in relatie tot landgebruik en landgebruikveranderingen in Nederland aan de UNFCCC. Alterra report 1035-3. 52 pp.
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- Kuikman, P.J., J.J.H van den Akker & F. de Vries (2005) Emission of N₂O and CO₂ from organic agricultural soils. Alterra report 1035-2. 66 pp
- Kuikman, P.J., L. Kooistra & G.J. Nabuurs (2004) Land use, agriculture and greenhouse gas emissions in the Netherlands: omissions in the National Inventory Report and potential under Kyoto Protocol article 3.4. Alterra report 994. 60 pp.
- Mills, J.A.N., J. Dijkstra, A. Bannink, S.B. Cammell, E. Kebreab & J. France (2001) A mechanistic model of whole-tract digestion and methanogenesis in the lactating dairy cow: Model development, evaluation, and application. *Journal of Animal Nutrition* 79, 1584-1597.
- Nabuurs, G.J., I.J. van den Wyngaert, W.D. Daamen, A.T.F. Helmink, W de Groot, W.C. Knol, H. Kramer & P Kuikman (2005) National System of Greenhouse Gas Reporting for Forest and Nature Areas under UNFCCC in The Netherlands. Alterra report 1035-1. 57 pp.

Nabuurs, G.J., W. Daamen, G.M. Dirkse, J. Paasman, P.J. Kuikman, J. Verhagen (2003) Present readiness of and white spots in the Dutch National System for greenhouse gas reporting of the Land Use, Land-Use Change and Forestry sector (LULUCF). Alterra report 774. 97 pp

RIVM/MNP, 2004, Implementatieplan Emissieregistratie 2004-2009

SenterNovem, in cooperation with ER and involved organizations, 2005, Background information on QA/QC of 'outside' agencies. Internal document, Version 1.0 - December 2005.

WOT 2010, Kwaliteitshandboek Unit Wettelijke Onderzoekstaken Natuur & Milieu Editie 1 september 2010, versie 2.4

Wyngaert, I.J.J. van den, H. Kramer, P. Kuikman, G.J. Nabuurs & H. Vreuls; Greenhouse gas reporting of the LULUCF sector, revisions and updates related to the Dutch NIR 2008. Alterra report 1035.6

Wyngaert, I.J.J. van den; Kramer, H.; Kuikman, P.J.; Lesschen, J.P. (2009) Greenhouse gas reporting of the LULUCF sector, revisions and updates related to the Dutch NIR 2009. Alterra report 1035.7.

Annex 1 Overview of QC Tier 1 procedures by ER and NIE

Tier 1 General Inventory Level QC Procedures (Table 8.1 GPG 2000)				
QC Activity	Procedures	Practical application in the Netherlands	Registration	Responsibility
1. Check that assumptions and criteria for the selection of activity data and emission factors are documented.	<ul style="list-style-type: none"> • Cross-check <u>descriptions of activity data and emission factors</u> with information on source categories and ensure that these are <u>properly recorded and archived</u>. 	<ul style="list-style-type: none"> • Performing in recent years extensive sectoral and other relevant reviews and studies as part of development of protocols • Any update of extensive reviews and studies arranged in QAQC programme. • Procedure described in release form for monitoring protocols • Documentation and archiving arranged in procedure. 	<ul style="list-style-type: none"> • Release Form monitoring protocols (NIE). • Monitoring Protocols. • Background documents on emission factors and activity data. 	<ul style="list-style-type: none"> • NIE responsible for recent improvement programme. • NIE and ER together responsible for documentation and updates. NIE checks against guidelines and procedures for documentation and archiving. Taskforce members ER responsible for annual cross-checks, registration and identification of need for updates. • NIE responsible for supervision and planning of QAQC programme.
2. Check for transcription errors in <u>data input and references</u> .	<ul style="list-style-type: none"> • Confirm that bibliographical data <u>references are properly cited</u> in the internal documentation. • Cross-check a sample of input data from each source category (either measurements or parameters used in calculations) for <u>transcription errors</u>. 	<ul style="list-style-type: none"> • Procedure described in the Release Form Monitoring protocols (NIE). The need of using this form is specified in the Work plan ER. • Planning for sample and cross checks on input data is annually described in the Work plan ER. Most cross-checks take place on the Trend Analysis Workshop. • Project manager ER responsible for instructions and documents for preparation of trend analysis workshop. 	<ul style="list-style-type: none"> • Release Form monitoring protocols (NIE). • Work plan ER. • E-mails by project-leader ER. • Report Trend Analysis. • QC registrations by taskforces. 	<ul style="list-style-type: none"> • Taskforce members are responsible for checking references and annual cross checks and identification of any required updates. • Project manager ER responsible for planning in the annual Work plan ER and for the instructions. • Taskforce members are responsible for cross-checks, registration and archiving. • NIE is responsible for checking that the planning and performance of these activities are according to agreements.

Tier 1 General Inventory Level QC Procedures (Table 8.1 GPG 2000)				
QC Activity	Procedures	Practical application in the Netherlands	Registration	Responsibility
3. Check that emissions are <u>calculated correctly</u> .	<ul style="list-style-type: none"> • <u>Reproduce</u> a representative sample of emission <u>calculations</u>. • Selectively mimic complex model calculations with abbreviated calculations to <u>judge relative accuracy</u>. 	<ul style="list-style-type: none"> • The planning of sample and abbreviated emission calculations and judgement of relative accuracy is annually described in the Work plan ER. • Reproducing representative samples of emission calculations is part of the work in the tasks forces. 	<ul style="list-style-type: none"> • Work plan ER. • E-mail project-leader ER (request). • QC registrations and reporting by taskforce members. 	<ul style="list-style-type: none"> • Project manager ER is responsible for planning and implementation of sample and abbreviated calculations and for judgement of relative accuracy. • Taskforce members are responsible for actual implementation of sample calculations and of judgement of relative accuracy, registration and archiving. • NIE is responsible for supervising that the planning and performance of these activities are according to agreements.
4. Check that parameter and emission <u>units</u> are correctly recorded and that appropriate conversion factors are used.	<ul style="list-style-type: none"> • Check that units are <u>properly labelled</u> in calculation sheets. • Check that units are <u>correctly carried through</u> from beginning to end of calculations. • Check <u>that conversion factors</u> are correct. • Check that temporal and spatial <u>adjustment factors</u> are used correctly. 	<ul style="list-style-type: none"> • Checks are part of primary process. Instructions are annually described in the Work plan ER. • Checks are performed by the taskforce members ER. • Entries in database are checked at least twice (by TNO and by taskforce members) on plausibility etc. • IEF checks provide additional check. 	<ul style="list-style-type: none"> • Work plan ER. • QC registrations by ER (e-mails + log). 	<ul style="list-style-type: none"> • Taskforce members are responsible for checks and registration. The quality coordinator of the ER responsible for archiving of QC registrations. • Project manager ER is responsible for description in the Work plan ER. • NIE is responsible for supervising the planning and checking that performance of these activities is according to agreements and requirements.

Tier 1 General Inventory Level QC Procedures (Table 8.1 GPG 2000)				
QC Activity	Procedures	Practical application in the Netherlands	Registration	Responsibility
5. Check the integrity of <u>database files</u> .	<ul style="list-style-type: none"> • Confirm that the appropriate <u>data processing steps</u> are correctly represented in the database. • Confirm that <u>data relationships</u> are correctly represented in the database. • Ensure that <u>data fields</u> are properly labelled and have the correct design specifications. • Ensure that <u>adequate documentation</u> of database and model structure and operation are archived. 	<ul style="list-style-type: none"> • Database only accessible by (very limited) number of authorized staff. • TNO performs checks in database and CRF. • Documentation on databases available with database manager. 	<ul style="list-style-type: none"> • QC registrations and reporting by taskforce member (e-mail and log). • Internal documentation on ER data base. 	<ul style="list-style-type: none"> • Database manager is responsible for checks, registration and archiving. • Project manager ER is responsible for description in the Work plan ER. • NIE is responsible for annual checks that information is according to agreements and requirements.
6. Check for <u>consistency</u> in data <u>between source categories</u> .	<ul style="list-style-type: none"> • <u>Identify</u> parameters (e.g. activity data, constants) that are common to multiple source categories and <u>confirm</u> that there is <u>consistency</u> in the values used for these parameters in the emission calculation. 	<ul style="list-style-type: none"> • Consistency checks are part of trend analysis workshop. • Checks also enabled through separate information on activity data etc. 	<ul style="list-style-type: none"> • QC registrations and reporting by taskforce member (e-mail and log). • Report on Trend Analysis Workshop. 	<ul style="list-style-type: none"> • Database manager is responsible for checks, registration and archiving. • Project manager ER is responsible for description in the Work plan ER. • NIE is responsible for annual checks that information is according to agreements and requirements.

Tier 1 General Inventory Level QC Procedures (Table 8.1 GPG 2000)				
QC Activity	Procedures	Practical application in the Netherlands	Registration	Responsibility
7. Check that the <u>movement of inventory data among processing steps</u> is correct.	<ul style="list-style-type: none"> • Check that emissions data are <u>correctly aggregated</u> from lower reporting levels to higher reporting levels when preparing summaries. • Check that emissions data are <u>correctly transcribed</u> between different intermediate products. 	<ul style="list-style-type: none"> • Process steps are described in to monitoring protocols. • QC checks performed on database in various steps of process. These include e.g. consistency and plausibility checks. 	<ul style="list-style-type: none"> • Monitoring protocols for process. • QC registrations for results. 	<ul style="list-style-type: none"> • Database manager is responsible for checks, registration and archiving. • Project manager ER is responsible for description in the Work plan ER. • NIE is responsible for annual checks that information is according to agreements and requirements.
8. Check that <u>uncertainties</u> in emissions and removals are estimated or calculated correctly.	<ul style="list-style-type: none"> • Check that <u>qualifications</u> of individuals providing expert judgement for uncertainty estimates are <u>appropriate</u>. • Check that qualifications, assumptions and expert judgements are <u>reported</u>. • Check that calculated uncertainties are <u>complete</u> and calculated <u>correctly</u>. • If necessary, duplicate error calculations or a small sample of the probability distributions used <u>by Monte Carlo analyses</u>. 	<ul style="list-style-type: none"> • According to Procedures on uncertainty analysis and on expert elicitation. • Tier 2 update studies at least every 5-year and in case of major methodological changes (including Monte Carlo analyses). 	<ul style="list-style-type: none"> • Procedures. • Background report on uncertainties. 	<ul style="list-style-type: none"> • NIE and ER together are responsible for uncertainties and expert elicitation. • Project manager ER is responsible for planning uncertainty estimations and calculations in the Workplan ER annual. • Taskforce members are responsible for calculations and for annual checks on complete and correct calculations of uncertainties, as well as registration and archiving. • NIE is responsible for supervising planning and checking that performance of these activities is according to the procedure. • NIE is facilitating regular Monte Carlo analyses (tier 2).

Tier 1 General Inventory Level QC Procedures (Table 8.1 GPG 2000)				
QC Activity	Procedures	Practical application in the Netherlands	Registration	Responsibility
9. Undertake <u>review</u> of internal documentation.	<ul style="list-style-type: none"> • Check that there is <u>detailed internal documentation</u> to support estimates and enable duplication of the emission and uncertainty estimates. • Check that inventory data, supporting data and inventory records are <u>archived</u> and stored to facilitate detailed review. • Check integrity of any data archiving arrangements of <u>outside organisations</u> involved in inventory preparation. 	<ul style="list-style-type: none"> • Implemented by Monitoring protocols and background documents. • Checked by internal reviews and audits in accordance with QA/QC programme. • Actual annual implementation using Procedure on archiving and documentation. • Maintaining and updating description of QA/QC outside agencies (and including appropriate improvement actions in QA/QC plan if needed and possible). 	<ul style="list-style-type: none"> • Monitoring protocols. • Reports on internal reviews and audits. • List of key documents. • Annual archives. • Report and background info on QA/QC of outside agencies. 	<ul style="list-style-type: none"> • NIE is responsible for regular review of internal documentation. • NIE and ER together are responsible for description QA/QC activities outside agencies. • Database manager is responsible for a description of the data base structure.
10. Check methodological and data changes resulting in <u>re-calculations</u> .	<ul style="list-style-type: none"> • Check for <u>temporal consistency</u> in time series input data for each source category. • Check for <u>consistency in the algorithm/method</u> used for calculations throughout time series. 	<ul style="list-style-type: none"> • Checks are part of primary process. Instructions and planning of checks are annually described in the Work plan ER. • Checks are performed by the taskforce members ER. • Consistency in methods and time series arranged in monitoring protocols. • Methodological and time series change requires special permission in accordance with procedure for modifications. 	<ul style="list-style-type: none"> • Work plan ER. • QC registrations and reporting by taskforce members (e-mail+log). • Monitoring protocols. • Procedure for modifications of methods and/or time series. 	<ul style="list-style-type: none"> • ER Taskforce members are responsible for checks and registration, quality coordinator ER for archiving of QC registrations. • Project manager ER is responsible for description in the Work plan ER. • NIE is responsible for monitoring protocols and procedures. • NIE responsible for supervising the planning and checking that performance of these activities is according to the procedure.

Tier 1 General Inventory Level QC Procedures (Table 8.1 GPG 2000)				
QC Activity	Procedures	Practical application in the Netherlands	Registration	Responsibility
11. <u>Undertake completeness checks.</u>	<ul style="list-style-type: none"> • Confirm that estimates are reported for all source categories and for all years from the base year to the period of the current inventory. • Check that known data gaps that result in incomplete source category emissions estimates are documented. 	<ul style="list-style-type: none"> • Annual checks are part of primary process. Instructions and planning of checks are annually described in the Work plan ER. • Checks are performed by the taskforce members ER. • General checks performed on completeness of sources in development of protocols and a supporting study on small and unknown sources. 	<ul style="list-style-type: none"> • Work plan ER. • QC registrations and reporting by taskforce members (e-mail+log). • Monitoring protocols. • Reports. 	<ul style="list-style-type: none"> • ER Taskforce members are responsible for checks and registration, quality coordinator ER for archiving of QC registrations • Project manager ER is responsible for description in the Work plan ER. • NIE responsible for supervising the planning and checking that performance of these activities is according to the procedure.
12. <u>Compare estimates to previous estimates.</u>	<ul style="list-style-type: none"> • For each source category, current inventory estimates should be compared to previous estimates. If there are significant changes or departures from expected trends, recheck estimates and explain any difference. 	<ul style="list-style-type: none"> • Annually procedure for comparing estimates to previous estimates is described in the Work plan ER, including the options for partially automated checks. • Comparison (also) part of Trend Analysis Workshop. 	<ul style="list-style-type: none"> • Report Trend Analysis Day. • Documentation-sheet ER. 	<ul style="list-style-type: none"> • Project manager ER is responsible for planning the comparison in the Workplan ER annual. • The database manager and/or taskforce members are responsible for checks, registration and archiving. • NIE responsible for supervising the planning and checking that performance of these activities is according to the agreements and requirements.

Annex 2 Overview of the additional QC at CBS

Introduction:

CBS participates in the annual Emission Registration project through a covenant. QA and QC activities related to greenhouse gas emissions and sinks are therefore integrated in those of the ER. These are described in the Description of the National System (SenterNovem, 2005), the QA/QC programme and Annual Work plan ER. The table below provides information on the additional QC activities by CBS.

Tier 1 Additional Inventory QC Procedures at CBS				
QC Activity	Procedures	Practical application at CBS	Registration	Responsibility
1. Check that assumptions and criteria for the selection of activity data and emission factors are documented	<ul style="list-style-type: none"> • See annex 1. 	<ul style="list-style-type: none"> • See annex 1; • Implemented in the release and modification checks of the monitoring protocols. 	<ul style="list-style-type: none"> • Release form protocols; • Background documents. 	<ul style="list-style-type: none"> • ER and SenterNovem(NIE).
2. Check for transcription errors in <u>data input and references</u>	<ul style="list-style-type: none"> • See annex 1. 	<ul style="list-style-type: none"> • See annex 1; • Implemented in the release and modification checks of the monitoring protocols; • Implemented in annual work plan ER. 	<ul style="list-style-type: none"> • Release form protocols; • Background documents; • Annual work plan ER. 	<ul style="list-style-type: none"> • ER and SenterNovem (NIE).
3. Check that emissions are <u>calculated correctly</u>	<ul style="list-style-type: none"> • See annex 1. 	<ul style="list-style-type: none"> • See annex 1. 	<ul style="list-style-type: none"> • Annual work plan ER • QC documentation sheets ER 	<ul style="list-style-type: none"> • ER.
4. Check that parameter and emission <u>units</u> are correctly recorded and that appropriate conversion factors are used	<ul style="list-style-type: none"> • See annex 1. 	<ul style="list-style-type: none"> • See annex 1. 	<ul style="list-style-type: none"> • Annual work plan ER; • QC documentation sheets ER. 	<ul style="list-style-type: none"> • ER; • SenterNovem carries out an annual check on the performance of the QC process.

Tier 1 Additional Inventory QC Procedures at CBS				
QC Activity	Procedures	Practical application at CBS	Registration	Responsibility
5. Check the integrity of <u>database files</u>	• See annex 1.	<ul style="list-style-type: none"> • See annex 1 • CBS carries out a.o.: <ul style="list-style-type: none"> ○ cross checks of questionnaire data with company environmental report data; ○ cross checks of energy production data with energy consumption data; ○ archiving of emission data since 1990; ○ archiving of raw electronic data; ○ archiving of hard copy basic data from questionnaires (at least 5 years) ; ○ Data bases and data spreadsheets within CBS are secured by authorisation procedures. 	<ul style="list-style-type: none"> • Annual work plan ER; • QC documentation sheets ER; • Descriptions of databases. 	<ul style="list-style-type: none"> • ER; • SenterNovem carries out an annual check on the performance of the QC process; • CBS for additional activities.
6. Check for <u>consistency</u> in data <u>between source categories</u>	• See annex 1.	<ul style="list-style-type: none"> • See annex 1 • CBS carries out a.o.: <ul style="list-style-type: none"> ○ cross checks of questionnaire data with company environmental report data; ○ cross checks of energy production data with energy consumption data. 	<ul style="list-style-type: none"> • QC documentation sheets ER. 	<ul style="list-style-type: none"> • ER; • SenterNovem carries out an annual check on the performance of the QC process; • CBS for additional activities.
7. Check that the <u>movement of inventory data among processing steps</u> is correct	• See annex 1.	• See annex 1.	<ul style="list-style-type: none"> • QC documentation sheets ER. 	<ul style="list-style-type: none"> • ER.
8. Check that <u>uncertainties</u> in emissions and removals are estimated or calculated correctly	• See annex 1.	• See annex 1.	<ul style="list-style-type: none"> • Procedure for uncertainty analyses; • Back ground document on uncertainties. 	<ul style="list-style-type: none"> • Procedure: SenterNovem + ER; • Implementation: ER; • Updating the background document: SenterNovem + ER.

Tier 1 Additional Inventory QC Procedures at CBS				
QC Activity	Procedures	Practical application at CBS	Registration	Responsibility
9. Undertake <u>review of internal documentation</u>	<ul style="list-style-type: none"> • See annex 1. 	<ul style="list-style-type: none"> • See annex 1; • CBS also maintains records of phone, conversation and e-mail exchange of information that may lead to changes in data (traceability); • CBS carries out a.o.: <ul style="list-style-type: none"> ○ archiving of emission data since 1990 ○ archiving of raw electronic data ○ archiving of hard copy basic data from questionnaires (at least 5 years) ○ CBS has strict integrity and confidentiality procedures. 	<ul style="list-style-type: none"> • In conformity with the procedure for documentation and archiving; • Additional archiving by CBS as described. 	<ul style="list-style-type: none"> • Procedure; SenterNovem and ER; • Implementation: relevant organisations; • CBS for additional actions and for basic processing within CBS.
10. Check methodological and data changes resulting in <u>re-calculations</u>	<ul style="list-style-type: none"> • See annex 1. 	<ul style="list-style-type: none"> • See annex 1; • In addition CBS checks energy balance data with previous year data. 	<ul style="list-style-type: none"> • Monitoring protocols; • Background documents; • QC documentation. 	<ul style="list-style-type: none"> • ER: implementation; • SenterNovem: protocols and annual system performance checks; • CBS: energy balance related checks.
11. Undertake <u>completeness checks</u>	<ul style="list-style-type: none"> • See annex 1. 	<ul style="list-style-type: none"> • See annex 1. 	<ul style="list-style-type: none"> • CRF/NIR 	<ul style="list-style-type: none"> • ER.
12. <u>Compare estimates to previous estimates</u>	<ul style="list-style-type: none"> • See annex 1. 	<ul style="list-style-type: none"> • See annex 1. 	<ul style="list-style-type: none"> • QC procedures, annual work plan ER. 	<ul style="list-style-type: none"> • ER.

Annex 3 Additional checks by the NL Agency Waste Management Department

The Waste Management Department takes part in the Emission Registration (ER) project of the MNP, and therefore the QA and QC activities related to greenhouse gas emissions are integrated in those of the ER. These general activities are described in the Description of the National System, the QA/QC programme and the Annual Work plan ER. Annex 1 also provides a brief general overview of Tier 1 QC checks within the National System. Above that the Waste Management Department undertakes additional QC checks. By the combination of the general 'ER-checks' and the additional QC checks all of the needed QC checks listed in table 8.1 of the GPG 2000, are fulfilled.

Additional QC checks for composting and digesting of separated collected organic waste of households					
Process step	Performer	Activity	Check	When	Remark (including the date of the check and the name of the person who checked it)
Determine the amount of organic waste composted or digested in the Netherlands	Working Group on Waste Registration	Sending questionnaires to all the facilities for composting and digesting organic waste	Check if all the operating facilities get a questionnaire. Are there any new ones?	Every year	
		Collecting questionnaires	Check if all the questions are answered.	Every year	
		Process and analyze questionnaires	Check if the given answers are in line with the information at the legal authorities.	Every year	
			Check if the given answers are processed correctly.	Every year	
			Check if the given answers (per facility) are in line with previous years. And explain differences.	Every year	

Additional QC checks for composting and digesting of separated collected organic waste of households					
Process step	Performer	Activity	Check	When	Remark (including the date of the check and the name of the person who checked it)
			Check if the total amount of organic waste composted is in line with other sources/questionnaires (Statistics Netherlands)	Every year	
		Report the results	Check if the reported results are adopted correctly.	Every year	
Determine the emissions from composting and digesting in the Netherlands	NL Agency	Determine the emissions in the Excel-tool	Check if the amount of organic waste per facility is correctly withdrawn from the report of the Working Group on Waste Registration.	Every year	
			Check if the formulae are copied correctly.	Every year	
			Check if the total emission is in line with former years. And explain differences.	Every year	
			Check if new information exists on emission factors.	Regular	
			Check if the total emission is in line with the expectation of experts from the field.	Regular	
		Deliver the emissions in the proper format to ER	Make sure the information is received and used.	Every year	

Additional QC checks for composting and digesting of separated collected organic waste of households					
Process step	Performer	Activity	Check	When	Remark (including the date of the check and the name of the person who checked it)
Emission check up	Task Force ER (ENINA)	Compare the total with former years	Check if the total amount is in line with former years. And explain differences.	Every year	
Production validated emissions	RIVM	Take the validated emissions in the databases	Check the total emission with the delivered total by NL Agency	Every year	

Additional QC checks for incinerating in municipal solid waste incinerators					
Process step	Performer	Activity	Check	When ?	Remark (including the date of the check and the name of the person who checked it)
Collect data on the amount of waste incinerated	Working Group on Waste Registration	Sending questionnaires to all waste incineration plants	Check if all the operating facilities get a questionnaire. Are there any new ones?	Every year	
		Collecting questionnaires	Check if all the questions are answered.	Every year	
		Process and analyze questionnaires	Check if the given answers are in line with the information at the legal authorities.	Every year	
			Check if the given answers are processed correctly.	Every year	
			Check if the given answers (per facility) are in line with previous years. And explain differences.	Every year	
		Report the results	Check if the reported results are adopted correctly.	Every year	
Determine the composition of household waste	NL Agency	Perform sorting of waste of selected municipalities	Check whether a representative group of municipalities is chosen	Every year	
			Make sure the waste is sorted out in the same way as earlier years	Every year	

Additional QC checks for incinerating in municipal solid waste incinerators					
Process step	Performer	Activity	Check	When ?	Remark (including the date of the check and the name of the person who checked it)
		Calculate the composition of household waste.	Compare results with known trends	Every year	
		Report the results	Check if the reported results are adopted correctly.	Every year	
Calculation of the fossil and not-fossil emissions	NL Agency	Determine the emissions in the Excel-tool	Check if the amount of waste per facility is correctly withdrawn from the report of the Working Group on Waste Registration.	Every year	
			Check if the formulae are copied correctly.	Every year	
			Check if the total emission is in line with former years. And explain differences.	Every year	
			Check if new information exists on emission factors.	Regular	
			Check if the total emission is in line with the expectation of experts from the field.	Regular	
		Deliver the emissions in the proper format to ER	Make sure the information is received and used.	Every year	
Emission check up	Task Force (ENINA)	Compare the total with former years	Check if the total amount is in line with former years. And explain differences.	Every year	

Additional QC checks for incinerating in municipal solid waste incinerators					
Process step	Performer	Activity	Check	When ?	Remark (including the date of the check and the name of the person who checked it)
Production validated emissions	RIVM	Take the validated emissions in the databases	Check the total emission with the delivered total by NL Agency	Every year	

Additional QC checks for land filling					
Process step	Performer	Activity	Check	When?	Remark (including the date of the check and the name of the person who checked it)
Collect data on the amount of waste land filled	Working Group on Waste Registration	Sending questionnaires to all the land fills	Check if all the operating facilities get a questionnaire. Are there any new ones?	Every year	
		Collecting questionnaires	Check if all the questions are answered.	Every year	
		Process and analyze questionnaires	Check if the given answers are in line with the information at the legal authorities.	Every year	
			Check if the given answers are processed correctly.	Every year	
			Check if the given answers (per facility) are in line with previous years. And explain differences.	Every year	
		Report the results	Check if the reported results are adopted correctly.	Every year	
Determine the amount of waste per sector land filled in the Netherlands	NL Agency	Preparation of national report on waste statistics	Check collected data per sector (various sources of information are used) on completeness and consistency with earlier years	Every year	

Additional QC checks for land filling					
Process step	Performer	Activity	Check	When?	Remark (including the date of the check and the name of the person who checked it)
			Correct for overlapping waste streams between the various sources used	Every year	
			Check total amount of waste land filled with information obtained from the various individual landfills	Every year	
		Report the results	Check if the reported results are adopted correctly.	Every year	
Determine the composition of household waste	NL Agency	Perform sorting of waste of selected municipalities	Check whether a representative group of municipalities is chosen	Every year	
			Make sure the waste is sorted out in the same way as earlier years	Every year	
		Calculate the composition of household waste.	Compare results with known trends	Every year	
		Report the results	Check if the reported results are adopted correctly.	Every year	
Determine the composition of industrial waste	CBS	Determine the composition of industrial waste	Check whether results are consistent with earlier years	Every year	

Additional QC checks for land filling					
Process step	Performer	Activity	Check	When?	Remark (including the date of the check and the name of the person who checked it)
Determine amount of landfill gas collected and its amount of methane	Working Group on Waste Registration	Sending questionnaires to all the facilities	Check if all the operating facilities get a questionnaire. Are there any new ones?	Every year	
		Collecting questionnaires	Check if all the questions are answered.	Every year	
		Process and analyze questionnaires	Check if the given answers are processed correctly.	Every year	
			Check if the given answers (per facility) are in line with previous years. And explain differences.	Every year	
Calculate amount of DOC	NL Agency	Combine amount of waste land filled with carbon content for each of its fractions	Make sure no fractions are missed (each waste stream consist for 100% of its fractions)	Every year	
			Check of sum of C in all fractions is same as sum of C in all waste streams	Every year	
			Check whether the resulting value is in line with earlier years and explain the trend found	Every year	

Additional QC checks for land filling					
Process step	Performer	Activity	Check	When?	Remark (including the date of the check and the name of the person who checked it)
Calculate emission of methane from landfills	NL Agency	Calculate amount of methane formed	Check whether the model is filled with the actual data.	Every year	
			Check if the formulae are copied correctly.	Every year	
			Check whether the resulting value is in line with earlier years and explain the trend found	Every year	
		Correct production for amount of gas calculated	Check whether the resulting value is in line with earlier years and explain the trend found	Every year	
			Check if new information exists on emission factors.	Regular	
			Check if the total emission is in line with the expectation of experts from the field.	Regular	
		Deliver the emissions in the proper format to TNO (ER)	Make sure the information is received and used.	Every year	
Emission check up	Task Force (ENINA)	Compare the total with former years	Check if the total amount is in line with former years. And explain differences.	Every year	

Additional QC checks for land filling					
Process step	Performer	Activity	Check	When?	Remark (including the date of the check and the name of the person who checked it)
Production validated emissions	RIVM	Take the validated emissions in the databases	Check the total emission with the delivered total by NL Agency	Every year	