National Institute for Public Health
and the Environment
Ministry of Health, Welfare and Sport

Greenhouse Gas Emission in the Netherlands 1990 - 2009

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National Inventory Report 2011

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Report prepared for submission in accordance with the UN Framework Convention on Climate Change (UNFCCC) and the European Union's Greenhouse Gas Monitoring Mechanism [Including electronic Excel spreadsheet files containing the Common Reporting Format (CRF) data for 1990 to 2009]

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Many colleagues from a number of organisations (CBS, EC-LNV, LEI, Alterra, NL Agency, PBL, RIVM and TNO) have been involved in the annual update of the Netherlands Pollutant Release & Transfer Register (PRTR), also called the Emission Registration (ER) system, which contains emissions data on about 350 pollutants. The emission calculations, including those for greenhouse gas emissions, are performed by members of the ER 'Task Forces'. This is a major task, since the Netherlands' inventory contains many detailed emission sources.

Subsequently, the emissions and activity data of the Netherlands' inventory are converted into the IPCC source categories contained in the CRF files, which form a supplement to this report.

The description of the various sources, the analysis of trends and uncertainty estimates (see Chapters 3 to 8) were made in co-operation with the following emission experts: Mr Guus van den Berghe (NL Agency) (waste), Mr Klaas van der Hoek (land use), Mr Gerben Geilenkirchen (transport), Mr Romuald te Molder (key sources), Mr Jan Dirk te Biesebeek (solvent and product use), Mrs Rianne Dröge (energy), Mr Kees Peek (fugitive, industrial processes), Mr Kees Baas (CBS) (wastewater handling), Mr Jan Vonk and Mrs Sietske van der Sluis (agriculture). In addition, Mr Bas Guis of CBS has provided pivotal information on CO_2 related to energy use. This group has also provided activity data and additional information for the CRF files in cases where these were not included in the data sheets submitted by the ER Task Forces. We are particularly grateful to Mrs Marian Abels, Mr Bert Leekstra, Mr Jack Pesik and Mr Dirk Wever, for their contribution to data processing, chart production and quality control.

We greatly appreciate the contributions of each of these groups and individuals to this National Inventory Report and supplemental CRF files, as well as the external reviewers that provided comments on the draft report.

Rapport in het kort

In 2009 is de totale broeikasgasemissie van Nederland met ongeveer 3 procent gedaald ten opzichte van de emissie in 2008. Deze daling komt vooral door een lagere industriële productie als gevolg van de economische crisis. De totale broeikasgasemissie in 2009 bedraagt 198,9 Teragram (Megaton of miljard kilogram) CO_2-equivalenten. Ten opzichte van het basisjaar 1990 (213,2 Tg CO_2-equivalenten) is dit een afname van bijna 7 procent. Beide getallen zijn exclusief de emissies afkomstig uit het soort landgebruik en de verandering daarin, zoals natuurontwikkeling of ontbossing. (land use, land use change and forestry, LULUCF).

Dit blijkt uit een inventarisatie van broeikasgasemissies die het RIVM op verzoek van het ministerie van Infrastructuur en Milieu (I&M) heeft opgesteld. Met deze inventarisatie voldoet Nederland aan de nationale rapportageverplichtingen voor 2011 van het Klimaatverdrag van de Verenigde Naties (UNFCCC), van het Kyoto Protocol en van het Bewakingsmechanisme Broeikasgassen van de Europese Unie.

De inventarisatie bevat verder trendanalyses voor de emissies van broeikasgassen in de periode 1990-2009, een analyse van belangrijkste emissiebronnen (sleutelbronnen) evenals de onzekerheid in hun emissies. Daarnaast biedt de inventarisatie documentatie van de gebruikte berekeningsmethoden, databronnen en toegepaste emissiefactoren. Ten slotte bevat het een overzicht van het kwaliteitssysteem en de validatie van de emissiecijfers door de Nederlandse Emissieregistratie.

Trefwoorden: broeikasgassen, emissies, trends, methodiek, klimaat

Abstract

The total greenhouse gas emission from the Netherlands in 2009 decreased by approximately 3% compared to the emission in 2008. This decrease is a result of the economic crisis, especially due to the decrease in the industrial production.

In 2009, total direct greenhouse gas emissions (excluding emissions from LULUCF – land use, land use change and forestry) in the Netherlands amount to 198.9Tg CO_2 eq. This is nearly 7 % below the emissions in the base year 1990 (213.2 Tg CO_2 eq).

This report documents the 2011 Netherlands' annual submission of its greenhouse gas emission inventory in accordance with the guidelines provided by the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and the European Union's Greenhouse Gas Monitoring Mechanism.

The report comprises explanations of observed trends in emissions; a description of an assessment of key sources and their uncertainty; documentation of methods, data sources and emission factors applied; and a description of the quality assurance system and the verification activities performed on the data.

Keywords: greenhouse gases, emissions, trends, methodology, climate

Contents

Samenvatting

Het National Inventory Report (NIR) 2011 bevat de rapportage van broeikasgasemissies (CO_2, N_2O, CH_4 en de F-gassen) over de periode 1990 tot en met 2009.
De emissiecijfers in de NIR 2011 zijn berekend volgens de protocollen behorend bij het 'National System' dat is voorgeschreven in het Kyoto Protocol. In de protocollen zijn de methoden vastgelegd voor zowel het basisjaar (1990 voor CO_2, CH_4 en N_2O en 1995 voor de F-gassen) als voor de emissies in de periode tot en met 2012. De protocollen staan op de website www.broeikasgassen.nl. Alle emissiecijfers en bijbehorende documentatie worden ook, met een vertraging van enkele maanden, gepubliceerd op www.emissieregistratie.nl.

National Inventory Report (NIR)

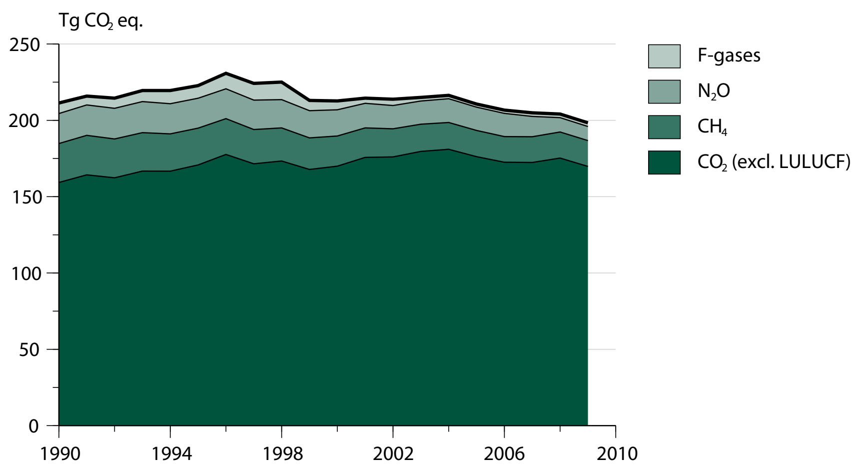
Dit rapport over de Nederlandse inventarisatie van broeikasgasemissies is op verzoek van het ministerie van Infrastructuur en Milieu (IenM) opgesteld om te voldoen aan de nationale rapportageverplichtingen in 2011 van het Klimaatverdrag van de Verenigde Naties (UNFCCC) het Kyoto protocol en het Bewakingsmechanisme Broeikasgassen van de Europese Unie. Dit rapport bevat de volgende informatie:

- trendanalyses voor de emissies van broeikasgassen in de periode 1990-2009
- een analyse van zogenaamde sleutelbronnen en de onzekerheid in hun emissies volgens de 'Tier 1'-methodiek van de IPCC Good Practice Guidance;
- documentatie van gebruikte berekeningsmethoden, databronnen en toegepaste emissiefactoren;
- een overzicht van het kwaliteitssysteem en de validatie van de emissiecijfers voor de Nederlandse Emissieregistratie;
- de wijzigingen die in de methoden voor het berekenen van broeikasgasemissies zijn aangebracht na de review van het Nationaal Systeem broeikasgassen vanuit het Klimaatverdrag. Op basis van de methoden die in de NIR en de Nederlandse protocollen broeikasgassen zijn vastgelegd, is de basisjaaremissie bepaald, en de hoeveelheid broeikasgassen die Nederland in de periode 2008 t/m 2012 (volgens het Kyoto Protocol) mag uitstoten.

De NIR bevat ook de informatie die voorgeschreven is volgens artikel 7 van het Kyoto protocol (deel 2 van dit rapport). Hiermee voldoet Nederland aan alle rapportagerichtlijnen van de UNFCCC.

Een losse annex bij dit rapport bevat elektronische data over emissies en activiteitsdata in het zogenaamde Common Reporting Format (CRF), waar door het secretariaat van het VN-Klimaatverdrag om wordt verzocht. In de bijlagen bij dit rapport is ondermeer een overzicht van sleutelbronnen en onzekerheden in de emissie opgenomen.

Figuur ES.1 Broeikasgassen: emissieniveaus en emissietrends (excl. LULUCF), 1990-2009.



De NIR gaat niet specifiek in op de invloed van het gevoerde overheidsbeleid met betrekking tot emissies van broeikasgassen; meer informatie hierover is te vinden in de Balans van de Leefomgeving en de vijfde Nationale Communicatie onder het Klimaatverdrag, die eind 2009 is verschenen.

Ontwikkeling van de broeikasgasemissies

De emissieontwikkeling in Nederland wordt beschreven en toegelicht in dit National Inventory Report (NIR 2011). Figuur ES.1 geeft het emissieverloop over de periode 1990-2009 weer. De totale emissies bedroegen in 2009 circa 198,9 Tg (Mton ofwel miljard kg) CO_2 equivalenten en waren daarmee bijna 7 procent lager dan de emissies in het basisjaar (213,2 Tg CO_2 eq). De hier gepresenteerde emissies zijn exclusief de emissies van landgebruik en bossen (LULUCF); deze emissies tellen mee vanaf het emissiejaar 2008 onder het Kyoto Protocol. De emissie van CO_2 is sinds 1990 met circa 7% toegenomen, terwijl de emissies van de andere broeikasgassen met circa 46% zijn afgenomen ten opzichte van het basisjaar.
In 2009 daalde de CO_2- emissie met circa 3 procent ten gevolge van de economische crisis. Ook de emissies van CH_4 en N_2O daalden in 2009 licht ten opzichte van 2008. De emissies van F- gassen steeg in 2009 met 3 % ten opzichte van 2008 door een relatief hoge toename van de HFC emissies en daling van de PFC en SF_6 emissie. De totale emissie van broeikasgassen in 2009 ligt 3% lager dan het 2008 niveau.

Box ES.1 Onzekerheden
De emissies van broeikasgassen kunnen niet exact worden gemeten of berekend. Onzekerheden zijn daarom onvermijdelijk. Het PBL schat de onzekerheid in de jaarlijkse totale broeikasgasemissies op circa 3%. Dit is geschat op basis van informatie van emissie-experts in een eenvoudige analyse van de onzekerheid (volgens IPCC Tier 1). De totale uitstoot van broeikasgassen ligt daarmee met 95% betrouwbaarheid tussen de 192 en 204 Tg (Mton). De onzekerheid in de emissietrend tussen het basisjaar (1990/1995) en 2009 is geschat op circa 3% ; dat wil zeggen dat de emissietrend in die periode met 95% betrouwbaarheid ligt tussen de -10 tot -4%.

Methoden

De methoden die Nederland hanteert voor de berekening van de broeikasgasemissies zijn vastgelegd in protocollen voor de vaststelling van de emissies, te vinden op www.broeikasgassen.nl. De protocollen zijn opgesteld door Agentschap NL, in nauwe samenwerking met deskundigen van de Emissieregistratie (voor wat betreft de beschrijving en documentatie van de berekeningsmethoden). Na vaststelling van deze protocollen in de Stuurgroep EmissieRegistratie (december 2005), zijn de protocollen vastgelegd in een wettelijke regeling door het ministerie van IenM. De methoden maken onderdeel uit van het Nationaal Systeem (artikel 5.1 van het Kyoto Protocol) en zijn bedoeld voor de vaststelling van de emissies in zowel het basisjaar als in de jaren in de budgetperiode. Naar aanleiding van de reviews vanaf het zogenaamde 'Initial Report' zijn de methoden en protocollen aangepast. Deze zijn daarmee in overeenstemming met de IPCC Good Practice guidance and Uncertainty Management, dat als belangrijkste voorwaarde is gesteld aan de te hanteren methoden voor de berekening van broeikasgassen. Deze methoden zullen de komende jaren (tot 2014) worden gehanteerd; tenzij er grote veranderingen plaatsvinden in bijvoorbeeld de beschikbaarheid van basisdata of de implementatie van beleidsmaatregelen aanleiding geeft de methoden aan te passen. In deze submissie is een grote methodewijziging doorgevoerd voor de sector landbouw. Het model waarmee de stikstofstromen in de landbouw wordt berekend is verbeterd hetgeen leidde tot een verminderde emissie in 2008 van ammoniak en verhoogde emissies van NO_x en lagere emissies van N_2O ten opzichte van eerdere submissies.

Executive Summary

ES1 Background information on greenhouse gas inventories and climate change

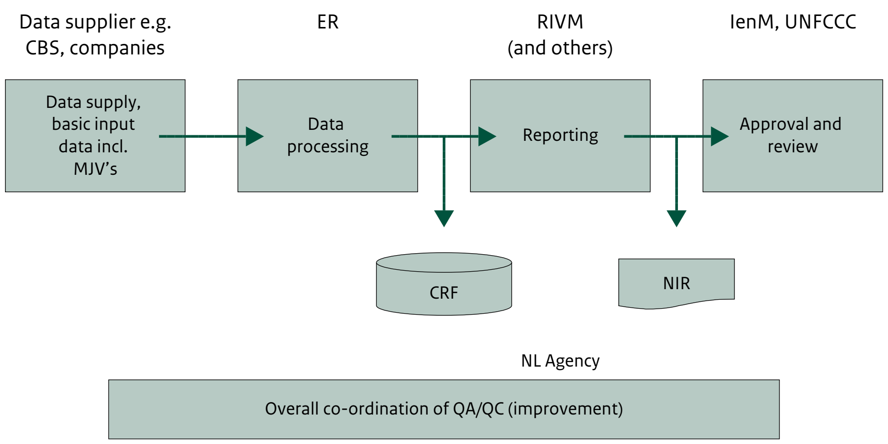
This report documents the 2011 Netherlands' annual submission of its greenhouse gas emission inventory in accordance with the guidelines provided by the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and the European Union's Greenhouse Gas Monitoring Mechanism. These guidelines, which also refer to Revised 1996 IPCC Guidelines and IPCC Good Practice guidance and Uncertainty Management reports, provide a format for the definition of source categories and for calculation, documentation and reporting of emissions. The guidelines aim at facilitating verification, technical assessment and expert review of the inventory information by independent Expert Review Teams of the UNFCCC. Therefore, the inventories should be transparent, consistent, comparable, complete and accurate as elaborated in the UNFCCC Guidelines for reporting and be prepared using good practice as described in the IPCC Good Practice Guidance. This National Inventory Report (NIR) 2011, therefore, provides explanations of the trends in greenhouse gas emissions, activity data and (implied) emission factors for the period 1990-2009. It also summarizes descriptions of methods and data sources of Tier 1 assessments of the uncertainty in annual emissions and in emission trends; it presents an assessment of key sources following the Tier 1 and Tier 2 approaches of the IPCC Good Practice Guidance; and describes Quality Assurance and Quality Control activities. This report provides no specific information on the effectiveness of government policies for reducing greenhouse gas emissions. This information can be found in the annual Environmental Balance (in Dutch: 'Balans van de leefomgeving') prepared by the Netherlands Environmental Assessment Agency (PBL) and the 5th National Communication (NC5) prepared by the Government of the Netherlands.

The Common Reporting Format (CRF) spreadsheet files, containing data on emissions, activity data and implied emission factors, accompany this report. The complete set of CRF files as well as the NIR in pdf format can be found at the website www.greenhousegases.nl. From July 2010, the emissions and documentation can also be found on www.prtr.nl.

Climate Convention and Kyoto Protocol

This NIR is prepared as a commitment under the UNFCCC and under the Kyoto Protocol. The NIR also contains a part 2 that focuses on supplementary information under article 7 of the Kyoto protocol. One of the commitments is the development of a National System for greenhouse gas emissions (art. 5.1 of the Protocol). This National System developed in the period 2000-2005 was reviewed by an Expert Review Team of the UNFCCC in April 2007 and

Figure ES.2 Main elements in the greenhouse gas inventory compilation process.



found to be in compliance with the requirements.

Key categories

For identification of the 'key categories' according to the IPCC Good Practice approach, national emissions are allocated according to the IPCC potential key category list wherever possible. The IPCC Tier 1 method consists of ranking this list of source category-gas combinations for the contribution to both the national total annual emissions and the national total trend. The results of these listings are presented in Annex 1: the largest sources, the total of which ads up to 95% of the national total, are 32 sources for annual level assessment and 31 sources for the trend assessment from a total of 72 sources. Both lists can be combined to give an overview of sources, which meet either of these two criteria. Next, the IPCC Tier 2 method for identification of key sources is used, which requires incorporating the uncertainty to each of these sources before ordering the list of shares. The result is a list of 45 source categories from a total of 72 that could be identified as 'key sources' according to the definition of the IPCC Good Practice Guidance report. Finally, four key categories are found in the LULUCF sector (Sector 5), after inclusion of 9 LULUCF subcategories in the key category analysis.

Institutional arrangements for inventory preparation

The greenhouse gas inventory of the Netherlands is based on the national Pollutant Release & Transfer Register (PRTR). The general process of inventory preparation has existed many years and is organised as a project with an annual cycle. In 2000, an improvement programme was initiated under the lead of SenterNovem (now NL Agency) to transform the general process of the greenhouse gas inventory of the PRTR into a National System, according to the requirements under article 5.1 of the Kyoto Protocol.

The National Institute for Public Health and the Environment (RIVM) has been contracted by the Ministry of Infrastructure and the Environment (IenM) to compile and maintain the PRTR and to co-ordinate the preparation of the NIR and filling the CRF (see Figure ES.2). NL Agency is designated by law as the National Inventory Entity (NIE) and co-ordinates the overall QA/QC activities and the support/response to the UNFCCC review process.

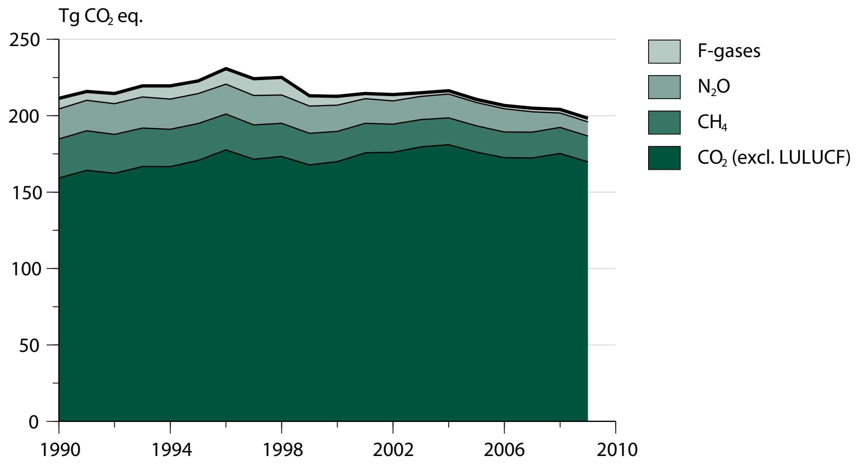
Monitoring protocols

As part of the improvement programme, the methodologies for calculating greenhouse gas emission in the Netherlands were reassessed and compared with UNFCCC and IPCC requirements. For the key sources and for sinks, the methodologies and processes are elaborated, re-assessed and revised when required. The final revision was done after review of the National System (including the protocols). The present CRF/NIR is based on methodologies approved during/after the review of the National System and the calculation of the Assigned Amount of the Netherlands. Monitoring protocols describing methodologies, data sources and the rationale for their selection are available at www.greenhousegases.nl.

Organisation of the report

This report is in line with the prescribed NIR format, starting with an introductory Chapter 1, containing background information on the Netherlands' process of inventory preparation and reporting; key categories and their uncertainties; a description of methods, data sources and emission factors, and a description of the quality assurance system, along with verification activities applied to the data. Chapter 2 provides a summary of trends for aggregated greenhouse gas emissions by gas and by main source. Chapters 3 to 9 present detailed explanations for

Figure ES.3 An overview of the emission trends for greenhouse gas emissions (excl. LULUCF) 1990-2009.



emissions in different sectors. Chapter 10 presents information on recalculations, improvements and response to issues raised in external reviews on the NIR 2010 and on the draft of the NIR 2011. In addition, the report provides detailed information on key categories, methodologies and other relevant reports in 10 Annexes. In Part II of this report the Supplementary information required under Article 7, Paragraph 1 of the Kyoto Protocol is reported.

ES2 Summary of national emission and removal related trends

In 2009, total direct greenhouse gas emissions (excluding emissions from LULUCF) in the Netherlands were estimated at 198.9 Tg CO_2 equivalents (CO_2 eq). This is about 7% below the emissions in the base year (213.2 Tg CO_2 eq). In the Netherlands, the base year emissions are 1990 for CO_2, CH_4 and N_2O, and 1995 for fluorinated gases. CO_2 emissions (excluding LULUCF) increased by about 7% from 1990 to 2009, mainly due to the increase in the emissions in the 1A1a Public Electricity sector and 1A3 Transport sector. CH_4 emissions decreased by 34% in 2009 compared to the 1990 level, mainly due to decrease in the waste sector, the Agricultural sector and fugitive emissions in the Energy sector. N_2O emissions decreased by 52% in 2009 compared to 1990, mainly due to decrease in emissions from agriculture and from Industrial Processes, which partly compensated emission increases from fossil fuel combustion (mainly from transport). Of the fluorinated greenhouse gases, HFC and PFC emissions decreased in 2009 by about 66% and 91%, respectively, while SF_6 emissions decreased by 42%. Total emissions of all F-gases decreased by about 71% compared to the 1995 level (chosen as the base year).

Between 2008 and 2009, the CO_2 emissions decreased (excluding LULUCF) by 5.7 Tg. The other greenhouse gas also showed a decrease in emissions in 2009 except for the HFC's which showed a small increase (0.2 Tg CO_2 eq). Overall the total greenhouse gas emission decreased by about 3 % compared to 2008.

ES3 Overview of source and sink category emission estimates and trends

Tables ES.1 and ES.2 provide an overview of the emission trends (in CO_2 equivalents) per gas and per IPCC source category. The Energy sector (category 1) is by far the largest contributor to national total greenhouse gas emissions. The emissions of this sector increased substantially compared to 1990. In contrast, emissions from the other sectors decreased compared to the base year, the largest being Industrial Processes, Waste and Agriculture.

Table ES.1 Summary of emission trend per gas (unit: Tg CO_2 equivalents).

	CO_2 incl. LULUCF	CO_2 excl. LULUCF	CH_4	N_2O	HFCs	PFCs	SF_6	Total (incl. LULUCF)	Total (excl. LULUCF)
Base yr	**162.0**	**159.3**	**25.5**	**20.1**	**6.0**	**1.9**	**0.3**	**215.9**	**213.2**
1990	162.0	159.3	25.5	20.1	4.4	2.3	0.2	214.5	211.9
1991	166.6	164.3	25.9	20.4	3.5	2.2	0.1	218.8	216.4
1992	165.0	162.4	25.5	20.6	4.4	2.0	0.1	217.7	215.1
1993	169.2	166.8	25.2	20.9	5.0	2.1	0.1	222.5	220.1
1994	169.1	166.7	24.4	20.2	6.5	2.0	0.2	222.4	220.0
1995	173.3	170.8	24.1	20.1	6.0	1.9	0.3	225.8	223.2
1996	180.0	177.7	23.5	20.0	7.7	2.2	0.3	233.7	231.3
1997	174.1	171.5	22.4	19.7	8.3	2.3	0.3	227.3	224.7
1998	175.9	173.4	21.7	19.0	9.3	1.8	0.3	228.1	225.5
1999	170.4	167.8	20.7	18.3	4.9	1.5	0.3	216.1	213.5
2000	172.5	170.0	19.7	17.7	3.9	1.6	0.3	215.7	213.2
2001	178.0	175.7	19.3	16.6	1.6	1.5	0.3	217.3	215.0
2002	178.3	176.0	18.4	15.8	1.6	2.2	0.3	216.6	214.3
2003	182.2	179.6	17.8	15.5	1.5	0.6	0.2	218.0	215.4
2004	183.6	181.0	17.6	16.0	1.6	0.3	0.3	219.3	216.8
2005	178.9	176.2	17.2	15.7	1.5	0.3	0.2	213.8	211.1
2006	175.2	172.6	16.8	15.6	1.7	0.3	0.2	209.8	207.1
2007	174.9	172.4	16.8	13.8	1.8	0.3	0.2	207.9	205.4
2008	178.0	175.3	17.0	9.9	1.9	0.3	0.2	207.3	204.6
2009	172.3	169.8	16.9	9.7	2.1	0.2	0.2	201.3	198.9

Table ES.2 Summary of emission trend per source category (unit: Tg CO_2 equivalents).

	1. Energy	2. Ind. Proc.	3. Solvents	4. Agriculture	5. LULUCF	6. Waste	7. Other	Total (incl. LULUCF)	Total (excl. LULUCF)
Base yr	**154.0**	**23.6**	**0.5**	**22.4**	**2.7**	**12.8**	**NA**	**215.9**	**213.2**
1990	154.0	22.2	0.5	22.4	2.7	12.8	NA	214.5	211.9
1991	159.1	21.2	0.5	22.8	2.3	12.9	NA	218.8	216.4
1992	157.8	21.5	0.4	22.7	2.6	12.7	NA	217.7	215.1
1993	162.5	22.3	0.4	22.4	2.4	12.3	NA	222.5	220.1
1994	161.8	24.3	0.4	21.6	2.4	11.9	NA	222.4	220.0
1995	165.9	23.6	0.4	22.0	2.5	11.3	NA	225.8	223.2
1996	173.6	24.8	0.4	21.6	2.4	10.9	NA	233.7	231.3
1997	166.4	26.1	0.3	21.2	2.6	10.6	NA	227.3	224.7
1998	168.3	26.4	0.4	20.2	2.5	10.2	NA	228.1	225.5
1999	162.6	21.2	0.4	19.9	2.6	9.4	NA	216.1	213.5
2000	164.9	20.3	0.3	18.8	2.6	8.9	NA	215.7	213.2
2001	171.2	16.7	0.3	18.4	2.3	8.4	NA	217.3	215.0
2002	171.6	17.1	0.2	17.4	2.2	8.0	NA	216.6	214.3
2003	175.1	15.5	0.2	17.0	2.6	7.5	NA	218.0	215.4
2004	176.3	16.0	0.2	17.0	2.5	7.2	NA	219.3	216.8
2005	171.2	16.0	0.2	16.9	2.7	6.8	NA	213.8	211.1
2006	167.9	15.8	0.2	16.8	2.7	6.4	NA	209.8	207.1
2007	167.8	14.7	0.2	16.7	2.5	6.1	NA	207.9	205.4
2008	171.8	10.2	0.2	16.7	2.6	5.7	NA	207.3	204.6
2009	166.7	9.9	0.2	16.7	2.5	5.3	NA	201.3	198.9

Sectors showing the largest growth in CO_2 equivalent emissions since 1990 are Transport (1A3) and Energy industries (1A1) (+31% and +22%, respectively). Half the marked increase in the public electricity sector of almost 30% between 1990 and 1998 is caused by a shift of cogeneration plants from manufacturing industries to the public electricity and heat production sector due to a change of ownership (joint ventures), simultaneously causing a 15% decrease in industry emissions in the early 1990s (1A2).

ES4 Other information

General uncertainty evaluation

The results of the uncertainty estimation according to the IPCC Tier 1 uncertainty approach are summarised in Annex 1 of this report. The Tier 1 estimation of annual uncertainty in CO_2 eq emissions results in an overall uncertainty of 3%, based on calculated uncertainties of 2%, 17%, 44% and 38% for CO_2 (excluding LULUCF), CH_4, N_2O and F-gases, respectively.

However, these figures do not include the correlation between source categories (e.g., cattle numbers for enteric fermentation and animal manure production), or a correction for not-reported sources. Therefore, the actual uncertainty of total annual emissions per compound and of the total will be somewhat higher; it is currently estimated by RIVM at:

CO_2	±3%		HFCs	±50%
CH_4	±25%		PFCs	±50%
N_2O	±50%		SF_6	±50%
Total greenhouse gas emissions				±5%

Table A1.4 of Annex 1 summarises the estimate of the trend uncertainty 1990-2009 calculated according to the IPCC Tier 1 approach in the IPCC Good Practice Guidance (IPCC, 2001). The result is a trend uncertainty in the total CO_2 eq emissions (including LULUCF) for 1990 -2009 (1995 for F-gases) of ±3% points. This means that the decrease in total CO_2 eq emissions between 1990 and 2009 (including LULUCF), which is calculated to be 7%, will be between -10% and -4%. Per individual gas, the trend uncertainty in total emissions of CO_2, CH_4, N_2O and the total group of F-gases has been calculated at ±3%, ±9%, ±8% and ±11% points, respectively. More details on the level and trend uncertainty assessment can be found in Annex 7.

Completeness of the national inventory

The Netherlands' greenhouse gas emission inventory includes all sources identified by the Revised Intergovernmental Panel on Climate Change (IPCC) Guidelines (IPCC, 1996) – with the exception of the following very minor sources:

- charcoal production (1B2) and use (1A4), due to missing activity data
- CO_2 from asphalt roofing (2A5), due to missing activity data
- CO_2 from road paving (2A6), due to missing activity data
- CH_4 from enteric fermentation of poultry (4A9), due to missing emission factors
- N_2O from industrial waste water (6B1), due to negligible amounts
- part of CH4 from industrial waste water (6B1b Sludge), due to negligible amounts
- Precursor emissions (carbon monoxide (CO), nitrogen oxide (NOx), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO_2) from Memo item "International bunkers" (international transport) have not been included.

For more information on this issue, see Annex 5.

Methodological changes, recalculations and improvements

This NIR 2011 is based on the envisaged National System of the Netherlands under article 5.1 of the Kyoto Protocol, as developed in the last decade and finalised by December 2005. In past years the results of various improvement actions have been implemented in the methodologies and processes of the preparation of the greenhouse gas inventory of the Netherlands. Compared to the NIR/CRF 2010 and based on the results of the review of the National System by an Expert Review Team of the UNFCCC, some recalculations were undertaken in the last year. The major recalculations are due to the methodical change in the assessment of N_2O-emissions from Manure management and agricultural soils (see chapter 6.4). The ratio behind chapter recalculations is documented in the sectoral Chapters 3-8 and chapter 10.

Table ES.3 provides the results of recalculations in the NIR 2011 compared to the NIR 2010.

Table ES.3 Differences between NIR 2010 and NIR 2011 due to recalculations (Unit: Tg CO_2 eq, F-gases: Gg CO_2 eq).

Gas	Source	1990	1995	2000	2005	2006	2007	2008
CO_2 Incl. LULUCF	NIR10	161.9	172.9	172.2	178.2	174.9	174.8	178.1
	NIR11	**162.0**	173.3	172.5	178.9	175.3	174.9	178.0
	Diff.	0.0%	0.2%	0.2%	0.4%	0.2%	0.0%	-0.1%
CO_2 Excl. LULUCF	NIR10	159.3	170.6	169.7	175.8	172.5	172.3	175.7
	NIR11	**159.3**	170.8	170.0	176.2	172.6	172.4	175.3
	Diff.	0.0%	0.1%	0.1%	0.2%	0.0%	0.1%	-0.2%
CH_4	NIR10	25.5	24.1	19.8	17.2	16.8	16.8	17.1
	NIR11	**25.5**	24.1	19.7	17.2	16.8	16.8	17.0
	Diff.	0.0%	0.0%	-0.1%	-0.2%	-0.2%	-0.1%	-0.3%
N_2O	NIR10	20.2	21.5	19.3	17.3	17.1	15.4	11.8
	NIR11	**20.1**	20.1	17.7	15.7	15.6	13.8	9.9
	Diff.	-0.7%	-6.8%	-8.4%	-9.3%	-9.1%	-10.2%	-15.4%
PFCs Gg	NIR10	2264	1938	1582	266	257	323	251
	NIR11	2264	**1938**	1582	266	257	323	251
	Diff.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
HFCs Gg	NIR10	4432	6018	3891	1514	1728	1845	1923
	NIR11	4432	**6018**	3886	1494	1704	1820	1889
	Diff.	0.0%	0.0%	-0.1%	-1.3%	-1.4%	-1.4%	-1.8%
SF_6 Gg	NIR10	217	301	318	254	217	226	224
	NIR11	217	**301**	315	239	198	192	186
	Diff.	0.0%	0.0%	-0.8%	-6.1%	-8.4%	-14.9%	-17.0%
Total Excl. LULUCF	NIR10	212.0	224.5	214.6	212.4	208.7	206.9	206.9
	NIR11	211.9	223.2	213.2	211.1	207.1	205.4	204.6
	Diff.	-0.1%	-0.6%	-0.7%	-0.6%	-0.7%	-0.7%	-1.1%
Total Incl. LULUCF	NIR10	214.6	226.9	217.1	214.7	211.1	209.5	209.4
	NIR11	214.5	225.8	215.7	213.8	209.8	207.9	207.3
	Diff.	-0.1%	-0.6%	-0.6%	-0.4%	-0.6%	-0.7%	-1.0%

Note: Base year values as applied for the calculation of the Assigned Amount are indicated in bold.

Table ES.4 Emission trends for indirect greenhouse gases and SO_2 (Unit: Gg).

	1990	1995	2000	2005	2006	2007	2008	2009
NOx	541	460	387	332	317	296	286	265
CO	1,142	903	749	661	654	636	641	593
NMVOC	460	326	231	174	165	162	162	152
SO2	187	128	71	63	63	59	50	37

Improving the QA/QC system

The QA/QC programme (quality assurance / quality control) is up to date and all procedures and processes have been established to meet the National System requirements (as part of the annual activity programme of the Netherlands PRTR). QA/QC activities to be undertaken as part of the National System are described in Chapter 1. Some actions that remained since the NIR 2007 are now being implemented.

Emission trends for indirect greenhouse gases and SO_2

Compared to 1990, CO and NMVOC emissions were reduced in 2009 by 58% and 69%, respectively. For SO_2 this is 75%, and for NO_x, the 2009 emissions are 52% lower than the 1990 level. Table ES.4 provides trend data.
In contrast to the direct greenhouse gases, emissions of precursors from road transport have not been corrected for fuel sales according to the national energy statistics but are directly related to transport statistics on vehicle-km, which differs to some extent from the IPCC approach. Recalculations (due to changes in methodologies and or allocation) have only been performed for 1990, 1995, 2000 and 2005 to 2009 for all sources.

Part I: Annual Inventory Report

1 Introduction

1.1 Background information on greenhouse gas inventories and climate change

1.1.1 Background information on climate change

The United Nations Framework Convention on Climate Change (UNFCCC) was ratified by the Netherlands in 1994 and entered into force in March of 1994. One of the commitments made by the ratifying Parties under the Convention is to develop, publish and regularly update national emission inventories of greenhouse gases. This national inventory report, together with the CRF, represent the 2010 national emission inventory of greenhouse gases under the UNFCCC (part 1 of this report) and under its Kyoto Protocol (part 2 of this report).

Geographical coverage

The reported emissions include those that have to be allocated to the legal territory of the Netherlands. This includes a 12-mile zone from the coastline and also inland water bodies. It excludes Aruba and the Netherlands Antilles, which are self-governing dependencies of the Royal Kingdom of the Netherlands. Emissions from offshore oil and gas production on the Dutch part of the continental shelf are included.

1.1.2 Background information on greenhouse gas inventory

As indicated, this national inventory report documents the 2010 Greenhouse Gas Emission Inventory for the Netherlands under the UNFCCC and under the Kyoto Protocol. The estimates provided in the report are consistent with the Intergovernmental Panel on Climate Change (IPCC) 1996 Guidelines for National Greenhouse Gas Inventories (IPCC, 1997) and the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2001) and the IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry (LULUCF). The methodologies applied for the Netherlands' inventory are also consistent with the guidelines under the Kyoto Protocol and the European Union's Greenhouse Gas Monitoring Mechanism.

For detailed assessments of the extent to which changes in emissions are due to the implementation of policy measures, see the Environmental Balance (PBL, 2009; in Dutch), the Fourth and the Fifth Netherlands National Communication under the United Nations Framework Convention on Climate Change (VROM, 2005 resp. VROM, 2009) and the Netherlands Report on Demonstrable Progress under Article 3.2 of the Kyoto Protocol (VROM, 2006b).

The Netherlands also reports emissions under other international agreements, such as the United Nations Economic Commission for Europe (UNECE), Convention on Long Range Transboundary Air Pollutants (CLRTAP) and the EU National Emission Ceilings (NEC) Directive. All these estimates are provided by the Netherlands Pollutant Release and Transfer Register (PRTR), which is compiled by a special project in which various organisations co-operate. The greenhouse gas inventory and the PRTR share the same underlying data, which ensures consistency between the inventories and other internationally reported data. Several institutes are involved in the process of compiling the greenhouse gas inventory (see also Section 1.3).

The National Inventory Report (NIR) covers the six direct greenhouse gases included in the Kyoto Protocol: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) (the F-gases).Emissions of the following indirect greenhouse gases are also reported: nitrogen oxides (NO_x), carbon monoxide (CO), and non-methane volatile organic compounds (NMVOC), as well as sulphur oxides (SO_x).
This report provides explanations of the trends in greenhouse gas emissions per gas and per sector for the 1990–2009 period and summarises descriptions of methods and data sources for: (a) Tier 1 assessments of the uncertainty in annual emissions and in emission trends; (b) key source assessments following the Tier 1 and Tier 2 approaches of the IPCC Good Practice Guidance (IPCC, 2001); (c) quality assurance and quality control (QA/QC) activities.

Under the National System under Article 5.1 of the Kyoto Protocol, methodologies were established (and documented) in monitoring protocols. These protocols are annually re-assessed and revised, if needed, for example, based on recommendations of UN reviews. The monitoring protocols and the general description of the National System are available on the website www.greenhousegases.nl. The emissions reported in the NIR 2011 are based on these methodologies, which have been incorporated in the National System for greenhouse gases. The emissions and all the documentation are, with a delay of some months, also available on the website www.prtr.nl

In 2007, the UN performed an in-country initial review under the Kyoto Protocol. The review concluded that the Netherlands National System has been established in accordance with the guidelines and that it meets the requirements. This was confirmed also by later reviews such as the centralised review of the NIR 2009. The National System has remained unchanged with the exception of an organisational change per 1 January 2010. At that date, co-ordination of the above mentioned PRTR project (emissions registration project) shifted from PBL (Netherlands Environmental Assessment Agency) to RIVM (National Institute for Public Health and the Environment). In 2010 arrangements were made to ensure the quality of the products of the PRTR project in the new setting.

The structure of this report complies with the format required by the UNFCCC (FCCC/SBSTA/2004/8 and the latest annotated outline of the National Inventory report including reporting elements under the Kyoto protocol). It also includes supplementary information under Article 7 of the Kyoto Protocol. Part 2 gives an overview of this information.

Greenhouse gas emissions presented in this report are given in gigagrammes (Gg) and teragrammes (Tg). Global warming potential (GWP) weighed emissions of the greenhouse gases are also provided (in CO2 equivalents), using the GWP values in accordance with the Kyoto Protocol and using the IPCC GWP for a time horizon of 100 years. The GWP of each individual greenhouse gas is provided individually in Annex 9.

The Common Reporting Format (CRF) spreadsheet files accompany this report as electronic annexes (the CRF files are included in the zip file for this submission: NETHERLANDS-2011-v1.1.zip. The CRF files contain detailed information on greenhouse gas emissions, activity data and (implied) emission factors specified by sector, source category and greenhouse gas. The complete set of CRF files as well as this report comprise the National Inventory Report (NIR) and are published on the website www.greenhousegases.nl.
Other information, such as protocols of the methods used to estimate emissions, is also available on this website. Section 10 provides details on the extent to which the CRF data files for 1990–2009 have been completed and on improvements made since the last submission.

1.1.3 Background information on supplementary information under Article 7 of the Kyoto Protocol

Part 2 of this report provides the supplementary information under (Article 7) of the Kyoto Protocol. As the Netherlands have not elected any activities to include under Article 3, paragraph 4 of the Kyoto Protocol, the supplementary information on KP LULUCF deals with activities under Article 3, paragraph 3. Information on the accounting of Kyoto units is also provided in the SEF file SEF_NL_2011_1_11-41-30 10-1-2011.xls and in the SIAR report file SIAR Reports 2010-NL v1.0.xls.

1.2 Institutional arrangements for inventory preparation

1.2.1 Overview of institutional arrangements for the inventory preparation

The Ministry of Infrastructure and Environment (IenM) has overall responsibility for climate change policy issues including the preparation of the inventory.

In August 2004, IenM assigned SenterNovem (now NL agency) executive tasks bearing on the National Inventory Entity (NIE), the single national entity required under the Kyoto Protocol. In December 2005, NL Agency was designated by law as the NIE. In addition to coordinating the establishment and maintenance of a National System, the tasks of NL Agency include overall coordination of improved QA/QC activities as part of the National System and coordination of the support/response to the UNFCCC review process. The National System is described in more detail in the (Fourth and Fifth National Communication (VROM 2006b, 2009).

Since 1 January 2010, RIVM has been assigned by IenM to take over the role of PBL as coordinating institute for compiling and maintaining the pollutants emission register/inventory (PRTR system), containing about 350 pollutants including the greenhouse gases. The PRTR project system is used as basis for the NIR and for filling the CRF. After the general elections in the Netherlands in 2010, the responsibilities of the former VROM moved to the restructured Ministry of Infrastructure and Environment (IenM).

1.2.2 Overview of inventory planning

The Dutch Pollutant Release & Transfer Register (PRTR) has been in operation in the Netherlands since 1974. This system encompasses data collection, data processing and registering and reporting emission data for some 350 policy-relevant compounds and compound groups that are present in air, water and soil. The emission data is produced in an annual (project) cycle (MNP, 2006). This system is also the basis for the national greenhouse gas inventory. The overall coordination of the PRTR was outsourced by (IenM) to the RIVM.

The main objective of the PRTR is to produce an annual set of unequivocal emission data that is up-to-date, complete, transparent, comparable, consistent and accurate. In addition to RIVM, various external agencies contribute to the PRTR by performing calculations or submitting activity data. These include: CBS (Statistics Netherlands), PBL, TNO (Netherlands Organisation for Applied Scientific Research), NL Agency, Centre for Water Management, Deltares and several institutes related to the Wageningen University and Research Centre (WUR).

Responsibility for reporting
The NIR part 1 is prepared by RIVM as part of the PRTR project. Most institutes involved in the PRTR also contribute to the NIR (including CBS and TNO). In addition, NL Agency is involved in its role as NIE. NL Agency also prepares the NIR part 2 and takes care of integration and submission to the UNFCCC in its role as NIE. Submission to the UNFCCC only takes place after approval by IenM.

1.2.3 Overview of the inventory preparation and management under Article 7 of the Kyoto Protocol

Following the annotated outline, the supplementary information under Article 2 of the Kyoto Protocol is reported together in the NIR part 2. This information is prepared by NL Agency, using information from various other involved organisations, such as the NEa (Dutch Emissions Authority), the WUR and the Ministry (IenM).

1.3 Inventory preparation

1.3.1 GHG and KP-LULUCF inventory

The primary process of preparing the greenhouse gas inventory in the Netherlands is summarised in Figure 1.1. This process includes three major steps that are described in more detail in the following Sections.

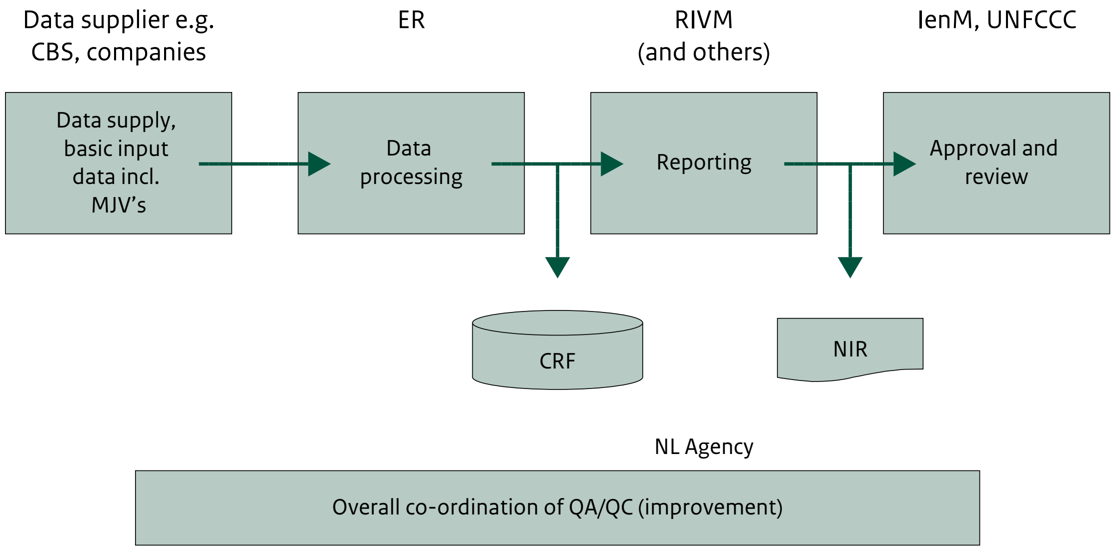
For the KP-LULUCF inventory, the inventory preparation is combined with the work for reporting LULUCF by the unit Wettelijke Onderzoekstaken Natuur & Milieu, part of Wageningen UR. The project team LULUCF oversees data management, the preparation of the reports for land-use, land-use change and forestry and the QA/QC activities and decides on further improvements.

1.3.2 Data collection processing and storage

Various data suppliers provide the basic input data for emission estimates. The most important data sources for greenhouse gas emissions include:

1.3.2.1 Statistical data
Statistical data are provided under various (not specifically greenhouse-gas related) obligations and legal arrangements. These include national statistics from Statistics Netherlands (CBS) and a number of other sources of data on sinks, water and waste. The provision of relevant data for greenhouse gases is guaranteed through covenants

Figure 1.1 Main elements in the greenhouse gas inventory process.



and an Order in Decree, the latter of which is under preparation by IenM. For greenhouse gases, relevant agreements with respect to waste management are in place with CBS and NL Agency. An agreement with the Ministry of Agriculture, Nature and Food Quality (LNV, now ELI) and related institutions was established in 2005.

1.3.2.2 Data from individual companies

Data from individual companies are provided in the form of annual environmental reports (MJVs). A large number of companies have a legal obligation to submit an MJV that includes – in addition to other pertinent information – emission data validated by the competent authorities (usually provincial and occasionally local authorities that also issue permits to these companies). A number of companies with large combustion plants are also required to report information under the BEES/A regulation. Some companies provide data voluntarily within the framework of environmental covenants. The data in these MJVs are used for verifying the calculated CO_2 emissions from energy statistics for industry, energy sector and refineries. If reports from major industries contain plant-specific information on activity data and emission factors of sufficient quality and transparency, this data is used in the calculation of CO_2 emission estimates for specific sectors. The MJVs from individual companies provide essential information for calculating the emissions of substances other than CO_2. The calculations of industrial process emissions of non-CO_2 greenhouse gases (e.g., N_2O, HFC-23 and PFCs released as by-products) are mainly based on information from these MJVs, as are the calculated emissions from precursor gases (CO, NO_x, NMVOC) and SO_2. As reported in previous NIRs, only those MJVs with high-quality and transparent data are used as a basis for calculating total source emissions in the Netherlands.

1.3.2.3 Additional greenhouse-gas-related data

Additional greenhouse gas related data are provided by other institutes and consultants that are specifically contracted to provide information on sectors not sufficiently covered by the above-mentioned data sources. For greenhouse gases, contracts and financial arrangements are made (by PBL/RIVM) with, for example, various agricultural institutes and TNO. In addition, NL Agency contracts out various tasks to consultants (such as collecting information on F-gas emissions from cooling and product use, on improvement actions). During 2004, the Ministry of LNV (now ELI) also issued contracts to a number of agricultural institutes; these consisted of, in particular, contracts for developing a monitoring system and protocols for the LULUCF data set. Based on a written agreement between LNV and PBL/RIVM, these activities are also part of the PRTR.

1.3.2.4 Processing and storage

Data processing and storage are coordinated by PBL/RIVM; these processes consist most notably of the elaboration of emission estimates and data preparation in the emissions data base and the CRF. The emission data are stored in a central database, thereby satisfying – in an efficient and effective manner – national and international criteria on emission reporting. The past two years, RIVM automated the process to fill the CRF with emissions from the central database.

The actual emission calculations and estimates that are made using the input data are implemented in five task forces, each dealing with specific sectors:

- energy, industry and waste (combustion, process emissions, waste handling)
- agriculture (agriculture, sinks)
- consumers and services (non-industrial use of products)
- transport (including bunker emissions)
- water (less relevant for greenhouse gas emissions).

The task forces consist of experts from several institutes. In 2009, in addition to the PBL, these included TNO, CBS, Centre for Water Management, Deltares, FO-I (the Facilitating Organisation for Industry, which co-ordinates annual environmental reporting by companies), NL Agency (Waste Management division) and two agricultural research institutes: Alterra (sinks) and LEI. The task forces are responsible for assessing emission estimates based on the input data and emission factors provided. RIVM commissioned TNO to assist compiling the CRF.

1.3.3 Reporting, QA/QC, archiving and overall co-ordination

The NIR is prepared by PBL with input from the experts in the relevant PRTR task forces and from NL Agency. This step includes documentation and archiving. IenM formally approves the NIR before it is submitted; in some cases approval follows consultation with other ministries. NL Agency is responsible for co-ordinating QA/QC and responses to the EU and for providing additional information requested by the UNFCCC after the NIR and the CRF have been submitted. NL Agency is also responsible (in collaboration with RIVM) for co-ordinating the submission of supporting data to the UNFCCC review process.

For KP-LULUCF, consistency with the values submitted for the Convention was assured by using the same base data and calculation structure. The data, as required in the KP LULUCF CRF, tables are derived from these base data using specific calculations.. The data and calculations were thus subject to the same QA/QC (Van den Wyngaert et al., 2009). The full time series since 1990 was calculated explicitly for re/afforestation and deforestation.

The calculated values were entered in the CRF reporting system at Alterra, and checked by the LULUCF sectoral expert. They were then exported as an XML file and sent to the Dutch inventory, which imported the data in the CRF database for all sectors and again checked. Any strange or incomplete values were reported to the LULUCF sectoral expert, checked and if necessary corrected.

Verification with other international statistics was performed only with FAO. The area of forest is systematically lower for FAO. This may be due to a different methodology. For discussion on different outcomes of different estimates of forest cover in the Netherlands, see Nabuurs et al., 2005. The net increase in forest area in the FAO statistics is higher that reported for KP-LULUCF, and this may indicate that the 1990 estimate may be low in the FAO statistics. These values indicate a conservative estimate of the net forest increase in the Netherlands.

The mean C stock in Dutch forests (used as emission factor for deforestation under the KP) is slightly higher in the UNFCCC estimates than in the FAO estimates. Considering that different conversion factors were used, the estimates are close, while the difference has the tendency to increase. If this continues for the 2010 FAO estimate, this will be reason for investigation. These values indicate a conservative estimate of C emissions from deforestation.

No values from FAO are available on young forests. FAO statistics also provide no information on fires or disturbances for the Kyoto period, since at the national level these statistics are no longer kept. The same accounts for EFFIS, the European Forest Fires Information System.

1.4 Brief description of methodologies and data sources used

1.4.1 GHG inventory

1.4.1.1 Methodologies

Table 1.1 provides an overview of the methods used to estimate greenhouse gas emissions. Monitoring protocols, documenting the methodologies and data sources used in the greenhouse gas inventory of the Netherlands as well as other key documents are listed in Annex 6. The protocols were elaborated, together with relevant experts and institutes, as part of the monitoring improvement program.

Explanation of notation keys used:

- Method applied: D, IPCC default; RA, reference approach; T, IPCC Tier; C, CORINAIR; CS, country-specific; M, model.
- Emission factor used: D, IPCC default; C, CORINAIR; CS, country-specific; PS, plant-specific; M, model.
- Other keys: NA, not applicable, NO, not occurring; NE, not estimated; IE, included elsewhere.

All key documents are electronically available in PDF format at www.greenhousegases.nl. The monitoring protocols describe methodologies, data sources and QA/QC procedures for estimating greenhouse gas emissions in the Netherlands. The sector-specific chapters provide a

Table 1.1 CRF Summary Table 3 with methods and emission factors applied.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2		CH4		N2O		HFCs		PFCs		SF6	
	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor	Method applied	Emission factor
1. Energy	**CS,D,T2,T3**	**CS,D,PS**	**CS,D,T1,T1b,T2,T3**	**CS,D,PS**	**CS,T1,T2**	**CS,D**						
A. Fuel Combustion	CS,D,T2	CS,D	CS,T1,T2,T3	CS,D	CS,T1,T2	CS,D						
1. Energy Industries	T2	CS	T2	CS	T1,T2	CS,D						
2. Manufacturing Industries and Construction	T2	CS	T2	CS	T1,T2	CS,D						
3. Transport	CS,T2	CS	CS,T2,T3	CS,D	CS,T2	CS,D						
4. Other Sectors	T2	CS	T1,T2	CS,D	T1	D						
5. Other	D,T2	D	CS,T2	CS	CS,T2	CS						
B. Fugitive Emissions from Fuels	CS,D,T2,T3	CS,D,PS	D,T1b,T2,T3	CS,D,PS	NA	NA						
1. Solid Fuels	T2	CS	T1b	D	NA	NA						
2. Oil and Natural Gas	CS,D,T2,T3	CS,D,PS	D,T1b,T2,T3	CS,D,PS	NA	NA						
2. Industrial Processes	**CS,T1,T1a,T1b,T2**	**CS,D,PS**	**CS,T1,T2**	**CS,D**	**CS,T2**	**CS,PS**	**T2**	**PS**	**CS,T2**	**PS**	**CS,T2**	**D,PS**
A. Mineral Products	CS	CS,D,PS	NA	NA	NA	NA						
B. Chemical Industry	CS,T1,T1b	CS,D,PS	T1,T2	D	T2	PS	NA	NA	NA	NA	NA	NA
C. Metal Production	T1a,T2	CS	NA	NA	NA	NA	NA	NA			NA	NA
D. Other Production	T1b	CS										
E. Production of Halocarbons and SF6							T2	PS	NA	NA	NA	NA
F. Consumption of Halocarbons and SF6									CS,T2	PS	CS,T2	D,PS
G. Other	CS,T1b	CS,D	CS	CS	CS	CS	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	**CS**	**CS**			**CS**	**CS**						
4. Agriculture			**T1,T2**	**CS,D**	**T1,T1b,T2,T3**	**CS,D**						
A. Enteric Fermentation			T1,T2	CS,D								
B. Manure Management			T2	CS	T2	D						
C. Rice Cultivation			NA	NA								
D. Agricultural Soils			NA	NA	T1,T1b,T2,T3	CS,D						
E. Prescribed Burning of Savannas			NA	NA	NA	NA						
F. Field Burning of Agricultural Residues			NA	NA	NA	NA						
G. Other			NA	NA	NA	NA						
5. Land Use, Land-Use Change and Forestry	**CS,D**	**CS,D**	**NA**	**NA**	**NA**	**NA**						
A. Forest Land	CS	CS	NA	NA	NA	NA						
B. Cropland			NA	NA	NA	NA						
C. Grassland			NA	NA	NA	NA						
D. Wetlands			NA	NA	NA	NA						
E. Settlements			NA	NA	NA	NA						
F. Other Land			NA	NA	NA	NA						
G. Other	D	D	NA	NA	NA	NA						
6. Waste	**NA**	**NA**	**T2**	**CS**	**T2**	**CS,D**						
A. Solid Waste Disposal on Land	NA	NA	T2	CS								
B. Waste-water Handling			T2	CS	T2	D						
C. Waste Incineration	NA	NA	NA	NA	NA	NA						
D. Other	NA	NA	T2	CS	T2	CS						
7. Other (as specified in Summary 1.A)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

brief description per key source of the methodologies applied for estimating the emissions.

1.4.1.2 Data sources

The monitoring protocols provide detailed information on activity data used for the inventory. In general, the following primary data sources supply the annual activity data used in the emission calculations:

- fossil fuel data: (1) national energy statistics from CBS (National Energy Statistics; Energy Monitor); (2) natural gas and diesel consumption in the agricultural sector (Agricultural Economics Institute, LEI)
- residential bio fuel data: (1) annual survey of residential woodstove and fireplace penetration from the Association for Comfortable Living (Vereniging Comfortabel Wonen); (2) a 1996survey on wood consumption by owners of residential woodstoves and fireplaces from the Stove and Stack Association (Vereniging van Haard en Rookkanaal, VHR); (3) a 2007 survey on wood consumption by CBS. These data were used to develop a new calculation method for the emissions from woodstoves which is implemented in this submission.
- transport statistics: monthly statistics for traffic and transportation
- industrial production statistics: (1) annual inventory reports from individual companies; (2) national statistics
- consumption of HFCs: annual reports from the accountancy firm PriceWaterhouseCoopers (only HFC data are used due to inconsistencies for PFCs and SF_6 with emissions reported elsewhere)
- consumption/emissions of PFCs and SF_6: reported by individual firms
- anaesthetic gas: data provided by Linde gas (former HoekLoos), the major supplier of this gas
- spray cans containing N_2O: the Dutch Association of

Aerosol Producers (Nederlandse Aerosol Vereniging, NAV)
- animal numbers: from the CBS/LEI agricultural database, plus data from the annual agricultural census
- manure production and handling: from the CBS/LEI national statistics
- fertiliser statistics: from the LEI agricultural statistics
- forest and wood statistics: (1) harvest data: FAO harvest statistics; (2) stem-volume, annual growth and fellings: Dirkse et al, (2003) (3) carbon balance: National Forestry Inventory data based on two inventories: HOSP (1988-1992) and MFV (2001-2005)
- land use and land use change: based on digitised and digital topographical maps of 1990 and 2004 (Kramer et al, 2009)
- area of organic soils: De Vries (2004)
- soil maps: De Groot et al. (2005)
- waste production and handling: Working Group on Waste Registration (WAR), NL Agency and CBS
- CH_4 recovery from landfills: Association of Waste Handling Companies (VVAV).

Many recent statistics are available on the internet at CBS's statistical website Statline and in the CBS/PBL environmental data compendium. However, it should be noted that the units and definitions used for domestic purposes on those websites occasionally differ from those used in this report (for instance: temperature corrected CO_2 emissions versus actual emissions in this report; in other cases, emissions are presented with or without the inclusion of organic CO_2 and with or without LULUCF sinks and sources).

1.4.2 KP-LULUCF inventory

1.4.2.1 Methodologies

The methods used to estimate data on sinks and sources as well as the units of land subject to Article 3.3 afforestation, reforestation and deforestation are additional to the methods used for LULUCF. The methodology of the Netherlands to assess the emission from LULUCF is based on a wall-to-wall approach for the estimation of area per category of land use. For the wall-to-wall map overlay approach were used harmonised and validated digital topographical maps of 1990 and 2004 (Kramer et al., 2009). The result was a national scale land use and land use change matrix.

To distinguish between mineral soils and peat soils, an overlay was made between two Basic Nature maps and the Dutch Soil Map (de Vries et al., 2004). The result is a map with national coverage that identifies for each pixel whether it was subject to RA or D between 1990 and 2004, and whether it is located on a mineral or on an organic soil.

1.4.2.2 Data sources

The changes in land use are based on comparing detailed maps that best represent land use in 1990 and 2004. Both datasets on land use were especially developed to support the temporal and spatial development in land use and especially designed to support policy in the field of nature conservation. Changes after 2004 have been obtained by linear extrapolation.

1.5 A brief description of the key categories

1.5.1 GHG inventory

The analysis of key sources is performed in accordance with the IPCC Good Practice Guidance (IPCC, 2001). To facilitate the identification of key sources, the contribution of source categories to emissions per gas are classified based on the IPCC potential key source list as presented in Table 7.1, Chapter 7 of the Good Practice Guidance.
A detailed description of the key source analysis is provided in Annex 1 of this report. Per sector, the key sources are also listed in the first Section of each of Chapters 3 to 8.

Compared to the key source analysis for the NIR 2010, eight new key categories are identified:
- 1A3 Mobile combustion: road vehicles (N_2O)
- 1A5 Military use of fuels (1A5 Other) (CO_2)
- 1B1b Coke production (CO_2)
- 2B5 Caprolactam production (N_2O)
- 4A1 CH_4 emissions from enteric fermentation in domestic livestock: mature dairy cattle
- 4A1 CH_4 emissions from enteric fermentation in domestic livestock: young cattle
- 4A8 CH_4 emissions from enteric fermentation in domestic livestock: swine
- 6b Emissions from wastewater handling (N_2O)

This is due to
- Use of new emission data (2009)
- Subdivision of category 4A1
- In this submission we set the cumulative emission threshold for the key sources at less than 91 % whereas in former submissions a threshold of less or equal to 90 % was used.

1.5.2 KP-LULUCF inventory

Deforestation is larger than the smallest key category in the Tier 1 key source analysis (excluding LULUCF). With -537 Gg CO_2 the annual contribution of re/afforestation under the KP is just below the smallest key category (Tier 1 level analysis including LULUCF). Deforestation under the KP in 2010 causes an emission of 833 Gg CO_2, which is more than the smallest key category (Tier 1 level analysis including LULUCF).

1.6 Information on the QA/QC plan

As one of the results of a comprehensive *inventory improvement program*, a National System fully in line with the Kyoto requirements was finalised and established at the end of 2005. As part of this system, an Act on the Monitoring of Greenhouse Gases also became effective in December 2005. This Act determines the establishment of the National System for monitoring of greenhouse gases and empowers the Minister for Infrastructure and Environment (IenM) to appoint an authority responsible for the National System and the National Inventory. The Act also determines that the National Inventory be based on methodologies and processes as laid down in the monitoring protocols. In a subsequent regulation the Minister has appointed NL Agency as NIE (National Inventory Entity, the single national entity under the Kyoto Protocol) and published a list of the protocols. Adjustments to the protocols will require official publication of the new protocols and announcement of publication in the official Government Gazette (Staatscourant).

As part of its National System, the Netherlands has developed and implemented a QA/QC program. This program is yearly assessed and updated, if needed. The key elements of the current program (SenterNovem, 2009) are briefly summarised in this chapter, notably those related to the current NIR.

1.6.1 QA/QC procedures for the CRF/NIR 2010

The *Monitoring Protocols* were elaborated and implemented in order to improve the transparency of the inventory (including methodologies, procedures, tasks, roles and responsibilities with regard to inventories of greenhouse gases). Transparent descriptions and procedures of these different aspects are described in the protocols for each gas and sector and in process descriptions for other relevant tasks in the National System. The protocols are assessed annually and updated if needed.

- Various QC issues:
  - Inconsistencies in the key category analysis between CRF and NIR were analysed and removed. The key category analysis is updated in the NIR (Annex 1) as well as the CRF files.
  - The Expert Review Team (ERT) recommended providing more information in the NIR report and protocols, that was until now only included in background information. The Netherlands has updated the protocols; for various sectors this implies that more information is included in the protocols, as requested by the ERT.
  - The ERT recommended providing more specific information on sector specific QC activities. In 2009 and early 2010, a project was performed to re-assess and update both the information on uncertainties and on sector specific QC activities [Ecofys, 2010]. The PRTR taskforces continue to work on the implementation of the recommendations from this report in 2011.
  - The Netherlands continues its efforts to include the correct notation keys in the CRF files.
- For the NIR 2011, changes were incorporated in and references were updated to the National System website (www.greenhousegases.nl), providing additional information on the protocols and relevant background documents.
- *General QC checks* were performed. To facilitate these general QC checks, a checklist was developed and implemented. A number of general QC checks have been introduced as part of the annual work plan of the PRTR and are also mentioned in the monitoring protocols. The QC checks included in the work plan aim at covering issues such as consistency, completeness and correctness of the CRF data. The general QC for the present inventory was largely performed in the institutes involved as integrated part of their PRTR work. The PRTR task forces fill in a standard-format database with emission data for 1990–2009. After a first check of the emission files by RIVM and TNO for completeness, the (corrected) data are available to the specific task force for checking consistency checks and trend analysis (comparability, accuracy). The task forces have access to information about the relevant emissions in the database. Several weeks before the dataset was fixed, a trend verification workshop was organised by RIVM (December, 2010) see Box 1.1. The result of this workshop including actions for the taskforces to resolve the identified clarification issues are documented at PBL. Required changes to the database are then made by the taskforces.
- *Quality Assurance* for the current NIR includes the following activities:
  - A peer and public review on the basis of the draft NIR in January/February 2011. Results of this review are summarised in Chapter 10 and have been dealt with as far as possible in the present NIR.
  - In preparing this NIR, the results of former UNFCCC reviews, including the results of the recent reviews. However, it was not possible to take into account the most recent review (on NIR 2010, in September 2010), because of delay in the reporting by ERT (see also Chapter 10.5 for an overview).
  - As part of the evaluation process of the previous

- cycle, internal audits were carried out by NL Agency on the use of the protocols and the implementation of QC checks. This year, special attention was given to the protocols in the "LULUCF sector". In the audit report recommendations were included in the field of QA/QC, transparency, evaluation and documentation of different elements in the process of emission estimation.
- Initiated by NL Agency, the description of the QA/QC of outside agencies (Alterra, ASG, Statistics Netherlands (CBS), Waste department of NL Agency) has been updated (Wever, 2011).

The QA/QC activities generally aim at a high-quality output of the emissions inventory and the National System; these are in line with international QA/QC requirements (IPCC Good Practice Guidance).

The QA/QC system should operate within the available means (capacity, finance). Within those boundaries, the main focal points of the QA/QC activities are:

- The *QA/QC program* (NL Agency, 2010) that has been developed and implemented as part of the National System. This program includes quality objectives for the National System, the QA/QC plan and a time schedule for implementation of the activities. It is updated annually as part of a yearly 'evaluation and improvement cycle' for the inventory and National System and held available for review.
- Up to and including 2009, PBL held ISO 9001/2000 certification. After 31 December 2009, PBL no longer applied for extension of this certificate, but uses its own quality management system, following the guidelines of the Dutch Institute for Quality Management (INK, a Dutch variety of the European Foundation for Quality Management (EFQM) Business Model). In practice, this did not have much impact on the quality checks and quality assurance within PBL. As part of this system, PBL will periodically contract consultants to assess the implementation of its quality system and the INK guidelines.
- As of 1 January 2010, the PRTR project and management are transferred from PBL to the Centre for Environmental Monitoring (CMM) at the RIVM. RIVM has an ISO 9001:2000 based AQ/QC system in place. Additionally CMM has an NEN-EN-ISO/IEC 17025:2005 based quality system in place for its laboratories. The combined quality systems serve the complete scope of the Centre, and documentation and archiving will be done according to procedures of the quality manual. Arrangements and procedures for the contributing institutes are described in an annual project plan (PBL, 2010).
- The adaptation of the PRTR-project to the quality system of CMM has started in 2010. In May 2011 the CMM will undergo its initial audit in the certification process for the integrated ISO 9001:2000 system.
- *The annual project plan* of the RIVM (PBL, 2010). The work plan describes the tasks and responsibilities of the parties involved in the PRTR process, such as products, time schedules (planning) and emission estimation methods – including the monitoring protocols for the greenhouse gases – as well as those of the members of several task forces. The annual work plan also describes the general QC activities to be performed by the task forces before the annual database is fixed (see Section 1.6.2)
- The responsibility for the quality of data in *annual environmental reports* (MJVs) lies with the companies themselves, while validation of the data is the responsibility of the competent authorities. It is the responsibility of the institutes involved in the PRTR to judge whether or not to use the validated data of individual companies to assess the national total emissions. (CO_2 emissions, however, are based on energy statistics and standard emission factors, and only qualified specific emission factor from environmental reports are used).
- *Agreements/covenants* between RIVM and other institutes involved in the annual PRTR process. The general agreement is that by accepting the annual work plan, the institutes involved commit themselves to deliver capacity for the products specified in that work plan. The role and responsibility of each institute have been described (and agreed upon) within the framework of the PRTR work plan.
- *Specific procedures* that have been established to fulfil the QA/QC requirements as prescribed by the UNFCCC and Kyoto Protocol. General agreements on these procedures are described in the QA/QC program as part of the National System. The following specific procedures and agreements have been set out and described in the QA/QC plan and the annual PRTR work plan:
  - QC on data input and data processing, as part of the annual process towards trend analysis and fixation of the database following approval of the involved institutions.
  - Documentation of consistency, completeness and correctness of the CRF data (see also Section 1.6.2). Documentation is required for changes in the historical data set or in the emission trend that exceeds 5% at the sector level and 0.5% at the national total level.
  - Peer reviews of CRF and NIR by NL Agency and institutions not fundamentally involved in the PRTR process.
  - Public review of the draft NIR: NL Agency organises every year a public review (by means of internet). Relevant comments are incorporated in the final NIR.
  - Audits: in the context of the annual work plan, it has been agreed that the involved institutions of the PRTR inform RIVM concerning possible internal audits. Furthermore, NL Agency is assigned the task of

organising audits, if needed, of relevant processes or organisational issues within the National System. In 2010, such an audit was performed for the LULUCF sector (the previous Section).
  - Archiving and documentation: internal procedures are agreed (amongst others in the PRTR annual activity program) for general data collection and the storage of fixed datasets in the RIVM database, including the documentation/archiving of QC checks. The RIVM database holds, as of this submission, storage space where the taskforces can store the crucial data for their emission calculations. The use of this feature is voluntary.
  - The improved monitoring protocols have been documented and will be published on the website www.greenhousegases.nl. To improve transparency, the implemented checklists for QC checks have been documented and archived. As part of the QA/QC plan the documentation and archiving system has been further upgraded. NL Agency (NIE) maintains the National System website and a central archive of relevant National System documents.
  - Each institution is responsible for QA/QC aspects related to reports based on the annually fixed database.
- *Evaluation and improvement*: those persons involved in the annual inventory tasks are invited once a year to evaluate the process. In this evaluation, the results of any internal and external review and evaluation are taken into account. The results are used for the annual update of the QA/QC program (including the improvement program) and the annual work plan. The (monitoring) improvement plan has been described in the previous sub-section;
- *Source-specific QC*: comparison of emissions with independent data sources was one of the study topics in the inventory improvement program. Because it did not seem possible to considerably reduce uncertainties through independent verification (measurements) – at least not on a national scale – this issue has received less priority. However, the theme is taken up in two projects. Following the UN review recommendations, NL Agency carried out a project together with Ecofys (Ecofys, 2010) and the PRTR project to re-assess and update the description of uncertainties and the sector specific QC activities. Based on this report, further action on this issue will be undertaken in 2011.
- In 2010, a quantitative assessment was made of the possible (in)consistencies in CO_2 emissions between data from ETS, NIR and National Energy Statistics. The figures that were analysed concerned about 40% of the CO_2 emissions in the Netherlands in 2009. The differences could reasonably be explained (e.g., different scope) within the given time available for this action [De Ligt, 2011].

1.6.2 Verification activities for the CRF/NIR 2011

Several weeks in advance of a trend analysis meeting, a snapshot from the database is made available by PBL in a web-based application (Emission Explorer, EmEx) for checks by the institutes and experts involved (PRTR task forces). This allows the task forces to check for level errors and consistency in the algorithm/method used for calculations throughout the time series. The task forces perform checks such as for CO_2, CH_4 and N_2O emissions from all sectors. The totals for the sectors are then compared with the previous year's data set. Where significant differences are found, the task forces evaluate the emission data in more detail. The results of these checks are then subject to discussion at the trend analysis workshop and subsequently documented.
Furthermore, the task forces were provided with the CRF Reporter software to check the time series of emissions per substance. The task forces examine these time series. During the trend analysis, the greenhouse gas emissions for all years between 1990 and 2009 were checked in two ways: (1) emissions from 1990 – 2009 should (with some exceptions) be identical to those reported last year; (2) the data for 2009 were compared with the trend development for each gas since 1990. Checks of outliers were carried out at a more detailed level for the sub-sources of all sector background tables:

- annual changes in emissions of all greenhouse gases
- annual changes in activity data
- annual changes in implied emission factors
- level values of implied emission factors

Exceptional trend changes and observed outliers are noted and discussed at the trend analysis workshop, resulting in an action list. Items on this list must either be processed within 2 weeks or be dealt with in next year's inventory.

The trend verification workshop held on 8 December 2010, showed the following results:

Issues per source category:

- Reallocation of fuel consumption of non-road vehicles based on new fuel consumption data from the agricultural sector. This also effected the emissiondata for Fisheries.
- Based on new data from Netherlands Statistics the bunker emissions changed and therefore the AD and Emissions from the to this topic related Transport.
- Because detailed data became available last year the historic emissions of F-gases changed
- Changes in emissions of waste incineration should be explained in Chapter 3
- Changes in emissions of N_2O from cat. 4. Agriculture (whole time series) should be explained in Chapter 6
- Minor changes in activity data and emissions in some

categories, caused by the new improved automated import procedure of data to the CRF Reporter, and should be explained in Chapter 10.

All above mentioned checks are planned inthe annual project plan for 2011 (RIVM, 2010). Furthermore, data checks (also for non greenhouse gases) are performed and a trend verification workshop is held. To facilitate the data checks and the trend verification workshop, three types of data sheets were prepared from the PRTR emission database:

- Based on the PRTR emission database, a table with a comparison of the emission years 2008 and 2009. In this table, differences >5% on sector level where marked for documenting trends;
- Based on the PRTR emission database, to check if no historical data have been accidentally changed, a table with a comparison of the complete inventories of 2010versus 2011;
- To check if no errors occur during transfer of data from the PRTR emission database to the CRF, a table with the comparison of data from both data sources.

The data checks are performed by the sector experts and others involved in preparing the emission database and the inventory. Communications (e-mail) between the participants in the data checks is centrally collected and analysed. This resulted in a checklist of actions to be taken. This checklist is used as input for the trend verification workshop and completed with the actions agreed in this workshop. Furthermore, in the trend verification workshop trends >5% on sector level are explained.

Completion of an action is reported in the checklist. Based on the completed checklist and the documentation of trends the dataset is formally agreed by the two most involved institutes: RIVM and Statistics Netherlands (CBS). The acceptance of the dataset is, furthermore, a subject in the PRTR Executive body (WEM).

All documentation (e-mails, data sheets and checklist) are stored electronically on a server at RIVM.

1.6.3 Treatment of confidentiality Issues

Some of the data used in the compilation of the inventory are confidential and cannot be published in print or electronic format. That is the reason the Netherlands has to use the notation key "C" in the CRF. Although this does impair the transparency of the inventory, all confidential data can be made available to the official review process of the UNFCCC.

1.7 Evaluating general uncertainty

The IPCC Tier 1 methodology for estimating uncertainty in annual emissions and trends has been applied to the list of possible key sources (see Annex 1) in order to obtain an estimate of the uncertainties in the annual emissions as well as in the trends. These uncertainty estimates have also been used for a first Tier 2 analysis to assess error propagation and to identify key sources as defined in the IPCC Good Practice Guidance (IPCC, 2001).

1.7.1 GHG inventory

The following information sources were used for estimating the uncertainty in activity data and emission factors (Olivier et al., 2009):

Table 1.2 Key items of the verification actions CRF/ NIR 2011.

Item	Date	Who	Result	Documentation *
Draft CRF	07-12-2010	NIC/TNO	Explanation of recalculations	CRFcontrole7_12_10.xls
Comparison sheets dataset 2009-2010	06-12-2010	RIVM	Input for trend analysis	Reeksen vergeleken 6 dec 2010.zip
List of required actions (action list)	06-12-2010	RIVM	Input for trend analysis	Actiepunten trendanalyse T-1 2010 definitief v 6 dec 2010.xls
Trend analysis	08-12-2010	Task Forces	Updated Action list	Actiepunten trendanalyse T-1 2010 definitief v 10 dec 2010.xls
Resolving the issues of the Action list	Until 22-12-2010	Task Forces RIVM/NIC/TNO	Final data set	Actiepunten trendanalyse T-1 2010 definitief v 22 dec 2010.xls
Comparison data in CRF and EPRTR database	Until 12-01-2011	NIC/TNO	Final CRF send to the EU	NLD-2011-v1.1.xml
Writing and Checks of NIR	Until 14-02-2011	Task forces/ NIC/TNO/NIE	Draft texts	S:\ \NI National Inventory Report\NIR 2011\ NIR2011-werkversie
Generate tables for NIR from CRF	Until 14-02-2011	NIC/TNO	Final text and tables NIR	Tabellen Hoofdstuk 3 versie 24-1-2011.xls NIR2011 Tables and Figures (version 1.3).xls

*: All documentation (e-mails, data sheets and checklists) are stored electronically on a data server at RIVM.

- Estimates used for reporting uncertainty in greenhouse gas emissions in the Netherlands that were discussed at a national workshop in 1999 (Van Amstel et al., 2000a)
- Default uncertainty estimates provided in the IPCC Good Practice Guidance report (IPCC, 2001)
- RIVM fact sheets on calculation methodology and data uncertainty (RIVM, 1999)
- other recent information on the quality of data (Boonekamp et al., 2001)
- a comparison with uncertainty ranges reported by other European countries have led to a number of improvements in (and increased underpinning of) the Netherlands' assumptions for the present Tier 1 (Ramírez-Ramírez et al., 2006)

These data sources were supplemented with expert judgments from PBL and CBS emission experts (also for new key sources). This was followed by an estimation of the uncertainty in the emissions in 1990 and 2009 according to the IPCC Tier 1 methodology – for both the annual emissions and the emission trend for the Netherlands. All uncertainty figures should be interpreted as corresponding to a confidence interval of 2 standard deviations (2σ), or 95%. In cases where asymmetric uncertainty ranges were assumed, the largest percentage was used in the calculation.

The results of the uncertainty calculation according to the IPCC Tier 1 uncertainty approach are summarised in Annex 7 of this report. The Tier 1 calculation of *annual uncertainty* in CO_2 equivalent emissions results in an overall uncertainty of about 3% in 2009, based on calculated uncertainties of 2%, 17%, 44% and 38% for CO_2 (excluding LULUCF), CH_4, N_2O and F-gases, respectively. The uncertainty in CO_2 equivalent emissions including emissions from LULUCF is calculated to be 3%.

Table 1.3 Uncertainty of total annual emissions (excl. LULUCF).

CO_2	±3%		HFCs	±50%
CH_4	±25%		PFCs	±50%
N_2O	±50%		SF_6	±50%
Total greenhouse gases				±5%

However, these figures do not include the correlation between source categories (e.g., cattle numbers for enteric fermentation and animal manure production) or a correction for not-reported sources. Therefore, the Tier 2 *uncertainty of total annual emissions* per compound and of the total will be somewhat higher; see Table 1.3 for the currently estimated values.

Table 1.4 shows the top ten sources (excluding LULUCF) contributing most to total *annual uncertainty* in 2009, after ranking the sources according to their calculated contribution to the uncertainty in total national emissions (using the column 'Combined uncertainty as a percentage of total national emissions in 2009' in Table A7.1). Compared to NIR 2010 N_2O uncertainties are clearly lower. This is caused by the change in the contribution of N_2O emissions from agriculture (4D1 and 4D3) to the total uncertainty. These emissions are now calculated using an improved method. This resulted in a significantly lower emission from this source, and as uncertainties here are relatively high, now also a lower total uncertainty is calculated.

Table A7.1 of Annex 7 summarises the estimate of the *trend uncertainty* 1990–2009 calculated according to the IPCC Tier 1 approach in the IPCC Good Practice Guidance (IPCC, 2001). The result is a trend uncertainty in the total CO_2 equivalent emissions (excluding LULUCF) for 1990–2009 (1995 for F-gases) of ±3% points. This means that the decrease in total CO_2 eq emissions between 1990 and 2009, which is calculated to be 7%, will be between 4% and 10%.

Per individual gas, the *trend uncertainty* in total emissions of CO_2, CH_4, N_2O and the total group of F-gases has been calculated to be ±3%, ±9%, ±8% and ±11% points respectively. More details on the level and trend uncertainty assessment can be found in Annex 7. Table 1.5 shows the top ten sources (excluding LULUCF) contributing most to *trend uncertainty* (calculated) in the national total (using the column 'Uncertainty introduced into the trend in total national emissions' in Table A7.1). Due to methodological changes in the calculation of the N_2O emissions from agriculture the uncertainty in the categories 4D3 and 4D1 decreased compaired to earlier submissions.

Five of these key sources are included in both the list presented above and the list of the largest contributors to annual uncertainty.

The propagation of uncertainty in the emission calculations was assessed using the IPCC Tier 1 approach. In this method, uncertainty ranges are combined for all sectors or gases using the standard equations for error propagation. If sources are added, total error is the root of the sum of squares of the error in the underlying sources. Strictly speaking, this is only valid if the uncertainties meet the following conditions: (a) standard normal distribution ("Gaussian"); (b) 2s smaller than 60%; (c) independent (not-correlated) sector-to-sector and substance-to-substance. It is clear, however, for some sources that activity data or emission factors are correlated, which may change the overall uncertainty of the sum to an unknown extent. It is also known for some sources, that the uncertainty is not distributed normally; in particular, when uncertainties are very high (of an order of 100%), it is clear that the distribution will be positively skewed.

Table 1.4 Top ten sources contributing most to total annual uncertainty in 2009.

IPCC category	Category	Gas	Combined uncertainty as a percentage of total national emissions in 2009[*)]
4D3	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	1.6%
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO_2	1.1%
4D1	Direct N_2O emissions from agricultural soils	N_2O	1.1%
4B1	Emissions from manure management : cattle	CH_4	0.9%
6A1	CH_4 emissions from solid waste disposal sites	CH_4	0.8%
4D2	Animal production on agricultural soils	N_2O	0.7%
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	0.6%
4B8	Emissions from manure management : swine	CH_4	0.6%
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	0.5%
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	0.5%

[*)] calculated uncertainties, for ranking purposes not rounded off

Table 1.5 Top ten sources contributing most to ***trend*** *uncertainty* in the national total.

IPCC cat.	Category	Gas	Uncertainty introduced into the trend in total national emissions
4D3	Indirect N2O emissions from nitrogen used in agriculture	N_2O	1.6%
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO_2	1.1%
6A1	CH4 emissions from solid waste disposal sites	CH_4	0.8%
4D2	Animal production on agricultural soils	N_2O	0.7%
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	0.5%
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO_2	0.4%
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	0.6%
2B2	Nitric acid production	N_2O	0.1%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gases	CO_2	0.4%
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	0.5%

Table 1.6 Effects of simplifying Tier 1 assumptions on the uncertainties of 2004 emissions (without LULUCF).

Greenhouse gas	Tier 1 annual uncertainty [1)]	Tier 2 annual uncertainty [2)]
Carbon dioxide	1.9%	1.5%
Methane	18%	15%
Nitrous oxide	45%	42%
F-gases	27%	28%
Total	4.3%	3.9%

[1)] Calculated in NIR 2006.
[2)] Source: Ramirez-Ramírez et al. (2006).

Even more important is the fact that although the uncertainty estimates have been based on the documented uncertainties mentioned above, uncertainty estimates are unavoidably – and ultimately – based on the judgment of the expert. On occasion, there is only limited reference to actual data for the Netherlands possible as support for these estimates. By focusing on the order of magnitude of the individual uncertainty estimates, it is expected that this data set provides a reasonable first assessment of the uncertainty of key source categories.

Furthermore, in 2006 a Tier 2 uncertainty assessment was carried out (Ramírez-Ramírez et al., 2006). This study used the same uncertainty assumption as the Tier 1 study but accounted for correlations and non-Gaussian distributions. Results reveal that the Tier 2 uncertainty in total Netherlands CO_2 equivalent emissions is in the same order of magnitude as that in the Tier 1 results, although a higher trend uncertainty is found (see Tables 1.6 and 1.7). Furthermore, the Tier 2 uncertainty for 1990 emissions is slightly higher (about 1.5%) than the uncertainty for the 2004 emissions. Finally, the resulting distribution for total Netherlands CO_2 equivalent emissions turns out to be clearly positively skewed.

As part of the above mentioned study, the expert judgments and assumptions made for uncertainty ranges in emission factors and activity data for the Netherlands have been compared to the uncertainty assumptions (and their underpinnings) used in Tier 2 studies carried out by other European countries, such as Finland, the United Kingdom, Norway, Austria and Flanders (Belgium). The correlations that have been assumed in the various European Tier 2

Table 1.7 Effects of simplifying Tier 1 assumptions on the uncertainty in the emission trend for 1990–2004 (without LULUCF).

Greenhouse gas	Emission trend 1990-2004	Tier 1 trend uncertainty [1)]	Tier 2 trend uncertainty [2)]
Carbon dioxide	+13%	2. 7%	2.1%
Methane	-32%	11%	15%
Nitrous oxide	-16%	15%	28%
F-gases	-75%	7.0%	9.1%
Total	+1.6%	3.2%	4.5%

[1)] Calculated in NIR 2006.
[2)] Source: Ramírez-Ramírez et al. (2006).

studies have also been mapped and compared. The comparisons of assumed uncertainty ranges have already led to a number of improvements in (and increased underpinning of) the Netherlands' assumptions for the present Tier 1 approach. Although a straightforward comparison is somewhat blurred due to differences in the aggregation level at which the assumptions have been made, results show that for CO_2 the uncertainty estimates of the Netherlands are well within the range of European studies. For non-CO_2 gases, especially N_2O from agriculture and soils, the Netherlands uses IPCC defaults which are on the high side compared to the assumptions used in some of the other European studies. This seems quite realistic in view of the state of knowledge on the processes that lead to N_2O emission. Another finding is that correlations (covariance and dependencies in the emission calculation) seem somewhat under-addressed in most present-day European Tier 2 studies and may require more systematic attention in future Tier 2 studies.
In the assessments made above, only random errors have been estimated, assuming that the methodology used for the calculation does not include systematic errors. It is well known that, in practice, this may well be the case. Therefore, a more independent verification of the emission level and emission trends using, for example, comparisons with atmospheric concentration measurements is encouraged by the IPCC Good Practice Guidance. In the Netherlands, these approaches have been studied for several years, funded by the National Research Program on Global Air Pollution and Climate Change (NOP-MLK) or by the Dutch Reduction Program on Other Greenhouse Gases (ROB). The results of these studies can be found in Berdowski et al. (2001), Roemer and Tarasova (2002) and Roemer et al. (2003). In 2006, the research program '*Climate changes spatial planning*' started to strengthen knowledge on the relationship between greenhouse gas emissions and land-use and spatial planning.

1.7.2 KP-LULUCF inventory

The analysis combines uncertainty estimates of the forest statistics, land use and land use change data (topographical data) and the method used to calculate the yearly growth in carbon increase and removals (Olivier et al., 2009). The uncertainty analysis is performed for Forests according to the Kyoto definition and is based on the same data and calculations as used for KP article 3.3 categories. Thus, the uncertainty for total net emissions from units of land under article 3.3 afforestation/reforestation are estimated at 63%, equal to the uncertainty in Land converted to Forest Land. Similarly, the uncertainty for total net emissions from units of land under article 3.3, deforestation is estimated at 66%, equal to the uncertainty in Land converted to Grassland (which includes for the sake of the uncertainty analysis all Forest land converted to any other type of land use.

1.8 General assessment of the completeness

1.8.1 GHG inventory

At present, the greenhouse gas emission inventory for the Netherlands includes all of the sources identified by the Revised IPCC Guidelines (IPCC, 1997). Except for a number of (very) minor sources Annex 5 presents the assessment of completeness and sources, potential sources and sinks for this submission of the NIR and the CRF.

1.8.2 KP-LULUCF inventory

As good data to relate carbon accumulation in litter and dead wood since the time of re/afforestation are lacking fort the Netherlands, this carbon sink is conservatively estimated as zero. Carbon stock changes in mineral and organic soils are not reported. Research is ongoing for this topic and result is expected to be available prior to next submission. In the next submission, a recalculation will be made for the year 2008.

Forest fertilisation does not occur in the Netherlands and therefore fertilisation in re/afforested areas are reported as not occurring.
Nitrous oxide emissions associated with disturbance of soils when deforested areas are converted to cropland are currently not estimated. However, research is ongoing and results are expected to be included in one of the next submissions.

Greenhouse gas emissions (CO_2, CH_4 and N_2O) related to biomass burning are not estimated because biomass burning has not been monitored since 1996. Wildfire statistics indicate that forest fires rarely occurred in the two decades before 1996.

2 Trends in greenhouse gas emissions

2.1 Emission trends for aggregated greenhouse gas emissions

Chapter 2 summarises the trends in greenhouse gas emissions during the period 1990–2009, by greenhouse gas and by sector. Detailed explanations of these trends are provided in Chapters 3–8. In 2009, total direct greenhouse gas emissions (excluding emissions from Land Use, Land Use Change and Forestry, LULUCF) in the Netherlands are estimated at 198.9 Tg CO_2 eq. This is 6.7% lower than the 213.2 Tg CO_2 eq reported in the base year (1990; 1995 is the base year for fluorinated gases).

Figure 2.1 shows the trends and relative contributions of the different gases to the aggregated national greenhouse gas emissions. In the period 1990–2009, emissions of carbon dioxide (CO_2) increased by 7% (excluding LULUCF), while emissions of non-CO_2 greenhouse gases decreased by 46% compared with base year emissions. Of the non CO_2 greenhouse gases, methane (CH_4), nitrous oxide (N_2O) and fluorinated gases (F-gases) decreased by 34%, 52% and 71% respectively.

Emissions of LULUCF related sources decreased by about 7% in 2009 compared to 2008. In 2009, total greenhouse gas emissions (including LULUCF) decreased by 5.9 Tg CO_2 eq compared to 2008 (201.3 Tg CO_2 eq in 2009).

2.2 Emission trends by gas

2.2.1 Carbon dioxide

Figure 2.2 presents the contribution of the most important sectors, as defined by the Intergovernmental Panel on Climate Change (IPCC) to the trend in total national CO_2 emissions (excluding LULUCF). In the period 1990–2009, the national CO_2 emissions increased by 7% (from 162 to 172.3 Tg). The Energy sector is by far the largest contributor to CO_2 emissions in the Netherlands (93%), with the categories 1A1 “Energy industries” (37%), 1A4 “Other sectors” (22%) and 1A3 “Transport” (19%) as largest contributors in 2009.

The relatively high level of CO_2 emissions in 1996 is mainly explained by a very cold winter, which increased energy use for space heating in the residential sector. The resulting emissions are included in the category 1A4 “Other sectors”. The relatively low level of CO_2 emissions in the category 1A1 “Energy industries” in 1999 is explained by the marked increase in imported electricity and a shift from the use of coal to residual chemical gas and natural gas in 1999; the share of imported electricity almost doubled. However, this increased import of electricity led to only a temporary decrease in the CO_2 emissions. In the period 2000-2004, the pre-1999 annual increase in CO_2 emissions from this category – about 1–2% – was observed again. In 2008, import of electricity decreased.

Figure 2.1 Greenhouse gases: trend and emission levels (excl. LULUCF), 1990–2009.

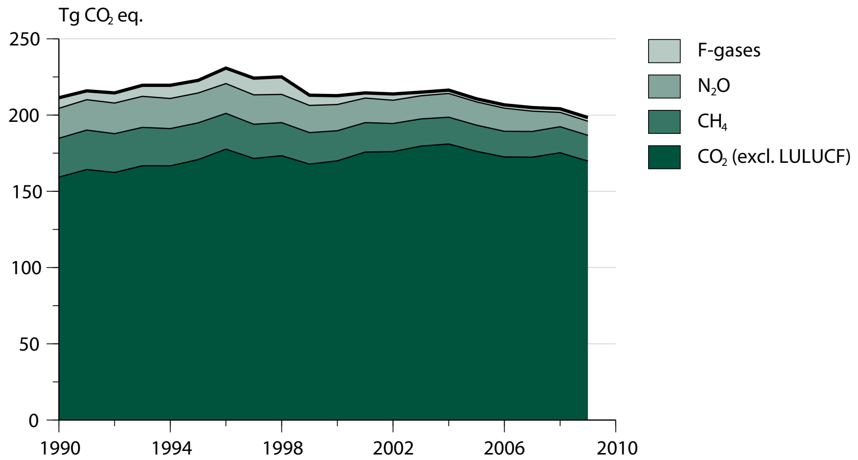
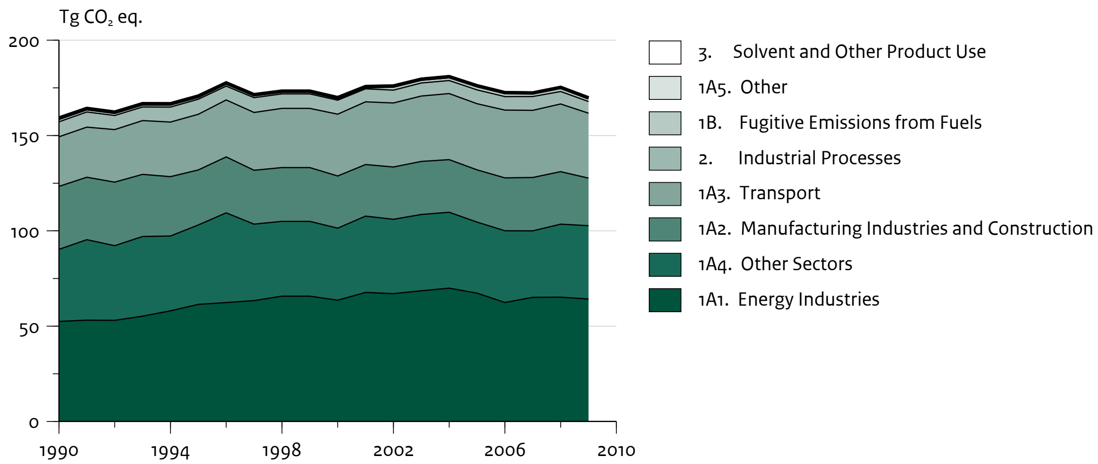


Figure 2.2 CO_2: trend and emission levels of sectors (excl. LULUCF), 1990–2009.



In 2009, CO_2 emissions decreased by 3% compared to 2008 due to the economic crisis.

2.2.2 Methane

Figure 2.3 presents the contribution of the most important IPCC sectors to the trend in total CH_4 emissions. The national CH_4 emissions decreased by 34%, from 1.22 Tg in 1990 to 0.81 Tg in 2009 (25.5 to 16.9 Tg CO_2 eq). The Agriculture and Waste sector (54% and 30%) are the largest contributors in 2009.

Compared to 2008, national CH_4 emissions decreased by less than 1% in 2009 (0.1 Tg CO_2 eq), due to the decrease of CH_4 emissions mainly in the categories 6A Solid Waste Disposal on Land.

2.2.3 Nitrous oxide

Figure 2.4 presents the contribution of the most important IPCC sectors to the trend in national total N_2O emissions. The total national inventory of N_2O emissions decreased by about 52%, from 64.9 Gg in 1990 to 31.4 Gg in 2009 (20.1 to 9.7 Tg CO_2 eq). The sector contributing the most to this decrease in N_2O emissions is “Industrial Processes”

Figure 2.3 CH_4: trend and emission levels of sectors, 1990-2009.

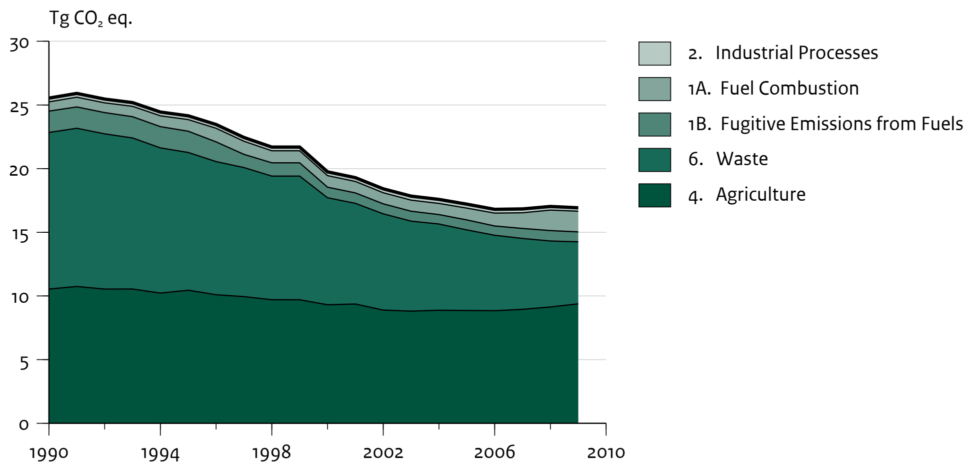
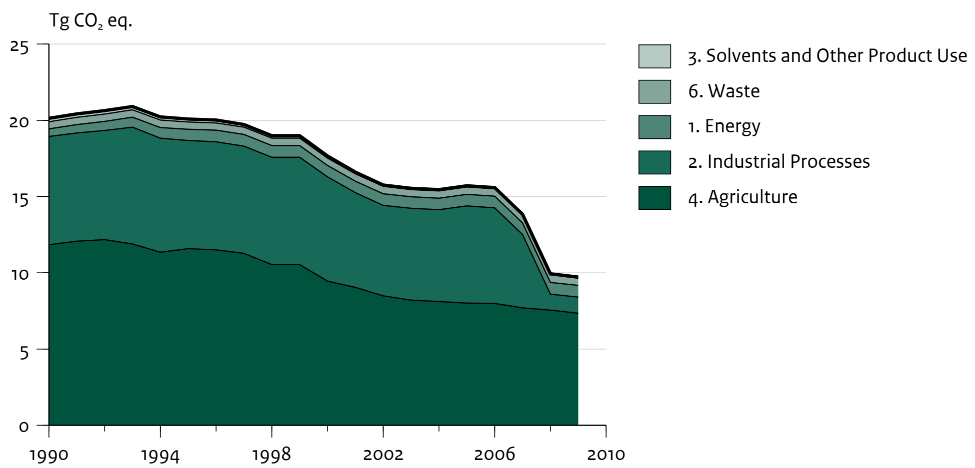


Figure 2.4 N_2O: trend and emission levels of sectors, 1990–2009.



(for which the emission decreased by 85% in the last twenty years).

Compared to 2008, total N_2O emissions decreased by 2.2% in 2009 (-0.22 Tg CO_2 eq) due to decreased emissions from agricultural soils.

2.2.4 Fluorinated gases

Figure 2.5 shows the trend in F-gas emissions included in the national greenhouse gas inventory. The emission level of the total F-gases decreased by 71% between 1995 and 2009, from 8.3 Tg CO_2 eq in 1995 (base year for F-gases) to 2.4 Tg CO_2 eq in 2009. Emissions of hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) decreased by approximately 66% and 91% respectively during this same period, while sulphur hexafluoride (SF_6) emissions decreased by 42%.
The aggregated emissions of F-gases decreased 3.4% between 2008 and 2009. HFC emissions showed an increase of 9%, PFC and SF_6 emissions decreased by 33% and 6% respectively.

Figure 2.5 Fluorinated gases: trend and emission levels of individual F-gases, 1990–2009.

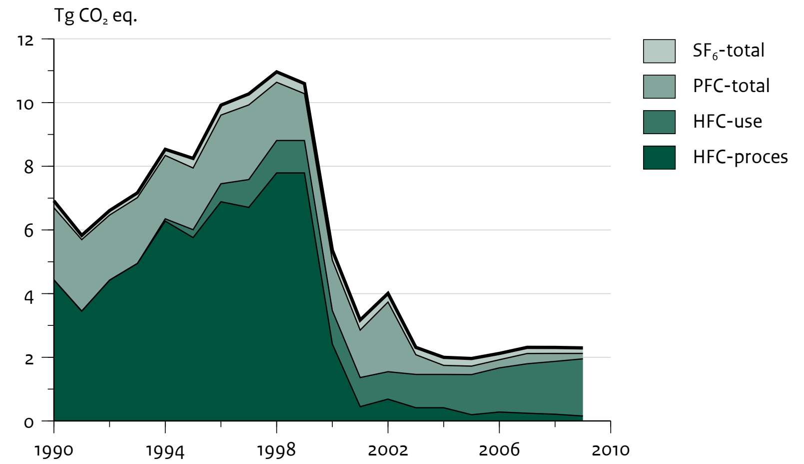
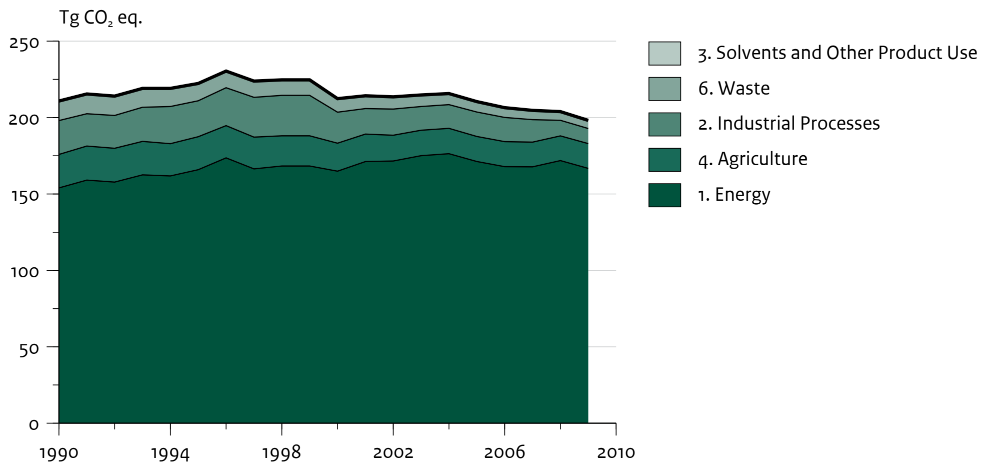


Figure 2.6 Aggregated greenhouse gases: trend and emission levels of sectors (excl. LULUCF), 1990-2009.



2.2.5 Uncertainty in emissions specified by greenhouse gas

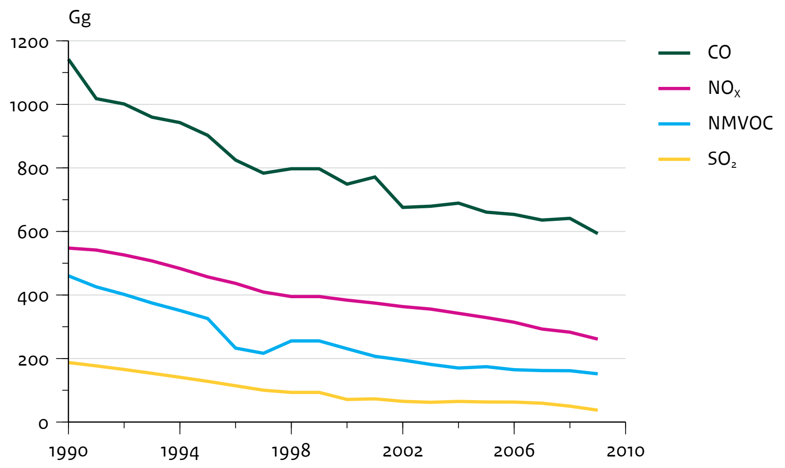
The uncertainty in the trend of CO_2 equivalent emissions of the six greenhouse gases together is estimated to be approximately 3% points, based on the IPCC Tier 1 Trend Uncertainty Assessment; see Section 1.7. Per individual gas, the *trend* uncertainty in total emissions of CO_2, CH_4, N_2O and the sum of the F-gases is estimated to be ±3%, ± 9%, ±8% and ±11% points, respectively.
For all greenhouse gases together, the uncertainty estimate in *annual* emissions is ±3% and for CO_2 ±2%. The uncertainty estimates in *annual* emissions of CH_4 and N_2O are ±25% and ±50% respectively, and for HFCs, PFCs and SF_6, ± 50% (see Section 1.7).

2.3 Emission trends specified by source category

Figure 2.6 provides an overview of emission trends per IPCC sector in Tg CO_2 equivalents.

The IPCC Energy sector is by far the largest contributor to the total greenhouse gas emissions in the national inventory (contributing 72% in the base year and 84% in

Figure 2.7 Emission levels and trends of NO_x, CO, NMVOC and SO_2 (Units: Gg)



2009). The relative share of the other sectors decreased correspondingly. The emission level of the Energy sector increased by approximately 13% in the period 1990–2009, and total greenhouse gas emissions from the Waste, Industrial Processes and Agriculture sectors decreased by 58%, 58%, and 25% respectively in 2009 compared to the base year.

Compared to 2008, greenhouse gas emissions in the Energy sector decreased by about 5.1 Tg in 2009, due to a decrease in the use of fossil fuels as a result of the economic crisis.
Trends in emissions by sub-category are described in more detail in Chapters 3–8.

2.3.1 Uncertainty in emissions by sector

The uncertainty estimates in annual CO_2 equivalent emissions of IPCC sectors Energy [1], Industry [2], Solvents and product use [3], Agriculture [4], and Waste [6] are about ±2%, ±11%, ±27%, ±38% and ±30% respectively; for sector 5 LULUCF it is ±100%. The uncertainty in the trend of CO_2 equivalent emissions per sector is calculated for sector 1 Energy at ±3% points in the 8% increase, for sector 2 Industry at ±6% points in the 58% decrease, for sector 4 Agriculture at ±12% points in the 26% decrease and for sector 6 Waste at ±8% points in the 58% decrease.

2.4 Emission trends for indirect greenhouse gases and SO_2

Figure 2.7 shows the trends in total emissions of carbon monoxide (CO), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO_2). Compared to 1990, CO and NMVOC emissions in 2009 were reduced by 48% and 67% respectively. For SO_2 this was as much as 80%, and for NO_x, 2009 emissions are 52% lower than the 1990 level. With the exception of NMVOC, most of the emissions stem from fuel combustion.

Because of the problems identified with annual environmental reporting (see Section 1.3.2.), emissions of CO from industrial sources are not verified. However, experts have suggested that possible errors will have a minor effect on total emission levels. Due to lack of data, the time series for 1991–1994 and 1996–1999 was interpolated between 1990 and 1995.

In contrast to direct greenhouse gases, calculations of emissions of precursors from road transport are not based on fuel sales according to the national energy statistics but are directly related to transport statistics on a vehicle-kilometre basis. To some extent, this is different from the IPCC approach (see Section 3.2.8.4.).

Uncertainty in the emission factors for NOx, CO and NMVOC from fuel combustion is estimated to be in the range of 10–50%. The uncertainty in the emission factors of SO_2 from fuel combustion (basically the sulphur content of the fuels) is estimated to be 5%. For most compounds, the uncertainty in the activity data is relatively small compared to the uncertainty in the emission factors. Therefore, the uncertainty in the overall total of sources included in the inventory is estimated to be in the order of 25% for CO, 15% for NO_x, 5% for SO_2, and approximately 25% for NMVOC (TNO, 2004).

3
Energy [CRF Sector 1]

Major changes in the Energy sector compared to the National Inventory Report 2010

Emissions: Compared to the previous submission the GHG emissions decreased by 3%

Key sources: Three new key sources were added compared to the previous submission (NIR2010):
- 1A3 Mobile combustion: road vehicles N_2O (Key L2)
- 1A5 Military use of fuels (1A5 Other) CO_2 (Key T1)
- 1B1b Coke production CO_2 (KeyL2)

Methodologies: In this year's submission the CH_4 emissions from 1A3b 'Road Transportation' have been recalculated for the entire time-series, using new estimates of the mass fractions of CH_4 in total VOC emissions for light and heavy duty vehicles. Furthermore, the fuel use for off-road machinery and wood stoves was recalculated.

3.1 Overview of sector

3.3.1 The Dutch Energy System

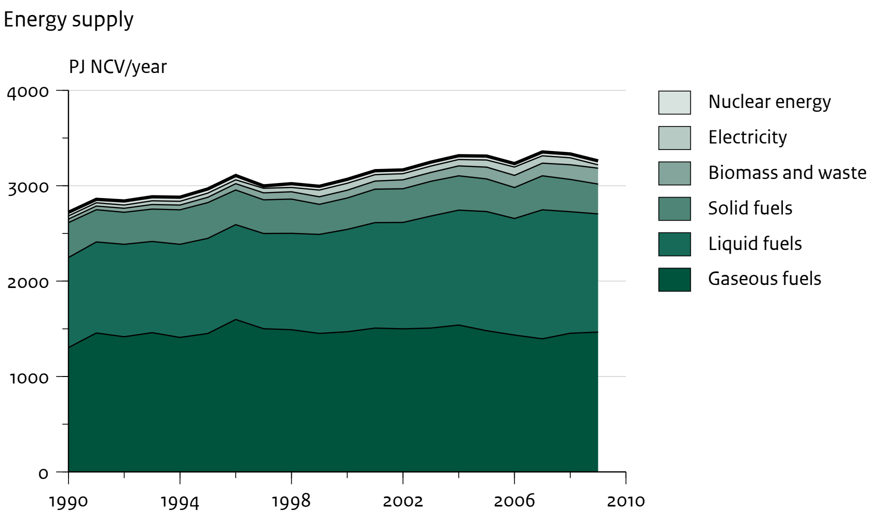
Energy Supply and Energy Demand

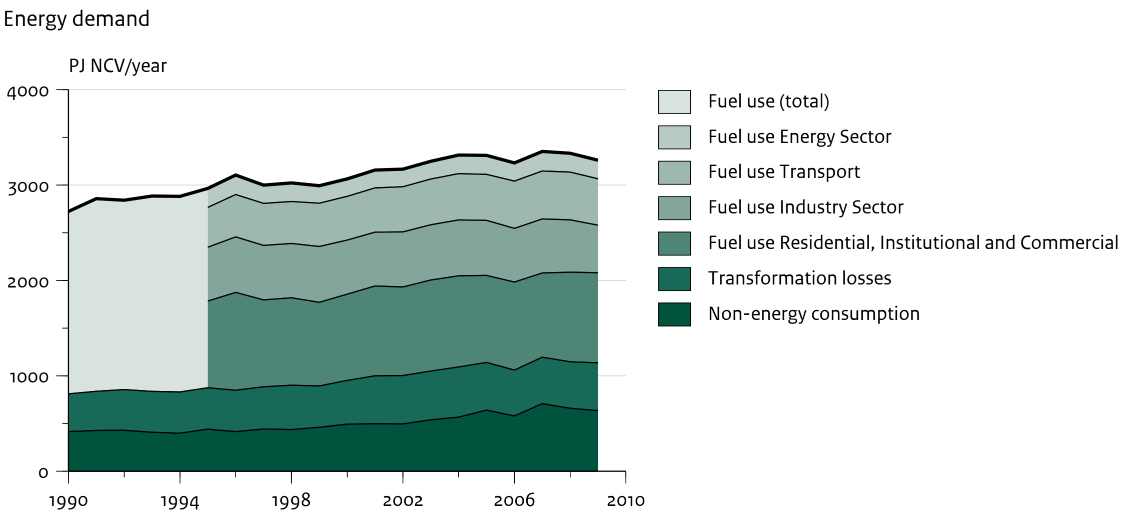
As for most developed countries, the energy system in the Netherlands is largely driven by the combustion of fossil fuels (Figure 3.1). In 2009, natural gas is supplying about 45.0% of the total primary fuels used in the Netherlands, followed by liquid fuels (38.0%) and solid fossil fuels (9.6%). The contribution of non-fossil fuels, including renewables and waste streams is rather limited.

Part of the supply of energy is not used for energy purposes. It is either used as feed stocks in (petro-) chemical or fertiliser industry (19.5%) or lost as waste heat in cooling towers and cooling water in power plants (15.4%).

Emissions from fuel combustion are consistent with the national energy statistics. The time-series of the energy statistics is not fully consistent at the detailed sector and detailed fuel-type levels for the years 1991 to 1994. This inconsistency is caused by revisions in the economic classification scheme implemented in 1993, a change from the "special trade" to "general trade" system to define the domestic use of oil products, some error corrections and the elimination of statistical differences. These changes were incorporated into the data sets for 1990, 1995 and subsequent years, thus creating the existing inconsistency with the 1991–1994 dataset. For the base year 1990, CBS has re-assessed the original statistics and made them compatible with the 'new' 1993 classification system and

Figure 3.1 Overview of energy supply and energy demand in the Netherlands. For the years 1990 – 1994, only the total fuel use is shown. See Section 3.1.1 for more details.





ECN (Energy Research Centre of the Netherlands) was commissioned to re-allocate the statistics of 1991–1994 at a higher level of detail (for both fuels and sectors). This is also visible in Figure 3.1, where fuel use is only shown as a total value.

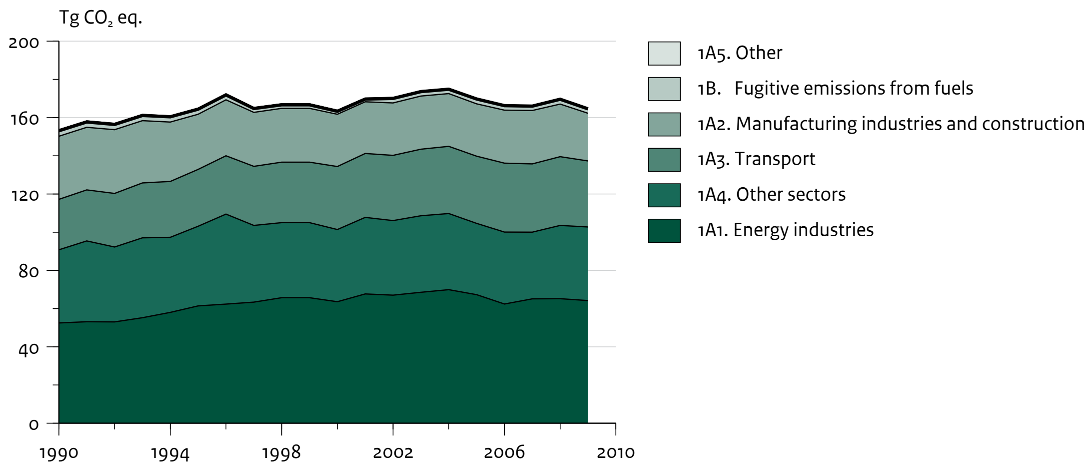
Trends in fossil fuel use and fuel mix

Natural gas represents a very large share of the national energy consumption in all non-transport sectors: power generation, industry and other sectors (mainly for space heating). Oil products are primarily used in the transport sector, refineries and in the petrochemical industry, while the use of coal is limited to power generation and steel production.

Although the combustion of fossil waste (reported under Other Fuels) has increased fourfold since 1990, its share in total fossil fuel use is still only 1% at the present time. In the 1990–2009 period, total fossil fuel combustion increased by 15%, due to a 12% increase in gas consumption, while liquid fuel use increased by 31%. At the same time, the combustion of solid fuels decreased by 14%.

Total fossil fuel consumption for combustion decreased by about 2% between 2008 and 2009, mainly due to a 7% decrease in solid fuel consumption.

Figure 3.2 Sector 1 'Energy': trend and emission levels of source categories, 1990-2009.



3.1.2 GHG Emissions from the energy sector

During combustion, carbon and hydrogen from fossil fuels are converted mainly into carbon dioxide (CO_2) and water (H_2O), releasing the chemical energy in the fuel as heat. This heat is generally either used directly or used (with some conversion losses) to produce mechanical energy, often to generate electricity or for transportation.

The energy sector is the most important sector in the Dutch greenhouse gas emission inventory, and contributes approximately 95% of CO_2 emissions in the country. The contribution of the energy sector to total greenhouse gas emissions in the country increases from 73% in 1990 to 84% in 2009. The greenhouse gas emissions from this sector are for over 98% in the form of CO_2 (see the previous chapter, Figure 2.2).

The energy sector includes:

- exploration and exploitation of primary energy sources,
- conversion of primary energy sources into more useable energy forms in refineries and power plants
- transmission and distribution of fuels
- final use of fuels in stationary and mobile applications.

Emissions arise from these activities by combustion and as fugitive emissions, or escape without combustion. Emissions from the energy sector are to be reported in the source category split as shown in Figure 3.2.

Overview of shares and trends in emissions

Table 3.1 and Figure 3.2 show the contribution of the source categories in the Energy sector to the total national greenhouse gas inventory. About 49% of CO_2 emissions from fuel combustion stems from the combustion of natural gas, 17% from solid fuels (coal) and 33% from liquid fuels. CH_4 and N_2O emissions from fuel combustion contribute 1.9% to the total emissions from this sector.

Key sources

Table 3.1 presents the key categories in the Energy sector specified by both level and trend (see also Annex 1). The key categories in 1A1, 1A2, 1A3 and 1A4 are based on aggregated emissions by fuel type and category, which is in line with the IPCC Good Practice Guidance (see Table 7.1 in IPCC 2001). Since CO_2 emissions have the largest share in the total of national greenhouse gas emissions, it is not surprising that – with the exception of inland aviation and railways – almost all CO_2 sources are identified as key category. The total CH_4 emissions from stationary combustion sources together are also identified as a key category.

Three new key sources were added compared to the previous submission (NIR2010):

- 1A3 Mobile combustion: road vehicles N_2O (Key L2)
- 1A5 Military use of fuels (1A5 Other) CO_2 (Key T1)
- 1B1b Coke production CO_2 (Key L2)

Table 3.1 Contribution of main categories and key sources in CRF sector 1 Energy.

Sector/category	Gas	Key	Emissions in base year	Emissions in 2008	Emissions in 2009	Change 2009 - 2008	Contribution to total in 2009 (%)		
		Level, Trend	Tg CO_2 eq	Tg CO_2 eq	Tg CO_2 eq	Tg CO_2 eq	By sector	Of total gas	Of total CO_2 eq
1 Energy	CO_2		151.1	168.6	163.6	-5.1	98.1	96.3%	82.2%
	CH_4		2.4	2.4	2.4	0.0	1.4	14.2%	1.2%
	N_2O		0.5	0.8	0.8	0.0	0.5	8.3%	0.4%
	All		154.0	171.8	166.7	-5.1	100.0		83.8%
1A Fuel combustion	CO_2		149.9	166.9	162.0	-5.0	97.2	95.4%	81.5%
	CH_4		0.7	1.6	1.6	0.0	1.0	9.6%	0.8%
	N_2O		0.5	0.1	0.8	0.0	0.5	8.3%	0.4%
	All		151.1	164.4	164.4	-4.9	98.6		82.7%
1A Emissions from stationary combustion (excl. 1A3)	CH_4	L,T	0.6	1.6	1.6	0.0	0.9	9.2%	0.8%
1A1 Energy Industries	CO_2		52.5	65.2	64.2	-1.0	38.5	37.8%	32.3%
1A1a. Public Electricity and Heat Production	CO_2		39.9	52.4	52.6	0.2	31.5	30.9%	26.4%
1A1a liquids	CO_2	L1,T1	0.2	0.8	0.7	-0.2	0.4	0.4%	0.3%
1A1a solids	CO_2	L,T1	25.8	25.4	23.6	-1.7	14.2	13.9%	11.9%
1A1a gas	CO_2	L1,T1	13.3	23.9	25.7	1.8	15.4	15.1%	12.9%
1A1a other fuels: waste incineration	CO_2	L,T	0.6	2.2	2.5	0.3	1.5	1.5%	1.3%
1A1b. Petroleum refining	CO_2		11.0	10.9	9.7	-1.2	5.8	5.7%	4.9%
1A1b liquids	CO_2	L,T	10.0	8.2	7.2	-1.1	4.3	4.2%	3.6%
1A1b gases	CO_2	L1,T1	1.0	2.7	2.6	-0.1	1.6	1.5%	1.3%
1A1c Manufacture of Solid Fuels and Other Energy Industries	CO_2		1.5	1.9	1.9	0.0	1.2	1.1%	1.0%
1A1c gases	CO_2	L,T	1.5	1.9	1.9	0.0	1.2	1.1%	1.0%
1A2 Manufacturing industries and construction	CO_2		33.0	27.5	24.9	-2.6	15.0	14.7%	12.5%
1A2 liquids	CO_2	L	9.0	9.0	8.5	-0.6	5.1	5.0%	4.3%
1A2 solids	CO_2	L,T1	5.0	4.7	3.9	-0.8	2.3	2.3%	2.0%
1A2 gases	CO_2	L,T	19.0	13.8	12.6	-1.2	7.5	7.4%	6.3%
1A2a. Iron and steel	CO_2		4.0	4.8	4.1	-0.7	2.4	2.4%	2.0%
1A2b. Non-Ferrous Metals	CO_2		0.2	0.2	0.2	-0.1	0.1	0.1%	0.1%
1A2c. Chemicals	CO_2		17.1	12.5	11.6	-0.9	7.0	6.8%	5.8%
1A2d. Pulp, Paper and Print	CO_2		1.7	1.2	1.1	-0.1	0.7	0.6%	0.5%
1A2e. Food Processing, Beverages and Tobacco	CO_2		4.1	3.6	3.3	-0.3	2.0	1.9%	1.6%
1A2f. Other	CO_2		5.8	5.2	4.7	-0.5	2.8	2.8%	2.4%
1A3. Transport	CO_2		26.0	35.5	34.1	-1.4	20.4	20.1%	17.1%
	N_2O	L2	0.3	0.4	0.4	0.0	0.3	4.7%	0.2%
	All		26.4	36.0	34.6	-1.4	20.7		17.4%
1A3a. Civil aviation	CO_2		0.04	0.04	0.04	0.0	0.0	0.0%	0.0%
1A3b. Road	CO_2		25.5	34.7	33.4	-1.4	20.0	19.6%	16.8%
1A3b gasoline	CO_2	L,T1	10.9	12.9	12.8	-0.1	7.7	7.5%	6.4%
1A3b diesel oil	CO_2	L,T	11.8	20.8	19.6	-1.3	11.7	11.5%	9.8%
1A3b LPG	CO_2	L1,T	2.7	1.0	1.0	0.0	0.6	0.6%	0.5%
1A3b. Road	N_2O		0.3	0.4	0.4	0.0	0.3	4.7%	0.2%
1A3c. Railways	CO_2		0.1	0.1	0.1	0.0	0.0	0.0%	0.0%
1A3d. Navigation	CO_2	L1	0.4	0.6	0.6	0.0	0.4	0.4%	0.3%
1A4. Other sectors	CO_2		37.8	38.3	38.5	0.2	23.1	22.7%	19.3%
	CH_4		0.5	1.4	1.4	0.0	0.8	8.3%	0.7%
	All		38.3	39.7	39.9	0.2	23.9		20.0%
1A4 liquids (excl. From 1A4c)	CO_2	T	1.4	0.3	0.5	0.2	0.3	0.3%	0.3%
1A4a. Commercial/Institutional	CO_2		8.4	11.1	11.4	0.2	6.8	6.7%	5.7%
1A4a Gas	CO_2	L,T	7.6	11.0	11.1	0.1	6.7	6.5%	5.6%

Table 3.1 Contribution of main categories and key sources in CRF sector 1 Energy.

Sector/category	Gas	Key	Emissions in base year	Emissions in 2008	Emissions in 2009	Change 2009 - 2008	Contribution to total in 2009 (%)		
		Level, Trend	Tg CO_2 eq	Tg CO_2 eq	Tg CO_2 eq	Tg CO_2 eq	By sector	Of total gas	Of total CO_2 eq
1A4b. Residential gas	CO_2	L	19.5	18	18	0.1	10.8	10.6%	9.0%
	CH_4		0.4	0.3	0.3	0.0	0.2	2.0%	0.2%
1A4b gases	CO_2		18.7	17.6	17.7	0.1	10.6	10.4%	8.9%
1A4c. Agriculture/Forestry/Fisheries	CO_2		9.9	9.3	9.1	-0.2	5.5	5.4%	4.6%
1A4c liquids	CO_2	L,T1	2.6	1.9	1.8	-0.1	1.1	1.1%	0.9%
1A4c gases	CO_2	L,T1	7.3	7.4	7.3	-0.1	4.4	4.3%	3.7%
1A5 Other	CO_2	T1	0.6	0.4	0.3	-0.1	0.2	0.2%	0.1%
1B Fugitive emissions from fuels	CO_2		1.2	1.7	1.6	-0.1	0.9	0.9%	0.8%
	CH_4		1.7	0.8	0.8	0.0	0.5	4.6%	0.4%
	All		2.9	2.5	2.4	-0.2	1.4		1.2%
1B1. Solid fuels transformation: coke production	CO_2	L2	0.4	0.8	0.5	0.0	0.3	30.2%	0.3%
1B2. venting/flaring	CO_2	T	0.3	0.0	0.0	0.0	0.0	0.6%	0.0%
1B2. venting/flaring	CH_4	T	1.2	0.4	0.3	0.0	0.2	2.0%	0.2%
National Total GHG emissions (excl. CO_2 LULUCF)	CO_2		159.3	175.3	169.8	-5.5			85.4%
	CH_4		25.5	17.0	16.9	-0.1			8.5%
	N2O		20.1	9.9	9.7	-0.2			4.9%
	All		213.2	204.6	198.9	-5.7			

Note: Key sources in the 1A1, 1A2, and 1A4 categories are based on aggregated emissions of CO_2 by fuel type.

3.2 Fuel Combustion [1A]

3.2.1 Comparison of the sectoral approach with the reference approach

Emissions from fuel combustion are generally estimated by multiplying fuel quantities combusted at specific energy processes with fuel and, in case of non-CO_2 greenhouse gases, source category dependent emission factors. This Sectoral Approach (SA) is based on fuel demand statistics. The IPCC guidance requires - as a quality control activity - also estimating CO_2 emissions from fuel combustion on the basis of a national carbon balance, derived from the fuel supply statistics. This is the Reference Approach (RA). In Annex 4, a detailed comparison of the sectoral approach with the reference approach is shown.

Energy Supply balance

The energy supply balance for the Netherlands in 1990 and 2009 is shown in Table 3.2 at a relatively high aggregation level. The Netherlands produces large amounts of natural gas, both onshore (Groningen gas) and offshore; 71% of the gas produced is exported. Natural gas represents a very large share of the national energy supply.

With carbon contents of each specific fuel, a national carbon balance can be derived from the energy supply balance and from this the national CO_2 emissions can be estimated by determining how much of this carbon is oxidised in any process within the country. To allow this, international bunkers are to be considered as “exports” and subtracted from the gross national consumption.

3.2.2 International bunker fuels

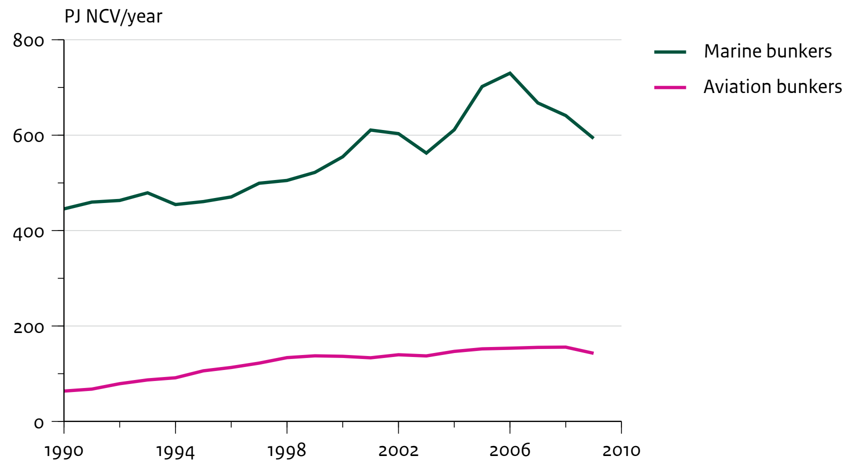
The Rotterdam area has four large refineries, producing relatively large quantities of heavy fuel oils. An important fraction of these heavy fuel oils is sold as international bunkers. In addition, most marine fuel oil produced in Russia is transported to Rotterdam where it is sold on the market. Combined, this makes Rotterdam the world’s largest supplier of marine bunker oils. The quantities of this bunker fuel are presented in Figure 3.3.

The Dutch refineries also produce considerable amounts of aviation fuels delivered to air carriers at the airports. In addition, Schiphol Airport is Western Europe’s largest supplier of aviation bunker fuels (jet fuel). Given the small size of the country, almost all of the aviation fuels are used in international aviation. Figure 3.3 presents the time

Table 3.2 Energy Supply Balance for the Netherlands (PJ NCV/year).

Year	Role	Indicator Name	Solid fuels	Crude oil and petroleum	Gas
1990	Supply	Primary production	0	171	2,301
		Total imports	491	5,367	85
		Stock change	-22	2	0
		Total exports	-101	-4,076	-1,081
		Bunkers	0	-500	0
	Gross inland consumption	Gross inland consumption	-368	-964	-1,305
	Demand	Final non-energy consumption	-11	-328	-101
2009	Supply	Primary production	0	73	2,363
		Total imports	516	7,690	770
		Stock change	-77	-24	1
		Total exports	-126	-5,753	-1,669
		Bunkers	0	-748	0
	Gross inland consumption	Gross inland consumption	-413	-1,238	-1,466
	Demand	Final non-energy consumption	-7	-590	-81

Figure 3.3 International navigation and aviation bunkers (PJ NCV/year).



series of the fuel quantities exported to marine and aviation bunkers.

3.2.3 Feed stocks and non-energy use of fuels

Table 3.2 shows that in 2009, 46% of the gross national consumption of petroleum products is used in non-energy applications, mainly as feedstock (naphta) in the petro-chemical industry and in products in many applications (bitumen, lubricants, etc.). Also a fraction of the gross national consumption of natural gas (6%, mainly in the ammonia production) and coal (2%, mainly in the iron and steel production) is used for non-energy applications and hence not directly oxidised. In many cases, these products will finally be oxidised in waste incinerators or during use (lubricants in two stroke engines). In the Reference Approach these product flows are excluded from the calculation of CO_2 emissions.

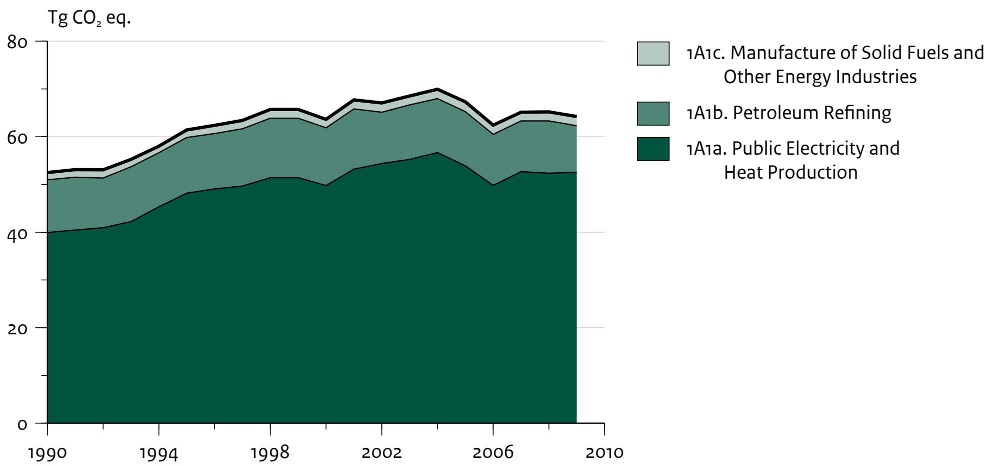
3.2.4 CO_2 capture from flue gases and subsequent CO_2 storage, if applicable

Not applicable yet.

3.2.5 Country-specific issues

See above.

Figure 3.4 1A1 'Energy industries': trend and emission levels of source categories, 1990-2009.



3.2.6 Energy Industries [1A1]

Source category description

"Energy Industries" are the main source category contributing to the Energy sector, accounting for 39% of the greenhouse gas emissions from this sector in 2009. In this sector, three source categories are included: Public Electricity and Heat Production [1A1a], Petroleum Refining [1A1b] and Manufacture of Solid Fuels and Other Energy Industries [1A1c]. Within these categories, natural gas and coal combustion by public electricity and heat production and oil combustion by petroleum refining are the dominating key sources. However, other key sources are liquid fuels and other fuels (waste) in public electricity and heat production, and natural gas combustion in petroleum refining and in manufacturing of solid fuels and other energy industries. CH_4 and N_2O emissions from 1A1 "Energy Industries" contribute relatively little to the total national inventory of greenhouse gas emissions. CH_4 from stationary combustion is a key source, due to an increase of the CH_4 emission factor from small CHP plants. N_2O emissions from "Energy Industries" are not identified as a key source (see Table 3.1).

In 2009, CO_2 emissions from category 1A1 "Energy Industries" contributed 32% to the total national greenhouse gas emission inventory (excluding LULUCF), while CH_4 and N_2O emissions from this same category contributed relatively little to the total national greenhouse gas emissions. The share contributed by 1A1 "Energy Industries" to the total greenhouse gas emissions from the Energy sector increased from 34% in 1990 to 39% in 2009 (see Figure 3.2), partly due to a change in ownership of CHP plants (joint ventures, which are allocated to this source category).

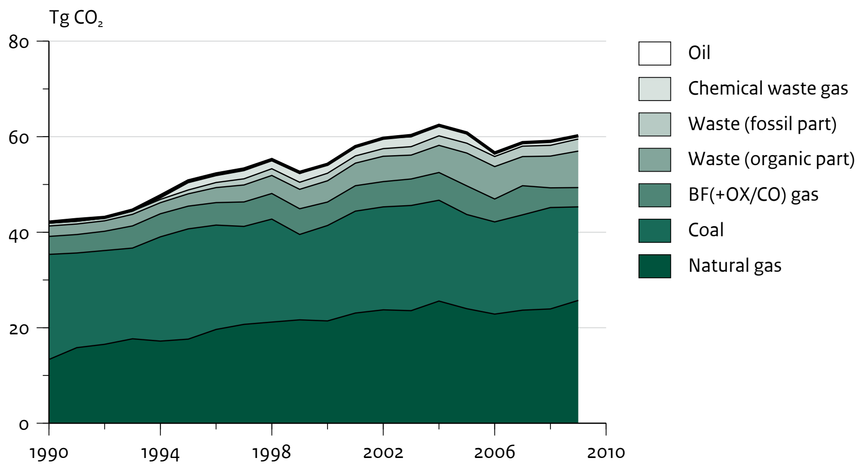
Between 1990 and 2009, total CO_2 emissions from 1A1 "Energy Industries" increased by 22% (see Figure 3.4). In 2009, CO_2 emissions from 1A1 "Energy Industries" decreased 1.5% compared to the emission in 2008.

Public Electricity and Heat Production [1A1a]

The Dutch electricity sector has a few notable features: it has a large share of coal-fired power stations and a large fraction of gas-fired cogeneration plants, with many of the latter being operated as joint ventures with industries. Compared to other countries in the EU, nuclear energy and renewable energy provide very little of the total primary energy supply in the Netherlands. The two main renewable energy sources are biomass and wind.
This source category also includes all emissions from large-scale waste incineration, since all incineration facilities also produce heat and/or electricity and hence, the waste incinerated in these installations is regarded as a fuel. In addition, a large fraction of the blast furnace gas and a significant part of coke oven gas produced by the one iron and steel plant in the Netherlands is combusted in the public electricity sector, see figure 3.5.

In 2009, 1A1a "Public Electricity and Heat Production" was the largest source category within the 1A1 Energy industries, accounting for 82% of the total greenhouse gas emissions from this category (see Figure 3.4 and Table 3.1). CO_2 emissions from waste incineration of fossil carbon represent 5% of the total greenhouse gas emissions in 1A1a Public electricity and heat production. In 2009, the

Figure 3.5 Trend in sources of CO_2 from fuel use in power plants.



emissions of CO_2 from the combustion of fossil fuels in this source category decreased by 0.4%.

Between 1990 and 2009, total CO_2 emissions from "Public Electricity and Heat Production" increased by 32%. The increasing trend in electric power production corresponds to considerably increased CO_2 emissions from fossil fuel combustion by power plants, which are partly compensated for by a shift from coal to natural gas and the increased efficiency of power plants.

The CO_2 emission level from waste incineration of fossil carbon increased from 0.6 Tg CO_2 in 1990 to 2.5 Tg CO_2 in 2009 due to the increasing amounts of municipal waste that are combusted instead of being deposited in landfills, which is the result of environmental policy to reduce waste disposal in landfills (see Chapter 8).

The increase in the CO_2 emission factor for "other fuels" since 2004 is due to the increase in the share of plastics (which have a high carbon fraction) in the combustible waste (see Table 8.6 on the composition of incinerated waste). The decrease in 2006 and 2008 in the implied emission factor for CO_2 from biomass is due to the increase of the share of pure biomass (co-combusted with coal-firing) as opposed to the organic carbon in waste combustion with energy recovery. For the former type a lower emission factor is applied than for the latter.

Between 1990 and 1998, changed ownership relations of plants (joint ventures) caused a shift of cogeneration plants from category 1A2 "Manufacturing Industries" to 1A1a "Public Electricity and Heat Production". Half of the almost 30% increase in natural gas combustion that occurred between 1990 and 1998 is largely explained by cogeneration plants and a few large chemical waste gas-fired steam boilers being shifted from "Manufacturing Industries" to the "Public Electricity and Heat Production" due to changed ownership (joint ventures). The corresponding CO_2 emissions allocated to the Energy sector increased from virtually zero in 1990 to 8.5 Tg in 1998 and 9.1 Tg in 2005. The same criterion applies for emissions from waste incineration, which are included in this category since they all are subject to heat or electricity recovery, albeit this is not their main activity. Most of the combustion of biogas recovered at landfill sites is in CHP operated by utilities; therefore, it is allocated in this category.

A remarkable drop is shown in the emissions from 1A1a 'Electricity and heat production' in 1999 (–6% compared to 1998), which is, however, associated to the increasing emission trend in the 1990–1998 period and 2000 and thereafter. In fact, electricity consumption in the Netherlands was 2% higher in 1999 than in 1998. The relatively low emissions for 1999 are explained by the higher share of imported electricity in domestic electricity consumption in that year, which was almost double that in 1998 (10% in 1998 versus 20% in 1999), and to a relatively large shift from coal to chemical waste gas and natural gas in 1999. The high import of electricity corresponds to approximately 4 Tg CO_2, while the shift from coal to natural gas and oil corresponds to approximately 1 Tg CO_2 in 1999. The net import of electricity decreased again in 2001, and this was compensated for by an increased production of electricity from gas and coal combustion in the public electricity sector. In 2004, CO_2 emissions increased by 3% as a direct result of the start-up in 2004 of a large new gas-fired 790 MW_e cogeneration plant, and a 2% decrease in coal combustion.

The strong increase in liquid fuel use in 1994 and 1995, with a sharp increase in 1995, is due to chemical waste gas being used in joint venture electricity and heat production facilities. This also explains the somewhat lower IEF for CO_2 from liquids since 1995.

Petroleum Refining [1A1b]

The Rotterdam harbour area houses four major refineries (a fifth one is located at Vlissingen) which export about 50% of their products to the European market. Consequently, the Dutch petrochemical industry is relatively large.

The share of 1A1b "Petroleum Refining" in total greenhouse gas emissions from the category 1A1 "Energy Industries" is estimated to be 21% in 1990 and 15% in 2009. However, the combustion emissions from this category should be viewed in relation to the fugitive emissions reported under category 1B2. Between 1990 and 2009 total CO_2 emissions from the refineries (including fugitive CO_2 emissions from hydrogen production reported in 1B2a-iv Refining) fluctuated between 10 and 12 Tg.

For 1A1b "Petroleum Refining" the calculation of emissions from fuel combustion is based on the sectoral energy statistics, using the fuel consumption for energetic purposes as activity data (including the consumption of residual refinery gases). Although the same method is still used, the quality of the data used to calculate and report CO_2 emissions is now improved by incorporating the CO_2 emissions reported by the individual refineries for 2002 onwards.

Since 1998, one refinery has operated the SGHP unit, supplying all the hydrogen for a large-scale hydrocracker. When producing hydrogen, CO_2 is also produced as a co-product from the chemical processes (CO_2 removal and a two stage CO shift reaction). Refinery data specifying these fugitive CO_2 emissions are available and used for 2002 onwards and are reported in the category 1B2. The fuel used to provide the carbon for this non-combustion process is subtracted from the fuel consumption used to calculate the combustion emissions reported in this category.

The use of plant-specific emission factors for refinery gas for 2002 onwards – arithmetically resulting from the reported CO_2 emissions and combustion emissions as calculated using the default data – also causes changes in the implied emission factor for CO_2 for total liquid fuel compared to the years prior to 2002 (emission factor for refinery gas is adjusted to get exact correspondence between the total calculated CO_2 emissions and the total CO_2 emissions officially reported by the refineries). Besides this non-energy/feedstock use of fuel for hydrogen production, for years prior to 2002 the energy and carbon balance between the oil products produced does not match the total crude oil input and of fuel used for combustion. The conclusion drawn, therefore, is that not all residual refinery gases and other residual fuels are accounted for in the national energy statistics. The carbon difference is always a positive figure. As such, it is assumed that part of the residual refinery gases and other residual fuels are all combusted (or incinerated by flaring) but not monitored/reported by the industry are thus unaccounted for. The CO_2 emissions from this varying fuel consumption are included in the fuel type 'liquids'. This represents approximately 10% (5–20%) of the total fuel consumption accounted for in the statistics. For 1998-2001, the unspecified CO_2 process emissions from the hydrogen plant are also included.

The inter-annual variation in the IEFs for CO_2, CH_4 and N_2O from liquid fuels is explained both by the high and variable shares (between 40% and 55%) of refinery gas in total liquid fuel, which has a relatively low default emission factor compared to most other oil products and has variable emission factors for the years 2002 onward, and by the variable addition of 'unaccounted for' liquids that is only used for estimating otherwise missing CO_2 emissions (but not for CH_4 and N_2O). However for 2002 onwards, the 'unaccounted for' amount has been reduced substantially due to the subtraction of fuel used for the non-combustion process of producing hydrogen (with CO_2 as by-product), of which the emissions are now reported under 1B2.

All remaining differences with the CO_2 calculation based on the national energy statistics and default emission factors are, therefore, shown up in the calculated carbon content of the combusted refinery gas and thus in the implied emission factor of CO_2 for liquid fuel.

Manufacture of Solid Fuels and Other Energy Industries [1A1c]

In accordance with IPCC classification guidelines, emissions from fuel combustion for on-site coke production by the iron and steel company (Tata steel, formerly known as Corus) are included in 1A2 "Manufacturing Industries and Construction" since this is an integrated coke, iron and steel plant (see Section 3.2.7). The emissions from the combustion of solid fuels of one independent coke production facility (Sluiskil), the operation of which discontinued in 1999, are also included in category 1A2.

Source category 1A1c comprises:

- Combustion of "own" fuel use by the oil and gas production industry for heating purposes (the difference between the amounts of fuel produced and sold, minus

Table 3.3 Overview of emission factors used in 2009 in the sector Energy Industries [1A1].

Fuel	Amount of fuel used in 2009 (TJ NCV)	Implied Emission factors (g/GJ) CO_2 (x 1000)	N_2O	CH_4
Natural gas	533089	56.74*	0.14	7.12
Coal	208348	93.82	1.40	0.44
Waste, biomass	32596	128.62	6.02	0.00
Waste Gas	91861	72.98	0.10	3.59
Waste, fossil	31012	81.60	4.14	0.00
Solid biomass	28228	109.6	4.00	30.00
Blast Furnace Gas	16136	246.55	0.10	0.35
Other	15953	NA	NA	NA

*: EF standard natural gas is 56.6. In 1.A.1.C unrefined gas is used (EF = 58.89)

the amounts of associated gas which is either flared or vented or otherwise lost by leakage).
- Fuel combustion for space heating and in use in compressors for gas and oil pipeline transmission by the gas, oil and electricity transport and distribution companies.

The share of 1A1c 'Manufacture of solid fuels (coke) and other energy industries' (fuel production) in the total greenhouse gas emissions from the category 1A1 "Energy Industries" is approximately 3% in both 1990 and 2009. This category comprises mostly CO_2 emissions from the combustion of natural gas. The dominating source is the use for energy purposes in oil and gas production and in the transmission industry. The combustion emissions from oil and gas production refer to 'own use' of the gas and oil production industry, which is the difference between the amounts of fuel produced and sold, after subtraction the amounts of associated gas which is either flared or vented or otherwise lost by leakage. Production and sales data are based on the national energy statistics; amounts flared and vented are based on reports from the sector. CO_2 emissions from this source category increased from 1.5 Tg in 1990 to 1.9 Tg CO_2 in 2009 mainly due to the exploitation of less favourable production sites for oil and gas production compared with those exploited in the past. This fact explains the steady increase in time shown by this category with respect to gas consumption. The inter-annual variability in the emission factors for CH_4 from gas combustion is mainly due to the variable losses in the compressor stations of the gas transmission network, which are reported in the Annual Environmental Reports (MJVs) of the gas transport company and are included here. The small amounts of solid fuel combustion by the one stand-alone coke production plant in Sluiskil, the operation of which was discontinued in 1999, are not separately recorded in the energy statistics but are included in the iron and steel industry (category 1A2a).

3.2.6.2 Methodological issues

The emissions from this source category are essentially estimated by multiplying fuel use statistics with country specific emission factors (Tier 2 method). Activity data are derived from the aggregated statistical data from the national energy statistics, which is published annually by the CBS (see www.cbs.nl). The aggregated statistical data from the national energy statistics is based on confidential data from individual companies. When necessary, data from individual companies are also used; for example, when companies report a different emission factor for derived gases (see the following section).

For CO_2 and N_2O, IPCC default emission factors are used, with the exception of CO_2 for natural gas, chemical waste gas and coal, for which country-specific emission factors are used. When available, company-specific or sector-specific emission factors have been used, in particular for derived gases such as refinery gas, chemical waste gas and blast furnace gas (see Annex 2, Table A2.1). If companies report different emission factors for derived gases, it is possible to deviate from the standard emission factor for estimating the emissions for these companies. The CH4 emission factors are taken from Scheffer en Jonker, 1997. An overview of the emission factors used for the most important fuels (up to 95% of the fuel use) in the sector Energy Industries [1A1] is provided in Table 3.3. Since some emission data in this sector originate from individual companies, the values (in Table 3.3) represent partly implied emission factors.

Notes to the source specific emission factors:
- The standard CH_4 emission factor for natural gas is 5.6 g/GJ. Only in category 1A1c other energy industries natural gas direct extracted from the wells is used for combustion,. Fotr this unprocessed gas a higher emission factor is used, which explains the higher emission factor for this sector.
- The CO_2 emissions from coal and blast furnace gas are based on emission data from the NEA. Therefore, the implied emission factor is slightly different from the standard country-specific emission factor.
- The CO_2 and N_2O emission factors for natural gas deviate from the standard emission factors (56.6 kg CO_2/GJ and

0.1 g N_2O/GJ), because this sector includes the emissions from the combustion of crude gas ("own" fuel use by the oil and gas production industry for heating purposes), which has a different emission factor.

- The CO_2 emissions from waste gas are CO_2 emissions occurring in the chemical industry and in refineries. The emissions are partly based on emission data from the NEA.
- The N_2O emission factor from waste combustion is depending on the amount of waste incinerated in incinerators with or without a SNCR, which have emission factors of 9.43 g/GJ and 1.89 g/GJ respectively. The emission factor for CH_4 from waste incineration has been changed to 0 g/GJ as a result of a recent study on emissions from waste incineration (DHV, 2010).

More details on emission factors, methodologies, the data sources used and country-specific source allocation issues are provided in the monitoring protocols (see www.greenhousegases.nl, Protocol 11-002: CO_2, CH_4 and N_2O from 'Stationary Combustion: Fossil Fuels' and Protocol 11-038: Emissions from biomass combustion). According to the IPCC Guidelines, only fossil-fuel related CO_2 emissions are included in the total national inventory, thus excluding CO_2 from organic carbon sources from the combustion of biomass. The CO_2 from biomass from waste incineration is reported as memo item.

3.2.6.3 Uncertainties and time-series consistency

The uncertainty in CO_2 emissions of this category is estimated to be 2% (see Section 1.7 for more details). The accuracy of fuel consumption data in power generation and oil refineries is generally considered to be very accurate, with an estimated uncertainty of approximately 0.5%. The high accuracy in most of these activity data is due to the limited number of utilities and refineries that report their large fuel consumption as part of the national energy statistics and which are verified as part of the European Emission Trading Scheme. The two exceptions are solids in power generation and liquids in refineries, which have a larger estimated uncertainty of 1% and 10%, respectively, based on the share of blast furnace gas in total solid consumption, the 'unaccounted for' liquids calculated for refineries and the recalculations made for 2002-2004 as presented in this report (Olivier et al., 2009). The high uncertainty in the liquids in refineries apply mainly to the years prior to 2002, for which accurate reported CO_2 emissions are not available at the required aggregation level. The consumption of gas and liquid fuels in the 1A1c category is mainly from the oil and gas production industry, where the split into own use and venting/flaring has proven to be quite difficult, and thus a high uncertainty of 20% is assigned. For other fuels a 10% uncertainty is used, which refers to the amount of fossil waste being incinerated and thus to the uncertainties in the total amount of waste and the fossil and biomass fractions.

For natural gas, the uncertainty in the CO_2 emission factor is now estimated to be 0.25% (instead of 1%) based on the fuel quality analysis reported by Heslinga and Van Harmelen (2006) and further discussed in Olivier et al. (2009). This value is used in the uncertainty assessment in Section 1.7 and key source assessment in Annex 1. For hard coal (bituminous coal), an analysis was made of coal used in power generation (Van Harmelen and Koch, 2002). For the default power plant factor, 94.7 CO_2/GJ is the mean value of 1270 samples taken in 2000, which is accurate within about 0.5%. However, in 1990 and 1998 the emission factor varies ±0.9 CO_2/GJ (see Table 4.1 in Van Harmelen and Koch, 2002); consequently when the default factor is applied to other years, the uncertainty is apparently larger, about 1%. Analysis of the default CO_2 emission factors for coke oven gas and blast furnace gas reveals uncertainties of about 10% and 15%, respectively (data reported by the steel plant). Since the share of BF/OX gas in total solid fuel emissions from power generation is about 15-20%, the overall uncertainty in the CO_2 emission factor of solids in power generation is estimated to be about 3%. The CO_2 emission factors of chemical waste gas and – to a lesser extent – of BF/OX gas are more uncertain than those of other fuels used by utilities. Thus, for liquid fuels in these sectors is a higher uncertainty of 10% is assumed in view of the quite variable composition of the refinery gas used in both sectors. For natural gas and liquid fuels in 'Oil and Gas Production' (1A1c), uncertainties of 5% and 2% are assumed, respectively, which refer to the variable composition of the offshore gas and oil produced. For the CO_2 emission factor of other fuels (fossil waste), an uncertainty of 5% is assumed, which reflects the limited accuracy of the waste composition and of the carbon fraction per waste stream. The uncertainty in the emission factors of CH_4 and N_2O from stationary combustion is estimated at about 50%, which is an aggregate for the various subcategories (Olivier et al., 2009).

3.2.6.4 Source-specific QA/QC and verification

The trends in fuel combustion in the "Public Electricity and Heat Production" (1A1a) are compared to trends in domestic electricity consumption (production plus net imports). Large annual changes are identified and explained (e.g., changes in fuel consumption by joint ventures). For 'Oil Refineries' (1A1b), a carbon balance calculation is made to check completeness. Moreover the trend in total CO_2 reported as fuel combustion from refineries is compared to trends in activity indicators, such as total crude throughput. The IEF trend tables are then checked for changes, and inter-annual variations are explained in this NIR. More details on the validation of the energy data are to be found in the monitoring protocol 11-002: CO_2, CH_4 and N_2O from 'Stationary Combustion: Fossil Fuels'

3.2.6.5 Source-specific recalculations
Energy consumption from marine bunkers was recalculated for the years 2005-2008, causing an increase in energy consumption from bunkers of 1.1% in 2008 compared to the previous submission. Emissions from the combustion of biomass in sector 1A1a in 2008 were recalculated (error correction) causing a reduction of 0.3% in CH_4 emissions and 0.2% in N_2O emissions from the combustion of biomass in 1A1a in 2008.

3.2.6.6 Source-specific planned improvements
From 2002 onwards, the data reported by the Dutch refineries are used to calculate plant-specific emission factors for CO_2 that represent an improvement compared to the use of the standard EF. This procedure will be continued. Analysis of the ETS data revealed that the use of these data would not improve the inventory,

3.2.7 Manufacturing Industries and Construction [1A2]

3.2.7.1 Source category description
This source category consists of the six categories 1A2a 'Iron and Steel', 1A2b 'Non-ferrous Metals', 1A2c 'Chemicals', 1A2d 'Pulp, Paper and Print', 1A2e 'Food Processing, Beverages and Tobacco' and 1A2f 'Other'. Within these categories, liquid fuel and natural gas combustion by the chemical industry, solid fuel combustion by the iron and steel industry and natural gas combustion by the food processing and other industries are the dominating emission sources. However, natural gas in the pulp and paper industries and liquid fuels (mainly for off-road machinery) in the other industries are also large emission sources. The shares of CH_4 and N_2O emissions from industrial combustion are relatively small and these are no key sources. Natural gas is mostly used in the chemical, food and drinks and other industries; solid fuels (that means coal and coke-derived fuels, such as blast furnace/oxygen furnace gas) are mostly used in 1A2a 'Iron and Steel' industry; liquid fuels are mostly used in 1A2c 'Chemicals' industry and in 1A2f 'Other' industries (see Figure 3.6).

Another feature of industry in the Netherlands is that it operates a large number of combined heat and power (CHP) facilities (and sometimes also steam boilers). Several of these facilities have changed ownership over time and are now operated as joint venture concerns with electrical utilities, the emissions of which are reported in "Energy Industries" (1A1a).

Within the category 1A2 "manufacturing industries and construction" the category 1A2c 'Chemicals' is the largest fuel user (see Figure 3.6). In this industry liquid fuel use is 104 PJ and natural gas use is 82 PJ in 2009. A second important industry is included in 1A2f other industries and include emissions from mineral products (cement, bricks, glass, other building materials), textiles, wood, wood products and building construction industry. Solid fuels (28 PJ in 2009) are almost exclusively used in 1A2a 'Iron and Steel. In this industry, a limited amount of natural gas is also used. All other industries are almost completely run on natural gas.

In 2009, the share of CO_2 emissions from 1A2 "Manufacturing Industries and Construction" in the total national greenhouse gas emission inventory was estimated to be 12% compared to 16% in 1990. In contrast, the share of the other greenhouse gas emissions in this category is relatively small. Category 1A2c 'Chemicals' is the largest contributor to CO_2 emissions, accounting for approximately 46% of the total emissions from the manufacturing industry in 2009.

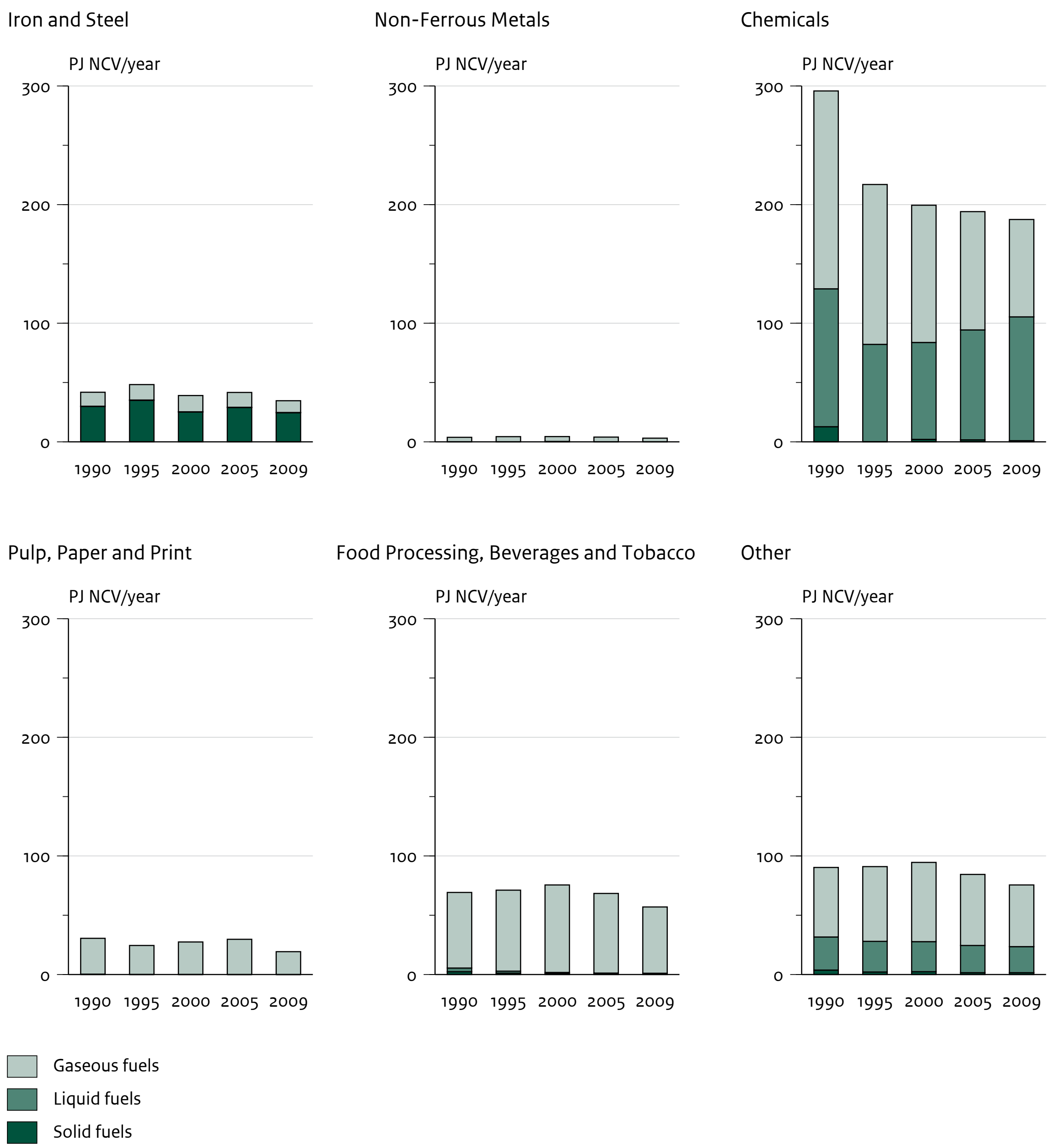
In the period 1990–2009, CO_2 emissions from combustion in 1A2 "Manufacturing Industries and Construction" decreased by 24% (see Figure 3.7). The chemical industry contributes the most to this decrease in emissions in this source category, with its contribution to CO_2 emissions decreasing by 5.5 Tg. Total CO_2 emissions from 1A2 "Manufacturing Industries and Construction" in 2009 decreased 9% compared to 2008.

The derivation of these figures, however, should also be viewed in the context of industrial process emissions of CO_2 since the separation of the source categories is not always fixed. Most industry process emissions of CO_2 are reported in CRF sector 2 (soda ash, ammonia, carbon electrodes and industrial gases such as hydrogen and carbon monoxide). However in manufacturing processes, this oxidation is accounted for in the energy statistics as the production and combustion of residual gases (e.g., in the chemical industry) – as is often the case in the Netherlands – then the corresponding CO_2 emissions are reported as combustion in sector 1A2 and not as an industrial process in sector 2.

Iron and Steel [1A2a]
This sector refers mainly to the integrated steel plant Corus, which produces approximately 6000 kton crude steel (in addition to approximately 100 kton of electric steel production and iron foundries). Since Corus is an integrated plant, the category includes fuel combustion for on-site coke production as well as the emissions of the combustion of blast furnace gas and oxygen furnace gas in the steel industry.

The contribution of 1A2a 'Iron and steel' to the CO_2 emissions from 1A2 "Manufacturing Industries and Construction" was about 12% in 1990 and 16% in 2009.

Figure 3.6 Fuel use in 1A2 'Manufacturing Industries and Construction' in selected years (TJ NCV/year).

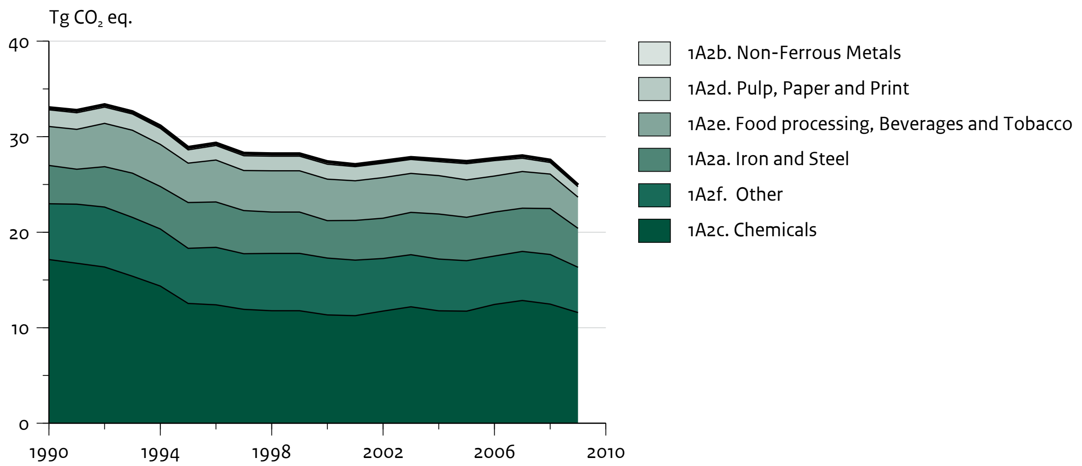


Inter-annual variations in CO_2 emissions from fuel combustion from the iron and steel industry can be explained as being mainly due to varying amounts of solid fuels used in this sector. In 2009 CO_2 emissions from solid fuel combustion of the iron and steel industry increased slightly (+0.3 Tg).

The 14% decrease in solid fuel use in 1999 and the 10% decrease in associated CO_2 emissions corresponds with the 8% decrease in crude steel production. When all CO_2 emissions from the sector are combined – including the net process emissions reported under category 2C1 – total emissions closely follow the inter-annual variation in crude steel production. Total CO_2 emissions have remained rather constant in the period 1990–2009 even though production has increased by about 30%. This indicates a substantial energy efficiency improvement in the sector.

The inter-annual variation in the IEF for CO_2 from solid fuels is due to variable shares of BF/OX gas and coke oven gas, which have much higher and lower emission factors, respectively, than hard coal and coke have. The relative

Figure 3.7 1A2 'Manufacturing Industries and Construction': trend and emission levels of source categories, 1990-2009.



low IEFs in 1990–1994 compared to later years are due to the higher share of coke oven gas in the solid fuel mix in those years due to CO gas combustion by the independent coke manufacturer in Sluiskil, which was in these years not accounted for in the energy statistics separately but included in this category.

Non-Ferrous Metals [1A2b]

This category consists mainly of two aluminium smelters. CO_2 emissions from anode consumption in the aluminium industry are included in 2C. This small source category only contributes about 0.2 Tg CO_2 to the total national greenhouse gas inventory, predominantly from the combustion of natural gas. Energy use in the aluminium industry is largely based on electricity, the emissions of which are included in 1A1a 'Public electricity and heat production'.

The amounts of liquid and solid fuels vary considerably between years, but the differences in the amounts and related emissions are almost negligible. The inter-annual variation of the IEFs from liquid fuels is a result of changes in the mix of underlying fuels (e.g., the share of LPG which has a relatively low emission factor) and partly due to the small amounts used.

Chemicals [1A2c]

The share of 1A2c 'Chemicals' to the total CO_2 emissions from 1A2 "Manufacturing Industries and Construction" decreased from 52% in 1990 to 46% in 2009. The combustion of natural gas and liquid fuels accounts for 40% respectively 59% in the CO_2 emissions from the chemical industry. CO_2 emissions from this source category have decreased by approximately 32% since 1990, which is mainly due to the 51% decrease in the consumption of natural gas during the same period.

The steady decreasing CO_2 emissions from the combustion of natural gas can be largely explained by the decreasing numbers of cogeneration facilities in this industrial sector. CO_2 emissions from liquid fuel combustion stem predominantly from the combustion of chemical waste gas. The marked decrease in liquid fuel consumption since 1995 is not due to a decrease in chemical production or data errors, but mainly to a large shift of ownership of a large cogeneration plant – one using chemical waste gas – into a joint venture, thus re-allocating it to energy industries. This also explains the 88% decrease in solid fuel combustion in 1994 and the 28% decrease in liquid fuel combustion in 1995. In these years, the then-existing coal-fired and oil-fired cogeneration plants, respectively, shifted to joint ventures and thus moved to the 'Energy Industry'.

Taking into account all CO_2 emissions, including the net process emissions included in category 2B and the re-allocation of CO_2 emissions to the energy industry, the total CO_2 emission level from the chemical industry was rather constant in the period 1990–2009. Given that since 1990 the production has increased significantly, the constant emission level indicates substantial improvements in the efficiency of energy use and/or structural changes within the chemical industry.

The increase in 2003 of the IEF for CO_2 from liquid fuels is also explained by the increase in the use of chemical waste gas and the change in composition. For CO_2 from chemical waste gas from liquid and solid fuels, source-specific emission factors are used for 1995 onwards based on data of selected years. For 16 individual plants, residual chemical gas from liquids is hydrogen, for which the specific CO_2 emission factor is 0. For CO_2 from phosphorous furnace gas, plant-specific values are used, with values around 149.5 kg/GJ. This gas is made from coke and therefore included in solid fuels. The operation of the phosphorous plant started around 2000, which explains the increase in the IEF for solid fuels to about 149.5 kg/GJ. For another 9 companies, plant-specific CO_2 emission factors were used based on annual reporting by the companies (most in the 50-55 range, with exceptional values of 23 and 95). The increased use of chemical waste gas (included in liquid fuels) since 2003 and the changes in the mix of compositions explain the increase in the IEF for liquid fuels from about 55 to about 67 kg/GJ. For 1990, an average sector-specific value for the chemical industry was calculated using the plant-specific factors for 1995 from the 4 largest companies and the amounts used per company in 1990. For more details, see Appendix 2 of the NIR 2005.

Pulp, Paper and Print [1A2d]
The contribution of 1A2d 'Pulp, paper and print' to CO_2 emissions from 1A2 "Manufacturing Industries and Construction" is estimated to be approximately 5% in 1990 and about 4% in 2009. In line with the decreased consumption of natural gas, CO_2 emissions have decreased by approximately 37% since 1990, of which a substantial fraction is used for co-generation. The relatively low CO_2 emissions in 1995 can be explained by re-allocation of emissions to the energy sector due to the above-mentioned formation of joint ventures. Between 1990 and 2009, CO_2 emissions from gaseous fuel combustion decreased by about 36%.

The amounts of liquid and solid fuel combustion vary considerably between years, but the amounts and related emissions are almost negligible. The inter-annual variation in the IEFs for liquid fuels is due to variable shares of derived gases and LPG in total liquid fuel combustion.

Food Processing, Beverages and Tobacco [1A2e]
The share of 1A2e 'Food processing, beverages and tobacco industries' in the CO_2 emission from 1A2 "Manufacturing Industries and Construction" was 12% in 1990 and 13% in 2009. CO_2 emissions decreased by almost 20% in the period 1990–2009. This is due to a decrease since 2003 of joint ventures of cogeneration plants located in the pulp and paper industry, of which the emissions were formerly allocated in 1A2e but are now reported under public electricity and heat production (1A1a). This shift in allocation corresponds with a CO_2 decrease of about 0.3 Tg. In 2009, CO_2 emissions from gaseous fuel combustion in this source category decreased by about 9.5% compared to last submission.

The amounts of liquid and solid fuels vary considerably between years, but the amounts and related emissions are verifiably small. The inter-annual variation in the IEFs for liquid fuels is due to variable shares of LPG in total liquid fuel combustion.

Other [1A2f]
This category includes all other industry branches, including mineral products (cement, bricks, other building materials, glass), textiles, wood and wood products. Also included are emissions from the building construction industry and from off-road vehicles (mobile machinery) for building construction and for the construction of roads and waterways and other off-road sources except agriculture (liquid fuels). The latter refers mainly to sand and gravel production.

The share of category 1A2f 'Other' (including construction and other off-road machinery) in CO_2 emissions from 1A2 "Manufacturing Industries and Construction" was approximately 18% in 1990 and 19% in 2009. Most of the 4.7 Tg CO_2 emissions from this source category in 2009 stem from gas combustion (2.9 Tg), while the remaining CO_2 emissions are mainly associated with the combustion of biomass (1.2 Tg CO_2) and the combustion of liquid fuels (1.6 Tg CO_2), of which off-road machinery accounts for 1.5 Tg CO_2. CO_2 emissions from this source category have decreased by 19% since 1990. In 2009, total CO_2 emissions from the other manufacturing industries decreased by 9% compared to 2008.

3.2.7.2 Methodological issues
The methods used for this source category are the same as those used for 1A1 "Energy Industries". A country-specific top-down (Tier 2) method is used for calculating emissions for fuel combustion from "Manufacturing Industries and Construction" (1A2). Fuel combustion emissions in this sector are calculated using fuel consumption data from national sectoral energy statistics and IPCC default emission factors for CO_2 and N_2O, with the exception of CO_2 for natural gas and chemical waste gas and coal, for which country-specific emission factors are used. When available, company-specific or sector-specific emission factors have been used, in particular for derived gases such as chemical waste gas, blast furnace gas and coke oven gas (see Annex 2). More details on methodologies, data sources used and country-specific source allocation issues are provided in the monitoring protocols (see www.greenhousegases.nl).
An overview of the emission factors used for the most important fuels (up to 95% of the fuel use) in the sector Manufacturing Industries and Construction [1A2] is provided in Table 3.4. Since some emission data in this sector originate from individual companies, the values in the Table 3.4 represent partly implied emission factors.

Table 3.4 Overview of emission factors used (in 2009) in the sector Manufacturing Industries and Construction [1A2].

Fuel	Amount of fuel used in 2009 (TJ NCV)	Implied Emission factors (g/GJ)		
		CO_2 (x 1000)	N_2O	CH_4
Natural gas	222170	56.60	0.10	7.27
Waste Gas	102580	65.02	0.10	3.60
Gas / Diesel oil	20187	74.30	0.60	5.00
Coke Oven Gas	12406	43.07	0.10	2.80
Blast Furnace Gas	11920	246.55	0.10	0.35
Solid biomass	10543	109.60	4.00	30.00
Other	10133	NA	NA	NA

Notes to the implied emission factors:

- The standard CH_4 emission factor for natural gas is 5.7 g/GJ. Only for gas powered CHP, a higher emission factor is used, which explains the higher emission factor for this sector.
- The CO_2 emissions from coke oven gas, blast furnace gas and waste gas are based on emission data from the NEA. Therefore, the implied emission factor is slightly different from the standard country-specific emission factor.
- Emission factor for CH_4 and N_2O from gas/diesel oil used in Machinery are based on source specific estimation methods.

More details on emission factors methodologies, the data sources used and country-specific source allocation issues are provided in the monitoring protocols (see www.greenhousegases.nl).

In 'Iron and Steel Industry', a substantial large fraction of total CO_2 emissions is reported as process emissions in CRF 2C1, based on net losses calculated from the carbon balance from the coke and coal inputs in the blast furnaces and the blast furnace gas produced. Since the fraction of BF/OX gas captured and used for energy varies over time, the trend in the combustion emissions of CO_2 accounted for by this source category should be viewed in association with the reported process emissions. The fuel combustion emissions from on-site coke production by the iron and steel company Corus are included here in 1A2a instead of in 1A1c, since these are reported in an integrated and aggregated manner. In addition to including the emission from Corus, this category also includes the combustion emissions of a small electric steel producer and – for the period 1990–1994 – of one small independent coke production facility for which the fuel consumption was not separately included in the national energy statistics during this period. The fugitive emissions, however, from all coke production sites are reported separately (see Section 3.2.7.1).

For the chemical industry, CO_2 emissions from the production of silicon carbide, carbon black, methanol and ethylene from the combustion of residual gas (produced as by-product from the non-energy use of fuels) are included in 1A2c 'Chemicals'. Although these CO_2 emissions are more or less process-related, they are included in 1A2 for practical purposes: consistency with Energy statistics that account for the combustion of residual gases. This inclusion in 1A2 is justified since there is no strict IPCC guidance on where to include those emissions.

The fuel consumption data in 1A2f 'Other Industries for Construction' and 'Other Off-road' are not based on large surveys. Therefore, the energy consumption data of this part of the Category 1A2f are the least accurate.

Details of the method for this source category are described in Protocol 11-002: CO_2, CH_4 and N_2O from 'Stationary Combustion: Fossil Fuels'

3.2.7.3 Uncertainties and time-series consistency

The uncertainty in CO_2 emissions of this category is estimated to be about 3% (see Section 1.7 for more details). The accuracy of fuel consumption data in the manufacturing industries is generally considered to be rather accurate, about 2%, with the exception of those for derived gases included in solids and liquids (Olivier et al., 2009). This includes the uncertainty in the subtraction of the amounts of gas and solids for non-energy/feedstock uses, including the uncertainty in the conversion from physical units to Joules, and the completeness of capturing blast furnace gas in total solid consumption and chemical waste gas in liquid fuel consumption.

For natural gas, the uncertainty in the CO_2 emission factor is now estimated to be 0.25% (instead of 1%) based on the recent fuel quality analysis reported by Heslinga and Van Harmelen (2006) and further discussed in Olivier et al. (2009), but not yet used in the uncertainty assessment in Section 1.7 and Annex 1. The 5% uncertainty estimate in the CO_2 emission factor for liquids is based on an uncertainty of 10% in the emission factor for chemical waste gas in order to account for the quite variable composition of the gas and its more than 50% share in the total liquid fuel use in the sector. An uncertainty of 10% is assigned for solids, which reflects the uncertainty in carbon contents of blast furnace gas/oxygen furnace gas based on the standard deviation in a 3-year average. BF/OX gas accounts for the majority of solid fuel use in this sector.

3.2.7.4 Source-specific QA/QC and verification

The trends in CO_2 emissions from fuel combustion in the iron and steel industry, non-ferrous industry, food processing, pulp and paper and other industries are compared to trends in the associated activity data: crude steel and aluminium production, indices of food production, pulp and paper production and cement and bricks production. Large annual changes are identified and explained (e.g., changed fuel consumption by joint ventures). Moreover, for the iron and steel industry the trend in total CO_2 emissions reported as fuel combustion-related emissions (included in 1A2a) and industrial process emissions (included in 2C1) is compared to the trend in the activity data (crude steel production). A similar comparison is made for the total trend in CO_2 emissions from the chemical industry (sum of 1A2c and 2B) and trends split per main fuel type or specific process (chemical waste gas combustion and process emissions from ammonia production). IEF trend tables are checked for large changes and large inter-annual variations at different levels and explained in the NIR. More details on the validation of the energy data are found in the monitoring protocol 11-002: CO_2, CH_4 and N_2O from 'Stationary Combustion: Fossil Fuels'.

3.2.7.5 Source-specific recalculations

The process and combustion emissions from on-site coke production at the iron and steel company Tata Steel can (from 2005 on) not be allocated exactly to 1B1b , 1A2a, and 2C15 since they are reported in an integrated and aggregated manner. In this submission a standardised method was developed and implemented to make an uniform division between process and combustion emissions for this category. The total emission from this activities from2005 on did not change due to this operation only the allocation between the two categories changed.
For the off-road machinery a recalculation of the fuel use was performed, see section 3.2.9.5.. This recalculation effects the distribution of emissions between the categories 1A2f and 1A4c and in some years the netto effect amounts to an increase in total emissions in the range of 0,5 Tg CO_2(2001)
Methane emissions from the combustion of biomass in sector 1A2e in 1990 were recalculated (error correction) causing a minor reduction (0.003%) in CH_4 emissions in 1A2e in 1990.

3.2.7.6 Source-specific planned improvements,

There is no source-specific improvement planned.

3.2.8 Transport [1A3]

3.2.8.1 Source category description

The source category 1A3 'Transport' comprises the following sources: 'Civil Aviation' (1A3a), 'Road Transportation' (1A3b), 'Railways' (1A3c), 'Water-borne Navigation' (1A3d) and 'Other Transportation' (1A3e). The source category 'Civil Aviation' only includes emissions from domestic aviation - aviation with departure and arrival in the Netherlands. In the same manner, the source category 'Water-borne Navigation' only includes emissions from domestic inland navigation. Emissions from international aviation and navigation (aviation and marine bunkers) are reported separately in the inventory; see Section 3.2.2. The source categories 'Road Transportation' and 'Railways' include all emissions from fuel sold to road transport and railways in the Netherlands.

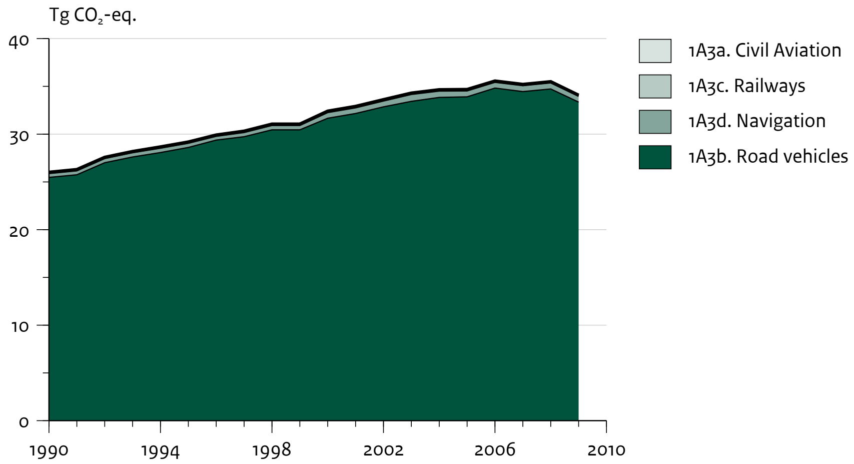
The source category 'Other Transportation' (1A3e) is not used; instead emissions from other mobile sources are reported in different source categories in the inventory. Emissions from national fisheries and agricultural non-road mobile machinery, such as tractors, are included in 1A4c 'Agriculture, Forestry and Fisheries'; see Section 3.2.9, whereas emissions from other non-road mobile machinery, such as road and building construction equipment, are reported under category 1A2f 'Other'; see Section 3.2.7. Emissions from fuel combustion by military aircraft and shipping activities are included in 1A5 'Other'; see Section 3.2.10. Energy consumption for pipeline transport is not recorded separately in the national energy statistics, but is included in 1A1c for gas compressor stations and in 1A4a for pipelines for oil and other products.

Overview of shares and trends in emissions

The source category 1A3 'Transport' is responsible for 17% of total greenhouse gas emissions in the Netherlands. Between 1990 and 2009, greenhouse gas emissions from transport increased by 31% to 34.6 Tg CO_2 eq in 2009. This increase is mainly caused by an increase in fuel consumption and corresponding CO_2 emissions from road transport. The greenhouse gas emissions from the transport sector are summarised in Figure 3.8. CO_2 emissions from 1A3b 'Road transportation' are dominant in this source category, accounting for more than 97% of total emissions over the whole time-series.

Greenhouse gas emissions by the transport sector decreased by 4% from 2008 to 2009. This decrease is primarily caused by a 6% decrease (17 PJ) in diesel fuel consumption by road transportation and a 28% increase (3 PJ) in the use of biofuels.

Figure 3.8 1A3 'Transport': trend and emission levels of source categories, 1990-2009.



Civil Aviation [1A3a]

The share of 1A3a 'Civil Aviation' in total greenhouse gas emissions in the Netherlands was less than 0.1% in both 1990 and 2009. The reported energy use and greenhouse gas emissions by domestic civil aviation in the Netherlands are based on a rough estimate of fuel consumption in 2000, which is applied to the whole time-series (see Section 3.2.8.2). Therefore, emissions remain constant over the time-series.

Road transportation [1A3b]

The contribution of 1A3b 'Road transportation' to the national CO_2 emissions was 16% in 1990 and 20% in 2009. Between 1990 and 2009, CO_2 emissions from road transport have increased from 25.5 to 33.4 Tg. This increase is mainly caused by a large increase in diesel fuel consumption. Between 1990 and 2009, diesel fuel consumption by road transport increased by 65% (104 PJ) due to a large growth in freight transportation and the growing number of diesel passenger cars and light duty vehicles in the Dutch car fleet. As a consequence, the share of diesel in fuel sales to road transportation (PJ) has increased from 45% to 58% between 1990 and 2009, as is shown in Figure 3.9. The share of LPG has decreased significantly, while the share of gasoline has decreased slightly.

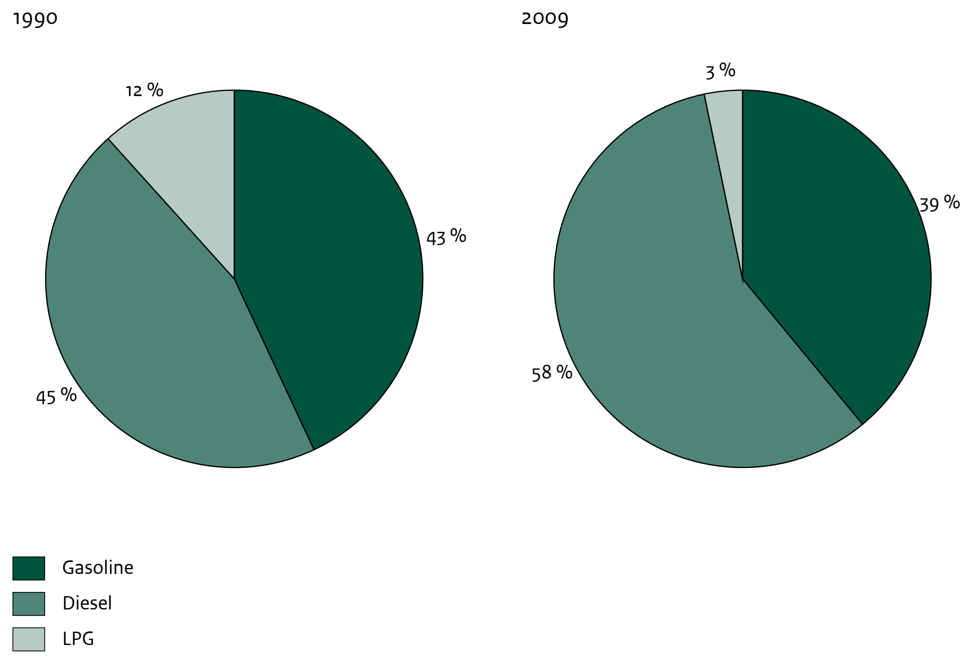
In 2009, CO_2 emissions from road transport decreased by 4% (1.4 Tg) compared to 2008, primarily because of a decrease in diesel fuel consumption. This decrease is mainly caused by a decrease of freight transport due to the economic crisis: the vehicle kilometres driven by heavy duty vehicles in the Netherlands decreased by approximately 4% from 2008 to 2009. Another cause for the decrease in CO_2 emissions from road transport is the increase in the use of biofuels between 2008 and 2009: in 2009 the share of biofuels in total energy use by road transport increased to 3,3% (compared to 2,6% in 2008).

CH_4 emissions from road transport fell from 6.9 Gg in 1990 to 2.7 Gg in 2009, which translates to a decrease of about 61%. Between 2008 and 2009, CH_4 emissions from road transport decreased by approximately 4% (0.1 Gg). The continuing decrease in CH_4 emissions from road transport is caused by a reduction in total VOC emissions resulting from the implementation of European Union emission legislation for new road vehicles. Total combustion and evaporative VOC emissions by road transport decreased by approximately 78% between 1990 and 2009, primarily due to the penetration of catalyst- and canister-equipped vehicles in the passenger car park. The share of CH_4 in the total greenhouse gas emissions by road transport (in CO_2 eq) is very small (0.2% in 2009).

N_2O emissions from road transport increased from 0.9 Gg in 1990 to 1.6 Gg N_2O in 1997, but have since decreased to 1.4 Gg in 2009. The increase in N_2O emissions up to 1997 can be explained by the increased penetration of petrol cars equipped with a catalytic converter in the Dutch passenger car fleet, as the latter emit more N_2O than petrol cars without a catalytic converter. The subsequent decrease in N_2O emissions between 1997 and 2009, despite an increase in vehicle-kilometres in this period, can be explained by a mix of developments:

- Subsequent generations of catalytic converters (the second was introduced in 1996) appear to have lower N_2O emissions (Gense and Vermeulen, 2002);
- The share of diesel cars in the passenger car park, which have lower N_2O emissions per vehicle kilometre than catalyst-equipped petrol cars, has increased throughout the last few years.

Figure 3.9 Shares of petrol (gasoline), diesel and LPG in fuel sales to 'Road Transport' 1990 and 2009.



Between 2008 and 2009, N_2O emissions from road transport decreased slightly (0.03 Gg). The share of N_2O in total greenhouse gas emissions from road transport (in CO_2 eq) was 1.3% in 2009.

Railways [1A3c]

Up until 2008, total diesel fuel consumption by 1A3c 'Railways' remained fairly constant in the time-series: in both 1990 and 2008 total energy use was 1.2 PJ. In 2009 diesel fuel consumption decreased by 26% compared to 2008. This decrease was mainly caused by a decrease in traffic volume: total freight traffic by rail (in ton-km) decreased by 20% from 2008 to 2009 according to Statistics Netherlands. The increasing share of electric traction in rail freight traffic also contributed to the decrease in diesel fuel consumption: the share of electric locomotives in the total locomotive fleet used in the Netherlands increased from 10% to 22% between 2007 and 2009 (Rail Cargo 2007 and 2009). The share of 1A3c 'Railways' in total greenhouse gas emissions from the transport sector is small throughout the entire time-series (0.2-0.3%).

Water-borne Navigation [1A3d]

The share of domestic water-borne navigation (1A3d) in total national greenhouse gas emissions from the transport sector varies between 1.5 and 2% in the time-series. Emissions increased from 0.4 Tg in 1990 to 0.6 Tg in 2009. This increase is mainly caused by an increase in freight transport by inland shipping. Total diesel fuel consumption by domestic water-borne navigation decreased by approximately 4% from 2008 to 2009 due to a decrease in freight transport by water.

Key sources

CO_2 emissions from 1A3b 'Road Transportation' (all fuel types), and from waterborn navigation are identified as key sources. This also applies to N2O emissions from 1A3b 'Road Transportation'.

3.2.8.2 Methodological issues

A detailed description of the methodology and data sources used to calculate transport emissions is provided in Klein et al. (2011) and in the monitoring protocols that can be found at www.greenhousegases.nl and are listed in Section 3.1.

Civil Aviation [1A3a]

An IPCC Tier 2 methodology is used for calculating the greenhouse gas emissions of civil aviation. There are however no reliable data available on the distribution of total fuel sales between national, international and military aviation. Therefore, the figures included in the national energy statistics (CBS Energy Balance) are not used in the inventory. Instead, fuel consumption by domestic aviation has been roughly estimated based on the 2000 consumption figures of aviation petrol (avgas) and jet kerosene for domestic flights in the Netherlands reported by the Civil Aviation Authority Netherlands (Pulles, 2000). Because of the very small amounts involved (342 TJ aviation petrol and 230 TJ jet kerosene), no attempt has been made to make new estimates for current years. Since the number of domestic flights has decreased since 2000, there is no reason to expect an increase in energy use and emissions since 2000. Therefore, the figures for the year 2000 are used for the entire time-series. The emission factors used to calculate CO_2 emissions from kerosene and aviation petrol are derived from Vreuls and Zijlema (2009). Default IPCC emission factors for kerosene and aviation petrol are used to calculate emissions of CH_4 and N_2O.

Emissions of precursor gases (NO_x, CO, NMVOC and SO_2) reported in the NIR under domestic aviation are the uncorrected emission values from the Netherlands Pollutant Emissions Register and refer to aircraft emissions associated with the Landing and Take-Off (LTO) cycles at Schiphol Airport. By far the most aircraft activities (>90%) in the Netherlands are related to Schiphol Airport; therefore emissions from other airports are ignored. No attempt has been made to estimate non-greenhouse gas emissions specifically related to domestic flights (including cruise emissions of these flights) since these emissions are almost negligible.

Road Transportation [1A3b]

An IPCC Tier 2 methodology is used for calculating CO_2 emissions from road transport, using national data on fuel sales to road transport from Statistics Netherlands (CBS) and country-specific emission factors, as reported in Klein et al. (2011) and in Vreuls and Zijlema (2009). See Annex 2 for more details.

An IPCC Tier 3 methodology is used for calculating CH_4 emissions from road transport, using fuel sales data from Statistics Netherlands and data on the mass fractions of different compounds in total VOC emissions (Ten Broeke and Hulskotte, 2009). Total VOC emissions from road transport are calculated bottom-up using data on vehicle-kilometres driven from Statistics Netherlands (CBS), and VOC emission factors obtained from the Netherlands Organisation for Applied Scientific Research (TNO), as reported in Klein et al. (2011). The calculation methodology for total VOC emissions distinguishes several vehicle characteristics, such as vehicle type, age, fuel type and weight. In addition, the methodology also distinguishes three road types and takes into account cold starts. The mass fraction of CH_4 in total VOC-emissions is dependent on the fuel type, vehicle type and – for petrol vehicles – whether or not the vehicle is equipped with a catalyst. Petrol-fuelled vehicles equipped with a catalyst emit more CH_4 per unit of VOC than vehicles without a catalyst. In absolute terms, however, passenger cars with catalysts emit far less CH_4 than passenger cars without a catalyst because total VOC emissions are far lower.

To make sure the reported CH_4 emissions from road transport are consistent with fuel sales data, the bottom-up approach described above is used to calculate average CH_4 emission factors per unit of fuel used. These emission factors are consequently combined with the fuel sales data from Statistics Netherlands to derive total CH_4 emissions from road transport.

N_2O emissions from road transport are calculated using a similar IPCC Tier 3 methodology as for CH_4. The emission factors for passenger cars and light-duty vehicles using petrol or LPG are based on country-specific data (Gense and Vermeulen, 2002). Emission factors for diesel light-duty vehicles, heavy-duty vehicles, motorcycles and mopeds are derived from Riemersma et al. (2003).

Since CO_2 emissions from 'Road Transport' are key sources (see Table 3.1), the present Tier 2 methodology complies with the IPCC Good Practice Guidance (IPCC, 2001). CH_4 emissions from 'Road Transport' are not a key source.

Emissions of all other compounds, including ozone precursors and SO_2, which are more directly involved in air quality, are calculated bottom-up using data on vehicle-kilometres driven.

Emissions from biodiesel and ethanol in gasoline are reported separately in the CRF. The emission calculation is comparable to the emission calculation for diesel/gasoline and is based on the sold amount of biodiesel and ethanol, as reported by Statistics Netherlands.

Railways [1A3c]

Information on diesel fuel sold in the railway sector is obtained from the Dutch Railways (NS). For calculating CO_2 emissions, country-specific emission factors are used (Olivier, 2004); see Annex 2 for more details. For CH_4 and N_2O emissions, IPCC default emission factors are used.

Water-borne navigation [1A3d]

An IPCC Tier 2 methodology is used for calculating CO_2 emissions from domestic water-borne navigation. CO_2 emissions are calculated based on fuel deliveries to water-borne navigation in the Netherlands and country-specific emission factors (Klein Goldewijk et al., 2004). In the Netherlands, domestic commercial inland ships are allowed to use bunker fuels (sold without levies and VAT). Although the national energy statistics (CBS Energy Balance) distinguish between trips on the Rhine River and other inland shipping in the fuel consumption data for shipping, the sum of bunker fuel sales and domestic fuel sales to water-borne navigation in the national energy statistics includes fuel used for international navigation that should not be reported as part of domestic shipping according to IPCC Good Practice. Using the Dutch Emission Monitor Shipping (EMS) however, it is possible to distinguish between national and international navigation based on ton-kilometres travelled by ships (AVV, 2003). The share of fuel used by international navigation as calculated with the EMS is therefore subtracted from the total fuel sales to navigation in order to arrive at the fuel sales to national navigation, which is reported under 1A3d. The present Tier 2 methodology level complies with the IPCC Good Practice Guidance (IPCC, 2001).

3.2.8.3 Uncertainties and time-series consistency

The uncertainty in fuel sales to 1A3b 'Road Transportation' is estimated to be +/- 3% for petrol, +/- 5% for diesel oil and +/- 10% for LPG. These estimates are based on the annual differences between the fuel sales data from Statistics Netherlands and the bottom-up calculation of fuel used by road transport (see Section 3.2.8.2). The uncertainty in the CO_2 emission factors for petrol, diesel and LPG is estimated to be +/- 2%. For petrol and diesel fuel, the uncertainty in the CO_2 emission factor was previously calculated to be +/- 0.2% and +/- 0.4% respectively, based on the analysis of 50 samples of petrol and diesel fuel from petrol stations in the Netherlands in 2004 (Olivier, 2004). There are however indications that the carbon content of petrol and diesel fuel for road transport is changing due to tightening of European fuel quality standards. Since no recent measurements have been performed, the uncertainty is expected to have increased and is currently estimated to be +/- 2% for all three fuel types. This estimation is based on expert judgment. Based on these estimates, total uncertainty in annual CO_2 emissions from road transport is estimated to be approximately +/- 5%.

The uncertainty in CH_4 emissions from road transport is estimated to be +/- 50% in annual emissions. The uncertainty in the total VOC emissions of road transport is roughly estimated to be +/- 30%. The uncertainty in the share of CH_4 in VOC emissions is estimated by Ten Broeke and Hulskotte (2009) to be +/- 40% for petrol and +/- 25% for diesel. Combined with the uncertainties in fuel sales and the share of both fuel types in total CH_4 emissions from road transport, the estimated uncertainty of the CH_4 emissions from road transport is estimated to be +/- 50%. The uncertainty in annual N_2O emissions from road transport is also estimated to be +/- 50%. N_2O emission factors have not been updated recently and therefore are relatively uncertain (+/- 50%).

The uncertainty in fuel used by domestic civil aviation is estimated to be about +/- 50%. Uncertainty is high due to the lack of data on fuel sales specifically for domestic flights. The uncertainty in emission factors for Civil Aviation is estimated to be +/- 0.5% for CO_2 and +/- 100% for CH_4 and N_2O. This results in a total uncertainty estimate of +/- 50% for CO_2 emissions and +/- 112% for CH_4 and N_2O emissions.

The uncertainty in fuel used by domestic water-borne navigation is estimated to be approximately +/- 20%. The uncertainty in emission factors is estimated to be +/- 0.2% for CO_2 and +/- 100% for CH_4 and N_2O. This results in a total uncertainty estimate of 20% for CO_2 emissions and 102% for CH_4 and N_2O emissions from domestic water-borne navigation. For more details on the uncertainty estimates for 1A3 'Transport', see Olivier et al. (2009).

3.2.8.4 Source-specific QA/QC and verification

The CO_2 emissions from 1A3b 'Road Transportation' are calculated based on fuel sales data. To check the quality of the emission totals, CO_2 emissions from road transportation are also calculated using a bottom-up approach based on vehicle kilometres travelled and fuel consumption per kilometre for different vehicle types. A comparison between the fuel sales data and the calculated fuel consumption gives an indication of the validity of the (trends in the) fuel sales data. The bottom-up calculation of petrol consumption shows good agreement with the petrol sales data from Statistics Netherlands: differences between both figures vary between +/- 3% for most of the time-series and both time-series show similar trends.

The time-series for diesel show larger differences, with the diesel fuel sales figures being higher than the bottom-up calculated diesel fuel consumption. Differences vary between 13 and 26%, with the differences growing larger in more recent years. The differences between both figures can partly be explained by the fact that current long-haul distribution trucks can travel several thousand kilometres on a full tank. The fuel sold to these trucks in the Netherlands can for the most part be consumed abroad and therefore is not included in the bottom-up calculated diesel fuel consumption. The differences can also partly be explained by a lack of reliable fuel consumption figures per vehicle kilometre for most vehicle types, especially for light and heavy duty vehicles (almost all off which are diesel vehicles in the Netherlands). This makes the calculated diesel fuel consumption rather uncertain.

The time-series for bottom-up calculated fuel consumption and reported fuel sales of LPG also show rather large differences. For the entire time-series from 1990 to 2009, fuel sales data for LPG are on average approximately 30% higher than the bottom-up calculated LPG consumption by road transport. This difference can partly be explained by the use of LPG in non-road mobile machinery (i.e. forklift trucks). In the Netherlands, the EMMA model

(Hulskotte & Verbeek, 2009) is used to calculate fuel consumption and (greenhouse gas) emissions from non-road mobile machinery. According to the model, industrial non-road mobile machinery uses 2-3 PJ of LPG annually in the Netherlands. This fuel consumption is however not separately reported in the Dutch energy statistics. This could explain approximately half of the difference between the fuel sales and the bottom-up calculation of fuel consumption of LPG. The remaining difference can partly be explained by the lack of reliable fuel consumption figures for LPG vehicles.

The time-series for the bottom-up calculated diesel and LPG consumption by road transport do show similar trends to the fuel sales data from Statistics Netherlands.

3.2.8.5 Source-specific recalculations

In this years' submission the CH_4 emissions from 1A3b 'Road Transportation' have been recalculated for the entire time-series, using new estimates of the mass fractions of CH_4 in total VOC emissions for light and heavy duty vehicles. The mass fractions that were previously used to calculate CH_4 emissions were derived in 1993 (Veldt and Van der Most, 1993) and were not validated since. Therefore an update of these estimates was required, as was reported in the NIR 2010. Last year, TNO derived new VOC-profiles based on an extensive review of available literature (Ten Broeke and Hulskotte 2009). The new mass fraction of CH_4 in total VOC-emissions for petrol vehicles has not changed significantly (12.4% compared to 12% in the old VOC-profile). The CH_4 mass fraction in total VOC emissions from light duty diesel vehicles has increased from 4% to 20.4%. This new estimate is applied to all passenger cars build since the year 2000, since the underlying literature mostly deals with vehicles types that were build after that year. This means that the mass fractions of CH_4 in total VOC emissions from diesel passenger cars slowly increases after 2000. Total CH_4 emissions from diesel cars are still decreasing though because of the decline in total VOC emissions.

Total VOC emissions from Road Transport have also been recalculated for the entire time-series from 1990 to 2009, using new VOC emission factors for different types of road vehicles, new annual mileages for light duty trucks and new data on the road type distribution for different vehicle types. The new emission factors were based on new measurements and derived using a new version of the VERSIT+ emission factors model (Ligterink and De Lange, 2009). The new annual mileages for light duty trucks were calculated by Statistics Netherlands based on odometer readings derived from the NAP-register (Nationale AutoPas). In the Netherlands, every time a vehicle goes to a garage for maintenance or repairs, the odometer reading is registered in a national database to prevent tampering. Based on these odometer readings, Statistics Netherlands estimates the annual mileages of different vehicle types. Last year, this method was used to estimate the mileages of light duty trucks.

Goudappel Coffeng (2010) estimated the new road type distribution for different vehicle types. In this study, a national transport model was used to estimate the distribution of total vehicle kilometres travelled over urban roads, rural roads and motorways for passenger cars and light and heavy duty trucks. License plate registrations were used to differentiate these distributions by fuel type and age of the vehicles. The new emission factors, annual mileages and road type distributions are reported in Klein et al. (2011).

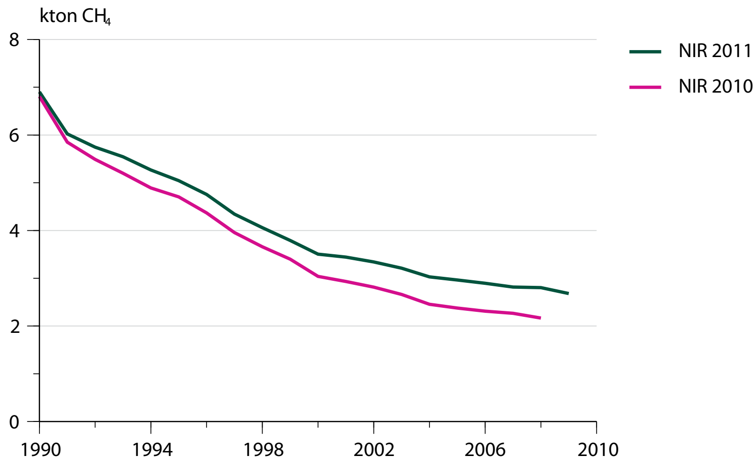
Combined, these new insights led to an increase of total VOC emissions from road transport of 1-3% in earlier years of the time-series (1990 to 1999), whereas the emission estimates for more recent years increased by approximately 6 to 9% compared to the previous estimates. The new VOC emissions factors derived from the VERSIT+ model are t he main cause for this increase. Because of the use of standard mass fractions of CH_4 in total VOC, the increase in total VOC emissions also leads to an increase in CH_4 emissions.

The old and new time-series of CH_4 emissions from 1A3b 'Road Transportation' are shown in Figure 3.10. The increase in CH_4 emissions is small in earlier years of the time-series, but increases in more recent years. The new estimate for 2008 is 29% higher that last year's estimate. The contribution of CH_4 emissions in total greenhouse gas emissions from road transport is still very small though. The new annual mileages for light duty vehicles and the new road type distributions also affect the time-series for N_2O emissions from road transport. Differences between the old and new time-series are very small though, the new time-series being approximately 0-1 % higher that the old time-series.

3.2.8.6 Source-specific planned improvements

In the coming year, the Netherlands plans to improve the fuel sales data for 1A3a 'Aviation' and 1A3c 'Railways'. Currently the fuel sales data for domestic aviation are based on an estimate for the year 2000 that is applied to the entire time-series because of a lack of recent data specifically for domestic aviation. Since 2005 though, a fuel tax is in place for fuel used on domestic flights. Therefore, the Dutch Tax and Customs Administration should have figures that are more reliable on fuel sales for domestic aviation. Statistics Netherlands plans to use these figures, if made available, to make annual estimations of fuel sales to domestic aviation next year.

Figure 3.10 Comparison of old (NIR 2010) and new (NIR 2011) time-series of CH_4 emissions for 1A3b 'Road Transportation'.



Fuel sales to 1A3c 'Railways' are currently obtained from Railways Netherlands (NS). The NS operates the fuel stations for trains in the Netherlands. In a recent research project by ECORYS (2010), the amount of fuel sold to railways was estimated to be higher than what was reported by the NS. Next year, these new insights are compared with the data from NS to try to explain the differences and, if necessary, to make a new estimate of fuel sales to the railways sector.

3.2.9 Other Sectors [1A4]

3.2.9.1 Source category description

Source category 1A4 "Other sectors" comprises the following categories:

- 1A4a 'Commercial and Institutional Services'. This sector comprises commercial and public services such as banks, schools and hospitals, and trade, retail and communication; it also includes the production of drinking water and miscellaneous combustion emissions from waste handling activities and from wastewater treatment plants.
- 1A4b 'Residential'. This sector refers to fuel consumption by households for space heating, water heating and cooking. Space heating requires about three-quarters of the total consumption of natural gas.
- 1A4c 'Agriculture, Forestry and Fisheries'. This sector comprises stationary combustion emissions from agriculture, horticulture, greenhouse horticulture, cattle breeding and forestry, and fuel combustion emissions from fisheries and from off-road machinery used in agriculture (mainly tractors).

CO_2 emissions of 1A4 "Other sectors" increased by 2% in the period 1990–2009 (see figure 3.11). In 2009, CO_2 emissions from 1A4 "Other sectors" increased by 0.4% compared to the 2008 level.

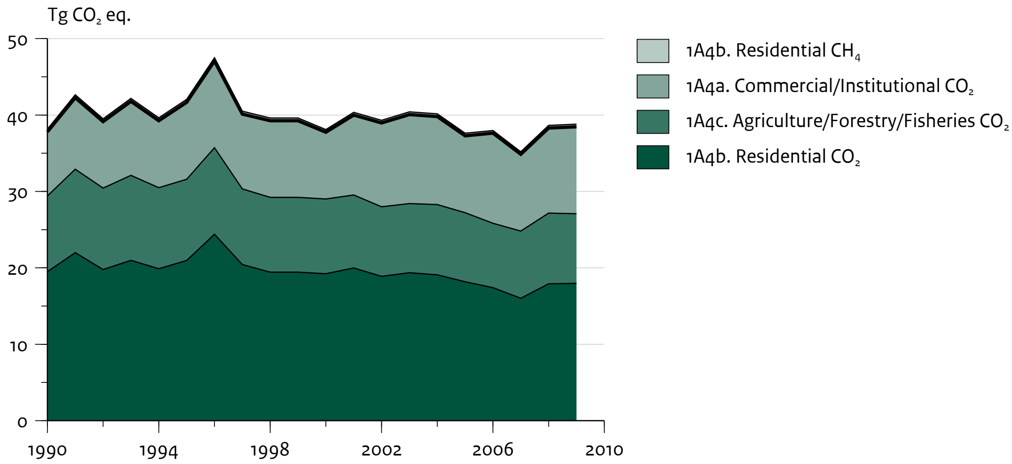
The share of CO_2 emissions from 1A4 "Other sectors" in total national CO_2 equivalent emissions (excluding LULUCF) was about 18% in 1990 and 19% in 2009, respectively. The share of CH_4 emissions from this source category in the national total greenhouse gas emissions is very small (0.7%); the share of N_2O emissions is almost negligible; 1A4b 'Residential' is the main contributor, contributing approximately 9% to the total national CO_2 equivalent emissions.

About 14% of the total CH_4 emissions in the Energy sector originate from the 'Residential' sector (0.3 Tg CO_2 eq, see Table 3.1). Almost 80% of these CH_4 emissions stem from gas combustion in particular from cooking losses; the remainder is from biofuel combustion.

The decreased emissions in 'Agricultural' are due to energy conservation measures in the category of greenhouse horticulture, CO_2 emissions from off-road machinery used in agriculture and from fisheries are included in the total emissions from category 1A4c (total CO_2 emissions from 1A4c: approximately 9 Tg CO_2).

Within this source category, the combustion of gases and liquids form a key source for CO_2 emissions. See Table 3.1 for details.

Figure 3.11 1A4 'Other sectors': trend and emission levels of source categories, 1990-2009.



Commercial / Institutional [1A4a]

The CO_2 emission in the 'Commercial/Institutional Services' sector has increased since 1990 by 36%. However, when a temperature correction is taken into account, the structural, anthropogenic trend shows a somewhat lower increase in this period. The 'Commercial/Institutional Services' sector has grown strongly during this period: the amount of manpower (in man-years) increased by 37% in the period 1990–2009. This increase is roughly comparable with the increase of fuel consumption (excluding electricity) of 39%, and thus of CO_2 emissions.

The emission trends should not be considered to be very robust. The fossil fuel consumption of natural gas and the small uses of liquid and solid fuels in this category show a very large inter-annual variation due to the relatively large inaccuracy of fuel consumption data in the energy statistics. This large inaccuracy is a result of the calculation scheme used in the national energy statistics, which allocates all fossil fuel use remaining after subtraction of the amounts allocated to the previous source categories (1A1, 1A2, 1A3) and other categories (1A4b and 1A4c) to this category. Thus, all uncertainties in the other allocations accumulate in this remaining category, which also results in large inter-annual changes in the underlying fuel mix of solid and liquid fuels. This explains the relatively large inter-annual variation that can be observed in the IEFs of CO_2, CH_4 and N_2O for solid and liquid fuels. As mentioned above, the strong decrease of CO_2 emissions in 2005, and of gas and solids consumption, must be an artefact of the very large uncertainty in the fuel consumption data of this category, which is for natural gas magnified in 2005 by the assumption of almost constant gas consumption in the agricultural category.

For 1991–1994, in particular, the detailed fuel mix assumed for liquid and solids fuels was different from the adjoining years 1990 and 1995 due to the revision of the energy statistics at a high aggregation level (discussed in Section 3.1.1). The biomass combustion reported here refers mainly to the combustion of biogas recovered by waste water treatment plants (WWTP), which shows a rather smooth increasing trend, and biomass consumption by industrial companies, which are classified in this economic sector, for example landfill gas used as fuel. According to the renewable energy statistics, the latter increased substantially in 2005.

Residential [1A4b]

When corrected for the inter-annual variation in temperatures, the trend in total CO_2 – i.e. in gas consumption – becomes quite smooth, with inter-annual variations of less than 5%. The variations are much larger for liquid and solid fuels because of the much smaller figures. The biomass consumption is almost all wood (fuel wood, other wood). For details see the monitoring protocol 11-038 on biomass fuel combustion

The IEF for CH_4 from national gas combustion is the aggregate of the standard emission factor for gas combustion of 5.7 g/GJ plus the 30 g/GJ of total residential gas combustion that represents start-up losses, which occur mostly in cooking but also in central heating and warm water production devices. This second component is neither accounted for in the IPCC default nor in emission factors used by most other countries.

In the 'Residential' sector, CO_2 emissions have remained almost constant since 1990. The structural anthropogenic trend including a temperature correction shows a significant decrease in this period. Although the number of households and residential dwellings increased since 1990, the average fuel consumption per household decreased more, mainly due to the improved insulation of dwellings and the increased efficiency of heating apparatusus (increased use of high-efficient boilers for central heating).

Agriculture / Forestry / Fishing [1A4c]
Most of the energy in this source category is used for space heating and water heating; although some energy is used for cooling. The major fuel used in the categories is natural gas, which accounts for approximately 81% of total fossil fuel consumption; much less liquid fuel is used by off-road machinery and by fisheries. Almost no solid fuels are used in these sectors.

Total CO_2 emissions in the 'Agriculture, Forestry and Fisheries' category have decreased since 1990, mainly due to decrease in gas consumption for stationary combustion as a result of different energy conservation measures (amongst others in the greenhouse horticulture). The surface area of heated greenhouses has increased but their energy consumption has been reduced. It should be noted that about 1 Tg of the CO_2 emissions from the agricultural sector are emissions from cogeneration facilities, which may also provide electricity to the public grid.

In addition, since the fall of 2005 CO_2 from the hydrogen production plant in a refinery is starting to be used for crop fertilisation in greenhouse horticulture, thereby avoiding some CO_2 emissions otherwise generated by CHP facilities merely for producing CO_2 for horticulture. Total annual amounts, however, will be limited to a few tenths of Tg CO_2. In addition, in 2009 production and use of biogas from composting of manure in the 'Agriculture/Forestry/Fisheries' category increased from virtually zero to 0.6 PJ. The CO_2 emissions from off-road machinery in agriculture in 2009 amount to 1.1 Tg, whereas the CO_2 emissions from fisheries amount to about 0.6 Tg. CO_2-emissions from fisheries have shown a decreasing trend in recent years, whereas CO_2-emissions from agricultural machinery have fluctuated in these years. In 2009, the CO_2 emissions from agricultural machinery remained stable compared to 2008.

3.2.9.2 Methodological issues
In this category liquid and gaseous fossil fuels are key sources of CO_2 emissions (in particular, gaseous fossil fuels, which cover about 81% of the source category 1A4). Emissions from the combustion of gases in the categories 1A4a, 1A4b and 1A4c are identified as key sources, as are the emissions from the combustion of liquids in 1A4c. IPCC Tier 2 methodologies are used to calculate greenhouse gas emissions from stationary and mobile combustion in this category. More details on methodologies, the data sources used and country-specific source allocation issues are provided in the monitoring protocols (www.greenhouse-gases.nl).

The activity data for the 'Residential' sector (1A4b) and from stationary combustion in agriculture (1A4c-i) are compiled using data from separate surveys for these categories ('HOME' survey, formerly the 'BAK' and 'BEK' surveys, and LEI). However, due to late availability of the statistics on agricultural fuel use, preliminary data are often used for the most recent year in the national energy statistics. Also, it is likely that trends in agricultural fuel consumption are estimated using indicators that take no account of the varying heating demand due to changes in heating degree days. The fuel consumption data in 1A4a 'Commercial/Institutional Services' is determined by subtracting the energy consumption allocated to the other source categories (1A1, 1A2, 1A3) and other categories (1A4b and 1A4c) from the total energy consumption, which means that resulting activity data are the least accurate of all three categories. The emission factors for CO_2 from natural gas and from diesel fuel are based on country-specific data; for the CH_4 emission factors country specific values are also used, which for the residential gas combustion includes start-up losses, a factor mostly neglected by other countries. For other factors IPCC defaults were used (see Annex 2 and the monitoring protocols on www.greenhousegases.nl).

Emissions from 'Off-road Machinery and Fisheries' in this category (1A4c-ii) are calculated based on IPCC Tier 2 methodologies. The fuel use data is combined with country-specific emission factors for CO_2 and IPCC default emission factors for N_2O and CH_4. Fuel consumption by 'Fisheries' (1A4c-ii) is included in the Netherlands international bunker statistics, which are part of the national energy statistics. However, since the national energy statistics do not separately account for fisheries, it is not possible to use fuel sales figures from the national energy statistics. Instead, the fuel consumption of diesel oil and heavy fuel oil by fisheries is estimated based on statistics of the number of days at sea ('hp-days') of four types of Dutch fishing ships. This information is compiled by LEI, and the estimate includes specific fuel consumption per ship [per day and per unit of power (hp) based on a study of TNO (Hulskotte, 2004b)]. This amount is reported as part of category 1A4c and subtracted from the amount of bunker fuel consumption in the national energy statistics. The modified bunker figures are reported as a Memo item. For more details, see the monitoring protocol 11-010 for Fisheries

Fuel consumption by off-road agricultural machinery is derived from the EMMA model (Hulskotte, 2009). This model is based on sales data for different types of mobile machinery and assumptions on the average use (hours per

Table 3.5 Overview of emission factors used (in 2009) in the Other Sectors [1A4].

Fuel	Amount of fuel used in 2009 (TJ NCV)	Emission factors (g/GJ)		
		CO_2 (x 1000)	N_2O	CH_4
Natural gas	637608	56.6	0.1	97.9
Gas / Diesel Oil	22025	74.3	0.6	5
Other	33211	NA	NA	NA

year) and the fuel consumption (kilogram per hour) for different machine types. It is assumed that only diesel fuel is used by mobile machinery. The use of gasoline and LPG is small and not specifically part of the national energy statistics. Instead it is part of the total use of gasoline and LPG in the transport sector.
An overview of the emission factors used for the most important fuels (up to 95% of the fuel use) in the Other Sectors [1A4] is provided in Table 3.5. Since some emission data is used for individual companies, some of these values represent implied emission factors.

Notes to the implied emission factors:

- The standard CH_4 emission factor for natural gas is 5.7 g/GJ. Only for gas engines, a higher emission factor is used, which explains the higher emission factor for this sector.
- Emission factor for CH_4 and N_2O from gas/diesel oil used in Machinery are based on source specific estimation methods.

More details on emission factors, methodologies, the data sources used and country-specific source allocation issues are provided in the monitoring protocols (see www.greenhousegases.nl).

3.2.9.3 Uncertainties and time-series consistency

It should be noted that the energy consumption data for the total category 1A4 'Other sectors' are much more accurate than the data for the other categories of 1A4. In particular, energy consumption by the commercial/institutional and – to some extent – agricultural categories (in particular the latest year) is monitored less accurately than that by the 'Residential' sector. Trends of emissions and activity data of these categories should be treated with some caution when drawing conclusions. The uncertainty in total CO_2 emissions from this source category is about 6%, with an uncertainty of the composite parts of about 5% for the 'Residential' sector, 10% for the 'Agricultural' sector and 20% for the 'Service' sector (see Section 1.7 and Annex 1 for more details).

The uncertainty in gas consumption data is estimated at 5% for the 'Residential' sector, 10% for 'Agriculture' and 20% for the 'Commercial' sector. An uncertainty of 20% is assumed for liquid fuel use for 'Off-road Machinery and Fisheries' and in the 'Service' sector. Since the uncertainty in small figures in national statistics are generally larger than large numbers, as also indicated by the high inter-annual variability of the data, the uncertainty in solid fuel consumption is estimated to be even higher at 50%. However, the uncertainty of fuel statistics for the *total* 'Other sectors' is somewhat smaller than the data for the sectors: consumption per fuel type is defined as the remainder of total national supply after subtraction of amount used in the 'Energy', 'Industry' and "Transport" sectors. Subsequently, energy consumption by the residential and agricultural sectors is estimated separately using a trend analysis of sectoral data ('HOME' survey of the 'Residential' sector and LEI data for 'Agriculture').

For natural gas the uncertainty in the CO_2 emission factor is now estimated at 0.25% (instead of 1%) based on the recent fuel quality analysis reported by Heslinga and Van Harmelen (2006) and further discussed in Olivier et al. (2009). This reduction in uncertainty did not effect the results of the key source analysis nor the uncertainty in the national emissions. For the CO_2 emission factors for liquids and solids, uncertainties of 2% and 5% were assigned. The uncertainty in CH_4 and N_2O emission factors is estimated to be much higher (about 50% and 100%, respectively).

If the changes made in earlier years are indicative of the quality of the data (see Table 3.22 of NIR 2004 and Table 3.26a of NIR 2005; Klein Goldewijk et al., 2004; 2005). then the uncertainty in total CO_2 emissions from this source category is about 7%, with an uncertainty of the composite parts of 3% for the 'Residential' sector, 15% for the 'Agricultural' sector and 20% for the 'Service' sector. This is in line with the results from the Tier 1 uncertainty analysis.

Since most of the fuel consumption in this source category is used for space heating, the gas consumption from the "Other sectors" varies considerably across years due to variations in winter temperatures over time. For trend analysis a method is used to correct the CO_2 emissions from gas combustion for the varying winter temperatures. This involves the use of the number of heating degree-days under normal climate conditions, which is determined by the long-term trend as explained in Visser (2005).

The deviating IEFs in the 1991–1994 period of CH_4 for liquids and gas and of N_2O for liquids are due to the higher aggregation level used in the revised energy statistics.

3.2.9.4 Source-specific QA/QC and verification

The trends in CO_2 from the three categories were compared to trends in related activity data: the number of households, number of persons employed in the 'Service' sectors and the area of heated greenhouses. Large annual changes were identified in special trend tables and explanations were sought (e.g., inter-annual changes in CO_2 emissions by calculating temperature-corrected trends to identify the anthropogenic emission trends). The trend tables for the IEFs were then used to identify large changes and large inter-annual variations at the category level for which explanations were sought and included in the NIR. More details on the validation of the energy data can be found in the monitoring protocol 11-002: CO_2 , CH_4 and N_2O from 'Stationary Combustion: Fossil Fuels'.

3.2.9.5 Source-specific recalculations

This resubmission includes revised activity data for the wood consumption for woodstoves in category 1A4b. The results from the latest survey (winter 2006-2007) have been interpreted and have been combined with surveys from previous years to recalculate the complete time series. This new method causes for the years 1990-2003, minor changes in the wood consumption figures. For years 2004-2008, the new method causes an increase in wood consumption figures of 11% - 28%, because the latest survey showed that wood consumption has increased during the last few years, while this was not yet included in the wood consumption data for these years. The emissions from this sources changed according the new wood consumption data over the total time series (in order of magnitude of Gg CH_4 emissions, CO_2 is reported under Biomass)

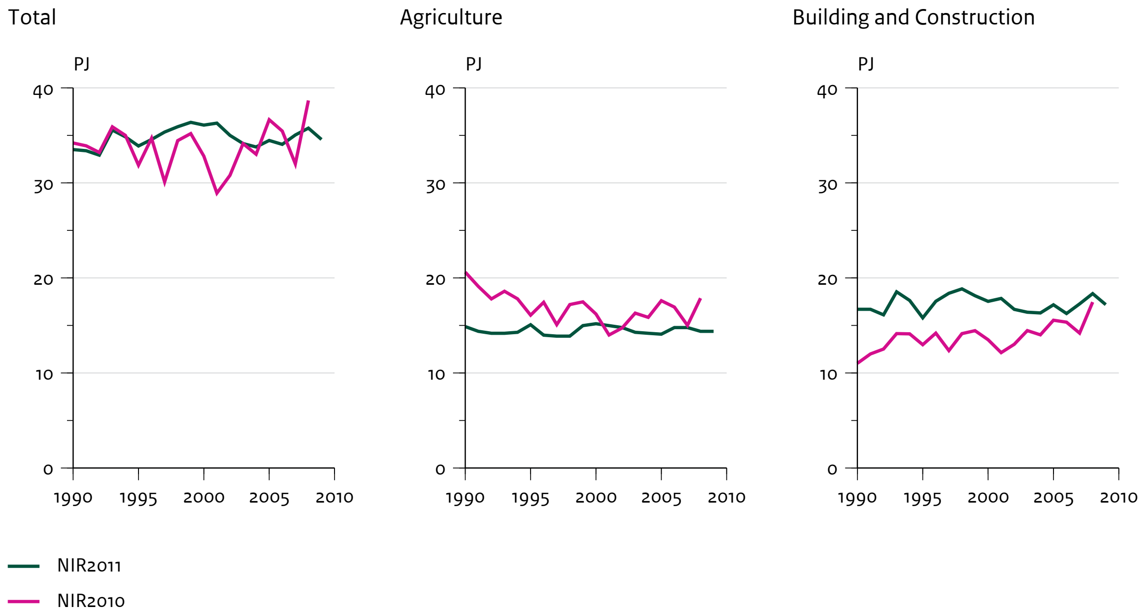
In this year's submission the energy use and greenhouse gas emissions from non-road mobile machinery have been recalculated using a new methodology. In last year's submission, total energy use by non-road mobile machinery in different sectors (e.g. agriculture, industry, building and construction, households, etc.) was calculated by the EMMA model from TNO (Hulskotte and Verbeek, 2009). This model uses sales data and assumptions on the lifetime, average use (hours per year) and fuel consumption (kilogram per hour) for different types of machinery to estimate total fuel consumption and emissions from mobile machinery. The results of the EMMA model were consequently adjusted to make sure total energy use was consistent with national energy statistics from Statistics Netherlands. However, the national energy statistics for non-road mobile machinery showed rather large fluctuations from year to year that did not seem consistent with economic activity data for the different sectors. Therefore, a research project was performed by Statistics Netherlands and TNO to improve the energy use figures for non-road mobile machinery. The project resulted in a new approach to calculate energy use by non-road mobile machinery. Total energy use by is now calculated solely with the EMMA model. Because the EMMA model is based on sales data and assumptions on the average use per year of the machinery, it is not able to properly take into account conjunctural effects that can not only lead to fluctuations in the sales data, but also in the use of machinery. The latter effect is not included in the model, therefore the annual EMMA results are corrected based on economic indicators from Statistics Netherlands for the specific sectors where the machinery is used. The adjusted EMMA results are used for the total energy use of non-road mobile machinery.
The new methodology leads to a more consistent time-series for the total energy use by non-road mobile machinery. In the old time-series total energy use by mobile machinery fluctuated between 29 and 39 PJ, whereas in the new time-series total energy use fluctuates between 33 and 37 PJ, see Figure 3.12. The differences between the new and the old time-series fluctuate from year to year.

The distribution of total energy use to different sectors (e.g. agriculture (1.A.4), industry, building and construction (1.A.2)) is estimated using different data sources. Total energy use by non-road mobile machinery in the agricultural sector (excluding agricultural contractors) is derived from LEI. Energy use by agricultural contractors is derived from CUMELA, the trade organisation for agricultural contractors in the Netherlands. Total energy use as reported by LEI and CUMULA is lower than the agricultural energy use calculated by EMMA. An explanation for this could be that some agricultural machinery (e.g. tractors) is frequently used in construction. In the EMMA model, which is based on machine types, this energy use is reported under agriculture. In the new approach this energy use is (properly) reported under construction industries. This leads to adjustments of the time-series for both agricultural and industrial machinery, see Figure 3.12. Total energy use by agricultural machinery is lower than previously reported, whereas total energy use by industrial machinery (including building and construction) is higher. Above changes in fuel use has been compensated in the commercial/institutional sector (1A4a). The total amount of fuel use in 1A4 remained stable, but the allocation to 1A4a and 1A4c changed.

3.2.9.6 Source-specific planned improvements,

There are no source-specific recalculations envisaged.

Figure 3.12 Comparison of old (NIR2010) and new (NIR2011) time-series of fuel use for the different off road sectors.



3.2.10 Other [1A5]

3.2.10.1 Source category description

Category 1A5 'Others' includes the emissions from military ships and aircraft (in 1A5b). This category is a key source. CO_2 emissions from this source category are approximately 0.4 Tg, with some inter-annual variation caused by different levels of operations, including fuel use for multilateral operations, which are included here. Emissions of CH_4 and N_2O are negligible.

The emission factors used are presented in Table 3.6.

Table 3.6 Emission factors used for military marine and aviation activities (g/GJ) [1].

Category		CO_2	CH_4	N_2O
Military ships	Emission factor	75.25	2.34	1.87
Military aviation	Emission factor	72.9	5.8	10
Total	Emissions in 2009 (Gg)	392.32	0.04	0.02

[1] Source: Hulskotte, 2004b.

3.2.10.2 Methodological issues

A country-specific top-down (Tier 2) method is used for calculating the emissions for fuel combustion from 1A5 'Others'. The fuel combustion emissions in this sector are calculated using fuel consumption data for both shipping and aviation that have been obtained from the Ministry of Defence and are the total emissions for domestic military shipping and aviation activities and the so-called multilateral operations. The fuel data for aviation consist of a mixture of jet kerosene, F65 and SFC. In the national energy statistics these activity data are included in the bunker fuel consumption. The sector-specific emission factors that are used are those reported by the Ministry of Defence. The methodology and data sources for the calculation of these emissions can be found on the website www.greenhousegases.nl.

3.2.10.3 Uncertainties and time-series consistency

The uncertainty in CO_2 emissions from fuel combustion from 1A5 'Others' is estimated to be about 20% in annual emissions. The uncertainty for CH_4 and N_2O emissions is estimated to be about 100%. The accuracy of fuel consumption data is tentatively estimated at 20%. For emission factors, the uncertainties were estimated at 2% for CO_2 and 100% for CH_4 and N_2O.

A consistent methodology is used throughout the time-series. The time-series consistency of the activity data is good due to the continuity in the data provided.

3.2.10.4 Source-specific QA/QC and verification

This source category is covered by the general QA/QC procedures discussed in Chapter 1.

3.2.10.5 Source-specific recalculations
There have been no source-specific recalculations.

3.2.10.6 Source-specific planned improvements,
There are no source-specific planned improvements.

3.3 Fugitive emissions from fuels [1B]

This source category includes fuel-related emissions from non-combustion activities in the energy production and transformation industries:
- 1B1 'Solid Fuels' (coke manufacture)
- 1B2 'Oil and Gas' (production. gas processing, hydrogen plant, refineries, transport, distribution).

The contribution of emissions from source category 1B to the total national greenhouse gas emissions inventory was 1.3% in 1990 and 1.2% in 2009.
Table 3.1 shows that total greenhouse gas emissions in 1B decreased from 2.9 Tg to 2.4 Tg. between 1990 and 2009.

3.3.1 Solid fuels [1B1]

3.3.1.1 Source category description
Fugitive emissions from this category refer mainly to CO_2 from 1B1b 'Coke Manufacture' (see Table 3.1). The Netherlands currently has only one on-site coke production facility at the iron and steel plant of Tata Steel. A second independent coke producer in Sluiskil discontinued its activities in 1999. The fugitive emissions of CO_2 and CH_4 from both coke production sites are included here.
There are no fugitive emissions from coal mining and handling activities (1B1a) in the Netherlands; these activities ceased with the closing of the last coal mine in the early 1970s.

With respect to fugitive emissions from 'Charcoal Production', the Netherlands has one large state of the art production location that serves most of the Netherlands and also occupies a large share of the market of our neighbouring countries. These emissions are presently not accounted for. Recent research showed only minor CH_4 emissions of the plant due to the abatement technology used. Because no activity data is available on a regular basis we do not foresee inclusion of this minor source in the inventory.

Table 3.1 shows that the CO_2 emissions in 1B1 remained rather stable between 1990 and 2009.

3.3.1.2 Methodological issues
The CO_2 emissions related to transformation losses (1B1) from *coke ovens* are based on national energy statistics of coal inputs and coke and coke oven gas produced and a carbon balance of the losses. The completeness of the accounting in the energy statistics of the coke oven gas produced is not an issue, since the not-captured gas is by definition included in the net carbon loss calculation used for the process emissions.
Detailed information on activity data and emission factors can be found in the monitoring protocols on the website www.greenhousegases.nl.

3.3.1.3 Uncertainties and time-series consistency
For emissions from 'Coke Production' (included in 1B1b) the uncertainty in annual CO_2 emissions from this source category is estimated to be about 50%. This uncertainty refers to the precision with which the mass balance calculation of carbon losses in the conversion from coking coal to coke and coke oven gas can be made (for details, see Olivier et al., 2009).

The methodology used to estimate emissions from solid fuel transformation is consistent throughout the time-series.

3.3.1.4 Source-specific QA/QC and verification
No source-specific QA/QC and verification.

3.3.1.5 Source-specific recalculations
There have been no source-specific recalculations in comparison to the previous submission.

3.3.1.6 Source-specific planned improvements
No source-specific improvements planned.

3.3.2 Oil and Natural Gas [1B2]

3.3.2.1 Source category description
The fugitive emissions from category 1B2 comprise:
- non-fuel combustion emissions from flaring and venting (CO_2, CH_4)
- emissions from oil and gas production (CO2, CH4);
- emissions from oil and gas transport (compressor stations(CO2, CH4)
- gas distribution networks (pipelines for local transport) (CO_2, CH_4)
- oil refining (CH_4)
- hydrogen plant (CO_2).

The fugitive CO_2 emissions from refineries are included in the combustion emissions reported in category 1A1b. In addition, the combustion emissions from exploration and production are reported under 1A1c.

From the 2007 submission the Process emissions of CO_2 from a hydrogen plant of a refinery (about 0.9 Tg CO_2 per year) are reported in this category. Refinery data specifying these fugitive CO_2 emissions are available from 2002 onwards (environmental report from the plant) and re-allocated from 1A1b to 1B2a-iv for 2002 onwards. CO_2 from gas flaring (including the venting of gas with high carbon dioxide content) and methane from gas venting/flaring are identified as key sources (see Table 3.1).

Gas production of which about 50% is exported, and gas transmission varies according to demand - in cold winters, more gas is produced – which explains the peak in 1996. The length of the gas distribution network is still gradually expanding as new neighbourhoods are being built; mostly using PVC and PE, which are also used to replace cast iron pipelines (see Table 3.44 in NIR 2005). The IEF for gas distribution gradually decreases as the share of grey cast iron pipelines decreases due to gradual replacement and expansion of the network. The present share is about 5%; in 1990 this was still 11%.

There is very little oil production in the Netherlands. The emission factors of CO_2 and CH_4 from oil and gas production, in particular for venting and flaring, have been reduced significantly and are now about 25% of the 1990 level. This is due to the implementation of environmental measures to reduce venting and flaring by optimizing the utilisation of energy purposes of produced gas that was formerly wasted.

The CO_2 emissions from the hydrogen plant remained rather stable between 2002 and 2009. The emissions from oil and gas transport and gas distribution networks remained rather stable between 1990 and 2009.

3.3.2.2 Methodological issues

Country-specific methods comparable with the IPCC Tier 3 method are used to estimate the emission of fugitive CH_4 and CO_2 emissions from 'Oil and Gas Production and Processing' (1B2) (Grontmij, 2000). The emissions for CH_4 from gas venting and flaring are plant-specific.

The IPCC Tier 3 method for CH_4 from 'Gas Distribution' due to leakages (1B2) is based on two country-specific emission factors: 610 m^3 (437 Gg) methane per 1000 km of pipeline for grey cast iron, and 120 m^3 (86 Gg) per 1000 km of pipeline for other materials. The emission factors are based on seven measurements of leakage per hour on grey cast iron at one pressure level and on 18 measurements at three pressure levels for other materials (PVC, steel, nodular cast iron and PE) and subsequently aggregated to factors for the material mix in 2004. From 2004 onwards, the gas distribution sector annually records the number of leaks found per material, and any future possible trends in the emission factors are derived from these data. Fugitive emissions of methane from refineries in category 1B2 are based on a 4% share in total VOC emissions reported in the annual environmental reports of the Dutch companies (Spakman et al., 2003). For more information, see the monitoring protocols available on www.greenhousegases.nl.

3.3.2.3 Uncertainty and time-series consistency

The uncertainty in CO_2 emissions from gas flaring and venting is estimated to be about 50%, while the uncertainty in methane emissions from oil and gas production (venting) and gas transport and distribution (leakage) is estimated to be 25% and 25% in annual emissions, respectively. The uncertainty in the emission factor of CO_2 from gas flaring and venting (1B2) is estimated at 2%. This uncertainty takes the variability in the gas composition of the smaller gas fields into account for flaring. For venting, this uncertainty accounts for the high amounts of CO_2 gas produced at a few locations, which is then processed and the CO_2 extracted and subsequently vented. For CH_4 from fossil fuel production (gas venting) and distribution, the uncertainty in the emission factors is estimated to be 25% and 50%, respectively. This uncertainty refers to the changes in reported venting emissions by the oil and gas production industry over the past years and to the limited number of measurements made of gas leakage per leak for different types of materials and pressures, on which the Tier 2 methodology for methane emissions from gas distribution is based.
A consistent methodology is used to calculate emissions throughout the whole time-series.

3.3.2.4 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures which are discussed in Chapter 1.

3.3.2.5 Source-specific recalculations

In reaction to the 2010 review the Dutch inventory now includes the emissions from oil transport in pipelines. The national emissions increased by approximately 5 Gg CO_2 eq for the complete time series.

3.3.2.6 Source-specific planned improvements

There is no source specific improvement planned.

4 Industrial processes [CRF Sector 2]

Major changes in sector 2 Industrial Processes compared to the National Inventory Report 2010

Emissions:	Despite the economic crisis, the total greenhouse gas emissions in this sector remained in 2009 almost at the same level as in 2008. Because more detailed information on activity data of Stationary refrigeration (HFC emissions), Mobile air conditioning (HFC emissions), new SF_6 emissions from the source Electrical equipment and several minor CO_2 and CH_4 sources came available, the emissions of these sources have been changed for a number of years.
Key sources:	2B5 Caprolactam production N_2O (L1) was added as a key source compared to the previous submission (NIR 2010)
Methodologies:	There have been no methodological changes in this sector
Descriptions:	In response to the ERT report 2010, a detailed description that explains in a transparent manner the significant reduction in N_2O emissions from nitric acid production in 2007 and 2008, is included in paragraph 4.3.3.

4.1 Overview of sector

Emissions of greenhouse gases in this sector include all non-energy-related emissions from industrial activities (including construction) and all emissions from the use of the F-gases HFCs, PFCs and SF_6 (including their use in other sectors). Please note that due to the specific Dutch estimation methods and absence of required activity data, only the actual emissions of F-gases can be estimated in detail. The potential emissions cannot be calculated in the detail which is required in the CRF (therefore the potential emissions from the CRF are not correct). In Table 4.1 the correct aggregated estimates of the potential emissions from refrigeration and air conditioning (the main source of F-gases) are given. In comparison with last submission some missing data have been added and several corrections have been made.

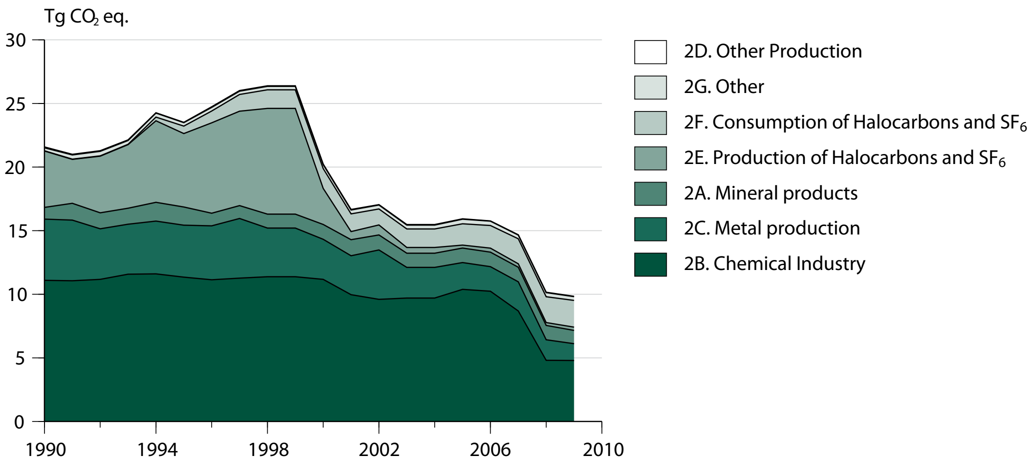
Greenhouse gas emissions from fuel combustion in industrial activities are included in the Energy sector. Fugitive emissions of greenhouse gases in the Energy sector (not relating to fuel combustion) are included in IPCC category 1B Fugitive emissions. The main categories (2A–G) in the CRF sector 2 Industrial processes are discussed in the following Sections.

The following protocols on www.greenhousegases.nl describe the methodologies applied for estimating

Table 4.1 Aggregated estimate of the potential emissions (Units: Gg CO_2 eq).

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
HFC-134a	190	428	763	1,113	1,404	1,922	2,375	2,864	3,294	3,737	4,129	4,599	4,942	5,226	5,426	5,598
HFC-125		50	149	238	342	517	729	965	1,165	1,407	1,669	1,819	2,032	1,223	2,375	2,512
HFC-143a		34	115	200	308	460	658	874	1,031	1,246	1,439	1,620	1,803	1,982	2,120	2,237
HFC-32		23	77	119	160	171	245	268	285	311	335	363	398	413	400	396
Unspecified HFCs							481	1,185	1,874	2,591	3,283	3,949	4,585	5,188	5,786	6,159
Sum	190	535	1,104	1,670	2,214	3,541	5,439	7,785	9,994	12,353	14,557	16,772	18,816	20,691	22,366	23,532

Figure 4.1 Sector 2 'Industrial processes': trend and emission levels of source categories, 1990-2009.



emissions of CO_2, CH_4, N_2O and F-gases of Industrial processes in the Netherlands:

- Protocol 11-003: CO_2, CH_4 and N_2O from Process emissions: fossil fuels
- Protocol 11-014: CO_2, CH_4 and N_2O from Process emissions and product use
- Protocol 11-015: N_2O from Nitric acid production (2B2)
- Protocol 11-016: N_2O from Caprolactam production (2B5)
- Protocol 11-017: PFCs from Aluminum production (2C3)
- Protocol 11-018: HFC23 from HCFC22 production (2E1)
- Protocol 11-019: HFCs from Handling (2E3)
- Protocol 11-020: HFCs from Stationary refrigeration (2F1)
- Protocol 11-021: HFCs from Mobile air conditioning (2F1);
- Protocol 11-022: HFCs from Foams (2F2)
- Protocol 11-023: HFCs from Aerosol (2F4);
- Protocol 11-026: SF_6 from Electrical equipment (2F8)
- Protocol 11-025: SF_6 and PFCs from Semiconductor manufacturing (2F7)
- Protocol 11-024: SF_6 from Sound-proof windows (2F9).

Key sources

The key sources in this sector are presented in Table 4.2. Annex 1 presents all sources identified in the Industrial processes sector in the Netherlands. Caprolactam production (N_2O) is added as a key source (L1), compared to the previous submission. Nitric Acid production is a key source at both the Tier 1 and 2 level, due to the reduction achieved in this category. Other key sources are CO_2 emissions from Ammonia production, CO_2 emissions from steel and aluminum production, HFC emissions from Substitutes for ozone-depleting substances and the production of HCFC-22. Also, the Manufacture of other chemical products is a key source for CO_2.

Overview of shares and trends in emissions

Figure 4.1 and Table 4.2 show the trends in total greenhouse gas emissions from the sector Industrial processes.

Table 4.2 Contribution of the main categories and key sources in CRF sector 2 Industry.

Sector/category	Gas	Key	Emissions in base year	Emissions in 2008	Emissions in 2009	Change 2009 - 2008	Contribution to total in 2009 (%)		
		Level, Trend	Tg CO_2 eq	Tg CO_2 eq	Tg CO_2 eq	Tg CO_2 eq	By sector	Of total gas	Of total CO_2 eq
2 Industry	CO_2		7.9	6.5	6.1	-0.4		4%	3%
	CH_4		0.3	0.3	0.3	0.0		1.6%	0.1%
	N_2O		7.1	1.0	1.1	0.1		11%	0.5%
	HFC		6.0	1.9	2.1	0.2		100%	1%
	PFC		1.9	0.3	0.2	-0.1		100%	0.1%
	SF_6		0.3	0.2	0.2	0.0		100%	0.1%
	All		23.5	10.2	9.9	-0.3			5%
2A. Mineral Products	CO_2		0.9	1.1	1.0	-0.1	11%	0.6%	0.5%
2B. Chemical industry	CO_2		3.7	3.5	3.5	0.0	35%	2.1%	2%
	N_2O		7.1	1.0	1.1	0.0	11%	11%	0.5%
	All		11.1	4.8	4.8	0.0	48%		2.4%
2B1 Emissions from ammonia production	CO_2	L1	3.1	2.9	2.9	0.0	29%	2%	1.4%
2B2 Emissions from nitric acid production	N_2O	T	6.3	0.6	0.4	-0.1	5%	5%	0.2%
2B5 Emissions from caprolactam production	N_2O	L1	0.8	0.5	0.6	0.1		6%	0.3%
2B5 Other chemical product manufacture	CO_2	L1	0.6	0.7	0.7	0.0	7%	0.4%	0.3%
2C. Metal Production	CO_2		2.9	1.5	1.3	-0.3	13%	0.8%	0.6%
	PFC		1.9	0.07	0.03	-0.03	0.4%	25%	0.02%
	All		4.8	1.6	1.3	-0.3	13%		0.7%
2C1 Iron and steel production (carbon inputs)	CO_2	L1,T1	2.5	1.1	1.1	0.0	11%	0.6%	0.5%
2C3 PFC emissions from aluminium production	PFC	T	1.9	0.07	0.03	-0.03	0.4%	25%	0.02%
2D. Food and drink production	CO_2		0.1	0.03	0.03	0.00	0.3%	0.02%	0.01%
2E. Production of halocarbons and SF_6	HFC		5.8	0.2	0.3	0.0	3%	13%	0.1%
2E1 HFC-23 emissions from HCFC-22 manufacture	HFC	T	5.8	0.2	0.2	-0.1	2%	8%	0.1%
2F. Consumption of Halocarbons and SF6	HFC	L,T	0.2	1.7	1.8	0.1	18%	87%	0.9%
	PFC		0.0	0.2	0.1	-0.1	1%	75%	0.1%
	SF_6		0.3	0.2	0.2	0.0	2%	100%	0.1%
	All		0.6	2.0	2.1	0.1	18%		1.1%
2G. Other	CO_2		0.2	0.3	0.3	0.0	3%	0.2%	0.1%
	N_2O		0.0	0.01	0.01	0.00	0.1%	0.1%	0.01%
	All			0.3	0.3	0.0	3%		0.1%
National Total GHG emissions (excl. CO_2 LULUCF)	CO_2		159.3	175.3	169.8	-5.5			
	CH_4		25.5	17.0	16.9	-0.1			
	N_2O		20.1	9.9	9.7	-0.2			
	HFCs		6.0	1.9	2.1	0.2			
	PFCs		1.9	0.3	0.2	-0.1			
	SF_6		0.3	0.2	0.2	0.0			
	All		213.2	204.6	198.9	-5.7			

* Base year for F-gases (HFCs, PFCs and SF_6) is 1995

In 2009, Industrial processes contributed 5% to the total national greenhouse gas emissions (without LULUCF) in comparison to 11% in the base year. The sector is a major source of N_2O emissions in the Netherlands, accounting for 11% of the national total N_2O emissions.

Compared to the base year, total CO_2 equivalent greenhouse gas emissions of the sector declined by 13.7 Tg to 9.9 Tg CO_2 eq in 2009 (–58%). CO_2 emissions from Industrial processes decreased 22% during the period 1990–2009. N_2O emissions decreased 85% in the same period. Total emissions of fluorinated gases (F-gases) have been strongly reduced.

In 2009, total greenhouse gas emissions of the sector remained almost at the same level as in 2008 (10.2 Tg CO_2 eq in 2008 versus 9.9 Tg CO_2 eq in 2009). CO_2 emissions decreased by 0.4 Tg, HFC emissions showed an increase of 0.17 Tg CO_2 eq and PFC emissions decreased by 0.08 Tg CO_2 eq, while N_2O and SF_6 emissions remained at the same level as the previous year.

Category 2B Chemical industry contributes most to emissions from this sector. Compared to the base year, total CO_2 equivalent greenhouse gas emissions of this category declined by 6.3 Tg to 4.8 Tg CO_2 eq in 2009 (–58%)

4.2 Mineral products [2A]

4.2.1 Source category description

General description of the source categories

This category comprises emissions of greenhouse gases related to the production and use of non-metallic minerals in:

- 2A1 Cement clinker production: CO_2 emissions;
- 2A3 Limestone and dolomite use: CO_2 emissions;
- 2A4 Soda ash production and use: CO_2 emissions;
- 2A7 Other (the production of glass and other production and use of minerals): CO_2 emissions.

CO_2 emissions from 2A5 Asphalt roofing and 2A6 Road paving with asphalt are not estimated. For more information see Annex 5.

4.2.2 Key sources

There are no key sources identified from this source category.

4.2.3 Overview of shares and trends in emissions

Total CO_2 emissions in category 2A increased from 0.9 Tg in 1990 to 1.1 Tg in 2008 (see Table 4.2). The increased emissions during the period 1990-2008 are related to the increased production levels during that period. As a result of the credit crunch the production levels decreased in 2009. For that reason, the emissions decreased to 1.0 Tg in 2009.

4.2.4 Activity data and (implied) emission factors

Detailed information on activity data and emission factors can be found in the monitoring protocols on the website www.greenhousegases.nl.

Activity data are based on the following sources:

- Cement clinker production: the environmental reports (MJVs) of the single Dutch company are used.
- Limestone and dolomite use: environmental reports are used for emission data. Activity data on plaster production for use in desulphurising installation for power plants are based on the environmental reports of the coal-fired power plants. Data on the consumption of limestone and dolomite are based on statistical information obtained from Statistics Netherlands (CBS) and can be found on the website www.cbs.nl.
- Soda ash production and use: the environmental reports for data on the non-energy use of coke are used. For activity data on soda use, see following bullet Glass production.
- Glass production: activity data are based on data from Statistics Netherlands (CBS) and the trade organisation.

The following emission factors (EF) are used to estimate the CO_2 emissions from the different source categories:

- Cement clinker production: Because of changes in raw material composition it is not possible to estimate reliable CO_2 process emissions by calculating the clinker production (as AD) by a default EF. For that reason the company has chosen to base the calculation of CO_2 emissions on the carbonate content of the process input. For more information, see Section 4.2.2
- Limestone use: EF= 0.440 t/t (IPCC default)
- Dolomite use: EF= 0.477 t/t (IPCC default)
- Soda ash production: EF= 0.415 t/t (IPCC default)
- Glass production: Plant-specific EFs have been used for the years 1990 (0.13 t CO_2 /t glass), 1995 (0.15 t CO_2 /t glass) and 1997 (0.18 t CO_2 /t glass). For other years in the time series, there were not enough data available to calculate plant-specific EFs. For the missing years 1991-1994 and 1996, EFs have been estimated by interpolation. Because no further measurement data are

available, the emission factor for 1998–2009 is kept at the same level as the EF of 1997 (0.18 t CO_2 /t glass).

4.2.5 Methodological issues

For all the source categories, country-specific methodologies are used to estimate emissions of CO_2, in compliance with the IPCC Good Practice Guidance (IPCC, 2001). More detailed descriptions of the methods used and emission factors are found in Protocols 11-003 and 11-014 on www.greenhousegases.nl, as indicated in Section 4.1.

- 2A1 Cement clinker production: the CO_2 process emissions from this source category are fromce 2002 based on (measured) data reported by the single company in the Netherlands that produces clinkers. The methodology for measurements and for calculating emissions can be described as follows:
  The first carbonate input in the kiln is the raw material. The CO_2 emission is calculated on a monthly basis by multiplying the amount of raw material by a derived process EF. From every batch in a month a sample is taken just before the raw material is fed to the kiln. The process EFs and composition data for batches of raw material are determined in a laboratory. The EF is determined by measuring the weight loss of the sample (excluded the amount of organic carbon). The monthly EF is set as the average of all sample EFs determined that month. The second carbonate input in the kiln is sewage sludge. Also the CO_2 emission from this source is calculated monthly by multiplying the amount of sewage sludge by the monthly derived process EF.
  Besides the CO_2 emissions resulting from calcination of the carbonate input in the kiln, the company considers the CO_2 emission from the burning off the small amount of organic carbon in the raw material as a process emission. As a result, the total yearly process emissions of the company is the sum of all monthly emissions of the following sources:
  A. CO_2 from the calcination of the carbonate input of the raw material, marl;
  B. CO_2 from the calcination of the carbonate input of sewage sludge;
  C. CO_2 from the burning of organic carbon in the raw material.
  Before 2002 only total CO_2 emissions from the environmental annual report are available. Because no detailed information is available for that period, it is not possible to split the total CO_2 emissions. Therefore, for that period, the CO_2 process emissions have been calculated by multiplying the average IEF of 2002 and 2003 by the clinker production.
  CO_2 process emissions from the environmental report related to clinker production figures give the implied CO_2 emission factor (IEF) for clinker production
  Table 4.3 shows the trend in the implied CO_2 emission factor (IEF) for clinker production during the period 2002–2009 (IPCC Default = 0.51 t/t clinker).

Table 4.3 Implied emission factor for CO_2 from clinker production (Units: t/t clinker) (2A1) .

Gas	2002	2003	2004	2005	2006	2007	2008	2009
CO_2	0.54	0.54	0.54	0.52	0.51	0.48	0.48	0,52

  There is a monitoring protocol applied for emissions trading (this protocol is approved by the Netherlands Emission authority (NEa); the Government organisation responsible for emission trading (ETS) in the Netherlands) This organisation is also responsible for the verification of the reported data from the company that produces clinkers.
- 2A3 Limestone and dolomite use: the CO_2 emissions from this source category are based on consumption figures for limestone use – derived from plaster production figures – for flue gas desulphurisation (FGD) with a wet process by coal-fired power plants and for apparent dolomite consumption (mostly used for road construction). No activity data are available to estimate other sources of limestone and dolomite use.
- 2A4 Soda ash production and use: only one company in the Netherlands is producing soda ash using the Solvay process. CO_2 emissions are calculated based on the non-energy use of coke, assuming the 100% oxidation of carbon.
- 2A7 Other: CO_2 emissions from this source category refer to Glass production. Emissions are estimated based on gross glass production data and a country-specific emission factors.

4.2.6 Uncertainties and time-series consistency

Uncertainties

The Tier 1 uncertainty analysis in Annex 7 shown in Tables A7.1 and A7.2 provides estimates of uncertainties according to IPCC source category.

Uncertainty estimates used in the Tier 1 analysis are based on the judgment of experts since no detailed information is available for assessing the uncertainties of the emissions reported by the facilities (Cement clinker production, Limestone and dolomite use and Soda ash production). The uncertainty in CO_2 emissions from cement production is estimated to be approximately 10% in annual emissions; for Limestone/dolomite use and other sources the uncertainty is estimated to be 25%, based on the relatively high uncertainty in the activity data.

Activity data for Soda ash use, Glass production and Limestone and dolomite use are assumed to be relatively uncertain (25%). The uncertainties of the IPCC default emission factors used for some processes are not assessed. However, as these are, minor sources for CO_2 this was not given any further consideration.

Time-series consistency

Consistent methodologies have been applied for all source categories. The time series involve a certain amount of extrapolation with respect to the activity data for *Soda ash use*, thereby introducing further uncertainties in the first part of the time series of this source.

4.2.7 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedure discussed in Chapter 1.

4.2.8 Source-specific recalculations

Because more detailed information on activity data for the sources Limestone use for flue gas desulphurisation (FGD), soda ash use and Glass production, came available, the emissions of these sources changed for a number of years. The change amounts to -3 Gg CO_2 for the categories under 2A in 2008.

4.2.9 Source-specific planned improvements

There are no source-specific improvements planned.

4.3 Chemical industry [2B]

4.3.1 Source category description

The national inventory of the Netherlands comprises emissions of greenhouse gases related to four source categories as belonging to this category:

- 2B1 Ammonia production: CO_2 emissions: in the Netherlands, natural gas is used as feedstock for ammonia production. CO_2 is produced as a by-product during the chemical separation of hydrogen from the natural gas. During the process of ammonia (NH_3) production, hydrogen and nitrogen are combined to react together to manufacture ammonia. Only prompt process emissions from the ammonia/urea production are included in this source category. Emissions from the use of urea in domestic agricultural activities are included in category 5C (see Chapter 7).
- 2B2 Nitric acid production: N_2O emissions: the production of nitric acid (HNO_3) generates nitrous oxide (N_2O) as a by-product of the high-temperature catalytic oxidation of ammonia. Until 2010 three companies, each with two HNO_3 production plants, were responsible for the N_2O emissions from nitric acid production in the Netherlands. Two plants of one company were closed in 2010 and one of these has been moved to one of the other companies. So, at this moment (2010) two companies, one with three and one with two HNO_3 production plants are responsible for the N_2O emissions from nitric acid production in the Netherlands.
- 2B4 Carbide production: CH_4 emissions: petrol cokes are used during the production of silicon carbide; the volatile compounds in the petrol cokes form CH_4.
- 2B5 CO_2 and N_2O emissions from Other chemical product manufacture:
  - Industrial gas production: hydrogen and carbon monoxide are produced mainly from natural gas used as chemical feedstock, but they can also be produced from petroleum coke and coke, during which processes CO_2 is produced.
  - Carbon electrode production: carbon electrodes are produced from petroleum coke and coke used as feedstock, during which processed CO_2 is produced.
  - Activated carbon production: Norit is one of world's largest manufacturers of activated carbon, for which peat is used as carbon source and CO_2 is produced as by-product.
  - Caprolactam production: N_2O emissions result from the production of caprolactam.
  - Ethylene oxide production: CO_2 emissions result from the production of ethylene oxide.

Adapic acid (2B3) and calcium carbide (included in 2B4) are not produced in the Netherlands. CO_2 emissions resulting from the use of fossil fuels as feedstocks for the production of silicon carbide, carbon black, ethylene and methanol are included in the Energy sector (1A1a and 1A2c; see Sections 3.2.1. and 3.3.1. for more details).

4.3.2 Key sources

"Ammonia production" , "Caprolactam production" and "Other chemical product manufacture" are identified as key-sources for CO_2 emissions. Since 2008 Nitric acid production is no longer a Tier 2 level key source for N_2O emissions. Due to the emission reduction in 2007 and 2008, it is devaluated to a trend key source (see Table 4.2).

4.3.3 Overview of shares and trends in emissions

Figure 4.2 shows the trend in CO_2 equivalent emissions from 2B 'Chemical industry' in the period 1990–2009. Table 4.2 gives an overview of shares in emissions of the main categories.

Emissions from this category contributed 5% to the total national greenhouse gas emissions (without LULUCF) in the base year and 2% in 2009. Caprolactam and Nitric acid production are the most important sources of N_2O emissions from industrial processes in the Netherlands.

Figure 4.2 2B 'Chemical industry": trend and emission levels of source categories, 1990-2009.

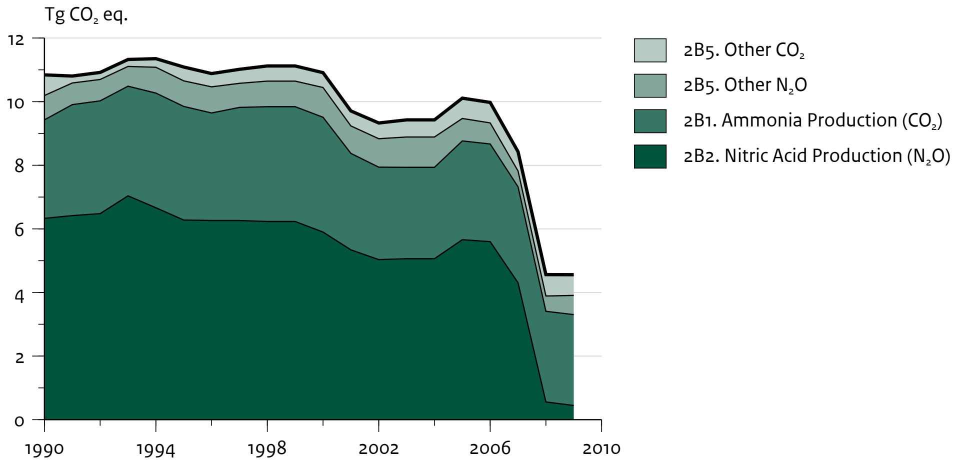


Table 4.4 Trend in N_2O emissions from Chemical industry processes (2B) (Units: Gg CO_2 eq).

	1990	1995	2000	2005	2006	2007	2008	2009
B2. Nitric acid production	6,330	6,278	5,898	5,659	5,597	4,305	558	447
B5. Other	766	805	936	705	662	497	481	603
Total	7,096	7,083	6,834	6,364	6,259	4,802	1,039	1,050

The contribution of N_2O emissions from 2B 'Chemical industry' was 3% of the total national greenhouse gas emission inventory in the base year and 0.5% in 2009.

From 1990 to 2008, total greenhouse gas emissions in 2B 'Chemical industry' decreased by 57% or 6.3 Tg CO_2 eq, mainly due to reduction of N_2O emissions from the production of nitric acid. In 2009, total greenhouse gas emissions in 2B 'Chemical industry' remained at the same level as in 2008..

Table 4.4 shows that N_2O emissions from the chemical industry remained rather stable between 1990 and 2000 – when there was no policy aimed at controlling these emissions.

2B2. Nitric acid production

Until 2002, N_2O emissions from nitric acid production were based on default IPCC emission factors. N_2O emission measurements made in 1998 and 1999 have resulted in a new emission factor of 7.4 kg N_2O/ton nitric acid for the total nitric acid production. Plant specific emission factors for the period 1990-1998 are not available. Because no measures haven been taken and the operation conditions did not change during the period 1990-1998, the emission factors obtained from the measurements have been used to recalculate the emissions for the period 1990-1998. Technical measures (optimised the platinum-based catalytic convertor alloys) implemented at one of the nitric acid plants in 2001 resulted in an emission reduction of 9% compared to 2000. The decreased emission level in 2002 compared to 2001 is related to the decreased production level of nitric acid in that year. In 2003, emissions and production did not fluctuate, whereas in 2004 the increased emission level is once again related to the marked increase in production. In 2005 and 2006, the N_2O emissions of the nitric acid plants remained almost at the same level as in 2004.

Technical measures implemented at all nitric acid plants in the third quarter of 2007 resulted in an emission reduction of 23% compared to 2006. In 2008, the full effect –a reduction of 90% compared to 2006- of the measures is reflected in the low emission. The reduction in 2009 is mainly caused by the economic crisis.

Table 4.5 gives an overview with detailed information per plant that explains the significant reduction of the N_2O emissions from nitric acid production in 2007 and 2008.

Table 4.5 Overview with detailed information per nitric acid plant.

Plant:	1	2	3	4	5	6
Type of production technology	Mono pressure (3,5 bar)	Dual pressure (4 / 10 bar)	Mono pressure (3,5 bar)	Dual pressure (4 / 10 bar)	Dual pressure (4-6, / 10-12 bar)	Dual pressure (4-6 / 10-12 bar)
Abatement technology implemented	Catalyst, which breaks down N_2O, in existing NH_3 reactors, just below the platinum catalyst system	EnviNOx [1] process variant 1 system from UHDE (tertiare technique	Idem 1	Idem 2	Catalyst (pellets) technology which breaks down N_2O in the first stage of nitric acid production when ammonia is burned	Idem 5
Time of installation	Oct 2007	Dec 2007	Oct 2007	Dec 2007	Nov 2007	May 2007
N_2O Emission in ton						
2006 :	1,269	1,273	770	4,015	4,527	5,888
2007 :	1,190	1,026	631	3,275	4,448	3,311
2008 :	415	0.05	143	2.26	318	921
2009 :	387	3.4	0.11	0.04	310	741
Abatement efficiency in 2007 and 2008 [2]	80,40 %	99,94 %	69,68 %	99,997 %	92,84 %	84,80 %

[1] Besides in 2 Dutch plants "EnviNOx process variant 1 systems" also are in operation with similar very high N_2O abatement rates (99% and above) in other nitric acid plants (for example in Austria).
[2] The abatement efficiency concerns IEFs. Because the IEFs are confidential they are not included in this table.

From 2008 onwards, the N_2O emissions of HNO_3 production in the Netherlands were opted in in the European emission trading scheme (EU-ETS). For this purpose the companies developed monitoring plans that were approved by the Dutch Emissions authority (NEa), the government organization responsible for EU ETS in the Netherlands. In 2009 an 2010 the companies sent their verified emission reports to NEa (2008 /2009 emissions).

The reported and verified (by a independent verifier) emissions (2008 and 2009) by the companies to NEa were checked against those as reported in the CRF tables (2008 and 2009). No differences were found between the emission figures in the CRF and the verified emissions in the emission reports under EU ETS.

2B5. Caprolactam production
After 2002, more accurate measurements were performed to estimate N_2O emissions from caprolactam production (2B5). Calculations of the pre-2003 emissions are based on a production-index series (real production data are confidential business information) over the period 1990-2004 and the 2003 and 2004 measurements from the company. The emission fluctuations during the period 2003-2009 are mainly caused by the uncertainty of the measurements within the plant. Annual emissions are actually based on only a few emission measurements per point per year.

4.3.4 Activity data and (implied) emission factors

Detailed information on activity data and emission factors can be found in monitoring protocols 11-003, 11-014, 11-015 and 11-016 on the website www.greenhousegases.nl.

Activity data are based on the following sources:
- Ammonia production: activity data on use of natural gas are obtained from Statistics Netherlands (CBS). Although ammonia and urea production data are considered confidential, international statistics such as UN, IFA and USGS do report production data for the Netherlands.
- Nitric acid production: activity data are confidential. Emissions are reported by the companies.
- Carbide production: silicon carbide production figures are derived from the Environmental Report (MJV) of the relevant company.
- Other: activity data on caprolactam production are confidential. Only emissions are reported by the companies. This year a production-index series over the period 1990-2005 were received from the company. For

Ethylene oxide production only capacity data are available; therefore, a default capacity utilisation rate of 86% is used to estimate CO_2 emissions (based on Neelis et al., 2005). Activity data for estimating CO_2 emissions are based on data for feedstock use of fuels provided by Statistics Netherlands (CBS).

The emission factors used to estimate greenhouse gas emissions from the different source categories are based on:

- Ammonia production: a country-specific CO_2 emission factor is used. This emission factor is based on a 17% fraction of the carbon in the gas-feedstock not being oxidised during the ammonia manufacture and was calculated from the carbon contained in the urea produced (based on Neelis et al., 2003).
- Nitric acid production: plant-specific N_2O emission factors are used (which are confidential).
- Silicon carbide production: the IPCC default emission factor is used for CH_4.
- Other: plant-specific N_2O emission factors are used for Caprolactam production (confidential). A default emission factor of 0.45 tons CO_2 per ton of ethylene oxide production is used. Country-specific CO_2 emission factors are used to estimate the CO_2 emissions of the other source categories because no IPCC methodologies exist for these processes. For activated carbon an emission factor of 1 t/t Norit derived from the carbon losses from peat uses is used.

4.3.5 Methodological issues

For all the source categories of the chemical industry, the methodologies used to estimate the greenhouse gas emissions are in compliance with the IPCC Good Practice Guidance (IPCC, 2001). Country-specific methodologies are used for the CO_2 process emissions from the chemical industry. More detailed descriptions of the methods used and emission factors can be found in the protocols (11-002, 11-014, 11-015 and 11-016) described on the website www.greenhousegases.nl, as indicated in Section 4.1:

- 2B1 Ammonia production: a method equivalent to IPCC Tier 1b; the amount of natural gas used as feedstock and a country-specific emission factor are used to estimate CO_2 emissions. This emission factor is based on the assumption that the fraction of carbon in the gas-feedstock oxidised during the ammonia manufacture is 17%. This figure is based on reported carbon losses from urea production (Neelis et al., 2003).
- 2B2 Nitric acid production: an IPCC Tier 2 method is used to estimate N_2O emissions. The emission factors are based on plant-specific measured data which are confidential. The emissions are based on data reported by the nitric acid manufacturing industry and are included in the emission reports under EU ETS and the national Pollutant Release and Transfer Register (PRTR).
- 2B5 Other chemical products: N_2O emissions from 2B5 Other chemical industry, which mainly originate from Caprolactam production, are also based on emission data reported by the manufacturing industry (based on measurements). Emission factors and activity data are confidential. The aggregated CO_2 emissions included in this source category are identified as a key source and based on country-specific methods and emission factors. These refer to the production of:
  - Industrial gases: CO_2 emissions are estimated based on use of fuels (mainly natural gas) as chemical feedstock. An oxidation fraction of 20% is assumed, based on reported data in environmental reports from the relevant facilities.
  - Carbon electrodes: CO_2 emissions are estimated based on fuel use (mainly petroleum coke and coke). A small oxidation fraction – 5% – is assumed, based on reported data in the environmental reports.
  - Activated carbon: CO_2 emissions are estimated on the basis of the production data for Norit and by applying an emission factor of 1 t/t Norit. The emission factor is derived from the carbon losses from peat uses reported in the environmental reports. As peat consumption is not included in the national energy statistics, the production data since 1990 have been estimated based on an extrapolation of production level of 33 Tg reported in 2002. This is considered to be justified because this source contributes relatively little to the national inventory of greenhouse gases.
  - Ethylene oxide: CO_2 emissions are estimated based on capacity data by using a default capacity utilisation rate of 86% and applying an emission factor of 0.45 t/t ethylene oxide.

For the minor sources of CH_4 emissions included in this source category, IPCC Tier 1 methodologies and IPCC default emission factors are used.

4.3.6 Uncertainties and time-series consistency

Uncertainties

The Tier 1 uncertainty analysis in Annex 7 shown in Table A7.1 and A7.2 provides estimates of uncertainties according to IPCC source categories.
No accurate information is available for assessing the uncertainties of the emissions reported by the facilities which belong to 2B1 Ammonia production, 2B4 Carbide production and 2B5 Other activitiesy . Activity data are assumed to be relatively certain. The uncertainties in CO_2 emissions from “Ammonia production” and “Other chemical products” are estimated to be approximately 2% and 70%, respectively, in annual emissions. The uncertainty in the annual emissions of N_2O from Caprolactam production is estimated to be approximately 30%.

Since the N_2O emissions of HNO_3 production in the Netherlands were opted in in the European emission trading scheme (EU-ETS), all companies have continuous measuring of their N_2O emissions. This has resulted in a lower annual emission uncertainty of approximately 8%.

Time-series consistency

Consistent methodologies are used throughout the time series for the sources in this category.

4.3.7 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures as discussed in Chapter 1. The N_2O emissions of HNO_3 production are also verified by EU ETS.

4.3.8 Source-specific recalculations

Because more detailed information on activity data for the minor sources of CH_4 and CO_2 emissions came available, the emissions of these sources (2B4 and 2B5) have been changed for a number of years. The change amounts to 23 Gg CO_2 and -0.3 Gg CH_4 for these categories in 2008.

4.3.9 Source-specific planned improvements

There are no source-specific improvements planned.

4.4 Metal production [2C]

4.4.1 Source category description

The national inventory of the Netherlands comprises emissions of greenhouse gases related to three source categories as belonging to 2C Metal production:

- 2C1 Iron and steel production: CO_2 emissions: The Netherlands has one integrated iron and steel plant (Corus, previously Hoogovens). During the production of iron and steel, coke and coal are used as reducing agents in the blast and oxygen furnaces, resulting in the production of the by-products blast furnace gas and oxygen furnace gas. A small part of these gases are emitted (lost) and the rest are subsequently used as fuels for energy purposes. Only the carbon losses are reported in category 2C1. In addition, CO_2 is produced as by-product from the use of limestone and during the conversion from pig iron to steel. These emissions are also reported in this category.
- 2C3 Aluminium production: CO_2 and PFC emissions: in the Netherlands aluminium is produced at two primary aluminium smelters (Zalco, previously Pechiney, and Aldel). CO_2 is produced by the reaction of the carbon anodes with alumina and by the reaction of the anode with other sources of oxygen (especially air).

  The PFCs (CF_4 and C_2F_6) from the Aluminium industry are formed during the phenomenon known as the 'anode effect' (AE), which occurs when the concentration of aluminium oxide in the reduction cell electrolyte drops below a certain level.

There are some small Ferroalloy Production (2C2) companies in the Netherlands. They don't have GHG process emissions. The combustion emissions are included in 1A2. 2C4 Magnesium and aluminium foundries, both of which use SF_6 as a cover gas, do not occur in the Netherlands. No other sources of metal production (2C5) are identified in the inventory.

4.4.2 Key sources

Iron and steel production (carbon inputs) is identified as a key source for CO_2 emissions, Aluminium production as a trend key source for PFC emissions (see Table 4.2).

4.4.3 Overview of shares and trends in emissions

Table 4.2 gives an overview of shares in emissions of the main categories.

Total CO_2 emissions from 2C1 'Iron and steel production' decreased by 1.4 Tg during the period 1990–2009. In 2009, CO_2 emissions remained at the same level as in 2008. PFC emissions from primary 'Aluminum industry' (2C3) decreased by 1.8 Tg CO_2 eq between 1995 and 2008. Because in 2008 the number of anode-effects decreased the PFC emissions decreased compared to 2007 Because of the economic crisis the PFC and CO_2 emissions decreased in 2009 compared to 2008.

Table 4.6 shows the trend in implied CF_4 and C_2F_6 emission factors (IEF) for aluminum production during the period 1990–2009. The largest company produces approximately two-thirds of the national total production. The IEFs decreased by 97% between 1995 and 2009. In 1998, the smallest company switched from side feed to point feed; this switch was followed by the larger company in 2002/2003, thereby explaining the decreased IEF from this year onwards. The higher level of the IEF in 2002 is caused by specific process-related problems during the switching process by the larger producer.

4.4.4 Activity data and (implied) emission factors

Detailed information on activity data and emission factors can be found in the monitoring protocols 11-002, 11-014 and 11-017 on the website www.greenhousegases.nl

Table 4.6 Implied emission factors for CF_4 and C_2F_6 from aluminium production (Units: kg/Tg) (2C3).

Gas	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
CF_4	1.02	1.10	0.53	0.52	0.83	0.19	0.041	0.033	0.027	0.039	0.028	0.033
C_2F_6	0.18	0.18	0.12	0.12	0.20	0.04	0.006	0.005	0.004	0.005	0.004	0.005

Activity data are based on the following sources:

- Iron and steel production: data on coke production and coal input, limestone use and the carbon balance are reported by the relevant company (by means of an environmental report);
- Aluminium production: activity data and emissions are based on data reported in the environmental reports of both companies.

Emission factors used in the inventory to estimate greenhouse gas emissions are based on:

- Iron and steel production: EF (limestone use) = 0.440 tons CO_2 per ton (IPCC default); EF (blast furnace gas) = 0.21485 tons CO_2 per GJ (plant specific);
- Aluminium production: EF (consumption of anodes) = 0.00145 tons CO_2 per ton aluminium (plant specific; IPCC default = 0.0015 t/t aluminium).

EF for PFCs is plant-specific and confidential. Emissions of PFCs are obtained from the environmental reports of both companies.

4.4.5 Methodological issues

The methodologies used to estimate the greenhouse gas emissions for all source categories of metal production are in compliance with the IPCC Good Practice Guidance (IPCC, 2001). More detailed descriptions of the methods used and emission factors are found in protocols 11-003, 11-014 and 11-017 on the website www.greenhousegases.nl as indicated in Section 4.1.

Iron and steel production (2C1):

CO_2 emissions are estimated using a Tier 2 IPCC method and country-specific value for the carbon contents of the fuels. Carbon losses are calculated from coke and coal input used as reducing agents in the blast and oxygen furnaces, including other carbon sources such as limestone and the carbon contents in the iron ore (corrected for the fraction that ultimately remains in the steel produced):

- CO_2 from coke/coal inputs = amount of coke * EF_{coke} + amount of coal * EF_{coal} – (blast furnace gas + oxygen oven gas produced) * EF_{BFgas} (1a)
- CO_2 from limestone use = limestone use * ZF(limestone) * $EF_{limestone}$ (1b)
- CO_2 from ore/steel = (C-mass in ore, scrap and raw iron purchased – C-mass in raw steel)* 44/12 (1c)
- The same emission factors for blast furnace gas and oxygen furnace gas are used (see Annex 2).

As mentioned above, only the carbon losses are reported in category 2C1. The carbon contained in the blast furnace gas and oxygen furnace gas produced as by-products and subsequently used as fuels for energy purposes is subtracted from the carbon balance and included in the Energy sector (1A1a and 1A2a; see Sections 3.2.2 and 3.2.3).

Data reported in the annual environmental reports (2000–2005) of Corus are used to calculate the CO_2 emissions from limestone use and the conversion from pig iron to steel in the period 1990–2000. The amount of limestone stone was calculated from the average consumption of 107.9 kg (lower: 107,1 kg; upper: 109.0 kg) in 2000–2005 per ton of crude steel produced. A similar calculation was made for the CO_2 from the carbon fractions in ore and crude steel. The CO_2-emission was calculated from the average CO_2-emission of 8.3 kg (lower: 6.0 kg; upper: 11.9 kg) in 2000–2005 per ton of crude steel produced.

Aluminium production (2C3)

A Tier 1a IPCC method (IPCC, 2001) is used to estimate CO_2 emissions from the anodes used in the primary production of aluminium, with aluminium production being as activity data. In order to calculate the IPCC default emission factor the stoichiometric ratio of carbon needed to reduce the aluminium ore to pure aluminium is based on the reaction Al_2O_3 + 3/2C ® 2Al + 3/2 CO_2 . This factor is corrected to include additional CO_2 produced by the reaction of the carbon anode with oxygen in the air. A country-specific emission factor of 0.00145 tons CO_2 per ton aluminium is used to estimate CO_2 emissions, and it has been verified that this value is within the range of the IPCC factor of 0.0015 and the factor of 0.00143 calculated by the World Business Council for Sustainable Development (WBCSD) (WBCSD/WRI, 2004). PFC emissions from primary aluminium production reported by these two facilities are based on the IPCC Tier 2 method for the complete period 1990–2009. Emission factors are plant-specific and are based on measured data.

4.4.6 Uncertainties and time-series consistency

Uncertainties

The Tier 1 uncertainty analysis in Annex 7 shown in Tables A7.1 and A7.2 provides estimates of uncertainties according to IPCC source category. The uncertainty in annual CO_2 emissions is estimated to be approximately 6% and 5% for Iron and steel production and Aluminium production respectively, whereas the uncertainty in PFC emissions from Aluminium production is estimated to be 20%. The uncertainty in the activity data is estimated at 2% for Aluminium production and 3% for Iron and steel production. The uncertainty in the emission factors for CO_2 is estimated at 5% and for PFC from Aluminium production at 20%.

Time-series consistency
The time series are based on consistent methodologies for the sources in this category. PFC emissions from the production of aluminium by the main company during the period 1990–1998 are based on the extrapolation of measured data from 1999, thereby increasing the uncertainties of the emissions during that period. It is assumed, however, that the emission factors reflect the plant specific circumstances better than the default emission factors used in previous reporting.

4.4.7 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

4.4.8 Source-specific recalculations

The emissions in this category changed (2005-2008) because of a reallocation of emissions from category 2C.1.5 to 1.B.1.B (see 3.2.7.5). The emission in category 2.C.1.5 decreased in 2008 by 256 Tg CO2.

4.4.9 Source-specific planned improvements

There are no source-specific improvements planned for this category.

4.5 Food and drink production [2D]

4.5.1 Source category description

This category comprises CO_2 emissions related to food and drink production in the Netherlands.
CO_2 emissions in this source category are related to the non-energy use of fuels. Carbon is oxidised during these processes, resulting in CO_2 emissions.

4.5.2 Key sources

This minor source is no key source for CO_2

4.5.3 Overview of shares and trends in emissions

Emissions vary at around 0.05 Tg, and are rounded off to either 0.1 or 0.0 Tg (see Table 4.2).

4.5.4 Activity data and (implied) emission factors

Detailed information on the activity data and emission factors can be found in monitoring protocol 11-003 on the website www.greenhousegases.nl.
The activity data used to estimate CO_2 emissions from this source are based on national energy statistics from Statistics Netherlands (CBS) on Coke consumption. Emission factors are derived from the national default carbon content of coke (Corus, MJVs 2000-2009).

4.5.5 Methodological issues

The methodology used to estimate the greenhouse gas emissions complies with the IPCC Good Practice Guidance (IPCC, 2001). More detailed descriptions of the method used and the emission factors can be found in protocol 11-003 on the website www.greenhousegases.nl, as indicated in Section 4.1.
CO_2 emissions are calculated based on the non-energy use of fuels by the food and drink industry as recorded in the national energy statistics, multiplied by an emission factor. The emission factor is based on the national default carbon contents of the fuels (see Annex 2), under the assumption that the carbon is fully oxidised to CO_2.

4.5.6 Uncertainties and time-series consistency

Uncertainties
The Tier 1 uncertainty analysis in Annex 7 shown in Tables A7.1 and A7.2 provides estimates of the uncertainties according to the IPCC source category. The uncertainty in the emissions of this category is estimated to be 5%. Since this is a very small emission source, the uncertainties in this category are not analysed further in more detail. Therefore, in the uncertainty analysis and the key source analysis the emissions in this category (2D) are combined with the emissions in category 2G (Other industrial emissions), see Section 4.8.

Time-series consistency
The time series is based on consistent methodologies and activity data for this source.

4.5.7 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures which are discussed in Chapter 1.

Table 4.7 Trends in HFC-23 by-product emissions from the Production of HCFC-22 and HFC emissions from Handling activities (2E) (Units: Gg CO_2 eq)

	1990	1995	2000	2005	2006	2007	2008	2009
2E1. HFC-23	4,432	5,759	2,421	196	281	243	212	154
2E3. HFCs	NO	12	418	39	37	24	18	109
HFC Total	4,432	5,771	2,838	235	318	267	230	263

4.5.8 Source-specific recalculations

During the compilation of the CRF an error in the previous submission for 2008 was detected in the CO_2 emission from the category Food and Drink. The emission for 2008 is increased by 32Gg CO_2 compared to the NIR 2010.

4.5.9 Source-specific planned improvements

There are no source-specific improvements planned.

4.6 Production of halocarbons and SF_6 [2E]

4.6.1 Source category description

The national inventory of the Netherlands comprises emissions of greenhouse gases related to the following source categories in this category:

- 2E1 Production of HCFC-22: HFC-23 emissions. HCFC-22 is produced at one plant in the Netherlands. Tri-fluormethane (HFC-23) is generated as a by-product during the production of chlorodifluormethane (HCFC-22) and emitted through the plant condenser vent.
- 2E3 Handling activities: emissions of HFCs. There is one company in the Netherlands that repackage HFCs from large units (e.g., containers) into smaller units (e.g., cylinders) and in addition trading with HFCs. Besides this company there are a lot of companies in the Netherlands which are importing small units with HFCs and sell them in the trading areas.

4.6.2 Key sources

Production of HCFC-22 (HFC-23 emission) is a trend key source; see Table 4.2.

4.6.3 Overview of shares and trends in emissions

Table 4.2 gives an overview of shares in emissions of the main categories.

Total HFC emissions in category 2E were 5.8 Tg in 1995 and 0.2 Tg CO_2 eq in 2009, with HFC-23 emissions from HCFC-22 production being the major source of HFC emissions. HFC emissions from handling contributed 8% to the total HFC emissions from this category in 2009.

Table 4.7 shows the trend in HFC emissions from the categories HCFC-22 production and HFCs from handling activities for the period 1990–2009. The emissions of HFC-23 increased about by 35% in the period 1995–1998 due to the increased production of HCFC-22. However, in the period 1998–2000, the emissions of HFC-23 decreased by 69% following the installation of a thermal afterburner at the plant.
The operation time of the thermal afterburner (84% in 2000; 95% in 2001; 93.6% in 2002) is the primary factor explaining the variation in emission levels during the period 2000–2002. The decreased emission (33%) in 2003 can be explained mostly by a lower production level. Despite a higher production level, emissions have remained stable because the operation time of the thermal afterburner increased from 92% in 2003 to 96% in 2004. The decreased emission (45%) in 2005 can be explained by a higher operation time of the thermal afterburner (97.1% in 2005) and a lower production level. Because of a higher production level, emission increased (40%) in 2006. The decreased emission (16%) in 2007 can be explained by a higher operation time of the thermal afterburner.
Due to the economic crisis the production level of HCFK22 was much lower in the last quarter of 2008 and in 2009, resulting in lower HFC-23 emissions in both 2008 and 2009.

The significant emission fluctuations in category 2.E.3 during the period 1992-2009 can be explained by the large variety in handling activities, which depends on the demand of the costumers.

4.6.4 Activity data and (implied) Emission factors

The activity data used to estimate emissions of F-gases from this category are based on confidential information provided by the manufacturers:

- Production of HCFC-22: production figures on HCFC-22

are confidential.
- Handling activities (HFCs): activity data used to estimate HFC emissions are confidential.

(Implied) emission factors used to estimate the emissions of F-gases from this category are based on the following:
- Production of HCFC-22: Destruction factor of the thermal afterburner used is 99.99%.
- Handling activities (HFCs): the emission factors used are plant-specific and confidential, and they are based on 1999 measurement data. More detailed information on the activity data and emission factors can be found in the monitoring protocols 11-018 and 11-019 on the website www.greenhousegases.nl.

4.6.5 Methodological issues

The methodologies used to estimate the greenhouse gas emissions included in this category are in compliance with the IPCC *Good Practice Guidance* (IPCC, 2001). More detailed descriptions of the method used and emission factors can be found in the protocols 11-018 and 11-019 on website www.greenhousegases.nl as indicated in Section 4.1:
- *Production of HCFC-22* (2E1): this source category is identified as a key source for HFC-23 emissions. In order to comply with the IPCC *Good Practice Guidance* (IPCC, 2001), an IPCC Tier 2 method is used to estimate the emissions of this source category. HFC-23 emissions are calculated using both (measured) data obtained on the mass flow of HFC-23 produced in the process and a destruction factor to estimate the reduction of this HFC-23 flow by the afterburner.
- *Handling activities (HFCs)* (2E3): Tier 1 country-specific methodologies are used to estimate the *handling* emissions of HFCs. The estimations are based on emissions data reported by the manufacturing and sales companies.

4.6.6 Uncertainties and time-series consistency

Uncertainties
The Tier 1 uncertainty analysis in Annex 7 shown in Tables A7.1 and A7.2 provides estimates of uncertainties according to the IPCC source category.

The uncertainty in HFC emissions from HCFC-22 production is estimated to be about 15%, while the uncertainty in HFC emissions from handling activities is estimated to be about 20%. The uncertainty in the activity data for these sources is estimated at 10%. The uncertainties in the emission factors for HFC-23 from HCFC-22 production and for HFC from Handling activities are estimated at 10% and 20%, respectively. These figures are all based on the judgments of experts.

Time-series consistency
The time series is based on consistent methodologies and activity data for this source.

4.6.7 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

4.6.8 Source specific recalculations

There have been no source-specific recalculations compared to the previous submission. For the last decade improved activity data came available which resulted in slightly changed emission figures

4.6.9 Source-specific planned improvements

There are no source-specific improvements planned for this category.

4.7 Consumption of halocarbons and SF_6 [2F]

4.7.1 Source category description

Halocarbons and SF_6 are released from the use of these compounds in different products. The national inventory of the Netherlands comprises emissions of greenhouse gases related to the following source category: 2F(1-9): Emissions from substitutes for Ozone- depleting substances.
- The inventory comprises the following sources in this source category:
- 2F1. Stationary refrigeration: HFC emissions;
- 2F1. Mobile air conditioning: HFC emissions;
- 2F2. Foam Blowing: HFC emissions; (included in 2F6);
- 2F4. Aerosols/Metered dose inhalers: HFC emissions; (included in 2F6);
- 2F6. Other applications using ODS substitutes
- 2F7. Semiconductor manufacture : PFC emissions (SF_6 emissions included in 2F9);
- 2F8. Electrical equipment: SF_6 emissions (included in 2F9);
- 2F9. Other: SF_6 emissions from Sound-proof windows and Electron microscopes

In the Netherlands, many processes related to the use of HFCs and SF_6 takes place in only one or two companies. Because of the sensitivity of data from that companies, only the sum of the HFC emissions of 2F2 and 2F4 (included in 2F6) and of the SF_6 emissions of 2F7 and 2F8 is reported (included in 2F9).

Table 4.8 Actual emission trends specified per compound from the use of HFCs, PFCs and SF_6 (2F) (Units: Gg CO_2 eq).

	1990	1995	2000	2005	2006	2007	2008	2009
HFC-134a	NO	45	199	414	448	472	487	499
HFC-143a	NO	7	110	294	329	364	394	418
HFC-125	NO	8	90	243	273	301	325	345
HFC-152a	NO	NO	NO	NO	NO	NO	NO	NO
HFC-32	NO	0.8	7.0	11.4	12.5	13.3	13.4	13.1
Other HFCs	NO	187	642	297	325	399	439	523
HFC Total	NO	247	1,047	1,260	1,386	1,549	1,659	1,785
PFC use	18	37	193	178	194	222	180	125
SF6 use	217	301	315	239	198	192	186	175
Total HFC/PFC/SF6	236	585	1,557	1,677	1,779	1,963	2,024	2,085

4.7.2 Key sources

Emissions from Substitutes for ozone-depleting substances [2F] are identified as a key source (see Table 4.1).

4.7.3 Overview of shares and trends in emissions

The contribution of F-gas emissions from category 2F to the total national inventory of F-gas emissions was 7% in the base year 1995 and 87% in 2009. This corresponds to 2,1 Tg CO_2 eq and accounts for 1.1% in the national total greenhouse gas emissions in 2009.

The level of HFC emissions increased by a factor of 7 in 2009 compared to 1995, mainly due to increased HFC consumption as a substitute for (H)CFC use. PFC emissions increased due to a higher production level of the Semiconductor manufacturing industry. And actual emissions of SF_6 remained rather stable during the period 1995–2009. Table 4.8 gives an overview of the trends in actual emissions from 1990-2009.

Activity data and (implied) emission factors
Detailed information on the activity data and emission factors can be found in the monitoring protocols 11-020–11-016 on the website www.greenhousegases.nl.

The activity data used to estimate the emissions of the F-gases are based on the following sources:
- Consumption data of HFCs (Stationary refrigeration, Mobile air-conditioning, Aerosols and Foams) are obtained from annual reports from PriceWaterhouseCoopers.
- Activity data on the use of PFCs in Semiconductor manufacturing and SF_6 in Sound-proof windows and electron microscopes are obtained from different individual companies (confidential information).

Emission factors used to estimate the emissions of the F-gases in this category are based on the following sources:
- Stationary refrigeration, Mobile air conditioning, Aerosols and Foams: annual leak rates are based on surveys (De Baedts et al., 2001) and other literature.
- Semiconductor manufacturing: emission factors which are confidential information of the only company.
- Sound-proof windows: EF used for production is 33% (IPCC default); EF (leak rate) used during the lifetime of the windows is 2% per year (IPCC default).
- Electron microscopes: emission factors are confidential information of the only company.

The source Electrical equipment comprises SF_6 emissions of users of high-voltage circuit breakers and the only international test laboratory for power switches. The emissions from the circuit breakers are obtained from EnergieNed, the Federation of Energy Companies in the Netherlands and the emissions from testing from the test laboratory.

4.7.4 Methodological issues

To comply with the IPCC Good Practice Guidance (IPCC, 2001) IPCC Tier 2 methods are used to estimate emissions of the sub-sources Stationary refrigeration, Mobile air conditioning, Aerosols, Foams and Semiconductor manufacturing.

The country-specific methods for the sources Sound-proof windows and Electron microscopes are equivalent to IPCC Tier 2 methods and from 2007 onwards the country-specific method for the source Electrical equipment is equivalent to the IPCC Tier 3 method.

More detailed descriptions of the methods used and emission factors can be found in the protocols 11-020–11-016 on the website www.greenhousegases.nl as indicated in Section 4.1.

4.7.5 Uncertainties and time-series consistency

Uncertainties
The Tier 1 uncertainty analysis in Annex 7 shown in Tables A7.1 and A7.2 provides estimates of the uncertainties according to the IPCC source category. The uncertainty in HFC emissions from HFC consumption is estimated to be 50%, and the uncertainties in PFC and SF_6 emissions are estimated to be about 25% and 55%, respectively. The uncertainty in the activity data for the HFC sources and for SF_6 and PFC sources is estimated at 10%, 50% and 5%, respectively. For the emission factors the uncertainties are estimated 50%, 25% and 25%. All of these figures are based on the judgments of experts.

Time series consistency
Consistent methodologies have been used to estimate emissions from these sources.

4.7.6 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures discussed Chapter 1.

4.7.7 Source-specific recalculations

Because more detailed information on activity data of Stationary refrigeration(HFC emissions), Mobile air conditioning(HFC emissions) and new SF6 emissions from the source Electrical equipment came available, the emissions of these sources have been changed for a number of years. The results of the recalculation and changes were corrected in this submission (see Table 4.9).

4.7.8 Source-specific planned improvements

There are no source-specific improvements planned for this category.

4.8 Other industrial processes [2G]

4.8.1 Source category description

The national inventory of the Netherlands comprises emissions of greenhouse gases related to four source categories in this category:
- Fireworks and candles: CO_2, CH_4 and N_2O emissions;
- Degassing of drinking water: CH_4 emissions;
- Miscellaneous non-energy fossil fuel product uses, (e.g., lubricants and waxes); CO_2 emissions (about 0.2 Tg).

The CO_2 emissions reported in category 2G stem from the direct use of specific fuels for non-energy purposes, which results in partially or fully 'oxidation during use (ODU) of the carbon contained in the products – for example, lubricants, waxes and other fuels. With the exception of lubricants and waxes no other fuels are included in this category. Oxidation for mineral turpentine is included in Sector 3 (Indirect CO_2 of solvent use).

4.8.2 Key sources
There are no key sources identified from these source category (see also Annex 1).

4.8.3 Overview of shares and trends in emissions

The small CO_2 and CH_4 emissions remained rather constant between 1990 and 2009.

4.8.4 Activity data and (implied) emission factors

Detailed information on the activity data and emission factors can be found in the monitoring protocols 11-003 and 11-014 on the website www.greenhousegases.nl
The activity data used are based on the following sources:
- Fireworks: data on annual sales from branch organisation;
- Candles: average use of 3.3 kg per person (www.bolsius.com);
- Production of drinking water: Volume Statistics Netherlands (CBS);

Table 4.9 Effects of changes in the use of HFCs and SF_6 (2F) 1990-2008 (Units: Gg CO_2 eq).

		1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008
HFCs	NIR 2010	NO	247	1,053	919	870	1,055	1,195	1,279	1,412	1,578	1,693
	NIR 2011	NO	247	1,047	913	863	1045	1183	1,260	1,386	1,549	1,659
	Difference	NO	0	-6	-6	-7	-10	-12	-19	-26	-29	-34
SF_6	NIR 2010	217	301	318	322	281	242	265	254	217	226	224
	NIR 2011	217	301	315	317	274	231	252	239	198	192	186
	Difference	0	0	-3	-5	-7	-11	-13	-15	-19	-34	-38

- Fuel use: energy statistics obtained from Statistics Netherlands (CBS).

Emission factors:
- Fireworks: CO_2 : 43 kg/t; CH_4: 0.78 kg/t; N_2O: 1.96 kg/t (Brouwer et al., 1995);
- Candles: CO_2 : 2.3 kg/t (EPA, 2001);
- Production of drinking water: 2.47 tons CH_4 /10^6 m^3;
- Use of fuels for production of lubricants: ODU factor of 50% (IPCC default);
- Production of waxes: ODU factor of 100% (IPCC default).

CO_2, CH_4 and N_2O emissions from Fireworks and candles showed a 'peak' in 1999 because of the millennium celebrations.

4.8.5 Methodological issues

The methodologies used to estimate the greenhouse gas emissions included in this category are in compliance with the IPCC Good Practice Guidance (IPCC, 2001). More detailed descriptions of the methods used and the emission factors can be found in protocols 11-003 and 11-014 on the website www.greenhousegases.nl as indicated in Section 4.1:
- Fireworks and candles: country-specific methods and emission factors are used to estimate emissions of CO_2, CH_4 and N_2O.
- Degassing of drinking water: a country-specific methodology and emission factor are used to estimate the CH_4 emissions, which is the main source of CH_4 emissions in this category.
- Miscellaneous non-energy fossil fuel product uses (i.e. lubricants and waxes): a Tier 1 method is used to estimate emissions from lubricants and waxes using IPCC default emission factors.

4.8.6 Uncertainties and time-series consistency

Uncertainties
The Tier 1 uncertainty analysis in Annex 7 shown in Tables A7.1 and A7.2 provides estimates of the uncertainties according to IPCC source category.

The uncertainty in CO_2 emissions of other industrial processes is estimated to be approximately 20% (5% in activity data and 20% in emission factor), mainly due to the uncertainty in the ODU factor for lubricants. The uncertainty in the activity data (such as domestic consumption of these fuel types) is generally very large, since it is based on production-, import- and export figures.

The uncertainty in CH_4 emissions of other industrial processes is estimated to be 50% (10% in activity data and 50% in emission factor). The uncertainty in N_2O emissions of other industrial processes is estimated at 70% (50% in activity data and 50% in emission factor). All figures are based on the judgments of experts, since no specific monitoring data or literature is available for the current situation in the Netherlands.

Time-series consistency
Consistent methodologies and activity data have been used to estimate the emissions of these sources.

4.8.7 Source specific QA/QC and verification

The source categories are covered by the general QA/QC procedures discussed in Chapter 1.

4.8.8 Source specific recalculations

The method for calculating the emission from fireworks changed to the extent that the method is now optimized to use activity data from Netherlands Statistics rather than the sales data from individual firework sellers. In this way the method is made future proof because sale data are not longer available. Emission figures changed only very little over the total time series (<1 Gg CO_2 eq/ year).

4.8.9 Source specific planned improvements

There are no source-specific improvements planned for this category.

5 Solvent and other product use [CRF Sector 3]

Major changes in Sector 3 Solvent and other product use compared to the National Inventory Report 2010
Emissions: No changes.
Key sources: There are no key sources in this sector.
Methodologies: There have been no methodological changes in this sector.

5.1 Overview of sector

Emissions of the greenhouse gases in this sector include indirect emissions of CO_2 related to the release of non-methane volatile organic compounds (NMVOC) with the use of solvents and a wide range of other fossil carbon-containing products (e.g., paints, cosmetics, cleaning agents). In addition, this sector includes N_2O emissions originating from the use of N_2O as anaesthesia and as a propelling agent in aerosol cans (for example cans with cream).
The Netherlands has three source categories in this IPPC Common Reporting Format (CRF) sector:

- 3A, 3B, 3D “Solvents and other product use”: indirect CO_2 emissions (related to NMVOC)
- 3D “Anaesthesia”: N_2O emissions
- 3D “Aerosol cans”: N_2O emissions.

This sector comprises non-combustion emissions from households, services, hospitals, research- and governmental institutions etc, except for the following emissions:

- Use of F-gases (HFCs, PFCs and SF_6). In accordance with the IPCC Reporting Guidelines F-gases are included in 2 “Industrial processes” (thus including their use in the Residential and Commercial sectors)
- Direct non-energy use of mineral oil products (e.g., lubricants, waxes). These are included in 2G “Industrial processes”
- Several minor sources of CH_4 emissions from non-industrial, non-combustion sources. These are included in Sector 2G because the CRF does not permit methane emissions to be included in Sector 3

The following emission from the manufacturing industry is also included in this Chapter:

- Indirect CO_2 emissions from 3C “Chemical products, manufacture and processing”. These NMVOC emissions are included in categories 3A, 3B and 3D.

The following protocol, which can be accessed on www.greenhousegases.nl, describes the methodologies applied for estimating CO_2 and N_2O emissions from solvent and product use in the Netherlands:

- Protocol 11-014: CO_2, N_2O en CH_4 from Other process emissions and product use.

Table 5.1 Contribution of main categories and key sources in CRF Sector 3.

Sector/category	Gas	Key	Emissions base-year (1990)	Emissions 2008	Emissions 2009	Change 2009 - 2008	Contribution to total in 2009 (in %)		
		Level, Trend	Tg CO_2 eq	Tg CO_2 eq	Tg CO_2 eq	Tg CO_2 eq	By sector	Of total gas	Of total CO_2 eq
3 Solvent and other product use	CO_2		0.3	0.1	0.1	0.0		0.1	0.1
	N_2O		0.2	0.1	0.1	0.0		0.8	0.0
	All		0.5	0.2	0.2	0.0			0.1
3A. Paint application	CO_2		0.2	0.1	0.1	0.0	26	0.0	0.0
	All		0.2	0.1	0.1	0.0	26		0.0
3B. Degreasing and dry cleaning	CO_2		0.0	0.0	0.0	0.0	1	0.0	0.0
	All		0.0	0.0	0.0	0.0	1		0.0
3D. Other	CO_2		0.1	0.1	0.1	0.0	34	0.0	0.0
	N_2O		0.2	0.1	0.1	0.0	38	0.8	0.0
3D1 Anaesthesia	N_2O		0.2	0.0	0.0	0.0	13	0.3	0.0
3D3 Aerosol cans	N_2O		0.0	0.0	0.0	0.0	25	0.5	0.0
3D. Other	All		0.3	0.1	0.1	0.0			0.1
National Total GHG emissions (excl. CO_2 LULUCF)	CO_2		159.3	169.8	175.3	-5.5			
	N_2O		20.1	9.9	9.7	-0.2			
	All		213.2	204.6	198.9	-5.7			

Overview of shares and trends in emissions

Table 5.1 shows the contribution of the emissions from Solvent and other product use in the Netherlands. Total greenhouse gas emissions from Solvent and product use in the Netherlands were 0.5 Tg CO_2 eq in 1990 and 0.2 Tg CO_2 eq in 2009.

Total emissions of the sector declined by 60% between 1990 and 2003, and decreased further to 64% in 2009. CO_2 emissions from the sector decreased by 62% between 1990 and 2009, mainly due to decreasing indirect emissions from paints that resulted from the implementation of an emission reduction program for NMVOC (KWS, 2000). N_2O emissions from anaesthesia fell by 87% from 1990 to 2009 due to the better dosing in hospitals and other medical institutions. The emissions of N_2O from food aerosol cans increased 110% in this period. Total N_2O emissions from this chapter have declined since 1990 by 67%.

Key sources

Solvent and product use is a minor source of greenhouse gas emissions. No key sources are included in this sector. The most relevant sources are indirect CO_2 emissions from paint application and the use of N_2O for anaesthesia in hospitals.

5.2 Indirect CO_2 emissions from Solvents and product use (Paint application [3A], Degreasing and dry cleaning [3B] and Other [3D])

5.2.1 Source category description

CRF source category 3A Paint application includes the indirect CO_2 emissions of solvents from the use of both industrial paints and paints used by households and professional painters. Indirect emissions from the use of solvents in degreasing and dry cleaning are included in CRF source category 3B, which covers the use of solvents for cleaning and degreasing of surfaces, the dry cleaning of clothing and textiles and the degreasing of leather.

5.2.2 Activity data and implied emission factors

Detailed information on the activity data and emission factors of NMVOC estimates can be found in the monitoring protocol 11-014 on the website www.greenhousegases.nl.

Activity data: consumption data and NMVOC contents of products are mainly provided by trade associations, such as the VVVF (for paints), the NCV (for cosmetics) and the

NVZ (for detergents). Consumption of almost all solvent-containing products has increased since 1990. However, the general NMVOC content of products (especially paints) has decreased over the last years, resulting in a steady decline in NMVOC emissions since 1990 (see Section 2.4). Due to the increased sales of hairspray and deodorant sprays NMVOC emissions have increased slightly in recent years. It is assumed that the NMVOC contents of these products have remained stable.
Emission factors: it is assumed that all NMVOC in the product is emitted (with the exception of some cleaning products and methylated spirit, which are partly broken down in sewerage treatment plants after use, or used as fuel in BBQs or fondue sets (methylated spirit). The carbon contents of NMVOC emissions are documented in the monitoring protocol on the website www.greenhousegas-es.nl.

5.2.3 Methodological issues

Country-specific carbon contents of the NMVOC emissions from 3A Paint application, 3B Degreasing and dry cleaning and 3D Other product use are used to calculate indirect CO_2 emissions. Monitoring of NMVOC emissions from these sources differs per source. Most of the emissions are reported by branch organisations (e.g., paints, detergents and cosmetics). The indirect CO_2 emissions from NMVOC are calculated from the average carbon contents of the NMVOC in the solvents:

Category	3A	3B	3D
C-content NMVOC (%)	0.72	0.16	0.69

The carbon content of degreasing and dry cleaning is very low due to the high share of chlorinated solvents (mainly tetrachloroethylene used for dry cleaning). The emissions are then calculated as follows:
CO_2 (in Gg) = Σ{NMVOC emission in subcategory i (in Gg) x C-fraction subcategory i} x 44/12
The fraction of organic carbon (of natural origin) in the NMVOC emissions is assumed to be negligible.

5.2.4 Uncertainty and time-series consistency

Uncertainty
These sources do not affect the overall total or the trend in the direct greenhouse gas emissions. The uncertainty of indirect CO_2 emissions is not explicitly estimated for this category, but it is expected to be fairly low. Based on the expert judgment, the uncertainty in the NMVOC emissions is estimated to be 25%, and the uncertainty in the carbon contents is estimated at 10%, resulting in an uncertainty in CO_2 emissions of approximately 27%.

Time-series consistency
Consistent methodologies have been applied for all source categories. As the quality of the activity data used was not uniform throughout the complete time-series, some extrapolation of the data was required. It is assumed that the accuracy of the estimates is not significantly affected by this. The emission estimates for the source categories are expected to be reasonably good.

5.2.5 Source-specific QA/QC and verification

This source category is covered by the general QA/QC procedures discussed in Chapter 1.

5.2.6 Source-specific recalculations

There were no recalculations in this sector.

5.2.7 Source-specific planned improvements

There are no source-specific improvements planned.

5.3 Miscellaneous N_2O emissions from solvents and product use (use of N_2O for anaesthesia [3D1] and N_2O from aerosol cans [3D3])

5.3.1 Source category description

Emissions of N_2O from the use of anaesthesia are included in 3D1. Emissions of N_2O from aerosol cans are included in category 3D3.

5.3.2 Activity data and implied emission factors

Detailed information on the activity data and emission factors of N_2O estimates are found in the monitoring protocol 11-014 on the website www.greenhousegases.nl.
Activity data: The major hospital supplier of N_2O for aesthetic use reports the consumption data of aesthetic gas in the Netherlands annually. The Dutch Association of Aerosol Producers (NAV) reports data on the annual sales of N_2O-containing spray cans. Missing years are then extrapolated on the basis of this data. Domestic sales of cream in aerosol cans have shown a strong increase since 1990. The increase is reflected in the increased emissions.
Emission factors: The emission factor used for N_2O in anaesthesia is 1 kg/kg. Sales and consumption of N_2O for anaesthesia are assumed to be equal each year. The emission factor for N_2O from aerosol cans is estimated to

be 7.6 g/can (based on data provided by one producer), and is assumed to be constant over time.

5.3.3 Methodological issues

Country-specific methodologies are used for the N_2O sources in Sector 3. Since the emissions in this source category are from non-key sources for N_2O, the present methodology complies with the IPCC Good Practice Guidance (IPCC, 2001). A full description of the methodology is provided in the monitoring protocol 11-014 on the website www.greenhousegases.nl.

5.3.4 Uncertainties and time-series consistency

Uncertainties

These sources do not affect the overall total or trend in the Dutch emissions of direct greenhouse gases. For N_2O emissions, the uncertainty is estimated to be approximately 50% based on the judgment of experts. Uncertainty in the activity data of N_2O use is estimated to be 50% and that of the emission factor to be 0% (all gas is released).

Time-series consistency

Consistent methodologies have been applied for all source categories. The quality of the activity data needed was not uniform for the complete time-series, requiring some extrapolation of data. This is not expected to introduce significant problems with the accuracy of the estimates. The estimates for the source categories are expected to be quite good.

5.3.5 Source-specific QA/QC and verification

This source category is covered by the general QA/QC procedures discussed in Chapter 1.

5.3.6 Source-specific recalculations

There are no source-specific recalculations compared to the previous submission.

5.3.7 Source-specific planned improvements

There are no source-specific improvements planned.

6 Agriculture [CRF Sector 4]

Major changes in the sector 4 Agriculture compared to the National Inventory Report 2010

Emissions: Compared to 2008, methane (CH_4) emissions in 2009 increased 2.7% while nitrous oxide (N_2O) emissions decreased by 2.7%. This is the result of increasing numbers of livestock and higher manure productions per animal. However for N_2O the effect was countered by a lower N-content in the rations, strengthened by a larger fraction of mature dairy cattle kept in the stable. EF for CH_4 is higher and for N_2O lower in this case.

Key sources: The former submissions were based on an aggregated source category " CH_4 emission from enteric fermentation cattle". As of this submission this source is split in three new separate sources:

- 4A1 CH_4 emissions from enteric fermentation in domestic livestock: mature dairy cattle (L)
- 4A1 CH_4 emissions from enteric fermentation in domestic livestock: mature non-dairy cattle (non key)
- 4A1 CH_4 emissions from enteric fermentation in domestic livestock: young cattle (L,T1)

Methodologies: Indirect N_2O emissions related to leaching are now based on a country specific (Tier 3) fraction instead of the IPCC default. Ample knowledge exists indicating this fraction is far lower in the Netherlands than the default value of 0.3. It has been modelled (STONE) and validated to values of 0.14 to 0.12 which are now used in the calculations.

Emission factors for manure application, fertilizer application and animal production in the meadow have been updated. New measurement data came available and in the process it was also possible to replace net nitrogen flows by gross nitrogen flows. Since ratio between mineral and organic soil types is fairly constant, factor is changed into a weighed average for these.

Deposition previously didn't account for NO_x-emissions. Since new EMEP-guidelines provide emission factors, these are now included in the inventory.

For calculating NH_3 (ammonia) within the framework of N_2O emissions, a new model (NEMA) was adopted. Main reason being the incorporation of TAN it's also more transparent, consistent and makes recalculations easier. Although it gives rise to considerable shifts in NH_3-emissions, the effect on emission of N_2O was -93.7 Gg CO_2 eq in 1990 and -1,825.7 Gg CO_2 eq in 2008 compared to the previous NIR.

6.1 Overview of the sector

Emissions of greenhouse gases from "Agriculture" include all anthropogenic emissions from the agricultural sector, with the exception of emissions from fuel combustion and carbon dioxide (CO_2) emissions by land use in agriculture. These emissions are included in 1A4c "Agriculture/forestry/fisheries" (Section 3.2.9) and in 5 "Land Use, Land Use Change and Forestry" (LULUCF, Sections 7.6 and 7.7).

In the Netherlands, three source categories occur in the agricultural sector:

- 4A "Enteric fermentation": CH_4 emissions;
- 4B "Manure management": CH_4 and N_2O emissions;
- 4D "Agricultural soils": N_2O emissions.

The other Intergovernmental Panel on Climate Change (IPCC) categories – 4C "Rice cultivation", 4E "Prescribed burning of savannas", 4F "Field burning of agricultural residues" and 4G "Other" – do not occur in the Netherlands. Open fires/burning in the field is prohibited by law and is therefore negligible in practice.

Manure management (4B) includes all emissions from confined animal waste management systems (AWMS). CH_4 emissions from animal manure produced in the meadow during grazing are included in category 4B "Manure management"; N_2O emissions from this source are included in category 4D2 "Animal production". These different approaches are in accordance with IPCC Guidelines (IPCC, 2001).

Methane emissions from agricultural soils are regarded as natural, non-anthropogenic emissions and therefore are not included.

The following protocols on www.greenhousegases.nl describe the methodologies, activity data and emission factors applied in estimating N_2O and CH_4 emissions from the agricultural sector in the Netherlands:

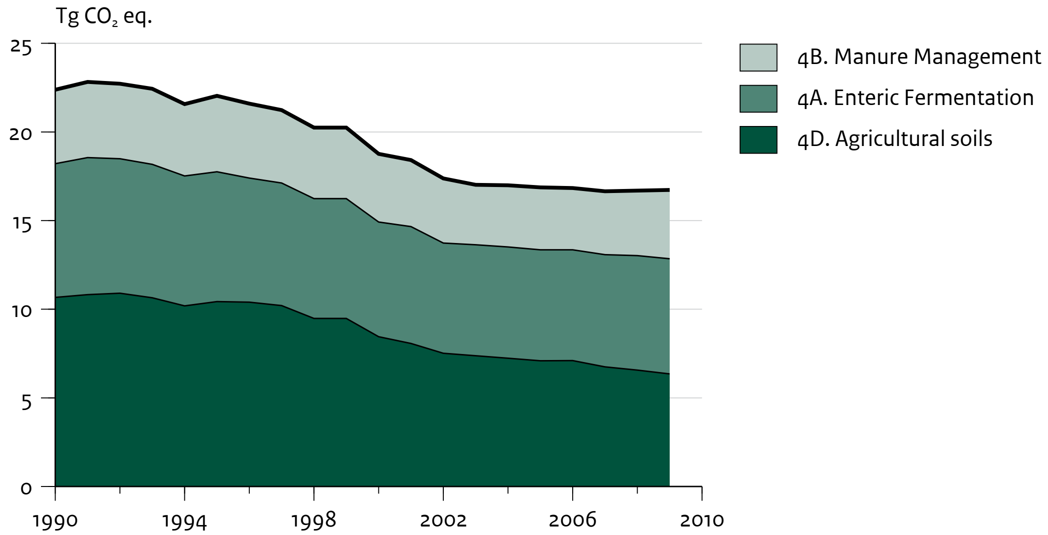
- Protocol 11-027: CH_4 from Enteric fermentation (4A);
- Protocol 11-028: N_2O from Manure management (4B);
- Protocol 11-029: CH_4 from Manure management (4B);
- Protocol 11-030: N_2O from Agricultural soils: indirect emissions (4D);
- Protocol 11-031: N_2O from Agricultural soils: direct emissions and emissions from animal production (4D).

Table 6.1 Contribution of main categories and key sources in sector 4 Agriculture.

Sector/category	Gas	Key	Emissions base-year	Emissions 2008	Emissions 2009	Change 2009 – 2008	Contribution to total in 2009 (%)		
		Level, Trend	Tg CO_2 eq	Tg CO_2 eq	Tg CO_2 eq	Tg CO_2 eq	By sector	Of total gas	Of total CO_2 eq
4. Agriculture	CH_4		10.5	9.1	9.4	0.2	56	55	4.7
	N_2O		11.8	7.6	7.3	-0.2	44	76	3.7
	All		22.4	16.7	16.7	0.0			8.4
4A. Enteric fermentation	CH_4		7.5	6.5	6.5	0.0	39	38	3.3
4A1 Cattle	CH_4	L,T	6.8	5.8	5.8	0.0	35	34	2.9
4A Swine	CH_4		0.4	0.4	0.4	0.0	2	2	0.2
4A2-13 Other animals	CH_4		0.3	0.3	0.3	0.0	2	2	0.1
4B. Manure management	CH_4		3.0	2.7	2.9	0.2	17	17	1.5
	N_2O	L,T2	1.2	1.0	1.0	0.0	6	10	0.5
	All		4.2	3.7	3.9	0.2	23		2.0
4B1 Cattle	CH_4	L	1.6	1.5	1.7	0.2	10	10	0.9
4B8 Swine	CH_4	L	1.1	1.1	1.1	0.0	7	7	0.6
4B9 Poultry	CH_4	T2	0.3	0.1	0.1	0.0	0	0	0.0
4B2-7, 10-13 Other animals	CH_4		0.0	0.0	0.0	0.0	0	0	0.0
4D Agricultural soils	N_2O		10.7	6.6	6.4	-0.2	38	65	3.2
4D1 Direct soil emissions	N_2O	L,T	4.1	3.5	3.5	0.0	21	36	1.8
4D2 Animal production on agricultural soils	N_2O	L,T	3.1	1.5	1.3	-0.2	8	13	0.7
4D3 Indirect emissions	N_2O	L,T	3.4	1.5	1.5	0.0	9	16	0.8
National Total GHG emissions (excl. CO_2 LUCF)	CH_4		25.5	17.0	16.9	-0.1			
	N_2O		20.1	9.9	9.7	-0.2			
	All		213.2	204.6	198.9	-5.7			

*Key sources: L = Level; T= Trend; 1 = Tier 1; 2 = Tier 2

Figure 6.1 Category 4 'Agriculture': trend and emission levels of source categories , 1990-2009.



Overview of shares and trends in emissions

Table 6.1 shows the contribution of the agricultural source categories to the total national greenhouse gas inventory. This table also presents the key sources identified in the agricultural sector as specified by trend or level, or both. In 2009, CO_2 equivalent emissions from Sector 4 "Agriculture" contributed 8.4% to the total national emissions (without LULUCF) compared to 10.5% in 1990. In 2009, emissions of CH_4 and N_2O from agricultural sources accounted for 55 and 76% of the national total CH_4 and N_2O emissions. Category 4A "Enteric fermentation" is the main source of CH_4 emissions and category 4D "Agricultural soils" is the largest source of N_2O emissions included in this sector.

Total greenhouse gas emissions from Agriculture decreased by approximately 25% between 1990 and 2009, from 22.4 Tg CO_2 eq in 1990 to 16.7 Tg CO_2 eq in 2009 (see also Figure 6.1). This decrease was largely the result of decreasing numbers of livestock, a decreased application of animal manure and a decreased use of synthetic fertilizers.

Compared to 2008, nitrous oxide (N_2O) emissions decreased although animal numbers increased. Because N-content of rations was lower and the fraction of mature diary cattle in the stable higher this effect was eventually counteracted. Methane (CH_4) emissions however were higher as a result of increased activity, with more stable days leading to even higher CH_4 emission because of the associated higher EF.

Overview of trends in activity data

Livestock numbers are the primary activity data used in the calculation of CH_4 and N_2O.
Activity data for livestock numbers are based on the annual agricultural survey performed by Statistics Netherlands (CBS). Data can be found on the website www.cbs.nl, in Annex 8, Table A8.1 and in background documents (e.g., Van der Hoek and Van Schijndel, 2006). Table 6.2 presents an overview.

For cattle, three categories are distinguished:
- mature dairy cattle: adult cows for milk production;

Table 6.2 Numbers of animals in 1990–2009 (1,000 heads) (www.cbs.nl).

Animal type	1990	1995	2000	2005	2006	2007	2008	2009
Cattle	4,926	4,654	4,070	3,799	3,745	3,763	3,890	3,968
- Mature dairy cattle	1,878	1,708	1,504	1,433	1,420	1,413	1,466	1,489
- Mature non-dairy cattle	120	146	163	152	143	144	127	123
- Young Cattle	2,929	2,800	2,403	2,214	2,182	2,206	2,297	2,355
Sheep	1,702	1,674	1,308	1,363	1,376	1,369	1,213	1,117
Goats	61	76	179	292	310	324	355	374
Horses	370	400	418	433	428	434	444	445
Pigs (*1,000)	13.9	14.4	13.1	11.3	11.4	11.7	12.0	12.2
Poultry (*1,000)	95.6	92.2	107.2	95.9	94.7	96.0	99.7	100.0

- mature non-dairy cattle: adult cows for meat production;
- young cattle: mix of different age categories for breeding and meat production, including adult male cattle.

Between 1990 and 2009, (dairy) cattle, pig and sheep numbers decreased by 19, 12 and 34% respectively, while poultry numbers increased by 5%. Goat numbers increased by a factor 6 and horse numbers increased by 20 % in this period.

For mature dairy cattle, the decrease in numbers was associated with an increase in milk production per cow between 1990 and 2009. The increased milk production per cow is the a result of both genetic changes (due to breeding programmes for milk yield) as well as the increase in feed intake and the high feeding quality of cattle diets. Total milk production in the Netherlands is determined mainly by European Union (EU) policy on milk quotas, which has remained mostly unchanged. In order to comply with the unchanged milk quota, animal numbers of mature dairy cattle had to decrease to counteract the effect of increased milk production per cow. The last few years extensions in milk quota have again led to an increase in number of mature dairy cattle. Between 1990 and 2009 the numbers of young (dairy) cattle follow the same trends as those of adult female cattle – namely, a decrease.

The Netherlands' manure and fertilizer policy also influences livestock numbers. Young cattle, pig and poultry numbers in particular decreased as a result of the introduction of measures such as buying up part of the pig and poultry production rights (ceilings for total phosphate production by animals) by the government and lowering the maximum application standards for manure and artificial fertilizer. For pigs and young cattle the decreasing trend of the past has levelled off in the last couple of years. In recent years, animal numbers have shown a slight increase.

The increased number of swine in 1997 was a direct result of the outbreak of classical swine fever in that year (see NIR 2009). In areas where this disease was present, the transportation of pigs, sows and piglets to the slaughterhouse was not allowed, so the animals had to remain on the pig farms for a relatively long period (accumulation of pigs).

An increase in the number of poultry is observed between 1990 and 2002. In 2003, however, poultry numbers decreased by almost 30% as a direct result of the avian flu outbreak. In the years after 2003 the poultry population recovered to a large extent and reached a level of 4% below the 2002 level in 2009.

The increase in the number of goats might be explained as an effect of the milk quota for cattle. As result of the milk quota for cattle and the market development for goat milk products, farmers tend to change their management towards goats.

6.2 Enteric fermentation [4A]

6.2.1 Source category description

Methane emissions from enteric fermentation are produced as by-product of the digestive process in which organic matter (mainly carbohydrates) is degraded and utilized by micro-organisms under anaerobic conditions. Both ruminant (e.g. cattle, sheep and goats) and non-ruminant animals (e.g. pigs and horses) produce CH_4, although ruminants produce far more CH_4 per unit of feed intake than non-ruminants due to the specialization of the digestive system to digest fibrous material. Ruminants have a strongly expanded chamber, the rumen, at the front side of their digestive tract that allows the selective retention of feed particles and that supports intensive microbial fermentation of the feed. This yields several nutritional advantages including the capacity to digest fibrous material and the synthesis of microbial protein that can be digested in the intestine, but which is also accompanied by a high methane production by methanogens in the rumen.

Camels and llamas do not occur in the Netherlands. The emissions from buffalo, mules and donkeys are negligible and, therefore, not taken up in the inventory. Enteric fermentation methane emission from poultry is not estimated due to the negligible amount of CH_4 emission for this animal category. The IPCC Guidelines do not provide a default emission factor for this animal category. Other countries do not estimate emissions from poultry either.

6.2.2 Overview of shares and trends in emissions

In 2009 enteric fermentation accounted for 39% of the total greenhouse gas emissions from the agricultural sector in the Netherlands (see Table 6.1). Cattle accounts for the majority of CH_4 emissions from enteric fermentation (89%) in 2009. The second largest CH_4 emission source in category 4A is swine (6%). 4A Other animals consists of sheep, goats and horses, and accounts for 5%.

CH_4 emissions from enteric fermentation decreased from 7.5 Tg CO_2 eq to 6.5 Tg (–13%) between 1990 and 2009, which is fully explained by a decrease in CH_4 emission from enteric fermentation in cattle. Although associated emission factors have generally risen during this period, lowering cattle numbers have more than compensated the effect.

6.2.3 Activity data and emission factors

Trends in CH_4 emission from enteric fermentation are explained by a change in animal numbers, a change in emission factor or both.
Detailed information on data sources for activity data and emission factors can be found in the following monitoring protocol:
- Protocol 11-027: CH_4 from Enteric fermentation (4A)

All relevant documents concerning methodology, emission factors and activity data are published on the website www.greenhousegases.nl. Table 6.2 (in Section 6.1) presents an overview of animal numbers. In Annex 8, Tables A8.1, A8.2 and A8.3 show the activity data for all animal categories and emission factors for cattle.

For swine, sheep, goat and horses, default IPCC emission factors are used (1.5, 8, 5 and 18 kg/animal, respectively). Changes in emissions for these animal categories are therefore explained entirely by changes in animal numbers. To a great extent this is also the case for cattle, but the total decrease in CH_4 emission is lower due to an increase in implied emission factor (IEF).

Trends in cattle IEF
The emission factors for three cattle categories are calculated annually. For mature dairy cattle, a Tier 3 approach is used to calculate the CH_4 production per cow per year on the basis of data on the share of feed components and their chemical nutrient composition (Smink et al., 2005). For mature non-dairy and young cattle, a Tier 2 approach is used to calculate the CH_4 production per animal per year on the basis of data on the feed intake (Smink, 2005). For more information on the methods and the recalculation used, see Section 6.2.4 and Section 6.2.5. Table 6.3 shows the implied emission factors (IEFs) of the different cattle categories reported. The implied emission factor for young cattle is an average of several subcategories (Annex 8, Table A8.3).

For both mature dairy cattle and mature non-dairy cattle, IEFs increased primarily as a result of an increase in total feed intake during the period 1990–2009. For dairy cattle, a change in the feed nutrient composition partly counteracted this effect (see Section 6.2.4). For young cattle the decrease of IEF between 1990 and 2009 can be explained by a decrease in the average total feed intake due to a shift towards relatively more meat calves in the population of young cattle (Annex 8 Table A8.1).

Comparison of cattle IEF with IPCC defaults
Table 6.4 shows that the mature dairy cattle IEF follows the increasing trend in milk production. Compared to the default IPCC IEF of 118 kg CH_4 per cow for mature dairy cattle (at a milk production rate of 6700 kg/cow/year), the IEF used in the Netherlands is slightly lower.

In 1997 for instance, a milk production of about 6800 kg per year per cow led to an emission factor of 117 kg/animal/year, less than 1% lower than the default of 118 kg/animal/year. An explanation of the difference can be found in the data on feed intake, dietary composition and nutrient composition of dietary components as input to an alternative country specific model that predicts the methane emission factor for mature dairy cattle (Bannink, 2010). With increasing milk production per cow a decrease in the amount of CH_4 emission per unit of milk produced (from 0.018 to 0.016 kg CH_4/kg milk) can be seen.

The higher IEF for mature non-dairy cattle, (compared to the IPCC default value of 48 kg per animal) can be explained by the higher total feed intake per adult non-dairy cow. The relatively large share of meat calves for white and rose veal production explains the relatively low IEF for young cattle compared to the IPCC default value (Annex 8 Table A8.1).

Table 6.3 Implied emission factors for methane emissions from enteric fermentation specified according to CRF animal category (Units: kg CH_4/animal/year).

	1990	1995	2000	2005	2006	2007	2008	2009
Mature dairy cattle	110	116	120	126	128	129	128	127
Mature non-dairy cattle	65	66	67	71	71	72	73	72
Young cattle	37	37	35	34	34	34	34	34

Table 6.4 Milk production (kg milk/cow/year) and IEF (kg CH_4/cow/year) for mature dairy cattle.

	1990	1995	2000	2005	2006	2007	2008	2009
Milk production	6003	6596	7416	7568	7744	7878	7927	7919
IEF for methane	110	116	120	126	128	129	128	127

6.2.4 Methodological issues

A detailed description of the method, data sources and emission factors is found in the protocol on www.greenhousegases.nl, as indicated in Section 6.2.1. A specified description with more details on data and data sources on cattle used in calculations until 2006 can be found in Smink et al. (2005) and Smink (2005). In 2009, a recalculation was carried out for the whole time series (Bannink, 2010 and CBS, 2009).

Emissions from enteric fermentation are calculated from activity data on animal numbers and the appropriate emission factors.

CH_4 emission = ΣEF_i (kg CH_4/animal$_i$) * [number of animals for livestock category i]

Cattle

The emission factors for cattle are calculated annually for several subcategories of dairy and non-dairy cattle. For mature dairy cattle a country-specific method based on a Tier 3 methodology is followed; for the other cattle categories, the calculation is based on a country-specific Tier 2 methodology.

The feed intake of cattle, which is estimated from the energy requirement calculation used in the Netherlands, is the most important parameter in the calculation of the CH_4 emission factor for cattle. For instance for dairy cows the energy requirement expressed as net energy value of lactation (or VEM in Dutch) is calculated based on total milk production and feed composition. For young cattle the energy requirement is calculated on the basis of total weight gain and feed composition.

The intake of grass silage, maize silage, wet by-products, concentrates and grass products is estimated from national statistics found at www.cbs.nl. More information on the Netherlands VEM system is presented in Smink et al. (2005) and Tamminga et al. (2004).

Mature dairy cattle

The CH_4 emission from enteric fermentation by mature dairy cattle is calculated by a Tier 3 approach using dynamic modelling (Smink et al., 2005). The model of Mills et al. (2001) is employed, including updates (Bannink et al., 2005). This model is based on the mechanistic, dynamic model of rumen fermentation processes developed by Dijkstra et al. (1992). It has been developed for mature cattle and is therefore not suitable for other ruminant categories such as young cattle. The model calculates the gross energy (GE) intake and CH_4 emission factor (kg CH4/cow/year) and the methane conversion factor (MCF; % of GE intake converted into CH_4) on the basis of data on the share of feed components (grass silage, maize silage, wet by-products and concentrates), their chemical nutrient composition (soluble carbohydrates , starch, NDF, crude protein, ammonia, crude fat and ash) and the intrinsic degradation characteristics of starch, NDF and crude protein in the rumen. Data on the share of feed components in the diet are found at www.cbs.nl. Data on the chemical nutrient composition of individual roughages are provided by Blgg (a leading laboratory in the Dutch agricultural and horticultural sector with roughage sampling, analytical and advisory activities, and able to deliver data that can be taken is representative of the average Dutch farming conditions; www.blgg.com). Data used between 1990 and present are published by Bannink (2010) (via www.prtr.nl).

Young cattle and non-dairy cattle

The methane emission factor (EF) for enteric fermentation by non-dairy and young cattle is calculated by multiplying the GE intake by a methane conversion factor (Smink, 2005). Changes in GE intake are based on changes in the total feed intake and on the share of feed components. Data on the amounts of feed components, expressed as dry matter (DM) intake are found at www.cbs.nl and in Annex 8 Table A8.2 Gross Energy intake can be found. The equation for calculating the EF (in kg per animal per year) is:

EF = (MCF * GE intake * 365 day/year) / 55.65 MJ/kg CH_4

Where:
- EF: Emission factor (kg CH_4/animal/year)
- MCF: Methane conversion factor; fraction of the gross energy of feed intake converted to CH_4
- GE intake: Gross energy intake (MJ/animal/day)

Where:
- GE intake = Dry Matter intake (kg DM/animal/day) × 18.45 MJ/kg DM (IPCC, 2001)
- MCF = 0.04 for white veal calves and 0.06 for the other categories of young cattle and mature non-dairy cattle (IPCC, 2001)

Other livestock

Emission factors for the source categories swine, sheep, horses and goats are based on default IPCC Tier 1 EF (IPCC, 1997).

The share in total CH_4 enteric fermentation emissions by these other livestock categories (sheep, goats, horses and swine) is less than 10% of the total CH_4 enteric fermentation emissions. According to IPCC good practice guidance (GPG), no Tier 2 method is needed if the share of a source category is less than 25–30% of the total emission by a key source category.

As already mentioned in Section 6.2.1, enteric fermentation emission from poultry is not estimated due to a lack of data on CH_4 emission factors for this animal category.

6.2.5 Uncertainty and time-series consistency

Uncertainty

The Tier 1 uncertainty analysis shown in Annex 7 provides estimates of uncertainty according to IPCC source categories. The uncertainty of CH_4 emissions from enteric fermentation from cattle sources is based on the judgements of experts and is estimated to be about 16% in annual emissions for mature diary cattle, using a 5% uncertainty for animal numbers (Olivier et al., 2009) and 15% for the emission factor (Bannink, 2010). For the other cattle categories this is 21% based on 5% uncertainty in activity data and 20% on the EF. The uncertainty in the emission factor for swine and other animals is estimated to be 50% and 30%, respectively (Olivier et al., 2009).

Time-series consistency

A consistent methodology is used throughout the time-series; see also Section 6.2.4. Emissions are calculated from animal population data and emission factors. The animal population data are collected in an annual census and published by Statistics Netherlands over a long period of time (several decennia). Emission factors are either constant (default IPCC) or are calculated from feed intake data collected by an annual survey published by Statistics Netherlands.

The compilers of the activity data strive to use consistent methods to produce the activity data. The time-series consistency of these activity data is, therefore, very good due to the continuity in the data provided.

6.2.6 Source-specific QA/QC and verification

This source category is covered by the general QA/QC procedures discussed in Chapter 1.

6.2.7 Source-specific recalculations

There were no source-specific recalculations during this submission.

6.2.8 Source-specific planned improvements

Within the calculation of the CH_4 emission factor for mature dairy cattle (Bannink, 2010) a subdivision is made in the NW and SE parts of the country. Until now, CH_4 emissions are not regionalized and thus the weighed mean for the whole of the Netherlands is used. However it is planned to start making this distinction, because rations and thus emissions differ considerably between regions. On the national scale this could induce slight differences (negligible) due to rounding off numbers.

6.3 Manure management [4B]

6.3.1 Source category description

Both CH_4 and N_2O are emitted during the handling or storage of manure from cattle, pigs, poultry, sheep, goats and horses. These emissions are related to the quantity and the composition of the manure, and to the manure management system types and conditions. For instance, in comparison to anaerobic conditions, aerobic conditions in the manure management system will in general increase N_2O emissions and decrease CH_4 emissions. Furthermore, longer storage times and higher temperatures will increase CH_4 emissions compared to shorter storage times and lower temperatures.

Camels and llamas do not occur in the Netherlands, and the numbers of buffalo, mules and donkeys are negligible and therefore not estimated. Three animal manure management systems are distinguished for emission estimates of both CH_4 and N_2O: liquid and solid manure management systems and manure produced in the meadow while grazing.

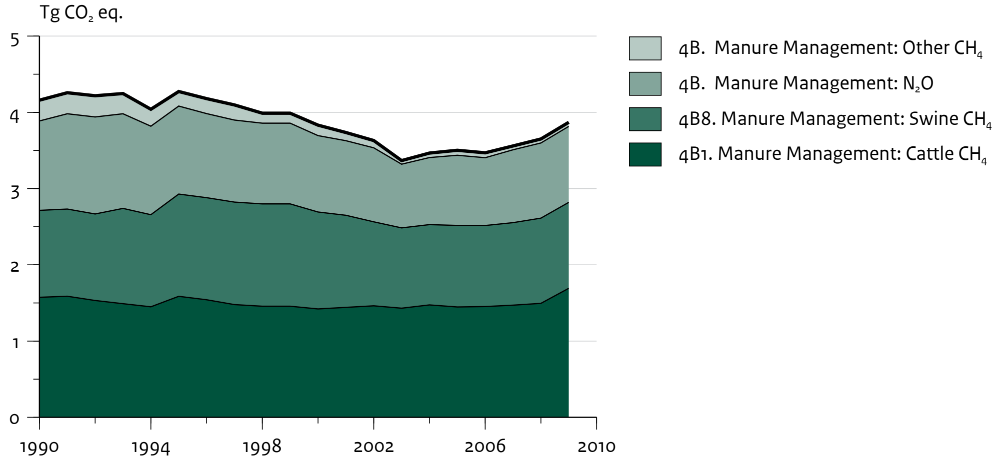
In accordance with IPCC Guidelines, N_2O emissions from manure produced in the meadow during grazing are not taken into account in the source category Manure management (see Section 6.1), but are included in the source category agricultural soils (Section 6.4).

6.3.2 Overview of shares and trends in emissions

In 2009, manure management accounted for 23% (CH_4 and N_2O) of the total greenhouse gas emissions from the agricultural sector (Table 6.1 and Figure 6.2). In the Netherlands CH_4 emissions from manure management are particularly related to cattle and swine manure management, which, in 2009, contributed 10% and 7%, respectively, to the total greenhouse gas emissions in the agricultural sector. Poultry is a minor key source for CH_4 emissions by manure management. Furthermore, N_2O emissions from manure management contribute 6% of the total greenhouse gas emissions from the agricultural sector.

Between 1990 and 2009, the emission of CH_4 from manure management decreased by 3%. Emissions from cattle increased by 6%, swine remained unchanged and poultry decreased by 67% during this period. From 2008 to 2009, the emission of CH_4 from manure management showed an 7% increase.

Figure 6.2 Category 4B Manure management: trend and emission levels of source categories , 1990-2009.



The emissions of N_2O from manure management decreased 15% between 1990 and 2009, from 1.2 to 1.0 Tg CO_2 eq (Table 6.1). Decreasing animal numbers have been the cause of this trend, from 2007 on it has reversed back into an increase. With the introduction of NEMA, N-flows have shifted giving rise to higher NH_3-emissions and thus lower emissions of N_2O from manure management. Also, emission factors have been updated and now follow a Tier 3 approach.

6.3.3 Activity data and (implied) emission factors

Detailed information on data sources (for activity data and emission factors) can be found in the following monitoring protocols:

- Protocol 11-029: CH_4 from Manure management (4B)
- Protocol 11-028: N_2O from Manure management (4B)

More details and specific data (activity data and emission factors), including data sources (emission factors), are documented in the background documents. All relevant documents concerning methodology, emission factors and activity data are published on the website www.greenhousegases.nl.

Activity data on animal numbers can be found on the website www.cbs.nl, in Annex 8, Table A8.1 and in a background document (Van der Hoek and Van Schijndel, 2006). Emission factor data can be found in Annex 8 Tables A8.3 to A8.9.

From the decrease in animal numbers and manure production for swine (Annex 8, Tables A8.1 and A8.8) a decrease in CH_4 emission is to be expected. However the decrease is countered by an increase in emission factor (Annex 8, Table A8.7). The emission factor has risen with fraction of manure stored under higher temperatures, i.e. in the stable. For young, mature dairy and non-dairy cattle, emissions do decrease as a result of animal numbers and only a small increase in emission factor. For poultry, the large decrease in CH_4 emissions between 1990 and 2009 can only be explained by the shift towards the solid manure management system with an associated lower IEF.

The slightly decreased N_2O emission from manure management between 1990 and 2009 is explained by a decrease in nitrogen (N) excretion in the stable partly counteracted by an increase in IEF.

CH_4 implied emission factors (IEF) for Manure management

The CH_4 IEF for manure management is calculated annually for all animal categories. A Tier 2 approach is used based on country-specific data on animal manure production per animal, on manure characteristics (such as organic matter (OM) content) and (liquid) manure storage conditions). For more information on methodology, see Section 6.3.4 and 6.3.5.

Table 6.5 shows the implied emission factors for manure management specified by the animal categories that contribute the most to CH_4 emissions.

Table 6.5 CH_4 implied emission factor (kg/head/year) for Manure management as specified by animal category, 1990–2009.

Animal type	1990	1995	2000	2005	2006	2007	2008	2009
Cattle								
- mature dairy cattle	27.70	30.48	33.15	37.50	38.34	39.19	37.50	41.73
- mature non-dairy cattle	3.23	3.53	3.45	3.45	3.45	3.45	3.45	3.45
- young cattle	7.70	8.22	7.18	6.63	6.52	6.42	6.86	7.66
Swine*	3.90	4.43	4.61	4.50	4.46	4.42	4.43	4.40
Swine excl. piglets	6.22	7.25	7.55	7.54	7.55	7.55	7.54	7.54
- fattening pigs	4.97	6.08	6.32	6.32	6.32	6.32	6.32	6.32
- breeding swine	11.39	12.24	12.86	12.96	12.99	12.95	13.38	13.26
Poultry	0.14	0.10	0.06	0.03	0.03	0.03	0.02	0.03

* IEF is calculated on basis of total pig numbers, including piglets. However, manure production by piglets is accounted for in manure production by adult breeding swine.

Trends in IEF

Mature dairy cattle

The IEF for manure management of mature dairy cattle increased between 1990 and 2009 because the increased milk production in that period (Table 6.4) is accompanied by an increase in manure production per cow and an increase in organic matter content of cattle manure. Both developments result from a higher feed intake. A third development concerns the shift in the proportion of the two dairy manure management systems (liquid manure in the stable and manure production in the meadow). The share of the amount of liquid stable manure increased between 1990 and 2009, while simultaneously the amount of manure produced in the meadow during grazing reduced (Annex 8, Table A8.8). This is a consequence of the increase of the average time period dairy cattle are kept indoors. An explanation for this is the increase in average farm size. Since large herds are difficult to collect for indoor milking, farmers tend to keep the animals indoors for 365 days per year. With stable manure showing a 17-fold higher emission factor for CH_4 emissions, the shift to more stable manure increased the methane emission per cow (Annex 8, Table A8.7; Van der Hoek and Van Schijndel, 2006).

In short, between 1990 and 2009 the increase in the manure production per cow and in the organic matter content of dairy cattle manure combined with a shift to more stable manure resulted in an increased methane emission from manure management per cow.

The lower IEF for mature dairy cattle in 2008 can be explained by the volume of manure collected in the animal house (see Annex Table A8.8). In that year mature dairy cattle spent more time in the meadow than usual due to favorable weather, and thus a larger fraction of the manure was excreted at far lower associated EF.

Poultry

For poultry, the substantial decrease in CH_4 IEF of manure management between 1990 and 2009 mainly explains the CH_4 emission decrease. This decrease can be explained by a shift in the proportion of the two poultry manure management systems (solid and liquid manure) in this period. The proportion of the solid manure system increased between 1990 and 2009 from approximately 40% to more than 95%. So the liquid manure system was almost completely replaced by the solid manure system. Compared to the liquid manure system the CH_4 emission factor for the solid system is about 15-fold lower (Annex 8, Table A8.7). Overall, this leads to a substantially decreased IEF, which in combination with only a slight increase in animal numbers fully explains the decrease in CH_4 emissions (Van der Hoek and Van Schijndel, 2006).

Swine

Compared to 1990, the IEF of swine manure management (based on total swine numbers, including piglets), increased in 1993 and 1997 as a result of storage of manure under higher temperature (increased storage capacity below stable) and in 1995 due to increasing volatile solids (Annex 8, Table A8.4 and A8.5). There are inter-annual changes not explained by this. These changes can be explained by looking at emissions factors of underlying swine categories. The calculation method for CH_4 emissions from swine manure management is based on the liquid manure production of adult breeding swine (in which manure production by piglets is accounted for). So presenting the underlying IEFs gives a better understanding of the inter-annual changes.

For fattening pigs the 22% increase in IEF between 1990 and 1995 is explained by a 4% decrease in manure production per animal combined with a 20% increase in organic matter (OM) content of the manure and a higher storage temperature. The 4% increase in IEF between 1995 and 2000 is explained by an 8% increase due to higher storage temperature counteracted by a 4% decrease in manure production per animal. These manure volume changes are mainly the result of a change in liquid manure

Table 6.6 N_2O implied emission factor for Manure management and total N-excretion per animal manure management system, 1990-2009 (Units: mln kg/year and kg N_2O/kg manure).

	1990	1995	2000	2005	2006	2007	2008	2009
Total N-excretion	514.5	516.1	432.6	393.6	390.5	406.3	413.0	418.1
- liquid system	412.4	411.8	337.7	305.2	304.9	316.1	319.4	322.9
- solid storage	102.1	104.3	94.8	88.4	85.6	90.2	93.6	95.2
N_2O emission manure management	3.78	3.72	3.23	2.97	2.87	3.08	3.18	3.22
N_2O IEF manure management	0.0074	0.0072	0.0075	0.0075	0.0073	0.0076	0.0077	0.0077

handling. In order to decrease the liquid manure volume, the mixing of rinsing water with manure was prevented as much as possible. As a consequence not only manure volume decreased, but also an increase in the OM concentration of manure occurred. A higher OM content results in a higher emission factor.

The inter-annual changes in the IEF for breeding pigs' manure are explained by inter-annual changes in the relative amount of different swine categories. Furthermore, between 1999 and 2000 a 2% decrease in manure production per animal occurred as a result of a change in liquid manure handling. In order to decrease the manure volume, the mixing of rinsing water with manure was prevented as much as possible.
For more details see Van der Hoek and Van Schijndel (2006) and Annex 8, Tables A8.4 to A8.8.

Comparison with IPCC default methane emission factor
The emission factors per animal type used by the Netherlands cannot be compared directly to the IPCC default values because of the assumptions on the share of the different animal manure management systems underlying the IPCC defaults.

Also the values of one of the underlying parameters per manure management system, Volatile Solids (VS), also called Organic Matter (OM) per animal type are not directly comparable. The Netherlands approach differs from the IPCC method in that the Netherlands uses the VS content of the manure (kg VS per kg manure) instead of volatile solids VS produced per animal per day (kg per head per day) in the IPCC calculation equations. By multiplying the VS per kg manure with the manure production per year, the annual VS production in manure in the Netherlands can be compared with the annual VS production underlying the default IPCC emission factors. More details are presented in Annex 8. Compared to the IPCC default MCF values, the Netherlands MCF values for liquid manure systems of swine (1990-1996) and cattle are slightly lower because part of the manure is stored under cooler conditions. For solid manure systems, the Netherlands uses a MCF of 1.5% for all animal categories (see Section 6.3.2); for manure production in the meadow, it uses the IPCC default MCF value.

N_2O implied emission factor (IEF) for Manure management
From this year on emissions of N_2O from manure management are calculated within the NEMA-model. Emission factors for N_2O from Manure management represent the IPCC default values for liquid, solid and poultry manure management systems and poultry manure, 0.001, 0.02 and 0.005 respectively.

Table 6.6 shows that the N_2O emissions from manure management decreased between 1990 and 2009, mainly as a consequence of the decrease in the total N-excretion.

6.3.4 Methodological issues

Methane emissions from animal manure
A Tier 2 approach is followed for CH_4 emission calculations. The amounts of manure (in kg) produced are calculated annually for every manure management system per animal category. Country-specific CH_4 emission factors are calculated for all three manure management systems for every animal category on a Tier 2 level. These calculations are based on country-specific data on:
- manure characteristics: organic matter (OM) and maximum CH_4 producing potential (Bo)
- manure management system conditions (storage temperature and period) for liquid manure systems, which determine the methane conversion factor (MCF).

The amount of manure produced is calculated by multiplying manure production factors (in kg per head per year) by animal numbers. Detailed descriptions of the methods can be found on the website www.greenhousegases.nl. More specified data on Manure management are based on statistical information on manure management systems found at www.cbs.nl. These data are also documented in Van der Hoek and Van Schijndel (2006) and in Annex 8, Table A8.8.

For the methane conversion factor (MCF) for solid manure systems and manure produced in the meadow, IPCC default values are used. The IPCC guidelines recommend a MCF value of 0.01 for stored solid cattle manure and MCF = 0.015 for stored solid poultry manure. However, literature shows that CH_4 emissions from stored solid cattle manure are probably higher (see Van der Hoek and Van Schijndel, 2006). For this reason, the Netherlands set the MCF value for stored solid cattle manure equal to the MCF for stored solid poultry manure. The IPCC guidelines recommend a MCF value of 0.01 for manure produced in the meadow. This value is used in the CH_4 emission calculations. Although the approach of the method applied by the Netherlands for CH_4 calculations differs slightly from the IPCC method, it is in accordance with the IPCC GPG. The Netherlands uses a country-specific emission factor for a specific animal category, which is expressed as the amount of CH_4 emitted per kg animal manure per year, whereas in the IPCC method the emission factor is expressed as the amount of methane (in kg) emitted per animal per year. Since the CH_4 emissions from manure management from cattle, swine and poultry are key sources (see Table 6.1), the present country-specific Tier 2 methodology fully complies with the IPCC Good Practice Guidance (IPCC, 2001).

Nitrous oxide emissions from animal manure
For the manure management systems and animal categories distinguished, the total N content of the manure produced – also called N excretion – (in kg N) is calculated by multiplying N excretion factors (kg/year per head) and animal numbers. Activity data are collected in compliance with a Tier 2 method. N_2O emission factors used for liquid and solid manure management systems are IPCC defaults. The method used is fully in compliance with the IPCC Good Practice Guidance (IPCC, 2001), which is required for this key source. N_2O emissions from manure produced in the meadow during grazing are not taken into account in the source category manure management. In accordance with the IPCC guidelines, this source is included in the source category agricultural soils (see Sections 6.1 and 6.4).

6.3.5 Uncertainty and time-series consistency

Uncertainty
The Tier 1 uncertainty analysis shown in Annex 7 provides estimates of uncertainty according to IPCC source categories. The uncertainty in the annual CH_4 and N_2O emissions from manure management from cattle and swine is estimated to be approximately 100%. The uncertainty in the amount of animal manure (10%) is based on a 5% uncertainty in animal numbers and a 5–10% uncertainty in excretion per animal. The resulting uncertainty of 7–11% was rounded off to 10%. The uncertainty in the CH_4 emission factors for manure management, based on the judgments of experts, is estimated to be 100% (Olivier et al., 2009).

Time-series consistency
A consistent methodology is used throughout the time-series. The time-series consistency of the activity data is very good due to the continuity in the data provided.

6.3.6 Source-specific QA/QC

This source category is covered by the general QA/QC procedures, discussed in Chapter 1.

6.3.7 Source-specific recalculations

From this year on emissions of N_2O from manure management are calculated within the new NEMA-model.
We still use IPCC default N_2O emission factors, however now also making the distinction for poultry manure as indicated in the Good Practice Guidance.
New information on solid and liquid systems is used in the new model leading to higher emissions compared to earlier submissions.
An error correction was made in the division of laying hens in liquid and solid manure systems for the year 2007, leading to more solid manure and thus lower CH_4 and higher N_2O emissions in this specific case.

6.3.8 Source-specific planned improvements

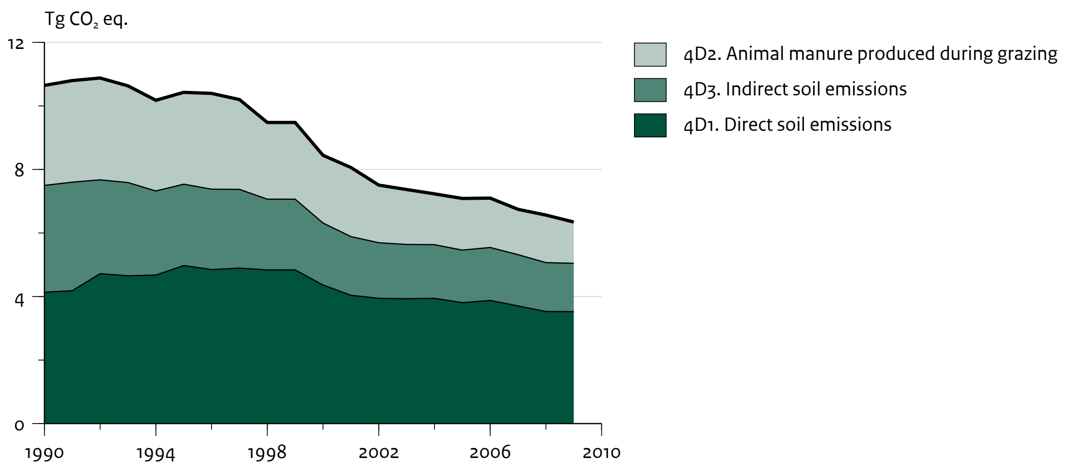
A possible technical measure to prevent methane emissions due to manure management is manure treatment in an anaerobic digester. In 2008, 0.6% of the total liquid stable manure has been treated in an anaerobic digester (www.cbs.nl). The Netherlands will examine future needs and possibilities in this area to include anaerobic treatment in the methodology and to extend calculations.

6.4 Agricultural soils [4D]

6.4.1 Source category description

In the Netherlands, this source consists of the N_2O source categories specified in Table 6.1:
- Direct soil emissions from the application of synthetic fertilizers, animal manure and sewage sludge to soils, and from N-fixing crops, crop residues and the cultivation of histosols (4D1)
- Animal production – animal manure produced in the meadow during grazing (4D2)
- Indirect emissions from N leaching and run-off, and from N deposition (4D3).

Figure 6.3 Category 4D Agricultural soils: trend and emission levels of source categories, 1990-2009.



6.4.2 Overview of shares and trends in emissions

In 2009, agricultural soils contributed 38% to the total greenhouse gas emissions in the agricultural sector. Direct and indirect N_2O emissions and emissions from animal production in the meadow contributed 21%, 9% and 8% respectively, to the total greenhouse gas emissions in the agricultural sector.

Total N_2O emissions from Agricultural soils decreased by 40% between 1990 and 2009 (see Figure 6.3). Direct emissions decreased by 15%, while emissions from animal manure produced in the meadow and indirect emissions decreased 59 and 55%, respectively.

This decrease is caused by a relatively high decrease in N-input to soil (from manure and chemical fertilizer application and animal production in the meadow), partly counteracted by the increased IEF in this period that resulted from a shift from the surface spreading of manure to the incorporation of manure into soil as a result of ammonia policy.

6.4.3 Key sources

Both direct and indirect N_2O soil emissions, as well as animal production on agricultural soils are level and/or trend key sources (see Table 6.1).

6.4.4 Activity data and (implied) emission factors

Detailed information on data sources (for activity data and emission factors) can be found in the following monitoring protocols:

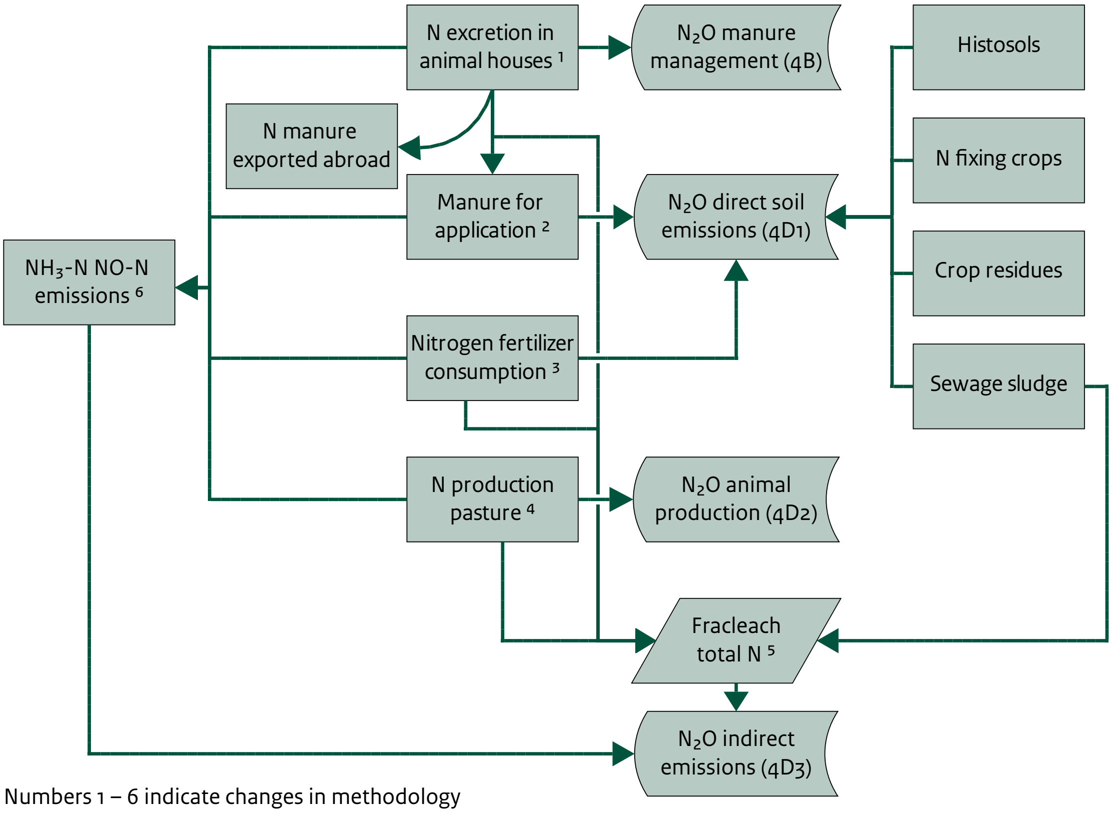
- Protocol 11-030: N_2O from Agricultural soils: indirect emissions (4D)
- Protocol 11-031: N_2O from Agricultural soils: direct emissions and emissions from animal production (4D).

More details and specific data (activity data and emission factors), including data sources (emission factors), are documented in background documents. All relevant documents concerning methodology, emission factors and activity data are published on the website www.greenhousegases.nl.

The calculation of N_2O emissions from agricultural soils is based on various activity data, for example animal numbers (see Section 6.1) and nitrogen flows. For an overview of data sources, see the protocols or the background document (Van der Hoek et al., 2007). The activity data and emission factors can also be found in Annex 8, Tables A8.10 and A8.11.

Nitrogen flows
Figure 6.4 shows a schematic representation of contributors to the N_2O emission source categories and their calculation. In this submission several improvements have been implemented, represented by numbers in the figure and to be discussed in more detail in Section 6.4.8.
Table 6.7 present the N flows from synthetic fertilizer consumption, animal manure production and application

Figure 6.4 Nitrogen flows in relationship to source categories for N_2O.



Numbers 1 – 6 indicate changes in methodology

in the Netherlands. 70%-80% of the manure N collected in the stable and in storage is applied to soils. A growing portion of the manure N (from 1% in 1990 to 10% in 2009) is exported; while approximately 10-20% is emitted as ammonia or nitric oxide during storage.
The total amount of gross N to soil (total manure production and fertilizer minus net export, including production of animal manure in the meadow) decreased by approximately 38% between 1990 and 2009. Explaination is the Netherlands manure and fertilizer policy, aimed at reducing N leaching and run-off. This policy regulates the amount of manure production and its application by the introduction of measures such as pig and poultry production rights and maximum nutrient application standards for manure and fertilizer.

Of the manure N applied to the soil between 1990 and 2009 the part emitted as ammonia (NH_3) decreased from 45 to 12%, due to a change in the method of animal manure application to agricultural soils. Before 1991 manure was applied to the soil by surface spreading on both grasslands and arable land. Initiated by the Netherlands' policy to reduce ammonia emissions, this practice changed in 1991 into manure incorporation into the soil (e.g., shallow injection or ploughing in), resulting in lower NH_3 emissions. Ultimately, between 1990 and 2009 the part of the N in manure and synthetic fertilizer emitted as NH_3 (in the stable and during storage, grazing and application to the field) decreased from approximately 24% to 12%. In 2010 new insights in the N_2O EFs for manure and fertilizer application were adopted, with the first leading to considerably lower N_2O emissions.

Part of the total nitrogen flow to the soil is subject to leaching and run-off and until 2009 the default IPCC fracleach factor of 0.3 was used. Now an Tier 3 approach (Velthof and Mosquera, 2011) has been adopted to asses this fraction, while keeping the IPCC default EF of 0.025 in place.

The decrease in indirect N_2O emissions is fully explained by the decrease in N from atmospheric deposition due to lower NH_3-emissions and less leaching and run-off because of lower total N to soil. The decrease in N_2O

Table 6.7 Nitrogen flows related to N_2O emissions from soils.

	1990	1995	2000	2005	2006	2007	2008	2009	Change 2009 - 1990
Nitrogen fertilizer consumption	412.4	405.8	339.5	279.2	287.8	257.5	238.1	238.1	-42%
Nitrogen excretion by animals	710.4	696.0	565.2	494.9	487.2	495.2	506.0	499.0	-30%
Nitrogen excretion in animals houses	514.5	516.1	432.6	393.7	390.5	406.3	413.0	418.1	-19%
of which in solid form	102.1	104.3	94.8	88.4	85.6	90.2	93.6	95.2	-7%
of which in liquid form	412.4	411.8	337.7	305.2	304.9	316.1	319.4	322.9	-22%
Nitrogen in manure exported abroad/ incinerated*	5.9	22.4	18.0	26.3	21.4	31.3	38.3	38.8	563%
Available manure for application	410.5	399.9	336.4	299.0	304.7	309.5	301.5	300.3	-27%
(N-excretion in animal houses - total N-emissions in animal houses - export)									
Nitrogen excretion in meadow	195.9	179.9	132.5	101.2	96.7	88.8	93.0	80.8	-59%
Nitrogen in sewage sludge on agric. land	5.0	1.5	1.5	1.2	1.1	1.0	1.0	1.0	-80%
Total nitrogen supply to soil	1121.9	1080.9	888.2	749.0	754.7	722.3	706.9	699.3	-38%
(manure + fertilizer + sewage sludge - export)									
Nitrogen fixation in arable crops	7.8	4.9	4.7	4.5	4.7	4.5	4.2	4.3	-45%
Nitrogen in crop residues left in field	36.4	34.9	34.1	32.1	29.8	29.3	26.7	26.4	-28%
Nitrogen in histosols	52.4	52.4	52.4	52.4	52.4	52.4	52.4	52.4	0%
NH_3-N emission from synthetic fertilizers	12.0	12.0	10.5	11.4	13.1	10.7	9.0	9.0	-25%
NO-N emission from synthetic fertilizers	4.9	4.9	4.1	3.4	3.5	3.1	2.9	2.9	-42%
NH_3-N emission in animal houses	72.3	70.5	56.3	46.1	45.7	46.3	47.3	47.3	-34%
NO-N emission in animal houses	2.4	2.4	2.1	1.9	1.8	2.0	2.0	2.0	-15%
NH_3-N emission from manure application	182.6	63.7	51.0	44.5	44.7	45.9	35.7	35.4	-81%
NO-N emission from manure application	4.9	4.8	4.0	3.6	3.7	3.7	3.6	3.6	-27%
NH_3-N emission in meadow	15.2	13.7	4.5	3.0	2.5	2.1	2.3	1.5	-90%
NO-N emission in meadow	2.4	2.2	1.6	1.2	1.2	1.1	1.1	1.0	-59%
Atmospheric deposition agr. NH_3-N NO-N	296.7	174.1	134.0	115.0	116.0	114.8	103.9	102.8	-65%
Nitrogen lost through leaching and run off	157.1	140.5	106.6	89.9	90.6	86.7	84.8	83.9	-47%

emissions from animal manure produced in the meadow is also entirely reflected in the decrease in N input to soil by this source. The decrease in direct N_2O emissions can be explained by the decrease in the direct N input to soil by manure and chemical fertilizer application, softened by an increase in IEF because of the incorporation into soil.

Implied emission factor

Table 6.8 shows the implied emissions factors (IEF) for N_2O emissions from agricultural soils for the application of animal manure. A 132% increase in IEF occurred in the period 1990–2009, which is caused by an ammonia policy driven shift from the surface spreading of manure to the incorporation of manure into the soil. Combined with a 27% decrease in N manure input to soil (see Table 6.7), this explains the 66% increase in N_2O from manure application.

Table 6.8 N_2O implied emission factors from animal manure applied to agricultural soils (Units: kg N/kg N-input).

Year	IEF
1990	0.004
1991	0.004
1992	0.007
1993	0.007
1994	0.008
1995	0.009
1996	0.009
1997	0.009
1998	0.009
1999	0.009
2000	0.009
2001	0.009
2002	0.009
2003	0.009
2004	0.009
2005	0.009
2006	0.009
2007	0.009
2008	0.009
2009	0.009

6.4.5 Methodological issues

Direct and indirect N_2O emissions from agricultural soils, as well as N_2O emissions by animal production in the meadow are estimated using country-specific activity data on N-input to soil and NH_3 volatilization during grazing, manure management (stable and storage) and manure application. Most of these data are estimated at a Tier 2 or Tier 3 level. The present methodologies fully comply with the IPCC Good Practice Guidance (IPCC, 2001). For a description of the methodologies and data sources used, see the monitoring protocols on www.greenhousegases.nl. A full description of the methodologies is provided in Van der Hoek et al. (2007), with more details in Kroeze (1994). An overview of the emission factors used is presented in Table 6.9. Default IPCC emission factors are included for comparison.

Table 6.9 Emission factors for direct N_2O emission from soils, expressed as kg N_2O-N per kg N supplied.

Source	Default IPCC	EF used	Reference
Nitrogen fertiliser	0.0125	0.013	4
Animal manure application	0.0125		
Surface spreading		0.004	4
Incorporation into soil		0.009	4
Sewage sludge	0.0125	0.01	2
Biological nitrogen fixation crops	0.0125	0.01	1
Crop residues	0.0125	0.01	2
Cultivation of organic soils (histosols)		0.02	2,3
Animal manure during grazing	0.02	0.033	4

References 1 = Kroeze, 1994; 2 = Van der Hoek et al., 2007; 3 = Kuikman et al., 2005; 4 = Velthof et al., 2010; Velthof and Mosquira, 2011; Van Schijndel et al., 2011

Direct N_2O emissions

The IPCC Tier 1b/2 methodology is used to estimate direct N_2O emissions from soil. Emissions from animal manure application are estimated for two types of manure application methods, surface spreading with lower and incorporation into soil with higher emission factor.
The higher value for incorporation is explained by two mechanisms. Incorporation of animal manure into the soil produces less ammonia emission and hence more reactive nitrogen enters the soil. Furthermore, the animal manure is more concentrated (e.g., hot spots) in comparison with surface spreading and hence the process conditions for nitrification and denitrification can be more suboptimal.

Animal production

The IPCC Tier 1b/2 methodology is used to estimate direct N_2O emissions from animal production. Due to the new emission factors, the methodology of calculation could be simplified. The country specific method now uses total animal production times a country specific emission factor.

Indirect N_2O emissions

The IPCC Tier 1 method is used to estimate indirect N_2O emissions from atmospheric deposition. Country-specific data on NH_3 and NO emissions (estimated at a Tier 3 level) are multiplied by IPCC default value for the N_2O emission factor.

Indirect N_2O emissions resulting from leaching and run-off N emissions are estimated using country-specific data on total N-input into soil and leaching fraction (estimated at a Tier 3 level). IPCC default values are used for the N_2O emission factor.

The main reason to use IPCC defaults is that direct and indirect N_2O emissions in the Netherlands partially originate from the same soils and sources. In the Netherlands, no experimental data are available to evaluate the value of the emission factor for indirect emissions.

6.4.6 Uncertainty and time-series consistency

Uncertainty

The Tier 1 uncertainty analysis, shown in Annex 7, provides estimates of uncertainty according to IPCC source categories. The uncertainty in direct N_2O emissions from Agricultural soils is estimated to be approximately 60%. The uncertainty in indirect N_2O emissions from N used in agriculture is estimated to be more than a factor of 2 (Olivier et al., 2009).

Time-series consistency

Consistent methodologies are used throughout the time series. The time-series consistency of the activity data is very good due to the continuity in the data provided.

6.4.7 Source-specific QA/QC

This source category is covered by the general QA/QC procedures discussed in Chapter 1.

6.4.8 Source-specific recalculations

Figure 6.4 shows a schematic representation of contributors to the N_2O emission source categories and their calculation. In this submission several improvements have been implemented, represented by numbers in the figure and to be discussed in more detail here.

1. In the calculation of ammonia emissions a new model (NEMA) has been adopted. Since NEMA also calculates the N_2O emissions (using IPCCC default emission factors), these are reported in the NIR to ensure consistency with data presented in the IIR. For a description on NEMA see Velthof et al., 2009 and 2011; Groenestein et al., 2011 and Van Bruggen, 2011).
2. Emission factors for manure application have been updated. As a consequence, calculations can now be based on gross instead of net nitrogen flows making them more transparant. Before, a higher emission factor than the IPCC default was used for the incorporation of manure into soil. The findings of a survey on N_2O emission factors for the field-scale application of animal manure abroad did not provide the necessary underpinning for an update of long-term average N_2O emission factors for this source in the Netherlands (Van der Hoek et al., 2007). Consequently, research has been carried out since 2007 to gain an insight into this. First results on the effect of manure application technique on N_2O emission in field and laboratory experiments were recently presented (Velthof et al, 2010). Translation into adjustments of the emission factors has been completed for this submission, see Velthof and Mosquera, 2011 and Van Schijndel et al., 2011.
3. Following the research described in point 2 emission factors for the application of nitrogen fertilizer have also been changed, including the change from net to gross nitrogen flows.
4. With regards to manure production during grazing emission factors and change from net to gross nitrogen flows was also made, see 2.
5. The specific characteristics of the Netherlands agricultural soils (with relatively high water tables) justify the calculation of the “fracleach” on the basis of country-specific data. Therefore, the Netherlands has adopted the use of a model (STONE). A description is given in Velthof and Mosquera (2011) including a translation of STONE results into a fracleach consistent with IPCC 1996 guidelines.
6. In this submission NO emissions from agriculture have been included in the deposition calculation for the first time. This was made possible by the publication of EMEP-guidelines which provided a method for calculation of these emissions, with the exclusion of stable and storage that is already part of the NEMA-calculations.

The above mentioned recalculations changed the emissions in 1990 with -94 and in 2008 with -1826 Gg CO_2 eq compared to the previous submission.

6.4.9 Source-specific planned improvements

None.

7
Land use, land use change and forestry [CRF Sector 5]

Major changes in the LULUCF sector compared to the National Inventory Report 2010
Emissions: The emission data from LULUCF from 2009 are 7% lower than in 2008.
Key sources: No changes to NIR 2010.
Methodologies: Changes in methodology have not been made.

7.1 Overview of sector

This chapter describes the 2009 greenhouse gas inventory for the Land Use, Land Use Change and Forestry (LULUCF) sector. It covers both the sources and sinks of CO_2 greenhouse gases from land use, land use change and forestry. The emission of nitrous oxide (N_2O) from land use is included in the “Agriculture” sector (category 4D) and the emission of methane (CH_4) from wetlands is not estimated due to the lack of data. All other emissions from forestry and land use can be considered to be negligible.
Land use in the Netherlands is dominated by agriculture (57%), settlements (13%), forestry (10%, including trees outside forests) and 2% comprises dunes, nature reserves, wildlife areas and heather. The remaining area (19%) in the Netherlands is open water. The soils in the Netherlands are dominated by mineral soils, mainly sandy soils and clay soils (of fluvial or marine origin). Organic soils, used mainly as meadowland or hayfields, cover about 8% of the land area. The Netherlands has an intensive agricultural system with high inputs of nutrients and organic matter. The agricultural land is used as grassland (51%), arable (25%), fodder maize (12%) and the remaining agricultural land is used for horticulture, fallow, fruit trees, etc. Grassland and fodder maize are cultivated in rotation. About 80% of the grasslands are permanent grasslands (of which 5% are high nature value grasslands); the remaining 20% is temporary grassland. Since 1990, the agricultural land area has decreased by about 5%, mainly because of conversion to settlements/infrastructure and nature.
The LULUCF sector in the Netherlands is estimated to be a net source, amounting in 2009 to some 2.5 Tg CO_2 equivalents. The fact that the LULUCF sector is a net source is due to the large contribution of carbon emitted from drained peat soils, which exceeds the sequestration of carbon in forestry. The LULUCF sector is responsible for 1.2% of total greenhouse gas emission in the Netherlands.
The structure of this Section and of the main submission for the National Inventory Report and Common Reporting Format (CRF) tables is based on the categories of the CRF tables at the 9th Conference of Parties to the United Nations Framework Convention on Climate Change (UNFCCC). The Sector 5 Report Tables in the CRF format have been submitted using the CRF Reporter.

7.2 Methods

The methodology of the Netherlands to assess the emission from LULUCF is based on the IPCC 1996 Revised Guidelines and its updates in the Good Practice Guidance: a carbon stock change approach based on inventory data subdivided into appropriate pools and land use types and a wall-to-wall approach for the estimation of area per category of land use. The information on the activities and land use categories used covers the entire territorial (land and water) surface area of the Netherlands.
The inventory comprises six classes: Forest Land; Cropland; Grassland; Wetlands; Settlements and Other Land. There is also a category "Other" which includes emissions from land use related activities such as liming. The changes in land use ("remaining" or "converted") are presented in a 6 x 6 matrix, which is fully in accordance with the approach described in the IPCC guidelines. To better match available national maps and databases on land use, the category "Forest Land" is the aggregation of two main subdivisions: Forest (according to the Kyoto definition) and Trees outside Forest, and the category "Grassland" is the aggregation of two main subdivisions: Grasslands and Nature. The latter subdivision includes heather, peat land and moors. All categories are relevant in the Netherlands.
The carbon cycle of a managed forest and wood production system is considered in the calculations of the relevant CO_2 emissions. The carbon stocks in soils from a single stratified measurement campaign for the various types of land use are used to calculate the emissions from land use categories. For the Netherlands, it is assumed that the impact of land use in terms of loss of soil carbon is likely to be relatively small. Simulation show that large quantities of carbon accumulate in soil. We have assumed no changes in the carbon stocks due to land and soil management and cultivation practices over the period 1990–2009. This is a conservative approach. The research that is ongoing aims to underpin whether land conversions are a source of soil carbon or not, and is not directed to quantifying the size of the sinks in the Netherlands. The requirement in the Kyoto Protocol to quantify changes in carbon stock for land use conversions to and from Kyoto forest only, led to quantified estimates for these specific land use changes in mineral soils. Both proved to be a sink (see chapter 11 for details). As the Convention allows a more aggregated and complete reporting, the Netherlands holds on to its choice to report the soils of the Netherlands as one aggregated sink of uncertain magnitude that is conservatively reported as zero (with exception of the cultivated organic soils, which are reported separately).

7.3 Data

In this NIR, the changes in land use are based on comparing detailed maps that best represent land use in 1990 and 2004. Both datasets on land use were especially developed to support the temporal and spatial development in land use and especially designed to support policy in the field of nature conservation (MNP, 2008). In the future, updates of the digital land use map will become available regularly and these will suite the future LULUCF process in their aim to present accurate information on land use changes.
Changes in land use over the period 1990–2004 were checked in detail (Kramer et al., 2009). Omissions due to methodological reasons (e.g., legend, classification and gridding) were manually adjusted in favour of a correct presentation of the changes in land use over the period 1990–2004. The sum of all land use categories is constant over time. It is likely that the updated reference maps will also follow future updates of the land use change matrix. Changes after 2004 have been obtained by linear extrapolation.

7.4 Recalculations

This year, there were three recalculations.

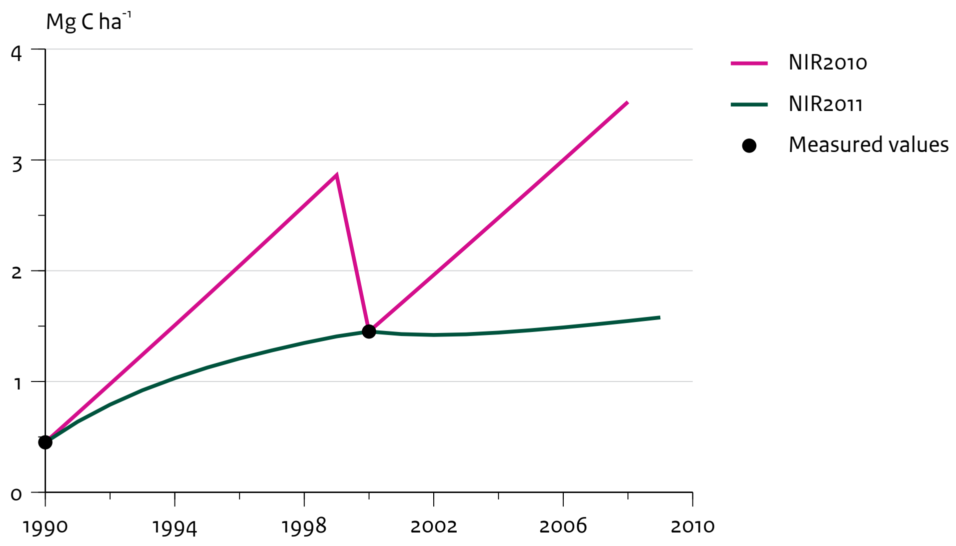
1. Carbon Stock Change in biomass loss in 'Forest Land remaining Forest Land' and in land changing from Forest Land to other land use categories.

   The harvest values for the period since 2000 have been changed. This involved an error correction in attributing the values to the right years, and an update of the values (from 2007 on). This resulted in modified values for biomass loss due to harvesting in 'Forest Land remaining Forest Land'. As it also affected values for the average amount of standing stock and thus standing carbon per hectare over The Netherlands, the emission factor for biomass loss due to land use conversion away from Forest Land was slightly modified as well.

2. Carbon Stock Change in dead wood in 'Forest Land remaining Forest Land' and in land changing from Forest Land to other land use categories.

   Built-up of dead wood was overestimated in the Netherlands. The decomposition of dead wood is based on measured values for longevity. However, the additional active removal of dead wood from forests was set to zero. This resulted in a built-up of dead wood between 1990 and 2000 that was not reflected in the measured values of dead wood in the NFI 2001-2005 (see Figure 7.1). The parameter describing the active removal of dead wood was therefore calibrated to

Figure 7.1 Carbon stock in dead wood, based on the National Forest Inventory (NFI).



match the observed built-up of dead wood between 1990 and 2000 and set to 20 %. Thus, on average 20% of all dead wood in the Netherlands is actively removed from site.

3. Emissions from liming of agricultural soils in Other (5G)

   In the previous NIR fertiliser data were not available for 2008 and therefore the 2008 emission was set equal to the 2007 emission. These fertiliser data have become available and have been used to calculate the 2008 emission.

The methodologies applied for estimating CO_2 emissions and removals of the land use change and forestry in the Netherlands are described in the updated background document (van den Wyngaert et al., 2011) and in updates of the two protocols (see also the website www.greenhousegases.nl):
- Protocol 11-032: CO_2 from forest (5A)
- Protocol 11-033: CO_2 from total land use categories (5B-5G).

Table 7.1 shows the sources and sinks in the LULUCF sector in 1990 and 2009. For 1990 and 2009, the total net emissions are estimated to be approximately 2.7 Tg CO_2 and 2.5 Tg CO_2 respectively, with the major source being CO_2 emissions from the decrease in carbon (C) stored in organic soils and peat lands: 4.2 Tg CO_2, included in 5C1 "Grassland remaining grassland", resulting from agricultural and water management. The major sink is the storage of carbon in forests: - 2.8 Tg CO_2, this includes the emissions from "Forest Land remaining forest land" (5A1) and "Land converted to Forest Land" (5A2). Sector 5 "Land use, land use change and forestry" (LULUCF) accounted for 1.2% of the total national CO_2 emission in 2009.

Table 7.1 Contribution of main categories and key sources in Sector 5 LULUCF.

Sector/category	Gas	Key	Emissions base year (1990)	Emissions 2008	Emissions 2009	Change 2009-2008	Contribution to total in 2009 (%)		
Key sources		Level, Trend	Tg CO_2 eq	Tg CO_2 eq	Tg CO_2 eq	Gg CO_2 eq	By sector	Of total gas	Of total CO_2 eq
5. Total land use categories	CO_2		2.7	2.7	2.5	-0.2	100	1.4	1.2
5A. Forest land	CO_2		-2.4	-2.6	-2.8	-0.2	-115	-1,7%	-1,4%
5A1. Forest Land remaining Forest Land	CO_2	L	-2.4	-2.0	-2.1	0.1	-87	-1,2%	-1,1%
5A2. Land converted to Forest Land	CO_2	L,T	0.0	-0.6	-0.7	-0.1	-29	-0,4%	-0,4%
5B. Cropland	CO_2		0.0	0.0	0.0	0.0	2	0,0%	0,0%
5B1. Cropland remaining Cropland	CO_2		IE	IE	IE				
5B2. Land converted to Cropland	CO_2		0.0	0.0	0.0	0.0	2	0,0%	0,0%
5C. Grassland	CO_2		4.6	4.8	4.8	0.0	194	2,8%	2,4%
5C1 Grassland remaining Grassland	CO_2	L,T	4.2	4.2	4.2	0.0	172	2,5%	2,1%
5C2. Land converted to Grassland	CO_2	L,T2	0.4	0.5	0.5	0.0	22	0,3%	0,3%
5D. Wetlands	CO_2		0.0	0.1	0.1	0.0	2	0,0%	0,0%
5D1. Wetlands remaining Wetlands	CO_2		NE	NE	NE				
5D2. Land converted to Wetlands	CO_2		0.0	0.1	0.1	0.0	2	0,0%	0,0%
5E. Settlements	CO_2		0.2	0.3	0.3	0.0	12	0,2%	0,1%
5E1. Settlements remaining Settlements	CO_2		NE	NE	NE				
5E2. Land converted to Settlements	CO_2		0.2	0.3	0.3	0.0	12	0,2%	0,1%
5F. Other Land	CO_2		0.0	0.0	0.0	0.0	1	0,0%	0,0%
5F1 .Other Land remaining Other Land	CO_2		0.0	0.0	0.0	0.0	0	0,0%	0,0%
5F2. Land converted to Other Land	CO_2		0.0	0.0	0.0	0.0	1	0,0%	0,0%
5G. Other	CO_2		0.2	0.1	0.1	0.0	4	0,1%	0,0%
Total National CO_2 Emissions (incl. CO_2 LULUCF)	CO_2		162.0	178.0	172.3	3.3			
	All		214.0	206.7	200.8	-0.1			

7.5 Forest Land [5A]

7.5.1 Source category description

This category includes emissions and sinks of CO_2 caused by changes in forestry and other woody biomass stock. All forests in the Netherlands are classified as temperate forest, with 30% of the forests being coniferous, 22% broad-leaved and the remaining area a mix of both. The share of mixed and broad-leaved forests has grown in recent decades (Dirkse et al., 2003).

The category includes two subcategories: 5A1 “Forest Land remaining Forest Land” and 5A2 “Land converted to Forest Land”. The first category includes estimates of changes in the carbon stock from different carbon pools in the forest. The second category includes estimates of the changes in land use from mainly agricultural areas into forest land since 1990.

7.5.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

The methodology of the Netherlands to assess the emission from LULUCF is based on a wall-to-wall approach for the estimation of area per category of land use. For the wall-to-wall map overlay approach were used harmonised and validated digital topographical maps of 1990 and 2004 (Kramer et al., 2009). The result was a national scale land-use and land-use change matrix. The information on the activities and land-use categories used covers the entire territorial (land and water) surface area of the Netherlands.

7.5.3 Definition

The land use category "Forest Land" is defined as all land with woody vegetation consistent with thresholds used to defined forest land in the national GHG inventory, sub-divided into managed and unmanaged units and also by ecosystem type as specified in IPCC Guidelines. It also includes systems with vegetation that currently fall below, but are expected to exceed the threshold of the forest land category (IPCC, 2003; 2006).

The Netherlands has chosen to define the land-use category "Forest Land" as all land with woody vegetation, now or expected in the near future (e.g., clear-cut areas to be replanted, young afforestations). This is further stratified in:

- "Forest" or "Forest according to the Kyoto definition" (FAD), - all forest land which complies to the following (more strict than IPCC) definition chosen by the Netherlands for the Kyoto protocol: forests are patches of land exceeding 0.5 ha with a minimum width of 30 m, with tree crown cover at least 20% and tree height at least 5 m, or, if this is not the case, these thresholds are likely to be achieved at the particular site. Roads in the forest less than 6 m wide are also considered to be forest. This definition conforms to the FAO reporting and was chosen within the ranges set by the Kyoto protocol.
- "Trees outside Forests" (TOF), that is - wooded areas that comply with the previous forest definition except for their surface (=< 0.5 ha or less than 30 m width). These represent fragmented forest plots as well as groups of trees in parks and nature terrains and most woody vegetation lining roads and fields. These areas comply with the GPG-LULUCF definition of Forest Land (they have woody vegetation) but not to the strict forest definition that the Netherlands applies.

7.5.4 Methodological issues

Removals and emissions of CO_2 from changes in forestry and woody biomass stock are estimated based on country-specific Tier 2 methodology. The approach chosen follows the IPCC 1996 Revised Guidelines and its updates in the Good Practice Guidance on Land Use, Land Use Change and Forestry (IPCC, 2003). The basis assumption is that the net flux can be derived from converting the change in growing stock volume in the forest into carbon. Detailed descriptions of the methods used and emission factors can be found in the protocol 11-032 on the website www.greenhousegases.nl, as indicated in Section 7.1.
The Netherlands' National System follows the carbon cycle of a managed forest and wood products system. The pools are distinguished by above-ground biomass, below-ground biomass, litter, dead wood, and soil organic carbon. Changes in the carbon stock are calculated for above-ground biomass, below-ground biomass and dead wood and litter in forests. Calculations for the living biomass carbon balance are carried out at plot level.

Living biomass

The following steps are taken to calculate the net carbon flux in living biomass. First, the age of the stand and the limit of dominant height are calculated, followed by a calculation of the height and expected volume in the next year. Based on the expected volume for the next year and from the number of trees, the average tree volume for the next year is derived. The next step is the calculation of the average diameter of the tree in the next year. The above-ground and below-ground total biomass is derived using the equations from the COST E21 database. The desired net flux is derived from the difference in tree mass between two years, the basic wood density and the carbon content of the dry mass. This last step is represented in the following equation:

$$\Delta C_{FF_G} = \sum_{1}^{n} (A_i \bullet G_{TOTALi}) \bullet CF$$

$$G_{TOTALi} = \left(\overline{B_{it+1}} - \overline{B_{it}}\right) \cdot nt_{it}$$

where:

ΔC_{FF_G}	Total net carbon emission due to biomass increase for Forest land remaining Forest land – FAD in The Netherlands	kg C ha^{-1}
A_i	Area represented per NFI plot	ha
CF	Carbon fraction of living biomass	0.5

and

G_{TOTALi}	Biomass increase for NFI plot i	kg DW
$\overline{B_{it}}$	Average tree biomass of NFI plot i at time t	kg DW
$\overline{B_{it+1}}$	Average tree biomass of NFI plot i at time t+1	kg DW
nt_{it}	Living tree density of NFI plot i at time t	ha^{-1}

Thinning

Thinning was carried out in all plots that met the criteria for thinning (age > 110 years or growing stock more than

300 m3 ha-1). The number of trees thinned was based on the volume harvested, and the net carbon flux due to thinning is then calculated from the average biomass of a single tree and the carbon content of the dry mass.

Dead wood

The net carbon flux to dead wood is calculated as the remainder of the input of dead wood due to mortality minus the decay of the dead wood. Leaves and roots were not taken into account for the build up of dead wood. The mortality rate was assumed to be a fixed fraction of the standing volume (0.4% year^{-1}), and the current stock of dead wood volume is assumed to be 6.6% of the living wood volume (based on data from Timber Production Statistics and Forecast (HOSP) and the MFV). A net build up may exist, since Dutch forestry only began to pay attention to dead wood a decade ago.
The following equations are used to calculate the net carbon flux to dead wood:

$$\Delta C_{FF_{DW}} = \sum \left(A_i \bullet \left(B_{DW\,\mathrm{int}\,o_i} - B_{DW\,out_i} \right) \right) \bullet CF$$

$$B_{DW\,\mathrm{int}\,o_i} = B_{it} \bullet f_{mort}$$

$$B_{DW\,out_i} = \left(\frac{V_{SDi}}{L_{SDi}} + \frac{V_{LDi}}{L_{LDi}} \right) \bullet D_{DW} + f_{removal} \bullet D_{DW}$$

$\Delta C_{FF_{DW}}$ Total net carbon emission due to change in dead wood for Forest land remaining Forest land – FAD in the Netherlands

$B_{DW\,\mathrm{int}\,o_i}$ Annual mass transfer into dead wood pool of NFI plot i

$B_{DW\,out_i}$ Annual mass transfer out of dead wood pool of NFI plot i

B_{it} Stand living biomass of NFI plot i at time t

f_{mort} Mortality fraction (0.4% year^{-1})

V_{SDi} Volume of standing dead wood of NFI plot i

V_{LDi} Volume of lying dead wood of NFI plot i

L_{SDi} Species specific longevity of standing dead wood

L_{LDi} Species specific longevity of standing lying wood

D_{DW} Species specific average wood density of dead wood

$f_{removal}$ Removal fraction of dead wood (was previously set to 0, is now 0.2)

Litter

The carbon stock change from changes in the litter layer was estimated using a stock change method at national level. Data for litter layer thickness and carbon in litter were available from five different datasets. Additional, selected forest stands, on poor and rich sands, were intensively sampled with the explicit purpose to provide conversion factors or functions.
None of the available datasets could be used exclusively. Therefore, a stepwise approach was used to estimate the national litter carbon stock and change therein in a consistent way. After which a hierarchy was developed to accord mean litter stock values to any of the sampled plots of the available forest inventories (HOSP and MFV). The difference between 2004 and 1990 was estimated and a mean annual rate of carbon accumulation was calculated. A Monte Carlo uncertainty analysis was carried out and showed that the result was considered the more conservative.

7.5.5 Activity data

Activity data on land use and land use change are derived from the land use maps and the land use change matrix. Carbon content is based on the soil map of the Netherlands (scale 1:50,000) combined with results of LSK, a national random check of map units that provides detailed descriptions of soil profiles. The random check was implemented both nationwide and on a stratified scale, combining main categories and/or symbol units in order to produce a more homogenous classification with respect to landscaping, soil formation or parent material. Within this framework, this random check was meant to provide further quantitative information for the existing soil maps.

Activity data on forests is based on forest inventories carried out in 1988–1992 (HOSP data) and in 2001–2002 and 2004–2005 (MFV data). HOSP data, which includes plot level data (in total 2007 plots, about 400 per year) for growing stock volume, increment, age, tree species, height, tree number and dead wood, was used for the 1990 situation. Forward calculation using this data was applied to the year 1999. Additional data on felling, final cut and thinning was used to complete the data set. MFV plot level data (in total 3622 plots, with same items as HOSP) was applied to the years 2000–2004. In addition, in order to assess the changes in activity data, databases with tree biomass information, with allometric equations to calculate above-ground and below-ground biomass and with forest litter, as well as wood harvest statistics, soil carbon estimations and high-resolution topographical maps of 1990 and 2004 were used. See the website at www.greenhousegases.nl for more details on activity data.

7.5.6 Implied emission factors

The total emissions from the tree component after deforestation is calculated by multiplying the total area deforested with the average carbon stock in living biomass, above- as well as below ground (Nabuurs et al., 2005) and the average carbon stock in dead organic matter and litter. Thus it is assumed that with deforestation, all carbon stored in above- and below ground biomass as well as in dead wood and litter is lost to the atmosphere. National averages are used as there is no record of the spatial occurrence of specific forest types.

The average carbon stock in living biomass follows the calculations from the gap filled forest inventory data. The calculated emission factors show a progression over time. The EF for biomass is 60.4 Mg C ha^{-1} in 1990 and increase to 88.1 Mg C ha^{-1} in 2009. The EF for litter is 29.0 Mg C ha-1 in 1990 and increase to 35.9 Mg C ha^{-1} in 2009 and the EF for dead wood is 0.45 Mg C ha^{-1} in 1990 and increase to 1.58 Mg C ha^{-1} in 2009. The systematic increase in average standing carbon stock reflects the fact that annual increment exceeds annual harvests in the Netherlands.

The IEF for biomass increase in land converted to either FAD or TOF reflects the age distribution of the re/afforested areas and will attain a constant value 20 years after 1990.

Non CO_2 emissions in forest land

N_2O emissions might occur as a result of using fertiliser in forests or from drainage. Both management practices are rarely applied in forestry in the Netherlands. Thus, it is assumed that N_2O emissions are irrelevant in forests. CH_4 emissions resulting from forest fires are considered to be negligible because fires seldom occur.

7.5.5 Uncertainty and time-series consistency

Uncertainties

The Tier 1 analysis in Annex 7 shown in Table A7.1 provides estimates of uncertainties according to IPCC source category. The Netherlands uses a Tier 1 analysis for the uncertainty assessment of the sector LULUCF. The analysis combines uncertainty estimates of the forest statistics, land use and land use change data (topographical data) and the method used to calculate the yearly growth in carbon increase and removals. The uncertainty in the CO_2 emissions from 5A1 “Forest Land remaining Forest Land” is calculated at 67%. The uncertainty in the CO_2 emission from 5A2 “Land converted to Forest Land” is calculated at 63%. See Olivier et al. (2009) for details.

The uncertainty in implied emission factors of 5A1 “Forest Land remaining Forest Land” concerns forest and trees outside the forest. As the methodology and data sets used are the same for both sources, the uncertainty calculation is performed for forests and the result is considered to be representative for trees outside forests as well.
The uncertainty in the implied emission factor of increment in living biomass is calculated at 13% (rounded off to 15% in the calculation spreadsheet). The uncertainty in the implied emission factor of decrease in living biomass is calculated at 30%. The uncertainty in the net carbon flux from dead wood is calculated at 30% (rounded off to 50% in the Tier 1 calculation spreadsheet).

Uncertainty in implied emission factor of 5A2 ‘Land converted to Forest Land’

For the increment in living biomass, the same data and calculations are used as for 5A1 “Forest Land remaining Forest Land” and, therefore, the same uncertainties are used in the Tier 1 calculation spreadsheet.
For soil carbon stock changes after land use change it is assumed that the average carbon stock in the soil under the new and old land use is the same (Groot et al., 2005). Therefore, the uncertainty is the uncertainty of the change in carbon content in mineral soil, which is calculated at 38% (rounded off to 50% in the Tier 1 calculation spreadsheet); see Section 7.3.3.

Uncertainty in activity data in categories 5A1 and 5A2

The activity data used is area change, calculated by comparing two topographic maps. The uncertainty of one topographic map is estimated at 5% (expert judgment). Therefore, the uncertainty in comparing two topographic maps is theoretically 5 × 5 = 25%. This is without doubt an overestimation, as not all land use may change over a decade.

Time-series consistency

The updated time series for category 5A shows an average of about 2,800 Gg CO_2 $year^{-1}$ and with a range from 2,500 Gg CO_2 $year^{-1}$ to 3,000 Gg CO_2 $year^{-1}$ over the period 1990-2009 (see Table 7.2). The figures in category 5A1 show the net result of the sequestration in live trees, in trees outside forest, dead wood and litter and the emission from harvest. The figures for live trees and harvest only change slightly over time, with no clear direction. The figures for afforestation have steadily increased since 1990 and reached in 2009 a sequestration level of 706 Gg CO_2 $year^{-1}$.

7.5.8 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures as discussed in Chapter 1.

Table 7.2 CO_2 emissions/removals from changes in forest and other woody biomass stocks (IPCC category 5A) (Units: Gg CO_2)

	1990	1995	2000	2005	2008	2009
5A Forest Land	-2,437	-2,584	-2,606	-2,563	-2,643	-2,850
5A1 Forest Land remaining Forest Land of which	-2,434	-2,524	-2,384	-2,106	-2,004	-2,144
Live trees	-3,754	-3,509	-3,505	-3,301	-3,214	-3,188
Harvest	1,746	1,257	1,247	1,356	1,363	1,193
Trees outside Forest	-212	-180	-160	-131	-116	-111
Dead wood	-213	-93	33	-29	-37	-37
5A2 Land converted to Forest Land (Afforestation)	-3	-59	-222	-457	-639	-706

7.5.9 Source-specific recalculations

The recalculations affected the Carbon Stock Change in biomass loss and in dead wood in 'Forest Land remaining Forest Land' and in land changing from Forest Land to other land use categories (see section 7.4). These recalculations resulted in an additional annual emission of 94.76 Gg CO_2 in 1990, and 204.58 Gg CO_2 in 2008 (corresponding to 3.74% respectively 7.19% of the total emission from category 5A).

7.5.10 Category-specific planned improvements, if applicable (e.g., methodologies, activity data, emission factors, etc.), including those in response to the review process

For this land use category no improvements are planned in the direct future.

7.6 Cropland [5B]

7.6.1 Source category description

The source category 5B "Cropland" includes only the emissions of CO_2 from 5B2 "Land converted into Cropland".

The land use category "Cropland" is defined as all arable and tillage land, including rice-fields, and agro-forestry systems where the vegetation structure falls below the thresholds used for the Forest Land category (IPCC, 2003).

7.6.2 Activity data and (implied) emission factors

The activity data is derived from the land use maps and the land use change matrix. Carbon content is based on the soil map of the Netherlands (scale 1:50,000) combined with results of LSK, a national random check of map units that provides detailed descriptions of soil profiles. The random check was implemented both nationwide and on a stratified scale, combining main categories and/or symbol units in order to produce a more homogenous classification with respect to landscaping, soil formation or parent material. Within this framework, this random check was meant to provide further quantitative information for the existing soil maps.

7.6.3 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

One consistent approach was used over all land use categories. See par 7.2.2.

7.6.4 Definitions

The Netherlands has chosen to define croplands as arable lands and nurseries (including tree nurseries). Intensive grasslands are not included in this category and are reported under Grasslands. For part of the agricultural land, rotation between cropland and grassland is frequent, but data on where exactly this is occurring are as yet lacking. Currently, the situation on the topographical map is leading, with lands under agricultural crops and classified as arable lands at the time of recording reported under Cropland and lands with grass vegetation at the time of recording classified as Grassland.

7.6.5 Methodological issues

The type of land use is determined using digitised and digital topographical maps (scale: 1:10,000), which allows the land-use matrix to be completed according to the recommendations in the Good Practice Guidance on Land Use, Land Use Change and Forestry (IPCC, 2003). The years 1990 and 2004 are based on observations of land use; the values for the period in between are obtained through linear interpolations, and the values for the years after 2004 are obtained by means of extrapolation. For more information on the methodology, see the description on land use and the land use change matrix in Chapter 7.2. More detailed descriptions of the methods used and emission factors can be found in the protocols 11-032 and 11-033 on the website www.greenhousegases.nl.

7.6.6 Uncertainty and time-series consistency

Uncertainties

The Tier 1 analysis in Annex 7 shown in Table A7.1 provides estimates of uncertainties according to IPCC source categories. The Netherlands uses a Tier 1 analysis for the uncertainty assessment of the sector LULUCF. The uncertainties in the Dutch analysis of carbon levels depend on the collective factors with which the calculations are implemented (calculation of the organic substances in the soil profile and the conversion to a national level) and data on land use and land use change (topographical data). The uncertainty in the CO_2 emissions from 5B2 "Land converted to Cropland" is calculated at 56%; see Olivier et al. (2009) for details.

Uncertainty in the implied emission factor of 5B2 Land converted to Cropland

The uncertainty in the implied emission factor of 5B2 "Land converted to Cropland" refers to the change in carbon content of mineral soils. The uncertainty in the change in the carbon content of mineral soils is calculated to be 38% (rounded off to 50% in the Tier 1 calculation spreadsheet, since it is the order of magnitude that is important).

Uncertainty in activity data

The activity data used is area change, calculated by comparing two topographic maps. The uncertainty of one topographic map is estimated to be 5% (expert judgment). Therefore, the uncertainty for comparing two topographic maps is theoretically 5 × 5 = 25%. This is without doubt an overestimation as not all land use may change over a decade.

Time-series consistency

The yearly emission of CO_2 due to the conversion of land converted tot cropland shows a small yearly increase from 35 Gg CO_2 in 1990 to 49 Gg CO_2 in 2009.

7.6.7 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures, as discussed in Chapter 1.

7.6.8 Source-specific recalculations

The recalculations in land converted to cropland are entirely the result of the recalculations in Forest Land, which affected the standing C stock in Forest Land and thus the emission factors of Forest Land converted to Cropland. These recalculations resulted in an additional annual emission of 0 Gg CO_2 in 1990, and - 0.14 Gg CO_2 in 2008 (corresponding to 0% respectively 0.30% of the total emission from category 5B).

7.6.9 Category-specific planned improvements, if applicable (e.g., methodologies, activity data, emission factors, etc.), including those in response to the review process

For this land use category no improvements are planned in the direct future.

7.7 Grassland [5C]

7.7.1 Source category description

The source category 5C "Grassland" includes only the emissions of CO_2 from 5C1 "Grassland remaining Grassland" and 5C2 "Land converted into Grassland". The source category 5C1 is by far the most important source of CO_2 within the sector LULUCF.

7.7.2 Activity data and (implied) emission factors

The activity data is derived from the land use maps and the land use change matrix. Carbon content is based on the soil map of the Netherlands in combination with results of LSK, a national random check of map units that provides detailed descriptions of soil profiles (see Section 7.3.1). The activity data for organic soils is based on soil maps (1:50,000 for the period 1960–1990), recent inventories on organic soils (2001–2003), profile information from LSK and data on field levels in 1990 and 2000.

7.7.3 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

One consistent approach was used over all land use categories. See par 7.2.2.

7.7.4 Definition

The land use category "Grassland" is defined as rangeland and pasture land that is not considered as croplands. It also includes vegetation that falls below the threshold used in the forest land category and are not expected to exceed, without human intervention, the threshold used in the forest land category. The category also includes all grassland from wild lands to recreational areas as well as agricultural and silvi-pastoral systems, subdivided into managed and unmanaged consistent with national definitions (IPCC, 2003). It is stratified in:

- "Grasslands" - all areas predominantly covered by grass vegetation (whether natural, recreational or cultivated)
- "Nature" - all natural areas excluding grassland (natural grasslands and grasslands used for recreation purposes).

It mainly consists of heath land, peat moors and other nature areas. Many have the occasional tree as part of the typical vegetation structure. This category was in the previous submissions a subcategory within Forest land.

The Netherlands currently reports under grassland any type of terrain which is predominantly covered by grass vegetation. No distinction is made between agricultural intensively and extensively managed grasslands and natural grasslands. However, the potential and the need for this are currently under discussion. Apart from pure grasslands, all orchards (with standard fruit trees, dwarf varieties or shrubs) are included in the category grasslands. They do not conform to the forest definition, and while agro-forestry systems are mentioned in the definition of Croplands, this is motivated by the cultivation of soil under trees. However, in the Netherlands the main undergrowth of orchards is grass. We therefore chose to report them as grasslands. As for grasslands no change in above-ground biomass is reported, the carbon stored in these trees is not reported.

7.7.5 Methodological issues

For information on the methodology to assess land use and land use change see Chapter 7.2. A country-specific Tier 2 method is used to estimate CO_2 emissions from the drainage of organic soils (Grassland remaining Grassland). For grassland, CO_2 emissions resulting from soil subsidence of peat land by oxidation of peat due to managed drainage are added. The CO_2 emission of 5C1 "Grassland remaining Grassland" is calculated and based on observations on yearly subsidence rates for various types of peat and available information on the extent of drainage and subsequent soil carbon losses through oxidation for each peat type and drainage level (Kuikman et al., 2005). The country-specific method used is based on the recommendations given in the IPCC 2003 Good Practice Guidance (IPCC, 2003). Uncertainty in the decrease in the area of organic soils in past decades – in particular, the estimate for 1990 – has led to the conclusion that the area can be considered to be relatively constant yet likely to be still decreasing at a low rate since 1990 (223,000 ha is the observed area of organic soils and thus a conservative estimate). The 2003 stated area of organic soils with the relevant water management conditions and measures and calculated loss of organic matter calculates an implied emission factor of on average 19.04 ton CO_2/ha (Kuikman et al., 2005). For the period 1990-2009 the emissions from organic soils under grassland are based on the fixed area and implied emission factor value. Both are the result of analysis of the developments in a range of different peat lands (including water and soil management). The area used so far conflicts to some extent with the results for grassland on organics soils of the land use change matrix. The matrix shows a 4% smaller area and overtime a very slight decrease in area. As long as the loss of carbon cannot be verified and calculated on an annual bases (based on accurate condition data e.g., temperature and water management) the use of year specific area figures of the matrix introduces a pseudo accuracy. Therefore we have decided not to change the calculation methodology as outlined in Kuikman et al, 2005. More detailed descriptions of the methods used and emission factors can be found in protocols 11-032 and 11-033 on the website www.greenhousegases.nl.

7.7.6 Uncertainty and time-series consistency

Uncertainties

The Tier 1 analysis in Annex 7 shown in Table A7.1 provides estimates of uncertainties according to the IPCC source category. The uncertainty for the CO_2 emissions in categories 5C1 Grassland remaining Grassland and 5C2 Land converted to Grassland is calculated to be 56%; see Olivier et al. (2009) for details.

Uncertainty in the implied emission factor of 5C1 Grassland remaining Grassland

The uncertainty for the oxidation of organic soils in category 5C1 is calculated at 55%. Combined with the 38% uncertainty of the change in carbon content of mineral soils (see Section 7.3.3), the overall uncertainty in the implied emission factor for category 5C1 will probably remain in the 50% range (50% used in the Tier 1 calculation spreadsheet).

Uncertainty in the implied emission factor of 5C2 Land converted to grassland

For the uncertainty of 5C "Land converted to Grassland", reference is made to the description of 5B2 "Land converted to Cropland" (Section 7.3.3). The calculation for "Land converted to Grassland" is based on the same assumptions as those made for 5B2 "Land converted to Cropland" and are, therefore, identical. The uncertainty is estimated to be 38% (50% used in the Tier 1 calculation spreadsheet).

Uncertainty in activity data of categories 5C1 and 5C2

The activity data used is area change, calculated by comparing two topographic maps. The uncertainty of one topographic map is estimated to be 5% (expert judgment). Therefore, the uncertainty in comparing two topographic maps is theoretically 5 × 5 = 25%. This is without doubt an overestimation as not all land use may change over a decade.

Time-series consistency

The yearly source of CO_2 that results from the drainage of organic soils is 4,246 Gg CO_2. The yearly emission of CO_2

due to the conversion of forest land to grassland shows a steady increase from 394 Gg CO_2 in 1990 to 556 Gg CO_2 in 2009.

7.7.7 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures, as discussed in Chapter 1.

7.7.8 Source-specific recalculations

The recalculations in land converted to grassland are entirely the result of the recalculations in Forest Land, which affected the standing C stock in Forest Land and thus the emission factors of Forest Land converted to Grassland. These recalculations resulted in an additional annual emission of 0 Gg CO_2 in 1990, and -2.13 Gg CO_2 in 2008 (corresponding to 0% respectively 0.04% of the total emission from category 5C).

7.7.9 Category-specific planned improvements, if applicable (e.g., methodologies, activity data, emission factors, etc.), including those in response to the review process

For this land use category no improvements are planned in the direct future.

7.8 Wetland [5D]

7.8.1 Source category description

The source category 5D "Wetland" includes only CO_2 emissions from 5D1 "Wetland remaining Wetland" and 5D2 "Land converted to Wetland".

7.8.2 Activity data and (implied) emission factors

The activity data is derived from the land use maps and the land use change matrix (see Section 7.3.2.). The carbon content of wetlands is not estimated and is set at zero in the land use change matrix.

7.8.3 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

One consistent approach was used over all land use categories. See par 7.2.2.

7.8.4 Definition

The land use category "Wetland" includes land that is covered or saturated with water for all or part of the year and does not fall into the forest land, cropland, grassland or settlements categories. It includes reservoirs as a managed sub-division and natural lakes and rivers as unmanaged sub-divisions (IPCC, 2003). Though the Netherlands is a country with many wet areas by nature, many of these are covered by a grassy vegetation and those are included under grasslands. Some wetlands are covered by a more rough vegetation of wild grasses or shrubby vegetation, which is reported in the subcategory "Nature" of Grassland. Forested wetlands like willow coppice are reported in the subcategories FAD or TOF of Forest Land, depending on their surface.

In the Netherlands, only reed marshes and open water bodies are included in the Wetland land use category. This includes natural open water in rivers, but also man-made open water in channels, ditches and artificial lakes. It includes bare areas which are under water only part of the time as a result of tidal influences, and very wet areas without vegetation. It also includes "wet" infrastructure for boats, i.e. waterways but also the water in harbours and docks.

7.8.5 Methodological issues

For information on the methodology to assess land use and land use change see Chapter 7.2. The emission of CH_4 from wetlands is not estimated due to the lack of data. More detailed descriptions of the methods used and the emission factors can be found in protocols 11-032 and 11-033 on the website www.greenhousegases.nl.

7.8.6 Uncertainty and time-series consistency

Uncertainties
For information on the uncertainty estimates, the reader is referred to Section 7.2.5, which discusses the uncertainty of soil carbon and changes in land use.

Time-series consistency
The time-series shows a consistent small increase from 40 Gg CO_2 in 1990 to 57 Gg CO_2 in 2009.

7.8.7 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures, as discussed in Chapter 1.

7.8.8 Source-specific recalculations

The recalculations in land converted to wetland are entirely the result of the recalculations in Forest Land, which affected the standing C stock in Forest Land and thus the emission factors of Forest Land converted to Wetland. These recalculations resulted in an additional annual emission of 0 Gg CO_2 in 1990, and -0.23 Gg CO_2 in 2008 (corresponding to 0% respectively 0.4% of the total emission from category 5D).

7.8.9 Category-specific planned improvements, if applicable (e.g., methodologies, activity data, emission factors, etc.), including those in response to the review process

For this land use category no improvements are planned in the direct future.

7.9 Settlement [5E]

7.9.1 Source category description

This source category 5E "Settlement" includes only those CO_2 emissions from 5E1 "Settlements remaining Settlements" and 5E2 "Land converted to Settlements".

7.9.2 Activity data and (implied) emission factors

The activity data are derived from the land use maps and the land use change matrix. Estimates of carbon content are based on the soil map of the Netherlands in combination with results of LSK, a national random check of map units that provides detailed descriptions of soil profiles. There is a lack of information on the carbon content for most of the settlement grid cells. Consequently, the carbon content was calculated using a weighed average over all carbon stock classes within each land use category.

7.9.3 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

One consistent approach was used over all land use categories. See par 7.2.2.

7.9.4 Definition

The land use category "Settlements" includes all developed land, including transportation infrastructure and human settlements of any size, unless they are already included under other categories (IPCC, 2003). In the Netherlands, the main classes included are urban areas and transportation infrastructure, and built-up areas. Built-up areas include any constructed item, independent of the type of construction material, which is (expected to be) permanent, fixed to the soil surface and serves as place for residence, trade, traffic and/or labour. Thus it includes houses, blocks of houses and apartments, office buildings, shops and warehouses but also fuel stations and greenhouses. Urban areas and transportation infrastructure include all roads, whether paved or not, are included in the land use category Settlements with exception of forest roads which are included in the official forest definition. It also includes train tracks, (paved) open spaces in urban areas, parking lots and graveyards. Though some of the last classes are actually covered by grass, the distinction cannot be made based on maps. As even the grass graveyards are not managed as grasslands, inclusion in the land use category "Settlements" conforms better to the rationale of the land use classification.

7.9.5 Methodological issues

For information on the methodology to assess land use and land use change see Chapter 7.2. The reporting is considered to be a Tier 2 level (see protocol 11-032). Because there has been no change in soil carbon and, in any case, no loss of soil carbon was expected for the period 1990–2004, the emissions from 5E1 "Settlement land remaining Settlement" are set at zero. The category 5E2 "Land converted to Settlement" includes the conversion from mainly grassland, cropland and other land to settlements. More detailed descriptions of the methods used and the emission factors can be found in the protocols 11-032 and 11-033 on the website www.greenhousegases.nl, as indicated in Section 7.1.

7.9.6 Uncertainty and time-series consistency

Uncertainties
Uncertainty estimates are provided in Section 7.2.5, which discusses the uncertainty of soil carbon and changes in land use.

Time-series consistency
The time-series shows a consistent increase from 212 Gg CO_2 in 1990 to 300 Gg CO_2 in 2009.

7.9.7 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures, as discussed in Chapter 1.

7.9.8 Source-specific recalculations

The recalculations in land converted to settlement are entirely the result of the recalculations in Forest Land, which affected the standing C stock in Forest Land and thus the emission factors of Forest Land converted to Settlement. These recalculations resulted in an additional annual emission of 0 Gg CO_2 in 1990, and -0.61 Gg CO_2 in 2008 (corresponding to 0% respectively 0.20% of the total emission from category 5E).

7.9.9 Category-specific planned improvements, if applicable (e.g., methodologies, activity data, emission factors, etc.), including those in response to the review process

For this land use category no improvements are planned in the direct future

7.10 Other Land [5F]

7.10.1 Source category description

This source category 5F "Other Land" includes only CO_2 emissions from 5F1 "Other Land remaining Other Land" and 5F2 "Land converted to Other Land".

7.10.2 Activity data and (implied) emission factors

The activity data are derived from the land use maps and the land use change matrix. Carbon content is based on the soil map of the Netherlands in combination with results of LSK, a national random check of map units that provides detailed descriptions of soil profiles.

7.10.3 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

One consistent approach was used over all land use categories. See par 7.2.2.

7.10.4 Definition

The land use category "Other Land" was included to allow the total of identified land to match the national area where data are available. It includes bare soil, rock, ice and all unmanaged land area that do not fall in any of the other five categories. (IPCC, 2003).

In general, Other Land does not have a substantial amount of carbon. The Netherlands uses this land use category to report the surfaces of bare soil which are not included in any other category. In the Netherlands this refers mostly to almost bare sands and the earliest stages of succession from sand in the coastal areas (beaches, dunes and sandy roads) or uncultivated land alongside rivers. It does not include bare areas that emerge from shrinking and expanding water surfaces (these "emerging surfaces" are included in wetlands).

7.10.5 Methodological issues

For information on the methodology to assess land use and land use change see Chapter 7.2. The land use category Other Land is introduced to allow wall-to-wall reporting of land areas even if not all land could be allocated to a land use category. The carbon stored in land allocated to Other Land need not be reported (as it is assumed that Other Land has no carbon). In previous submissions, a quite broad definition of Other Land was used, and the carbon in land converted to or from Other Land was assumed to change between reported and not reported. Therefore, large positive and negative emissions were reported which did not actually reflect changes in carbon in soil, but the reporting status of carbon in soil. This was deemed not realistic. In the 2009 submission a more narrow definition of Other Land is used, and the reporting of "administrative emissions" was stopped. More detailed descriptions of the methods used and the emission factors can be found in protocols 11-032 and 11-033 on the website www.greenhousegases.nl, as indicated in Section 7.1.

7.10.6 Uncertainty and time-series consistency

Uncertainties

For information on the uncertainty estimation, the reader is referred to Section 7.2.5, which discusses the uncertainty of soil carbon and changes in land use.

Time-series consistency

The time-series shows a consistent small increase from 18 Gg CO_2 in 1990 to 26 Gg CO_2 in 2009.

7.10.7 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures, as discussed in Chapter 1.

7.10.8 Source-specific recalculations

The recalculations in land converted to other land are entirely the result of the recalculations in Forest Land, which affected the standing C stock in Forest Land and thus the emission factors of Forest Land converted to Other Land. These recalculations resulted in an additional annual emission of 0 Gg CO_2 in 1990, and -0.15 Gg CO_2 in 2008 (corresponding to 0% respectively 0.59% of the total emission from category 5F).

Table 7.3 CO_2 emissions from using limestone and dolomite in agriculture (Units: Gg CO_2)

	1990	1995	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
5G Other (liming of agricultural soils)	183	98	98	80	85	86	79	75	81	71	91	91

7.10.9 Category-specific planned improvements, if applicable (e.g., methodologies, activity data, emission factors, etc.), including those in response to the review process

For this land use category no improvements are planned in the direct future.

7.11 Other [5G]

7.11.1 Source category description

The source category 5G "Other" includes only the emissions of CO_2 from the liming of agricultural land with limestone and dolomite. Limestone and dolomite are used in the agricultural sector to increase the chalk content of the soil in order to maintain a pH range suitable for crop and grass production.

Activity data and (implied) emission factors

The activity data is derived from agricultural statistics for total lime fertilisers (period 1990–2009). Data available on the application of limestone and dolomite does not address its use on grassland and cropland separately.

7.11.2 Information on approaches used for representing land areas and on land-use databases used for the inventory preparation

Information on liming was derived from national, yearly updated, statistics on fertiliser use. The yearly amount of limestone and dolomite are converted into carbon dioxide emissions conform the calculations in the guidelines.

Definition

The category "other land' was included to allow the total of identified land to match the national area for which data are available. It includes bare soils, rock and all unmanaged land area that do not fall in any other five categories.

7.11.3 Methodological issues

The reporting is considered to be at the Tier 2 level (see protocol 11-033). Limestone ("lime marl") and dolomite ("carbonic magnesium lime") amounts, reported in CaO equivalents, are multiplied with the emission factors for limestone (440 kg CO_2/ton pure limestone) and for dolomite (477 kg CO_2/ ton pure dolomite). More detailed descriptions of the methods used and the emission factors can be found in protocols 11-032 and 11-033 on the website www.greenhousegases.nl, as indicated in Section 7.1.

7.11.4 Uncertainty and time-series consistency

Uncertainties

The Tier 1 analysis in Annex 7 shown in Table A7.1 provides estimates of uncertainties according to IPCC source category. The uncertainty in the CO_2 emissions from 5G "Liming of soils" is calculated to be 25%. The uncertainty in the activity data is estimated to be 25%, and the uncertainty in emission factors is 1%. When considered over a longer time span, all carbon that is applied through liming is emitted.

Time-series consistency

The methodology used to calculate CO_2 emissions from limestone and dolomite for the period 1990–2009 is consistent over time. The use of chalk containing fertiliser in the Netherlands decreased from 265 million kg in 1990 to 112 million kg in 2008. Over that period the proportion of limestone more than doubled, from about 12% in 1990 up to about 30% in 2008 and the proportion of dolomite decreased from about 38% in 1990 to levels between 25-30% in following years and reached 37% in 2008 again (the remaining 38% is earth foam). The CO_2 emissions related to these fertilisers is 91 Gg CO_2 (2008) which is 20 Gg CO_2 more than in 2007 (see Table 7.3). This difference is explained by different amounts of limestone and dolomite in both years. Due to lack of fertiliser statistics the 2009 emission is set equal to the previous year.

7.11.5 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures, as discussed in Chapter 1.

7.11.6 Source-specific recalculations

The 2008 emission has been recalculated because fertiliser data for 2008 has become available. In the previous NIR the 2008 emission had been set equal to the 2007 emission.

7.11.7 Category-specific planned improvements, if applicable (e.g., methodologies, activity data, emission factors, etc.), including those in response to the review process

A recalculation over 2009 will be carried out when fertiliser data become available.

8
Waste [CRF Sector 6]

Major changes in Waste sector compared to the National Inventory Report 2010
Emissions: In 2009, the total greenhouse gas emissions in this sector decreased further.
Key sources: Compared to the previous submission (NIR 2010) 6B, Emissions from wastewater handling (N_2O) was added as a key source (L2)
Methodologies: Based on new research the EF for the GHG from organic waste composting activities and waste incineration were updated.

8.1 Overview of sector

The national inventory of the Netherlands comprises four source categories in the Waste sector:
- 6A Solid waste disposal: CH_4 (methane) emissions
- 6B Wastewater handling: CH_4 and N_2O emissions
- 6C Waste incineration: CO_2 and N_2O emissions (included in [1A1a])
- 6D Other waste: CH_4 emissions

Carbon dioxide emissions from the anaerobic decay of waste in land fill sites are not included, since this is considered to be part of the carbon cycle and is not a net source. The Netherlands does not report emissions from waste incineration facilities in the Waste sector because these facilities also produce electricity or heat used for energetic purposes and, as such, these emissions are included in category 1A1a (to comply with IPCC reporting guidelines). Methodological issues concerning this source category are briefly discussed in Section 8.4.

The following protocols, which can be found on the website www.greenhousegases.nl, describe the methodologies applied for estimating CO_2, CH_4 and N_2O emissions of the Waste sector in the Netherlands (see also Annex 6):
- Protocol 11-034: CH_4 from Waste disposal (6A1)
- Protocol 11-035: CH_4, N_2O from Wastewater treatment (6B)
- Protocol 11-036: CH4, N2O from Industrial composting (6D)
- Protocol 11-038: CO2 CH4 N2O from Biomass (1A)

The Waste sector accounted for 2% of total national emissions (without LULUCF) in 2009 compared with 6% in 1990, with the emissions of CH_4 and N_2O accounting for 91% and 9% of CO_2 equivalent emissions from the sector, respectively. Emissions of CH_4 from waste – almost all (87%) from Landfills (6A) – accounted for 27% of the national total CH_4 emissions in 2009. The N_2O emissions from the Waste sector stem from domestic and commercial wastewater. The fossil-fuel related emissions

Figure 8.1 Sector 6 'Waste': trend and emission levels of source categories, 1990-2009.

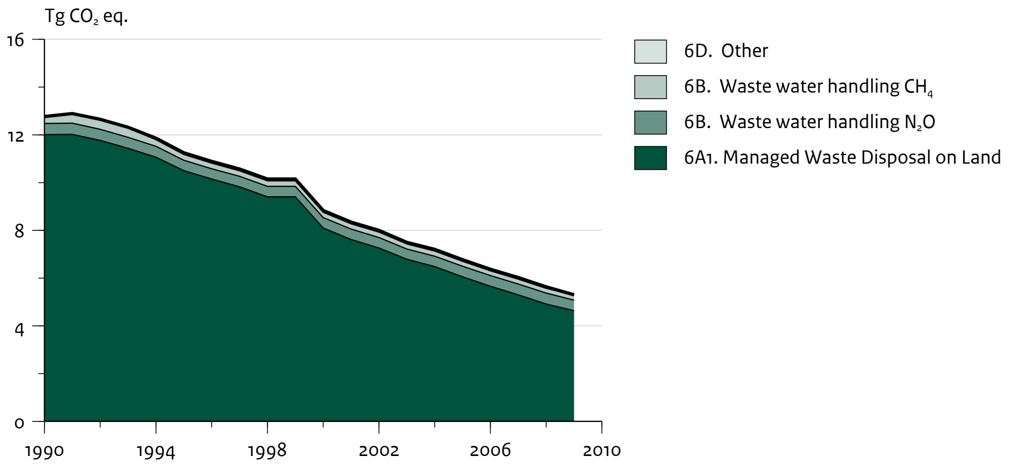


Table 8.1 Contribution of main categories and key sources in Sector 6 Waste

Sector/category	Gas	Key	Emissions base-year	Emissions 2008	Emissions 2009	Change 2009–2008	Contribution to total in 2009 (%)		
			Tg CO_2 eq	Tg CO_2 eq	Tg CO_2 eq	Gg	By sector	Of total gas	Of total CO_2 eq
6 Waste	CH_4		12.3	5.2	4.9	-0.3	91	29	2
	N_2O		0.5	0.5	0.5	0.0	9	5	0.2
	All		12.8	5.7	5.3	-0.3	100		3
6A. Solid Waste Disposal on Land	CH_4		12.0	4.9	4.6	-0.3	87	27	2
6A1. Managed Waste Disposal on Land	CH_4	L.T	12.0	4.9	4.6	-0.3	87	27	2
6B Waste water handling	N_2O	L2	0.5	0.5	0.4	0.0	8	5	0.2
	CH_4		0.3	0.2	0.2	0.0	4	1	0.1
	All		0.8	0.7	0.6	0.0	12		0.3
6D. Other	CH_4		0.0	0.1	0.0	0.0	0.4	0.1	0.0
Total GHG National Emissions	CH_4		25.5	17.0	16.9	-0.1			
(excl. CO_2 LULUCF)	N_2O		20.1	9.9	9.7	-0.2			
	All		213.2	204.6	198.9	-5.7			

from waste incineration, mainly CO_2, are included in the fuel combustion emissions from the Energy Sector (1A1) since all large-scale incinerators also produce electricity and/or heat for energetic purposes.
Emissions from the Waste sector decreased by 53% between 1990 and 2009 (see Figure 8.1), mainly due to a 61% reduction in CH_4 from Landfills (6A1 'Managed waste disposal on land). Between 2008 and 2009 the CH_4 emissions from landfills decreased by about 6%. The decreased methane emission from "Landfills" since 1990 is the result of:

- increasing recovery and recycling of waste for composting and/or incineration
- a considerable reduction in the amount of municipal solid waste (MSW) disposal at landfills
- a decreasing organic waste fraction in the waste disposed
- increasing methane recovery from the landfills (from 5% in 1990 to 17% in 2009)(Agentschap NL, 2010a).

Table 8.1 shows the contribution of the emissions from the Waste sector to the total greenhouse gas emissions in the Netherlands and also presents the key sources in this sector specified by level, trend or both. The list of all (key- and non-key) sources in the Netherlands is shown in Annex 1. Total greenhouse gas emissions from the Waste sector decreased from 12.8 Tg CO_2 eq in 1990 to 5.3 Tg CO_2 eq in 2009. This decrease is mainly due to (SenterNovem, 2008b):

- Increased recovery and recycling, resulting in a decreasing amount of solid waste disposed at landfills;
- A decreasing amount of organic waste disposed of at landfills;
- Increasing CH_4 recovery from landfills

CH_4 emissions from landfills contribute the largest share to the greenhouse gas emissions of this sector. Category 6A1 Solid waste disposal sites (SWDS) is a key source specified by both level and trend , category 6B N_2O emissions from waste water handling is a minor key source (L2) when uncertainties are taken into account (see Annex 1).

8.2 Solid waste disposal on land [6A]

8.2.1 Source category description

In 2009 there were 22 operating landfill sites as well as a few thousand older sites that are still reactive. CH_4 recovery takes place at 53 sites in the Netherlands. As a result of anaerobic degradation of the organic material within the landfill body, all of these landfills produce CH_4 and CO_2. Landfill gas comprises about 60% (vol.) CH_4 and 40% (vol.) CO_2. Due to a light overpressure, the landfill gas migrates into the atmosphere. On several landfill sites the gas is extracted before it is released into the atmosphere and subsequently used as an energy source or flared off. In both of these cases the CH_4 in the extracted gas is not released into the atmosphere. The CH_4 may be degraded (oxidised) to some extent by bacteria when it passes through the landfill cover; this results in a lower CH_4 emission.

Anaerobic degradation of organic matter in landfills is a time-dependent process and may take many decades. Some of the factors influencing this process are known; some are not. Each landfill site has its own unique characteristics: concentration and type of organic matter, moisture and temperature, among others. The major factors determining the decreased net CH_4 emissions are lower quantities of organic carbon deposited into landfills (organic carbon content × total amount of land-filled waste) and higher methane recovery rates from landfills (see Sections 8.2.2 and 8.2.3).
The share of CH_4 emissions from landfills in the total national inventory of greenhouse gas emissions was 6% in 1990 and 2% in 2009. Between 1990 and 2009 CH_4 emissions have decreased by 61%. This decrease is due to the increase in recovered CH_4 – from about 5% in 1990 to 17% in 2009 – but also to the decrease in methane produced in solid waste disposal sites.

In 2009 solid waste disposal on land accounted for 87% of the total emissions in the Waste sector and 2% of the total national CO_2 equivalent emissions (see Table 8.1).

The policy that has been implemented in the Netherlands is one directly aimed at reducing the amount of waste used in land fill sites. This policy requires enhanced prevention of waste production and the increased recycling of waste, followed by incineration. As early as the 1990s the government introduced bans on the use of certain categories of waste for land-filling; for example, the organic fraction of household waste. Another method implemented to reduce land-filling was to raise the landfill tax to comply with the increased costs of incinerating waste. Depending on the capacity of incineration, the government can grant exemption from these 'obligations'. Due to this policy the amount of waste used at landfill has decreased from more than 14 million tonnes in 1990 to 2 million tonnes in 2009, thereby reducing emissions from this source category.

Methodological issues
A more detailed description of the method used and emission factors can be found in the protocol 11-034 on the website www.greenhousegases.nl as indicated in Section 8.1.

Activity data on the amount of waste disposed of at landfill sites are mainly based on the annual survey performed by the Working Group on Waste Registration at all the landfill sites in the Netherlands. This data can be found on the website www.uitvoeringafvalbeheer.nl and are documented in Agentschap NL, 2010a. This document also contains the amount of CH_4 recovered from landfill sites yearly.
The implied emission factors correspond with the IPCC default values.

In order to calculate the CH_4 emissions from all the landfill sites in the Netherlands, the simplifying assumption was made that all the wastes are assumed to be disposed of on one landfill site, an action that started in 1945. However, as stated above, characteristics of individual sites vary substantially. CH_4 emissions from this 'national landfill' are then calculated using a first-order decomposition model (first-order decay function) with an annual input of the total amounts deposited and the characteristics of the land-filled waste and the amount of landfill gas extracted. This is equivalent to the IPCC Tier 2 methodology. Since the CH_4 emissions from landfills are a key source, the present methodology is in line with the IPCC Good Practice Guidance (IPCC, 2001).

Parameters used in the landfill emissions model are as follows:

Table 8.2 Parameters used in the IPCC Tier 2 method that change over time (additional information on solid waste handling part).

Parameter	1990	1995	2000	2005	2006	2007	2008	2009
Waste generation rate[1] (kg/cap/day)	1.52	1.50	1.69	1.75	1.74	1.77	1.74	1.71
Fraction MSW disposed to SWDS	0.38	0.29	0.09	0.01	0.01	0.01	0.01	0.01
Fraction DOC in MSW	0.13	0.13	0.11	0.10	0.11	0.07	0.05	0.05
CH_4 generation rate constant (k)	0.09	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Number of SWDS recovering CH_4	45	50	55	50	54	51	52	53
Fraction CH_4 in landfill gas	0	0	0	0.52	0.55	0.52	0.51	0.50

[1] Waste generation rate refers to MSW (municipal solid waste), excluding inorganic industrial waste such as construction or demolition waste.

- total amount of land-filled waste
- fraction of degradable organic carbon (DOC) (see Table 8.2 for a detailed time-series)
- CH_4 generation (decomposition) rate constant (k): 0.094 up to and including 1989, decreasing to 0.0693 in 1995 and constant thereafter; this corresponds to half-life times of 7.4 and 10.0 years respectively (see Table 8.2 for a detailed time-series);
- CH_4 oxidation factor: 10%;
- fraction of DOC actually dissimilated (DOCF): 0.58; (see also (Oonk et al., 1994))
- CH_4 conversion factor (IPCC parameter): 1.0.
- Fraction of methane in landfill gas is determined yearly from 2002 onwards, based on the composition of landfill gas at all sites with CH_4 recovery. For the years until 2001, the fraction of methane in landfill gas is set at 60%.

Trend information on IPCC Tier 2 method parameters that change over time is provided in Table 8.2. The change in DOC values is due to such factors as the prohibition of land filling of combustible wastes, whereas the change in k-values (CH_4 generation rate constant) is caused by a sharp increase in the recycling of vegetable, fruit and garden waste in the early 1990's. The integration time for the emission calculation is defined as the period from 1945 to the year for which the calculation is made.

8.2.2 Uncertainty and time-series consistency

Uncertainty

The Tier 1 uncertainty analysis shown in Tables A7.1 and A7.2 of Annex 7 provides estimates of uncertainties according to IPCC source category and gas. The uncertainty in CH_4 emissions of solid waste disposal sites is estimated to be approximately 35% in annual emissions. The uncertainty in the activity data and the emission factor are estimated to be 30% and 15%, respectively. For a more detailed analysis of these uncertainties, see Olivier et al. (2009).

Time-series consistency

The estimates for all years are calculated from the same model, which means that the methodology is consistent throughout the time-series. The time-series consistency of the activity data is very good due to the continuity in the data provided. Since 2002 the fraction of CH_4 in landfill gas is determined yearly based on the composition of the landfill gas of the sites recovering CH_4. It is expected that this will reflect the average fraction of CH_4 in the landfill gas better than the default used in previous inventories and slightly reduces uncertainties in the emission estimations of the post-2001 period. This "new" CH_4 fraction is only used to estimate methane in the recovered biogas and not for the generation of methane within the landfill site.

8.2.3 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures as discussed in Chapter 1. And the specific QA/QC as described in the document for QA/QC of outside agencies 2011 (Wever e.a.,2011).

8.2.4 Source-specific recalculations

There are no source specific recalculations compared to the previous submission. For the year 2008 there was an error-correction in the emission. All landfill emissions were corrected due to a correction in the amount of waste disposed on land in 2008.

8.2.5 Source specific planned improvements

During the review of the NIR 2006 by the ERT it was recommended to investigate the composition of soils in order to verify the fraction of organic carbon present and to include this fraction in the estimation of CH_4 emissions. In 2009 a project started studying, among others things, contaminated soils at landfill sites. In the first half of 2011 the results will be available and will be incorporated in the estimation method.

8.3 Wastewater handling [6B]

8.3.1 Source category description

This source category covers emissions released from Wastewater handling and includes emissions from industrial, commercial and domestic wastewater and septic tanks.

The treatment of urban wastewaters and the resulting wastewater sludge is accomplished using aerobic and/or anaerobic processes. During the treatment, the biological breakdown of Degradable Organic Compounds (DOC) and nitrogen compounds can result in CH_4 and N_2O emissions, respectively. The discharge of effluents subsequently results in indirect N_2O emissions from surface waters due to the natural breakdown of residual nitrogen compounds. The source category also includes the CH_4 emissions from anaerobic industrial wastewater treatment plants (WWTP) and from septic tanks, but these are small compared to urban WWTP.

N_2O emissions from waste water treatment (see Table 8.1) contributed about 5% to total N_2O emissions in 2009 and 0.2% in total CO_2 eq. N_2O emissions from waste water handling decreased by 6% during the period 1990–2009. This small decrease is the result of two counteracting trends. Improved biological breakdown of nitrogen compounds at urban WWTPs (see Table 8.4) leads to a gradual increase of N_2O emissions. However, this improved nitrogen removal results in lower effluent loads (see Table 8.4) and a subsequent decrease in the (indirect) N_2O emissions from human sewage.

The contribution of wastewater handling to the national total of CH_4 emissions in 2009 was 1.2%. Since 1994, CH_4 emissions from wastewater treatment plants have decreased due to the introduction in 1990 of a new sludge stabilization system in one of the largest wastewater treatment plants. As the operation of the plant took a few years to optimize, venting emissions were higher in the introductory period (1991–1994) than under normal operating conditions. CH_4 emissions from waste water handling decreased by 28% during the period 1990–2009. The amount of wastewater and sludge being treated does not change much over time. Therefore, the inter-annual changes in methane emissions can be explained by varying fractions of methane being flared instead of vented or used for energy purposes. It should be noted that non-CO_2 emissions from the combustion of biogas at wastewater treatment facilities are allocated to category 1A4 “Fuel combustion – Other sectors” because this combustion is partly used for heat or power generation at the treatment plants.

Table 8.3 shows the trend in greenhouse gas emissions from the different sources of wastewater handling.

Table 8.3 Wastewater handling emissions of CH_4 and N_2O (Units: Gg/year).

	1990	1995	2000	2005	2006	2007	2008	2009
CH_4 industrial wastewater	0.25	0.33	0.34	0.36	0.33	0.32	0.33	0.32
CH_4 domestic & commercial wastewater	9.07	7.90	7.96	8.20	8.12	8.37	8,23	8.75
CH_4 septic tanks	4.47	3.25	2.20	1.22	1.11	0.98	0.86	0.81
Net CH_4 emissions	13.79	11.48	10.50	9.78	9.56	9.68	9.42	9.87
CH_4 recovered and/or flared	33.0	39.2	40.4	41.9	43.8	42.6	43.7	44.2
Recovery/flared (% gross emission)	70.5	77.4	79.4	81.1	82.1	81.5	82.3	81.7
N_2O domestic & commercial wastewater	0.66	0.75	0.88	0.99	1.05	1.10	1.14	1.12
N_2O from human sewage	0.37	0.37	0.53	0.44	0.38	0.37	0.34	0.29
Total N_2O emissions	1.50	1.40	1.41	1.43	1.43	1.47	1.48	1.41

Table 8.4 Activity data of domestic and commercial wastewater handling (Gg/year), total volume of treated urban waste water (Mm^3/year) and percentage of population connected to septic tanks (%).

	1990	1995	2000	2005	2006	2007	2008	2009
Wastewater DOC [1)]	933	921	921	943	938	942	946	938
Sludge DOC	254	269	281	298	318	294	316	320
Nitrogen removed in urban WWTP	42.0	47.7	55.8	63.1	66.8	70.0	72.5	71.5
Nitrogen in effluents [2)]	53.8	41.5	33.8	27.8	24.3	23.6	23.2	19.8
Treated volume	1,711	1,908	2,034	1,841	1,854	2,069	1.929	1,818
% Inhabitants with septic tanks	4.0	2.8	1.9	1.1	0.9	0.8	0.7	0.7

[1)] DOC, Degradable organic component.
[2)] Total of industrial, domestic and commercial effluents.

8.3.2 Methodological issues

Activity data and (implied) emission factors

Detailed information on activity data and emission factors can be found in the monitoring protocol 11-035 on the website www.greenhousegases.nl.

Most of the activity data on wastewater treatment are collected by Statistics Netherlands in yearly questionnaires which cover all urban WWTPs as well as all anaerobic industrial WWTPs; see also www.statline.cbs.nl for detailed statistics on wastewater treatment. Table 8.4 shows the development in the key activity data with respect to urban (= domestic and commercial) wastewater treatment. Due to varying weather conditions the volumes of treated wastewater and of the total load of DOC can fluctuate from year to year, depending on how much run-off rainwater enters the sewer systems. In the method developed for calculating methane emissions, the Degradable Organic Components (DOC) is based on an organic load in terms of the Chemical Oxygen Demand (COD).

Table 8.3 shows that total N_2O emissions from wastewater handling decreased 6% between 1990 and 2009. This small decrease is the overall result of an increase in N_2O emissions caused by improved nitrogen removal at urban WWTPs, and a decrease in the (indirect) N_2O emissions from human sewage as a result of lower effluent loads (see Table 8.4).

From Table 8.4 it can be concluded that the DOC of treated wastewater and sludge does not significantly change over time. Therefore, the inter-annual changes in CH_4 emissions can be explained by varying fractions of CH_4 being vented instead of flared or used for energy purposes.
The source Septic Tanks has steadily decreased from 1990 onwards. This can be explained by the increased number of households connected to the sewer system in the Netherlands (and therefore no longer using septic tanks; see Table 8.4).

A full description of the methodology is provided in the monitoring protocol 11-035 (see the website www.greenhousegases.nl) and in the background document (Oonk et al., 2004). In general, the emissions are calculated according to the IPCC guidelines, with country-specific parameters and emission factors being used for CH_4 emissions from wastewater handling (including sludge). The calculation methods are equivalent to the IPCC Tier 2 methods.

CH_4 emissions

For anaerobic industrial WWTPs, the CH_4 emission factor is expressed as 0.056 t/t DOC design capacity, assuming a utilisation rate of 80%, a CH_4-producing potential (B_o) of 0.22 t/t DOC and a methane recovery (MR) of 99%. The DOC design capacity is expressed in terms of the Chemical Oxygen Demand (COD) design capacity.

- DOC is measured and calculated as the Chemical Oxygen Demand (COD). For Urban wastewater treatment and anaerobic sludge handling, the combined emission factor is defined as 0.0085 tons CH_4 per ton $DOC_{influent}$. The following parameters are underlying the calculation of this emission factor (for further details, see also background document Oonk et al., 2004)
- Methane formation B_o = 0.25 t CH4/t DOC converted (IPCC, 1996)
- MCF_{stp} = Methane Correction Factor of Sewage Treatment Plants = 3.5% (Doorn et al, 1997, as referred to in IPCC-GPG, 2001)
- 37% of the $DOC_{influent}$ remains in the sludge (Country Specific Long Term Annual Average)
- MCF of anaerobic sludge treatment = 54% (Country Specific LTAA)
- In anaerobic sludge treatment 42% of the incoming DOC is digested (Country Specific LTAA)
- CH_4 recovery (MR) from anaerobic sludge treatment = 94% (Hobson and Palfrey, 1996, as referred to in IPCC-GPG, 2001).

Incidental venting of biogas at urban WWTPs is recorded by the plant operators and subsequently reported to Statistics Netherlands. In 2009, the amount of CH_4 emitted via venting of biogas was 0.8 Gg CH_4, equaling 9% of total CH_4 emissions of the category Domestic and commercial wastewater. During the last decade this value usually varied between 2 and 10%.

For septic tanks, the emission factor for CH_4 is expressed as 0.0075 tons per year per person connected to a septic tank, assuming a methane correction factor (MCF) of 0.5 and a CH_4-producing potential (B_o) of 0.25. In 2009, only 0.7% of the population was connected to a septic tank.

N_2O emissions

The N_2O emissions from wastewater handling are not determined via the average per-capita protein intake – as many countries do – but on basis of data on the total Nitrogen loads removed in Urban Waste Water treatment plants (see also Table 8.4). Influent and effluent loads of Urban WWTP are monitored systematically in accordance with the rules of the EU Urban Waste Water Treatment Directive, by all of the Dutch Regional Water Authorities. Waste water treated at Urban WWTP is a mix of household waste water, run-off rainwater and waste water from industries and services, so the forthcoming N_2O emissions are reported under the category 6B2 'Domestic and commercial waste water'. Because of their insignificance compared to N_2O from urban wastewater treatment, no N_2O emissions were estimated for separate industrial wastewater treatment and from septic tanks.

N_2O emissions from the biological N removal processes in Urban WWTP as well as indirect N_2O emission from effluents are calculated using the IPCC default emission factor of 0.01 tons N_2O-N per ton N removed or discharged. Since N_2O emissions from wastewater handling is identified in earlier NIRs as a key source, the present Tier 2 methodology complies with the IPCC Good Practice Guidance (IPCC, 2001).

8.3.3 Uncertainties and time-series consistency

Uncertainties
The Tier 1 uncertainty analysis in Tables A7.1 and A7.2 in Annex 7 provides estimates of uncertainties according to IPCC source category and gas. The uncertainty in annual CH_4 and N_2O emissions from wastewater handling are estimated to be 30% and 50%, respectively. The uncertainty in activity data is based on the judgments of experts and estimated to be 20%. The uncertainty in emission factors for CH_4 and N_2O are estimated to be 25% and 50% respectively.

Time-series consistency
The same methodology has been used to estimate emissions for all years, thereby providing a good time-series consistency. The time-series consistency of activity data is very good due to the continuity in the data provided by Statistics Netherlands.

8.3.4 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures as discussed in Chapter 1.

8.3.5 Source-specific recalculations

Compared to the previous submission no recalculations took place for this submission.

8.3.6 Source-specific planned improvements

There are no source specific planned improvements compared to the previous submission.

8.4 Waste incineration [6C]

8.4.1 Source category description

The source category “Waste incineration” is included in category 1A1 (Energy industries) as part of the source 1A1a Public electricity and heat production, since all waste incineration facilities in the Netherlands also produce electricity and/or heat used for energetic purposes. According to the IPCC Guidelines (IPCC, 2001), these are included in category 1A1a: Public electricity and heat production: other fuels (see Section 3.2.1).

8.4.2 Methodological issues

Activity data and emission factors
The activity data for the amount of waste incinerated are mainly based on the annual survey performed by the Working Group on Waste Registration at all 11 waste incinerators in the Netherlands. Data can be found on the website www.uitvoeringafvalbeheer.nl and in a background document (Agentschap NL, 2010a).

Table 8.5 Composition of incinerated waste,

	1990	1995	2000	2005	2007	2008	2009
Total waste incinerated (Gg)	2,780	2,913	4,896	5,503	5,790	6,053	6,333
of which household waste (Gg)	2,310	2,083	3,115	4,413	3,738	3,681	2,763
made up of							
paper/cardboard (weight %)	26%	33%	32%	25%	25%	26%	20%
wood (weight %)	1%	2%	2%	3%	3%	3%	4%
other organic (weight %)	51%	37%	35%	35%	34%	33%	33%
plastics (weight %)	8%	11%	13%	19%	20%	19%	20%
other combustible (weight %)	3%	5%	5%	6%	6%	6%	10%
non-combustible (weight %)	11%	13%	13%	13%	12%	12%	14%
Total waste incinerated (TJ)	22,746	27,903	51,904	55,058	59,678	62,341	63,609
Energy content (MJ/kg)	8.2	9.6	10.6	10.0	10.3	10.3	10.0
Fraction organic (energy %)	58.2%	55.2%	50.4%	47.8%	47.9%	48.8%	51.2%
Amount of fossil carbon (Gg)	164	221	433	561	596	611	690
Amount of organic carbon (Gg)	544	561	938	909	988	1,046	1,143

A more detailed description of the method used and the emission factors can be found in the protocol 11-038 on the website www.greenhousegases.nl, as indicated in Section 8.1 and in a background document (Agentschap NL, 2010b) .

Total CO_2 emissions – i.e. the sum of organic and fossil carbon – from waste incineration are reported per facility in the annual environmental reports and included in the ER-I data set. The fossil-based and organic CO_2, and N_2O emissions from Waste incineration are calculated from the total amount of waste incinerated. The composition of the waste is determined per waste stream (houshold waste and several others). An assumption is made for each of the six types composition of waste with respect to the specific carbon and fossil carbon fractions, which will subsequently yield the CO_2 emissions. Table 8.5 shows the total amounts of waste incinerated, the fractions of the different waste components used for calculating the amounts of fossil and organic carbon in the waste (from their fossil and organic carbon fraction) and the corresponding amounts of fossil and organic carbon in total waste incinerated. The method is described in detail in Agentschap NL, 2010b and in the monitoring protocol. Based on measurement data (Spoelstra, 1993), an emission factor of 20 g/ton waste is applied for N_2O from incineration with SCR. For Incineration with SNCR an emission of 100 g/ton is applied. The percentage SCR increased from 6% in 1990 to 39% in 2009.

In 2009 the carbon fraction of the household waste fractions and the percentage fossil of these fractions were determined. These values are still used for the calculation of the fossil and not fossil emissions from household waste. For the other fraction, the older values are still used (Agentschap NL, 2010b).

The emissions of CH_4 are for the whole time-series changed. An survey of emissions factors for CH_4 used in other countries and analyses of emissions from Waste incinerators made clear that the emissions of Waste incinerators are below the background level. All emissions for CH4 are set on 0 Gg a year. More information is in Agentschap NL, 2010b.

8.4.3 Uncertainties and time-series consistency

Uncertainties

The Tier 1 uncertainty analysis is shown in Tables A7.1 and A7.2 in Annex 7 provides estimates of uncertainties according to IPCC source category and gas. The uncertainty in annual CO_2 emissions from Waste incineration is estimated at 11%. The main factors influencing these emissions are the total amount being incinerated. The fractions of different waste components used for calculating the amounts of fossil and organic carbon in the waste (from their fossil and organic carbon fraction) and the corresponding amounts of fossil and organic carbon in the total waste incinerated. The uncertainty in the amounts of incinerated fossil waste and the uncertainty in the corresponding emission factor are estimated to be 10% and 5% respectively. These figures are based on expert judgment.

Time-series consistency

The time-series are based on consistent methodologies for this source category. The time-series consistency of the activity data is considered to be very good due to the continuity of the data provided by Working Group on Waste Registration.

8.4.4 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures that are discussed in Chapter 1. And the specific QA/QC as described in the document for QA/QC of outside agencies 2011 (Wever et al., 2011).

8.4.5 Source-specific recalculations

There are source-specific recalculations done for this category as discribed in 8.4.2.

8.4.6 Source-specific planned improvements

There are no source-specific improvements planned for this category.

8.5 Other waste handling [6D]

8.5.1 Source category description

This source category, which consists of the CH_4 and N_2O emissions from composting separately collected organic waste from households, is not considered to be a key source. Emissions from small-scale composting of garden waste and food waste by households are not estimated as these are assumed to be negligible.

The amount of composted organic waste from households increased from nearly 0 million tons up to 1.3 million tons in 2009. In 2009 there were 23 industrial composting sites in operation; these accounted for less than 1% of the emissions in the Waste sector in that year (see Table 8.1).

8.5.2 Methodological issues

Activity data and (implied) emission factors

Detailed information on activity data and emission factors can be found in the monitoring protocol 11-036 on the

website www.greenhousegases.nl.
The activity data for the amount of organic waste composted at industrial composting facilities are mainly based on the annual survey performed by the Working Group on Waste Registration at all industrial composting sites in the Netherlands. Data can be found on the website www.uitvoeringafvalbeheer.nl and in a background document (Agentschap NL, 2010a). This document also contains the amount of compost produced on a yearly basis.

A more detailed description of the method used and the emission factors can be found in protocol 11-036 on the website www.greenhousegases.nl as indicated in Section 8.1.

A country-specific methodology is used for estimating the industrial composting of organic food and garden waste from households. Since this source is not considered to be a key source, the present methodology level complies with the general IPCC Good Practice Guidance (IPCC, 2001). No mention is made of a method for estimating the industrial composting of organic waste in the Good Practice Guidance.

8.5.3 Uncertainties and time-series consistency

Uncertainty
The emissions of this source category are calculated using an average emission factor that has been obtained from the literature. Given the large scatter in reported emission factors the uncertainty is estimated to be more than 100%.

Time-series consistency
The time-series consistency of the activity data is very good due to the continuity in the data provided.

8.5.4 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures that are discussed in Chapter 1. And the specific QA/QC as described in the document for QA/QC of outside agencies 2011 (Wever e.a., 2011).

8.5.5 Source-specific recalculations

In 2007 the NIR 2006 was reviewed by an ERT. As a result of the review, the ERT recommended to investigate the application of compost to land and report the emissions from this application. In 2009 a study began to collect this information. In this study also the wide range of applied emission factors was examined. The results were internationally peer reviewed in 2010 (DHV, 2010). This peer review resulted in a new emission factor for CH_4 for composting. Until 2008 the emission factor was 2.400 gram per ton organic waste composted, as from 2009 the factor is 750 gram per ton organic waste composted. Furthermore it was concluded that the emissions from the use of compost in the agricultural sector are part of the emissions from that sector, and therefore not reported here in the waste sector.
The details on the recalculation can be found in the protocol 11-036.
The CH_4 and N_2O emissions from compost production decreased by approximately 0.2 % in 2008 compared to the NIR 2010 due to the use of the final activity data in this submission.

8.5.6 Source-specific planned improvements

There are no source-specific improvements planned for this category.

9
Other [CRF Sector 7]

The Netherlands allocates all emissions in Sectors 1 to 6; there are no sources of greenhouse gas emissions included in Sector 7.

10 Recalculations and improvements

Major changes compared to the National Inventory Report 2010
For the NIR 2011, the data for the most recent year (2009) were added to the corresponding Common Reporting Format (CRF). This submission also includes recalculated data for N_2O emissions from manure management and agricultural soils. Furthermore, new data on the distribution of fuels in the different source categories related off road transport lead to changed emission figures in source categories 1.A.2 and 1.A.4. In order to be able to estimate the emissions from woodstoves and fireworks in the future the algorithm for the calculation was changed. In doing so the emissions changed somewhat compared to earlier submissions. Furthermore the emission factors for CH_4 for waste incineration and for compost production were updated. The latter will only effect the emissions from 2008 onwards.

During the compilation of this NIR some errors from previous submissions were detected and corrected. These result in minor changes in emissions over the total period 1990-2008.

For more details on the effect and justification of the recalculations, see Chapters 3–8.

10.1 Explanation and justification for the recalculations

10.1.1 GHG inventory

For this submission (NIR 2011), the Netherlands uses the CRF reporter software 3.5. The present CRF tables are based on improved methodologies after the UNFCCC review in 2010. These improved methodologies are also described in the (updated) monitoring protocols 2011 (see Annex 6).

This chapter summarises the relevant changes in emission figures compared to the NIR 2010. A distinction is made between:

- methodological changes: new emission data are reported resulting from revised or new estimation methods; improved emission factors or activity data are also captured in recalculations as a result of methodological changes
- allocation: changes in the allocation of emissions to different sectors (only affecting the totals per category or sector)
- error corrections: correction of incorrect data.

10.1.1.1 Methodological changes

The improvements of the QA/QC activities in the Netherlands as implemented last year (process of assessing and documenting methodological changes) are still in place. This process (using a brief check list for timely discussion with involved experts and users of information on likely changes) improves the peer review of and timely documentation on the background and justification of changes.

As encouraged by the ERT report 2009, one major methodological change for agricultural N_2O emission estimates was implemented in this submission. This methodical change (related to a new method of calculation of the nitrogen flows in the agricultural sector, effecting the emissions of manure management and agricultural soils) influenced the total time series. This recalculation improves the transparency and the time series consistency of the N2O emissions and is based on the latest scientific knowledge and uses recent country specific measurements.

The emissions of waste incineration were recalculated based on improved data and information. Monitoring data from the sector showed that no CH_4 was emitted from waste combustion in the Dutch situation.

For the emission sources "Woodstoves, category 1.A.4.b" and "Fireworks, category 2.G" the calculation algorithm was adapted to ensure a future proof emission estimation method. These improvements affected the emission figures only to a small extend.

Furthermore, improved data on the use and the distribution of fuels for non-road transport and shipping (also effecting the bunker emissions) came available for the total time series (shipping and bunkers only from 2005 on). As a result the fuel use in relevant source categories 1.A.4.c and 1.A.2.f and bunkers changed as well as the corresponding emissions.

10.1.1.2 Source allocation

During the last five years the emissions (and fuel use) from coke production (which takes place at the only steel plant in the Netherlands) could not be separated from other emissions. In this submission an uniform methods for the fuel allocation was introduced which influenced the emission distribution between categories 1.B1b and 2.C15.

10.1.1.3 Error correction

The Netherlands used an improved automated system to transfer the activity (and emission) data from the National Inventory Database to the CRFReporter. This system aims at standardizing the data used for different reporting obligations. Therefore the activity data for some categories changed compared to last submission. Due to the further improvement of the system minor errors in the data in the CRF of last submission were eliminated (especially in the emissions of the precursor gases). These error corrections (in the order of magnitude of max ± 10 Gg CO_2 eq per category) will not be explained in detail below. The following error corrections and or improvements are included in this submission:

- As response to the review more detailed data on F-gas use and consumption were made available. Due to these improved data the emissions could be calculated in more detail according to the protocol. This resulted in changed emission figures for SF_6 and HFCs (2.F9 and 2.F1) in most recent years. For the base year (1995) the emissions of F-gases did not change and decreased by 72,3 Gg CO_2 eq in 2008 compared to the latest submission.
- In general, the 2008 figures (and in some cases earlier years) were updated whenever improved statistical data became available after the submission of 2009.
- From now on the biomass statistics are included in the National Energy Statistics. As a result errors from the past are eliminated.

Due to the above mentioned methodical changes and error corrections the national emissions in 1990 decreased with 0.06 Tg CO_2 eq. For 1995 the corrections led to a decrease in emissions of 1.09 Tg CO_2 eq. The total national emission decreased for 2008 with 2.09 Tg CO_2 eq compared to the latest submission.

All above changes in previous data (methodological, allocation and error correction) are explained in the CRF.

10.1.2 KP-LULUCF inventory

Carbon stock changes in mineral and organic soils are reported in this submission for the first time, and a recalculation was made for 2008. Carbon stock changes in mineral soils over the whole of the Netherlands were a sink of 32.2 Gg CO_2 for re/afforested land and a sink of 4.4 Gg CO2 for deforested soils. CO_2 emissions from organic ARD soils over the whole of the Netherlands resulted in a source of 144.4 Gg CO_2 for 2008. The areas of deforested land that were converted to cropland and lost carbon in that process, led to an N_2O emission of 1.03 Gg N_2O.

Furthermore there was an error correction and update in harvest values for the Netherlands since 2000, which resulted in slightly modified values for the average amount of standing stock per ha. This resulted in 6 Gg CO_2 more emissions from biomass loss in deforested land. An update of the parameters describing the build-up of dead wood in the Netherlands led to 13 Gg CO_2 less emission from dead wood from deforested land.

An update of the liming statistics increased the estimated CO_2 emissions from liming of deforested land now used as croplands by 0.05 Gg C (or 0.17 Gg CO_2).
These recalculations are further detailed in par 11.3.1.4.

Table 10.1 Differences between NIR 2010 and NIR 2011 for the period 1990–2008 due to recalculations (unit: Tg CO_2 eq; for F-gases: Gg CO_2 eq).

Gas	Source	1990	1995	2000	2005	2006	2007	2008
CO_2 Incl. LULUCF	NIR 2010	161.9	172.9	172.2	178.2	174.9	174.8	178.1
	NIR 2011	**162.0**	173.3	172.5	178.9	175.3	174.9	178.0
	Diff.	0.0%	0.2%	0.2%	0.4%	0.2%	0.0%	-0.1%
CO_2 Excl. LULUCF	NIR 2010	159.3	170.6	169.7	175.8	172.5	172.3	175.7
	NIR 2011	**159.3**	170.8	170.0	176.2	172.6	172.4	175.3
	Diff.	0.0%	0.1%	0.1%	0.2%	0.0%	0.1%	-0.2%
CH_4	NIR 2010	25.5	24.1	19.8	17.2	16.8	16.8	17.1
	NIR 2011	**25.5**	24.1	19.7	17.2	16.8	16.8	17.0
	Diff.	0.0%	0.0%	-0.1%	-0.2%	-0.2%	-0.1%	-0.3%
N_2O	NIR 2010	20.2	21.5	19.3	17.3	17.1	15.4	11.8
	NIR 2011	**20.1**	20.1	17.7	15.7	15.6	13.8	9.9
	Diff.	-0.7%	-6.8%	-8.4%	-9.3%	-9.1%	-10.2%	-15.4%
PFCs Gg	NIR 2010	2264	1938	1582	266	257	323	251
	NIR 2011	2264	**1938**	1582	266	257	323	251
	Diff.	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
HFCs Gg	NIR 2010	4432	6018	3891	1514	1728	1845	1923
	NIR 2011	4432	**6018**	3886	1494	1704	1820	1889
	Diff.	0.0%	0.0%	-0.1%	-1.3%	-1.4%	-1.4%	-1.8%
SF_6 Gg	NIR 2010	217	301	318	254	217	226	224
	NIR 2011	217	**301**	315	239	198	192	186
	Diff.	0.0%	0.0%	-0.8%	-6.1%	-8.4%	-14.9%	-17.0%
Tot. Excl. LULUCF	NIR 2010	212.0	224.5	214.6	212.4	208.7	206.9	206.9
	NIR 2011	211.9	223.2	213.2	211.1	207.1	205.4	204.6
	Diff.	-0.1%	-0.6%	-0.7%	-0.6%	-0.7%	-0.7%	-1.1%
Tot. Incl. LULUCF	NIR 2010	214.6	226.9	217.1	214.7	211.1	209.5	209.4
	NIR 2011	214.5	225.8	215.7	213.8	209.8	207.9	207.3
	Diff.	-0.1%	-0.6%	-0.6%	-0.4%	-0.6%	-0.7%	-1.0%

Note: base year values as applied for the calculation of the Assigned Amount are indicated in bold.

10.2 Implications for emission levels

10.2.1 GHG inventory

This chapter outlines and summarises the implications of the changes described in Section 10.1, for the emission levels over time. Table 10.1 elaborates the differences between the submissions from last year and the current NIR with respect to the level of the different greenhouse gases. More detailed explanations are elaborated in the relevant Chapters 3-8.

10.2.1.1 Effect of recalculations on base year and 2008 emission levels

Table 10.1 gives the changes due to the recalculations for the base year 1990, 1995, 2000 and 2005 to 2008 (compared to the NIR 2010). From the table emerges that the recalculations reduced the national emissions only to a small extend. The recalculation in the agricultural sector for N_2O was contributing by far the most to the changes.

10.2.2 KP- LULUF inventory

Due to the changes described in par 10.1.2 the data for 2008 were recalculated. In table 10.2 the differences for the reported values in the NIR 2009 and 2010 are presented. Th table shows that the recalculations increased the emission for KP-LULUCF by approximately 44%.

Table 10.2 Differences between NIR 2010 and NIR 2011 for 2008 due to recalculations for KP-LULUCF

		AR	D	Total
Gg CO_2	NIR 2010	-546.68	780.45	233.77
Gg CO_2	NIR 2011	-484.61	821.07	336.46
Gg CO_2	Diff	62.06	40.62	102.68
Gg N_2O	NIR 2010		0.002	
Gg N_2O	NIR 2011		0.002	
Gg CO_2-eq	Diff	62.06	40.62	102.68

Table 10.3 Differences between NIR 2010 and NIR 2011 with respect to emission trends during the period 1990–2008 (Units: Gg CO_2 eq, rounded).

Gas	Trend (absolute)			Trend (%)		
CO_2 eq [Gg] [1)]	NIR 2010	NIR 2011	*Difference*	NIR 2010	NIR 2011	*Difference*
CO_2	16,364	16,039	-325	10.3%	10.1%	-0.2%
CH_4	-8,471	-8,511	-40	-33.2%	-33.3%	-0.2%
N_2O	-8,469	-10,191	-1,722	-41.9%	-50.6%	-8.8%
HFCs	-2,509	-2,543	-34	-56.6%	-57.4%	-0.8%
PFCs	-2,013	-2,013	0	-88.9%	-88.9%	0.0%
SF_6	7	-31	-38	3.1%	-14.5%	-17.5%
Total	-5,090	-7,251	-2,160	-2.4%	-3.4%	-1.0%

[1)] Excluding LULUCF

10.3 Implications for emission trends, including time-series consistency

10.3.1 GHG inventory

In general, the recalculations improve both the accuracy and time-series consistency of the estimated emissions. Table 10.3 presents the changed trends in the greenhouse gas emissions during this period due to the recalculations carried out.

10.3.2 KP- LULUF inventory

Not applicable, the Netherlands reports the KP data only for the second time in the NIR 2011.

10.4 Recalculations, response to the review process and planned improvements

10.4.1 GHG inventory

10.4.1.1 Recalculations

No recalculations are anticipated in the next submission of the CRF.

10.4.1.2 Response to the review process

Public and peer review

Drafts of the NIR are subject to an annual process of general public review and a peer review.
No remarks were received from the public on the draft NIR of January 2011.
The peer review includes a general check on all chapters. In addition, a special focus is given to a specific sector or topic each year. This year, a separate study (Oonk, 2011) focused on the emissions in the waste sector. For the most part the report deals with emissions from solid waste disposal on land (land fills) that are responsible for almost 90% of the total emissions from the waste sector. In the report the conclusion is drawn that the Dutch quantification of methane emissions from landfills seems a good one, especially in comparison with quantifications of other Annex 1 countries. Furthermore, recommendations were formulated on the following issues: improvement of the explanation for the observed reduction of methane emissions, the determination of the rate constant of biodegradation (k), the assumption of oxidation of methane flux through the top layer, the inclusion of new techniques (e.g. capped landfills) in the calculation method and uncertainties. For waste-water handling recommendations were reported on the transparency and readability of the text in the NIR, transparency of data in a table, incompletion of data (flaring), the use of N_2O emission factors and uncertainties. For waste incineration recommendations were included on the use of emission factors for CH_4 and N_2O. For large scale composting a new emission factor was used in NIR 2011. It is recommended to take into account that in the choice of country specific emission factors there could be a tension between the principle of accuracy and comparability. The recommendations are incorporated in the present NIR as far as possible, other recommendations will be processed in NIR 2012.

Peer reviews in the past three years were performed on the following sectors: agriculture (Monteny, 2008), combustion and process emissions in industry (Neelis et al, 2009) and transport (Hanschke, 2010).
In general, the conclusion of these peer review is that the Dutch NIR adequately describes the way that the Netherlands calculates the emissions of greenhouse gases. The major recommendations refer to readability and transparency of the NIR and suggestions of textual improvement.

UNFCCC reviews

In September 2010 the centralized UN review of the NIR 2010 took place. An rather intensive process of questions and answers was part of this process. On

Table 10.4 Improvements made in response to UNFCCC review 2010.

Recommendation	General	Improvement made
Use IPCC method on reporting emissions by oil pipelines	Sat Pap	According to the recommendation by the ERT in the Saturday paper, the Netherlands collected the relevant activity data and used the default EFs for CO_2 and CH_4 (IPCC good practice guidance, p. 2.87, Table 2.16) to calculate the emissions from oil transport where in the NIR2010 submission this source was reported as NE (Not Estimated). The Netherlands has included the new source in the CRF and resubmitted the CRF 2010 on 14 October 2010.
N_2O emissions from nitric acid production	Sat Pap	N_2O emissions from nitric acid production: the Netherlands gave an extensive answer to the question on the significant reductions of N_2O emissions by nitric acid industry in 2007 and 2008. The answer gave insight in emission reduction technologies, used in each plant. In addition, Dutch Emissions authority (NEa) confirmed that "No Differences were found between the emission figures in the CRF (reporting year 2008) and the verified emissions in the emission reports under EU ETS (reporting year 2008)".
Improve the use of notation keys for industrial waste water	Review week	The notation key NE for CH_4 emissions from industrial waste water (6B1b Sludge) is replace by NE, IE because most of the emissions are included in domestic and commercial waste water and only a small part of the emission is not estimated (see annex 5).
Improve KP LULUCF reporting on carbon pools	Sat Pap	The soil carbon stock changes for mineral and organic soils and Kyoto activities re/afforestation and deforestation for 2008 are calculated, where in the NIR 2010 submission these sources were reported as NE. These new data are not included in the resubmission of CRF tables (October 2010), because the research results were preliminary at that time (not peer-reviewed). The final data are included in NIR/CRF 2011.

September 11th the ERT sent the Saturday paper with 3 potential problems and further questions. After the response by the Netherlands, the ERT sent a message indicating that all potential problems are resolved. However, the draft report by the ERT is not received until 15 February 2011. Therefore, the Netherlands could not use the recommendations in the ERT report for further improvements in NIR 2011.
Table 10.4 contains the improvements made in response to the UNFCCC review 2010, based on the questions in the review week and the issues in the Saturday Paper.

10.4.1.3 Completeness of sources

The Netherlands' greenhouse gas emission inventory includes all sources identified by the Revised Intergovernmental Panel on Climate Change (IPCC) Guidelines (IPCC, 1997) with the exception of the following, very minor, sources:

- charcoal production (1B2) and use (1A4), due to missing activity data
- CO_2 from asphalt roofing (2A5), due to missing activity data
- CO_2 from road paving (2A6), due to missing activity data
- CH_4 from enteric fermentation of poultry (4A9), due to missing emission factors
- N_2O from industrial waste water (6B1), due to negligible amounts
- part of CH4 from industrial waste water (6B1b Sludge), due to negligible amounts
- Precursor emissions (i.e. carbon monoxide (CO), nitrogen oxide (NO_x), non-methane volatile organic compounds (NMVOC) and sulphur dioxide (SO_2) from Memo item "International bunkers" (international transport) have not been included.

For more extended information on this issue, see Annex 5.

10.4.1.4 Completeness of the CRF files

For the years 1991–1994, energy data are less detailed for all industrial source categories than in both the preceding and following years, but they adequately cover all sectors and source categories. All emissions are specified per fuel type (solid, liquid and gaseous fossil fuels). Coal-derived gases (coke oven gas, blast furnace gas etc.) are included in Solid fuels and refinery gases and residual chemical gases are included in Liquid fuels (also LPG, except for Transport). The fuel category Other Fuels is used to report emissions from fossil waste in waste incineration (included in 1A1a).

Since the Industrial processes source categories in the Netherlands often comprise only a few companies, it is generally not possible to report detailed and disaggregated data. Activity data are confidential and not reported when a source category comprises three (or fewer) companies.

Potential emissions (total consumption data) for PFCs and SF_6 are not reported due to the confidentiality of the consumption data. A limited number of companies report emissions or consumption data, and actual estimates are made on the basis of these figures. Data to estimate potential emissions, however, are confidential (Confidential Business Information).

10.4.1.5 Planned improvements

The Netherlands National System was established by the end of 2005, in line with the requirements under the Kyoto Protocol and under the EU Monitoring Mechanism. The establishment of the National System was a result of the implementation of a monitoring improvement programme (see Section 1.6). In 2007, the system was reviewed during the initial review. The review team concluded that the Netherlands' National System has been established in accordance with the guidelines for national systems under Article 5, Section 1, of the Kyoto Protocol (decision 19/CMP.1) and that it meets the requirements for implementation of the general functions of the National System as well the specific functions of inventory planning, inventory preparation and inventory management.

Monitoring improvement

The National System includes an annual evaluation and improvement process. The evaluation is based on experience in previous years, and results of UN reviews, peer reviews and audits. Where needed, improvements are included in the annual update of the QA/QC program (SenterNovem, 2009).
One of the recent improvement actions relates to the emission factor (EF) for natural gas. This EF has been calculated on a yearly basis for a number of years, using detailed data from the gas supply companies. The annual EF was established in this way for the NIR 2006, for 2004 and the base year 1990. For both years, the emission factor proved to be 56.8. Given the time constraints, the EF for intermediate years was assumed to be constant. In 2009, a study analysed this further using two further sample years and the conclusion was that annual fluctuations in intermediate years were very minor. It was therefore decided not to carry out more detailed assessment for further intermediate years and to maintain the EF for these intermediate years at 56.8, especially since these years are neither base years nor commitment period years. Since 2007, the EF has been assessed annually. The value in both 2007 and 2008 was 56.7 (Zijlema, 2008 and Zijlema, 2009), the value in 2009 was 56.6 (see Annex 2).

Monitoring protocol and QAQC program

The Netherlands uses monitoring protocols that describe the methodology, data sources (and the rationale for their selection). These protocols are available on the website www.greenhousegases.nl. The protocols were given a legal basis in December 2005. The monitoring protocols are assessed annually and –when needed– updated. The initial review recommended that some of the protocols should include more details (inclusion of some additional information that is now only included in background documents). For 2009. the Netherlands has included this recommendation in its QAQC program and to improve the 'balance' between NIR, protocols and background reports. This process started in 2009 and was finalised in 2010.
The QA/QC program for this year (SenterNovem, 2009) also continues the assessment of improvement options in the longer term, partly based on the consequences of the new 2006 IPCC guidelines. This will provide a basis for a possible improvement program for the longer term.
In response to the ERT report 2009, one methodological change was implemented in this submission: stationary cooling. The review team recommended the further centralisation of the archiving of intermediate calculations. Most documentation and archiving is already centralised, with the exception of some intermediate/supporting data calculations archived at task force level. This recommendation will also be considered during the data process in the coming years.

10.4.2 KP-LULUCF inventory

The Netherlands received questions and comments on a number of polls that were not (yet) reported in the NIR 2010. For two of these (i.e. litter and dead wood in AR-land) the responses given by the Netherlands were considered sufficient, and the additional information given to the review team is now included in the NIR-II. For mineral and organic soils of ARD land, the carbon stock changes have been calculated and reported in the NIR 2011.

Part II: Supplementary Information required under Article 7, Paragraph 1

11 KP-LULUCF

11.1 General information

11.1.1 Definition of forest and any other criteria

The Netherlands identified in its Initial Report the single minimum values under Article 3.3 of the Kyoto Protocol.

The complete forest definition the Netherlands uses for Kyoto reporting is: Forest is land with woody vegetation and with tree crown cover of more than 20% and area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 m. at maturity in situ. They may consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground, or open forest formations with a continuous vegetation cover in which tree crown cover exceeds 20%. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 20% or tree height of 5 m are included under forest, as areas normally forming part of the forest area which are temporally unstocked as a result of human intervention or natural causes but which are expected to revert to forest. Forest Land also includes:

- forest nurseries and seed orchards that constitute an integral part of the forest;
- forest road, cleared tracts, firebreaks and other small open areas, all smaller than 6 m. within the forest;
- forest in national parks, nature reserves and other protected areas such as those of special environmental, scientific, historical, cultural or spiritual interest, with an area of more than 0.5 ha and a width of more than 30m;
- windbreaks and shelterbelts of trees with an area of more than 0.5 ha and a width of more than 30 m.

This excludes tree stands in agricultural production systems, for example, in fruit plantations and agro forestry systems.

This definition is in line with the FAO reporting since 1984 and was chosen within the ranges set by the Kyoto Protocol. The definition matches the subcategory “Forests according to the Kyoto definition” (abbreviated as FAD) of Forest Land in the inventory under the Convention on Climate Change.

11.1.2 Elected activities under Article 3, paragraph 4, of the Kyoto Protocol

The Netherlands has not elected any activities to include under Article 3, paragraph 4, of the Kyoto Protocol.

11.1.3 Description of how the definitions of each activity under Article 3.3 and each elected activity under Article 3.4 have been implemented and applied consistently over time

Units of land subject to Article 3.3 afforestation and reforestation are reported jointly and are defined as units of land that did not comply with the forest definition on 1 January 1990 and do so at any time (that can be measured) before 31 December 2012. Land is classified as re/afforested as long as it complies with the forest definition.

Units of land subject to Article 3.3 deforestation are defined as units of land that did comply to the forest definition at in time on or after 1 January 1990, and again ceased to comply to this forest definition at any moment in time (that can be measured) after 1 January 1990. Once land is classified as deforested, it remains in this category, even if it is reforested and thus complies with the forest definition again later in time.

11.1.4 Description of precedence conditions and/or hierarchy among Article 3.4 activities, and how they have been consistently applied in determining how land was classified.

This is not applicable as no article 3.4 activities have been elected. `

11.2 Land-related information

11.2.1 Spatial assessment unit used for determining the area of the units of land under Article 3.3

The Netherlands has complete and spatially explicit land use mapping that allows for geographical stratification at 25 m x 25 m (0.0625 ha) pixel resolution (Kramer et al., 2009). This corresponds with the wall-to-wall approach used for reporting under the Convention (approach 3 in GPG-LULUCF chapter 2) and is described as reporting method 2 in GPG-LULUCF for Kyoto (par. 4.2.2.2). ARD activities are recorded on a pixel basis. For each pixel individually, it is known whether it is part of a patch that complies to the forest definition or not.

Any pixel changing from non-compliance to compliance to the forest definition is treated as re/afforestation. This may be the result of a group of clustered pixels that together cover at least 0.5 ha of non-forest land changing land use into forest land. It may also occur when one or more pixels adjacent to a forest patch change land use. Similarly, any pixel changing from compliance with the Kyoto forest definition to non-compliance is treated as deforestation, whether it involves the whole group of clustered pixels or just a subgroup of them. Thus, the assessment unit of land subject to ARD is 25 m x 25 m (0.0625 ha).

11.2.2 Methodology used to develop the land transition matrix

The Netherlands has complete and spatially explicit land-use mapping with map dates on 1 January 1990 and 1 January 2004 (Kramer et al., 2009). An overlay was made between those two maps and this resulted in a land-use change matrix between January 1990 and January 2004. Mean annual rates of change for all land-use transitions between those years was calculated by linear interpolation, and after 2004 by extrapolation. The values based on extrapolation after 1 January 2004 will be subject to recalculation when a new land -use map of later date has been created. Our aim is to make land-use maps for 1 January 2009 and 1 January 2013, ensuring that we are able to capture land-use changes between before 2012 (IPCC, 2003). Though a land use map with map date 1st January 2008 would have allowed exact land use changes during the CP, this was practically not feasible. As emissions of all land changing between 1990 and 2012 are part of the KP, this was not considered a major problem.

Thus, in table NIR-2 the transitions from “other land” to either AR or D activities during the reporting years 2008 and 2009 (last rows in respective tables for NIR-2) are extrapolated values based on the mean annual rate of land use change between 1990 and 2004, and will be subject to recalculation when updates of the land-use maps become available. Land subject to AR or D between 1990 and 2009 is based on the sum of:

- the cumulative area under AR respectively under D for the (reporting) years 1990 to 2003, as derived from a land-use map overlay (these values can be considered as final): and
- the cumulative area under AR respectively under D for the (reporting) years 2004 to 2009, based on an extrapolation of the mean annual rate of land use change between 1990 and 2004 (these values will be subject to recalculation when updates of the land use maps become available).

Table 11.1 gives the annual values from 1990 on for the article 3.3 related cells in table NIR-2. Due to the use of extrapolation in the current submission, the values from 2004 on can be considered preliminary, with updates foreseen in the 2012 submission.

The summed values in Table 11.1 for AR (AR land remaining AR land + Other land converted to AR land) match with the sum of values reported under the Convention sector 5.A.2 land converted to Forest Land subcategory Forests according to the Kyoto definition (FAD), and Forest Land - Trees outside Forest converted to Kyoto Forest (included in Forest land – Kyoto Forest) for the respective years. The annual values for deforestation (Other land converted to D

Table 11.1 Results of the calculations of the area change (in kha) of re/afforestation (AR) and deforestation (D) in the period 1990-2009.

year	AR land remaining AR land	Other land converted to AR land	AR land converted to D land	D land remaining D land	Other land converted to D land	Other land remaining other land	Land in KP article 3.3 ARD
1990	0	2.56	0	0	1.99	4146.95	4.55
1991	2.56	2.56	0	1.99	1.99	4142.40	9.10
1992	5.12	2.56	0	3.98	1.99	4137.85	13.65
1993	7.68	2.56	0	5.98	1.99	4133.29	18.21
1994	10.24	2.56	0	7.97	1.99	4128.74	22.76
1995	12.80	2.56	0	9.96	1.99	4124.19	27.31
1996	15.36	2.56	0	11.95	1.99	4119.64	31.86
1997	17.92	2.56	0	13.95	1.99	4115.09	36.41
1998	20.47	2.56	0	15.94	1.99	4110.54	40.96
1999	23.03	2.56	0	17.93	1.99	4105.99	45.51
2000	25.59	2.56	0	19.92	1.99	4101.43	50.07
2001	28.15	2.56	0	21.91	1.99	4096.88	54.62
2002	30.71	2.56	0	23.91	1.99	4092.33	59.17
2003	33.27	2.56	0	25.90	1.99	4087.78	63.72
2004	35.83	2.56	0	27.90	1.99	4083.23	68.27
2005	38.39	2.56	0	29.88	1.99	4078.68	72.82
2006	40.95	2.56	0	31.87	1.99	4074.13	77.37
2007	43.51	2.56	0	33.87	1.99	4069.57	81.93
2008	46.07	2.56	0	35.86	1.99	4065.02	86.48
2009	48.63	2.56	0	37.85	1.99	4060.47	91.03

land) match with the sum of the values reported in sectors 5.B.2.1 Forest Land - FAD to 5.F.2.1 Forest Land – FAD, and Forest Land – Kyoto forest converted to Trees outside Forest (included in Forest land - Trees outside Forest) for the respective years.

11.2.3 Maps and/or database to identify the geographical locations, and the system of identification codes for the geographical locations

The land use information reported under both the Convention (see also par. 7.1.2) and the Kyoto Protocol is based on two maps for monitoring nature development in the Netherlands, "Basiskaart Natuur" (BN) for 1990 and 2004.

The source material for BN1990 consists of the paper topographic map 1:25,000 (Top25) and digital topographical map 1:10,000 (Top10Vector). Map sheets with exploration years in the period 1986-1994 were used. The source material for BN 2004 consists of the digital topographic map 1:10,000 (Top10Vector). All topographic maps have been explored in the period 1999-2003. For the BN 2004, information from the Top 10 vector is combined with four other sources, that is information from two subsidy regulations (information from 2004), a map with the geophysical regions of the Netherlands (Fysisch Geografische Regio's) and a map with the land use in 2000 (Bestand BodemGebruik, 2000; Kramer et al., 2007). Table 11.2 summarises the characteristics of both maps (taken from Kramer et al., 2009).

In 2008, a series of improvements were made to the methodology for digitalisation, classification and aggregation. One of the main improvements for the 1990 map is a better distinction between built-up areas and agricultural lands. This was based on manually checking of all areas. If the source information was a paper map, it was converted to a digital high resolution raster map. Then both Top10Vector files and digitised Top25 maps were (re)classified to match the requirements set by UNFCCC reporting. In this process additional data sets were used, and the forest definition was applied to distinguish forests that comply with the minimum area and width chosen for the Kyoto Protocol (see Section 11.1.1) from other wooded areas ("Trees outside forests").

Simultaneously, harmonisation between the different source materials was applied to allow a sufficiently reliable overlay. Harmonisation included the use of road maps to check the representation of linear features, and correct for any artefact movement of roads due to differences in source material.

Table 11.2 Characteristics of BN 1990 and BN 2004.

Characteristics	BN 1990	BN 2004
Name	Historical Land use Netherlands 1990	Base map Nature 2004
Aim	Historical land use map for 1990	Base map for monitoring nature development
Resolution	25 m	25 m
Coverage	Netherlands	Netherlands
Base year source data	1986-1994	1999-2003
Source data	Hard copy topographical maps at 1:25,000 scale and digital topographical maps at 1:10,000	Digital topographical maps at 1:10,000 and additional sources to distinguish specific nature types
Number of classes	10	10
Distinguished classes	Grassland, Arable land, Heath land/peat moor, Forest, Buildings, Water, Reed marsh, Sand, Built-up area, Greenhouses	Grassland, Nature grassland, Arable land, Heath land, Forest, Built-up area and Infrastructure, Water, Reed marsh, Drifting sands, Dunes and beaches

The final step in the creation of the land use maps was the aggregation to 25 m × 25 m raster maps. For the 1990 map (which to a large extend was based on information derived from paper maps), an additional validation step was applied to check on the digitising and classifying processes.

To distinguish between mineral soils and peat soils, an overlay was made between the two BN maps and the Dutch Soil Map (De Vries et al., 2003). The result is a map with national coverage that identifies for each pixel whether it was subject to AR or D between 1990 and 2004, and whether it is located on a mineral or on an organic soil.

Following this procedure, the status as re/afforested area or deforested area is certain for each of the individual locations on the map that were subject to ARD between 1990 and 2004. However, it is unknown for each individual location when exactly this occurred. A mean annual rate for the Netherlands as a whole is derived from this by interpolating. For ARD occurring after 1 January 2004 until the reporting year, the mean annual rate for ARD activities is derived by extrapolating the mean annual rates between 1990 and 2004. As such, the exact location of ARD activities after 2004 is not known. The location will be specified as soon as a new land use map of later date is created. All ARD will be recalculated for the years where extrapolated data have been used.

11.3 Activity-specific information

11.3.1 Methods for carbon stock change and GHG emission and removal estimates

11.3.1.1 Description of the methodologies and the underlying assumptions used

The linkage between AR the reporting based on land use (sub-)categories for the Convention is as follows:

5.A.2.1 Cropland converted to Forest Land – Forests according to the Kyoto definition
5.A.2.2 Grassland converted to Forest Land – Forests according to the Kyoto definition
5.A.2.3 Wetland converted to Forest Land – Forests according to the Kyoto definition
5.A.2.4 Settlement converted to Forest Land – Forests according to the Kyoto definition
5.A.2.5 Other Land converted to Forest Land – Forests according to the Kyoto definition as well as the conversion from 5.1.1. Trees outside Forest to Forests according to the Kyoto definition, included in 5.1.1. Forests according to the Kyoto definition.

The methodologies used to calculate carbon stock changes in biomass due to AR activities are in accordance with those under the Convention as presented in Section 7.2.4. The carbon stock changes due to changes in biomass were attributed to above- respectively below-ground biomass using one average R value derived from the plots 0-20 years old (Van den Wyngaert et al., 2009). Carbon stock changes in dead wood and litter are not reported (see Section 11.3.1.2). Carbon stock changes in mineral and organic soils are reported in this submission for the first time, and a recalculation was made for 2008. The methods are presented below and results for carbon stock changes for all pools are given for the full time series since 1990 in Table 11.3 .

The linkage between D and the reporting based on land use (sub)categories for the Convention is as follows:

5.B.2.1 Forest Land – Forests according to the Kyoto definition converted to Cropland
5.C.2.1 Forest Land – Forests according to the Kyoto definition converted to Grassland
5.D.2.1 Forest Land – Forests according to the Kyoto definition converted to Wetland
5.E.2.1 Forest Land – Forests according to the Kyoto definition converted to Settlement

Table 11.3 Emissions (in Gg C) of re/afforestation activities since 1990.

Year	CSC in AG biomass	CSC in BG biomass	CSC in litter	CSC in DW	CSC in mineral soil	CSC in organic soil
1990	0,8	0,3	0,0	0,0	0,5	-1,4
1991	2,1	0,7	0,0	0,0	0,9	-2,7
1992	3,7	1,4	0,0	0,0	1,4	-4,1
1993	5,8	2,2	0,0	0,0	1,8	-5,4
1994	8,3	3,3	0,0	0,0	2,3	-6,8
1995	11,3	4,5	0,0	0,0	2,8	-8,1
1996	14,6	5,9	0,0	0,0	3,2	-9,5
1997	18,4	7,6	0,0	0,0	3,7	-10,8
1998	22,6	9,4	0,0	0,0	4,2	-12,2
1999	27,2	11,4	0,0	0,0	4,6	-13,5
2000	32,5	13,6	0,0	0,0	5,1	-14,9
2001	44,4	18,9	0,0	0,0	5,5	-16,2
2002	51,4	22,0	0,0	0,0	6,0	-17,6
2003	58,8	25,3	0,0	0,0	6,5	-18,9
2004	66,8	28,8	0,0	0,0	6,9	-20,3
2005	75,3	32,5	0,0	0,0	7,4	-21,6
2006	84,3	36,5	0,0	0,0	7,8	-23,0
2007	93,8	40,8	0,0	0,0	8,3	-24,3
2008	103,9	45,2	0,0	0,0	8,8	-25,7
2009	114,4	49,9	0,0	0,0	9,2	-27,1

CSC: carbon stock change
AR: afforestation and reforestation
AG: above ground
D: deforestation
BG: below ground
DW: dead wood

Table 11.4 Emissions (in Gg C) of deforestation activities since 1990.

Year	CSC in AG biomass	CSC in BG biomass	CSC in litter	CSC in DW	CSC in mineral soil	CSC in organic soil
1990	-89,6	-17,9	-51,3	-0,8	0,1	-0,7
1991	-90,8	-18,1	-52,3	-1,1	0,1	-1,4
1992	-92,4	-18,5	-53,3	-1,4	0,2	-2,2
1993	-93,8	-18,8	-54,3	-1,6	0,3	-2,9
1994	-95,5	-19,1	-55,3	-1,8	0,3	-3,6
1995	-97,2	-19,4	-56,3	-2,0	0,4	-4,3
1996	-98,9	-19,8	-57,3	-2,2	0,4	-5,0
1997	-100,7	-20,1	-58,3	-2,3	0,5	-5,8
1998	-102,3	-20,4	-59,3	-2,4	0,6	-6,5
1999	-104,0	-20,8	-60,3	-2,5	0,6	-7,2
2000	-102,5	-19,5	-61,3	-2,6	0,7	-7,9
2001	-104,9	-19,9	-62,3	-2,6	0,8	-8,6
2002	-107,5	-20,4	-63,3	-2,5	0,8	-9,4
2003	-110,2	-20,9	-64,3	-2,6	0,9	-10,1
2004	-112,5	-21,3	-64,3	-2,6	0,9	-10,8
2005	-114,8	-21,8	-64,3	-2,6	1,0	-11,5
2006	-116,9	-22,1	-64,3	-2,7	1,1	-12,2
2007	-119,0	-22,5	-64,3	-2,7	1,1	-13,0
2008	-121,2	-22,9	-64,3	-2,8	1,2	-13,7
2009	-123,3	-23,3	-64,3	-2,8	1,3	-14,4

5.F.2.1 Forest Land – Forests according to the Kyoto definition converted to Other Land
as well as the conversion from Forests according to the Kyoto definition to Trees outside Forest and, included in 5.1.1. Trees outside Forest.

The methodologies used to calculate carbon stock changes in biomass due to D activities are in accordance with those under the Convention as presented in Section 7.2.4. The carbon stock changes due to changes in biomass change were differentiated in above- respectively below-ground biomass using data available from the simple bookkeeping model used (Van den Wyngaert et al., 2009). All emissions were attributed to the year of deforestation, and no emissions were reported for any other years. As under the Convention, emissions as well as areas under deforestation are reported on an annual basis, while under the KP areas are reported cumulative while all emissions are reported in the year of deforestation, emissions are equal under both reporting, but implied emission factors are different. Carbon stock changes in mineral and organic soils are reported in this submission for the first time, and a recalculation was made for 2008. The methods are presented below and results for carbon stock changes for all pools are given for the full time series since 1990 in Table 11.4 .

Method to estimate carbon stock change in ARD land in mineral soils

Carbon stock changes in mineral and organic soils are reported in this submission for the first time, and a recalculation was made for 2008. The carbon stock change in mineral soils was calculated for from base data from the LSK survey (de Groot et al., 2005; Lesschen et al., in prep.) The LSK database contains quantified soil properties, including soil organic matter, for about 1,400 locations at five different depths. The soil types for each of the sample points were reclassified to 11 main soil types, which represent the main variation in carbon stocks within the Netherlands. Combined with the land use at the time of sampling, this lead to a new soil-land use based classification of all points.

The LSK data set only contains data on soil carbon stocks for the land uses grassland, cropland and forest. For the remaining land use categories separate estimates were made. For settlements (about 25% of deforested land becomes settlements) the estimates make use of information in the IPCC 2006 guidelines. An average soil carbon stock under settlement that is 0.9 times the carbon stock of the previous land use is assumed based on the following assumptions:

(i) 50% of the area classified as settlement is paved and has a soil carbon stock of 0.8 times the corresponding carbon stock of the previous land use. Considering the high resolution of the land use change maps in the Netherlands (25x25 m grid cells) it can be assumed that in reality a large portion of that grid cell is indeed paved.
(ii) The remainder 50% consists mainly of grassland and wooded land for which the reference soil carbon stock from the previous land use i.e. forest is assumed.

For the land use categories wetland and trees outside forest (TOF) no change in carbon stocks in mineral soils is assumed upon conversion to or from forest. For the category other land a carbon stock of zero is assumed. This is a conservative estimated, yet in many cases very realistic (other land in the Netherlands are sandy beaches and inland (drifting) sand areas).

The estimated annual C flux associated with re/afforestation or deforestation is then estimated from the difference between land use classes divided by 20 years (IPCC default):

$$E_{\min\_xy} = \sum_{1}^{i}\left(\frac{C_{yi} - C_{xi}}{T} \cdot A_{\min\_xyi}\right)$$

$E_{\min\_xy}$ Annual emission for land converted from land use x to land use y on soil type I (Gg C yr^{-1})

$A_{\min\_xy}$ Area of land converted from land use x to land use y on soil type I in years more recent than the length of the transition period (= less than 20 years ago) (ha)

C_x, C_y Carbon stocks of land use x respectively y on soil type I (Gg $C.ha^{-1}$)

T length of transition period (= 20 years)

This results in a net sink of 4.4 kton CO_2 per year for deforestation and a net sink of 32.2 kton CO_2 per year for re/afforestation in 2008, and a net sink of 4.6 kton CO_2 per year for deforestation and a net sink of 33.9 kton CO_2 per year for re/afforestation in 2009. The reason for the net sink of deforestation is that a large part of the deforested area is located on poor sandy soils with conversion of forest land to grassland. On these sandy soils the soil carbon stock is higher for grassland compared to forest land. This results in an increase of the soil carbon pool, which offsets the negative soil carbon stock changes due to deforestation on soil types other than sandy soils.

Method to estimate carbon stock change in ARD land in organic soils

The area of organic soils under forests is very small: 11,539 ha (4.0% of total peat area), based on the land use map of 2004. The area of re/afforested land on organic soils is 2,912 ha (8% of re/afforested area) and of deforested land 1,536 ha (5% of deforested area), based on the land use change between 1990 and 2004 (Kramer et al., 2009). The majority of this is a conversion between Kyoto forest and agricultural land (cropland or grassland). Drainage of organic soils to sustain forestry is not part of the land management nor actively done. However, indirectly also organic soils under forest are affected by drainage from the nearby cultivated and drained agricultural land.

Based on the land use maps of 1990 and 2004 the locations of deforestation and re/afforestation were determined in the ongoing study by Van den Wyngaert et al. (in prep) and overlaid with the ground surface lowering map of peat areas. The emissions from organic soils are then calculated using the ground surface lowering rate, the bulk density of the peat, the organic matter fraction and the carbon fraction in organic matter (see Kuikman et al., 2005). For organic soils under deforestation the assumption that emissions are equal to the emissions of cultivated organic soils is realistic. For re/afforestation this assumption is rather conservative as active drainage in forests is not common practice. For this reason and since no data is available about emissions from peat soils under forest or about the water management of forests, we have assumed that emissions remain equal to the emissions on cultivated organic soils before re/afforestation.

The result of the overlay of the ground surface lowering map of peat soils with the locations of re/afforestation and deforestation (land use changes from 1990 – 2004) results in area (ha) and emissions (kton CO_2). The average CO_2 emission from organic soils under re/afforestation is 23.7 ton CO_2 per ha per year and under deforestation 23.9 ton CO_2 per ha per year.

Method to estimate nitrous oxide emissions associated with disturbance of soils when deforested areas are converted to cropland

Nitrous oxide emissions associated with disturbance of soils when deforested areas are converted to cropland are calculated using equations 3.3.14 and 3.3.15 of Good Practice Guidance for LULUCF (IPCC, 2003) for each aggregated soil type (see mineral soils above). The default EF1 of 0.0125 kg N2O-N/kg N was used. For 3 aggregated soil types average C:N ratio's, based on measurements, were available and used. For all other aggregated soil types we used the default C:N ratio of 15 (GPG p. 3.94 , IPCC, 2003). For aggregated soil types where conversion to cropland lead to a net gain of carbon the nitrous oxide emission was set to zero.

Method to estimate carbon stock change in ARD land due to liming

Liming of forest in the Netherlands might occur occasionally but no statistics are available. All liming based on quantities of product sold is attributed to agricultural land (Cropland, Grassland) which is the main sector where liming occurs. Liming is thus reported only for deforested land that is converted to any of these categories. The total amount of liming is reported in sector 5G of the Convention and described in Section 7.8. There is no information how much of the total amount of lime is applied on croplands and grasslands that are reported under deforestation (as opposed to other croplands and grasslands). A mean per ha lime application was calculated based on the total amount of lime applied and the total area under grassland and cropland. This was multiplied with the total area of grassland and cropland reported under article 3.3 deforestation to calculate the amount of CO_2 emission due to liming.

11.3.1.2 Justification when omitting any carbon pool or GHG emissions/removals from activities under Article 3.3 and elected activities under Article 3.4

Carbon stock change due to changes in dead wood and litter in units of land subject to article 3.3 AR

The national forest inventory provides an estimate for the average amount of litter (in plots on sandy soils only) and the amount of dead wood (all plots). The data do provide the age of the trees and assume that the plots are no older than the trees. As such the age of the plot does not take into account any litter accumulation from previous forests on the same location and does not necessarily represent time since re/afforestation. This is reflected in a very weak relation between tree age and carbon in litter (Figure 11.2), and a large variation in dead wood even for plots with young trees (Figure 11.1).

Apart from forests, no land use has a similar carbon stock in litter (in Dutch grasslands, management prevents the built-up of a significant litter layer). Thus, the conversion of non-forest tot forest always involves a built-up of carbon in litter. However, as good data are lacking to quantify this sink, we report the accumulation of carbon in litter for re/afforestation conservatively as zero.

Similarly, no other land use has carbon in dead wood. Thus, the conversion of non-forest to forest involves a built-up of carbon in dead wood. However, as it is unlikely that much dead wood will accumulate in very young forests (having regeration years in 1990 or later), accumulation of carbon in dead wood in re/afforestated plots is most likely a very tiny sink that is too uncertain to quantify reliably. Thus we report this carbon sink conservatively as zero.

Figure 11.1 Volume of dead wood (standing and lying) in Dutch NFI plots in relation to tree age.

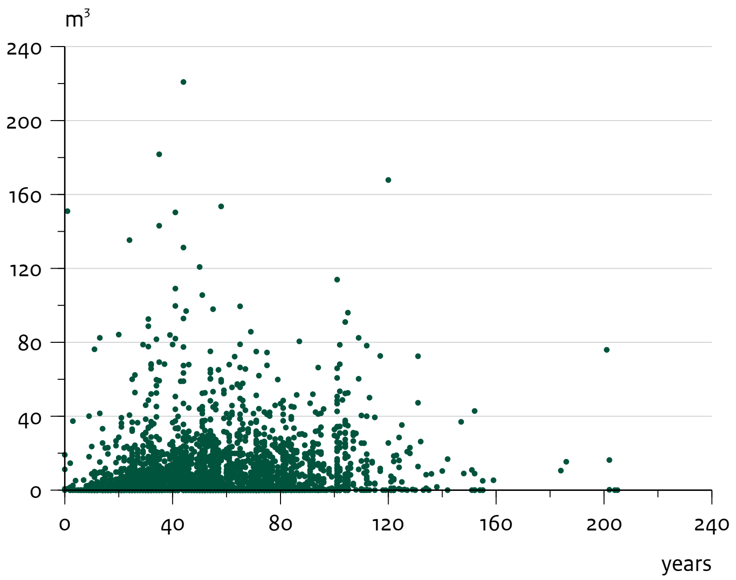
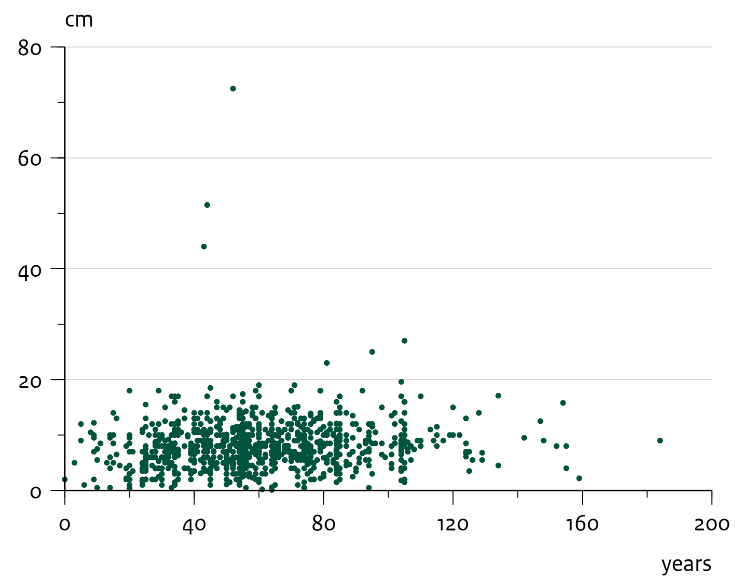


Figure 11.2 Thickness of litter layer (LFH) in Dutch NFI plots in relation to tree age. LFH measurements were conducted only in plots on sandy soils.



N_2O emission due to nitrogen fertilisation in units of land subject to article 3.3 AR

Forest fertilisation does not occur in the Netherlands. Therefore, fertilisation in re/afforested areas is reported NO.

GHG emission due to biomass burning in units of land subject to article 3.3 ARD

Greenhouse gas emissions (CO_2, CH_4 and N_2O) related to biomass burning are not estimated because biomass burning has not been monitored since 1996. Wildfire statistics indicated that forest fires rarely occurred in the two decades before 1996 (Wijdeven et al., 2006).

11.3.1.3 Information on whether or not indirect and natural GHG emissions and removals have been factored out

For all article 3.3 AR activities, forests were created only after 1990 and factoring out of effects on age structure of practices and activities before 1990 is not relevant. For article 3.3 D activities, the increase in mean carbon stock since 1990 may be an effect of changes in management as well as a change in age structure resulting from activities and practices before 1990. However, it is not known which factor contributes to what extent. This increase in mean carbon stock results in a higher carbon emission due to deforestation. Thus, not factoring out the effect of age structure dynamics since 1990 results in a more conservative estimate of emissions due to article 3.3 D activities.

There has been no factoring out of indirect GHG emissions and removals due to effects of elevated carbon dioxide concentrations or nitrogen deposition. To our knowledge, there is no internationally agreed methodology to factor out the effects of these that could be applied to our data.

11.3.1.4 Changes in data and methods since the previous submission (recalculations)

Values have changed for 2008 since the previous submission for:

1. CSC in mineral soils in all ARD land
   In the previous submission no estimate was given for CSC in mineral soils in ARD land, as research was ongoing. This has been finalized sufficiently now to allow a definite estimate. The method is explained short in par. 11.3.1.1 and more extensively in Lesschen et al (in prep.).
2. CSC in organic soils in all ARD land
   In the previous submission no estimate was given for CSC in organic soils in ARD land, as research was ongoing. This has been finalized sufficiently to allow a definite estimate. The method is explained short in par. 11.3.1.1 and more extensively in Van den Wyngaert et al. (in prep.).
3. CSC in biomass (losses) in deforested land
   The harvest values since 2000 have been changed. This involved an error correction in attributing the values to the right years, and an update of the values (from 2007 on). This resulted in slightly modified values for the average amount of standing stock and thus standing carbon per hectare over the Netherlands. Thus the emission factor for biomass loss due to deforestation was slightly modified. See also NIR 2011 par. 7.4.
4. CSC in dead wood in deforested land
   Built-up of dead wood was overestimated in the Netherlands. The decomposition of dead wood is based on measured values for longevity. However, the additional active removal of dead wood from forests was set to zero. This resulted in a built-up of dead wood between 1990 and 2000 that was not reflected in the measured values of dead wood in the NFI 2001-2005. The parameter describing the active removal of dead wood was therefore calibrated to match the observed built-up of dead wood between 1990 and 2000 and set to 20 %. Thus, on average 20% of all dead wood in the Netherlands is actively removed from site. See also NIR 2011 par. 7.4
5. N2O emission due to soil disturbance associated with conversion to cropland in units of land subject to. article 3.3 D.
   In the previous submission, no estimate was given for N2O emission due to soil disturbance associated with conversion to cropland, as research on CSC after deforestation to croplands was ongoing. This has been finalised sufficiently now to allow a definite estimate according to Tier 1 methodology as explained in par. 11.3.1.1.

11.3.1.5 Uncertainty estimates

The Tier 1 analysis in Annex 7, Table A7.3 provides estimates of uncertainties of LULUCF categories. The Netherlands uses a Tier 1 analysis for the uncertainty assessment of the sector LULUCF. The analysis combines uncertainty estimates of the forest statistics, land use and land use change data (topographical data) and the method used to calculate the yearly growth in carbon increase and removals (Olivier et al., 2009). The uncertainty analysis is performed for Forests according to the Kyoto definition (par. 7.2.5) and is based on the same data and calculations as used for KP article 3.3 categories.

Thus, the uncertainty for total net emissions from units of land under article 3.3 afforestation/reforestation are estimated at 63%, equal to the uncertainty in Land converted to Forest Land. Similarly, the uncertainty for total net emissions from units of land under article 3.3 deforestation is estimated at 66%, equal to the uncertainty in Land converted to Grassland (which includes for the sake of the uncertainty analysis all Forest land converted to any other type of land use (see Olivier et al., 2009). As a result of recent improvements in both maps and calculations (see NIR 2009), it is likely that the current estimate is an overestimate of the actual uncertainty. It is foreseen that new uncertainty estimates will be calculated before the final accounting for the KP commitment period.

11.3.1.6 Information on other methodological issues
There is no additional information on other methodological issues.

11.3.1.7 The year of the onset of an activity, if after 2008
The forestry activities under Article 3, paragraph 3 are reported from the beginning of the commitment period.

11.4 Article 3.3

11.4.1 Information that demonstrates that activities under Article 3.3 began on or after 1 January 1990 and before 31 December 2012 and are direct human-induced

The land use map is dated on 1 January 1990. Only ARD activities relative to this map, that is after this date, are taken into account.

In the Netherlands, forests are protected under the Forest Law (1961), which stipulates that “The owner of ground, on which a forest stand, other than through pruning, has been harvested or otherwise destroyed, is obliged to replant the forest stand within a period of three years after the harvest or destruction of the stand (...)”. A system of permits is applied for deforestation, and compensation forests have been planted at other locations. This has in the past created problems for (local) nature agencies that wanted to restore the more highly valued heather and peat areas in the Netherlands and as a result will not allow forest regeneration on areas where it is not intended.

With the historic and current scarcity of land in the Netherlands (which has the highest population density of Europe), any land use is the result of deliberate human decisions.

11.4.2 Information on how harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation

Following the forest definition and the mapping practice applied in the Netherlands, areas subject to harvesting or forest disturbance are still classified as forests and as such will not result in a change in land use in the overlay of the land use maps (Kramer et al., 2009).

11.4.3 Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested

The land use maps do not provide information on forest areas that have lost forest cover if they are not classified as deforested. However, from the national forest inventory it can be estimated that about 0.3% of the forests was classified as clear cut area, that is without tree cover.

11.5 Article 3.4

This is not applicable as no article 3.4 activities have been elected.

11.6 Other information

11.6.1 Key category analysis for Article 3.3 activities and any elected activities under Article 3.4

Under the Convention, conversion to Forest Land (5A2) is a key category. Despite differences in definition between forests under the Convention and under the Kyoto Protocol, 5A2 is a corresponding category and as such re/afforestation is considered a key category under the KP. Under the Convention, conversion of Forest Land to Grassland (5C2) is a key category. Despite differences in definition between forests under the Convention and under the Kyoto Protocol, 5C2 is a corresponding category and as such deforestation is considered a key category under the KP.

The smallest key category based on level for Tier 1 level analysis including LULUCF is 541 Gg CO_2 (1A4 Stationary combustion: Other sectors, liquids excl. from 1A4c, see Annex 1). With 537.09 Gg CO_2 the annual contribution of re/afforestation under the KP is just below the smallest key category (Tier 1 level analysis including LULUCF). Deforestation under the KP in 2009 causes an emission of 832.68 Gg CO_2, which is more than the smallest key category (Tier 1 level analysis including LULUCF). Additionally, deforestation is larger than the smallest key category in the Tier 1 key source analysis (excluding LULUCF), which is 603 Gg CO_2, (2B5 Caprolactam production).

11.7 Information relating to Article 6

The Netherlands is not buying or selling emission rights from JI projects related to land subject to a project under Article 6 of the Kyoto protocol.

12 Information on accounting of Kyoto units

12.1 Background information

The Netherlands' Standard Electronic Format report for 2010 containing the information required in paragraph 11 of the annex to decision 15/CMP.1 and adhering to the guidelines of the SEF has been submitted to the UNFCCC Secretariat electronically - SEF_NL_2011_1_11-41-30 10-1-2011.xls.

12.2 Summary of information reported in the SEF tables

There were 1.030.101.297 AAUs in the Netherlands' National Emission Trading Registry at the end of the year 2010, of which 626.814.684 AAU's were in the Party holding account; 115.303.838 AAU's in the entity holding accounts; 500 AAU's in the other cancellation accounts and 287.982.275 AAU's in the retirement account.

There were 20.835.552 CERs in the registry at the end of 2010: 15.103.900 CERs were held in the Party holding account, 5.730.632 CERs were held in the entity holding accounts, 1.020 CERs in the other cancellation accounts and no CERs were held in the retirement account.

There were 3.770.748 ERUs in the registry at the end of 2010: 2.602.173 ERUs were held in the Party holding account, 1.168.575 ERUs were held in the entity holding accounts and no ERUs in the other cancellation accounts or the retirement account.

The registry did not contain any RMUs, t-CERs or l-CERs. There were no units in the Article 6 issuance and conversion accounts; no units in the Article 3.3 and Article 3.4 issuance or cancellation accounts and no units in the Article 12 afforestation and reforestation accounts.

The total amount of the units in the registry corresponded to 1.054.707.597 tonnes CO_2 eq.

The Netherlands' assigned amount is 1.001.262.141 tonnes CO_2 eq.

Annual Submission Item	Submission
15/CMP.1 annex I.E paragraph 11: Standard electronic format (SEF)	The Standard Electronic Format report for 2010 has been submitted to the UNFCCC Secretariat electronically (SEF_NL_2011_1_11-41-30 10-1-2011.xls). The contents of the report (R1) can also be found in annex 6 of this document.

12.3 Discrepancies and notifications

Annual Submission Item	Submission
15/CMP.1 annex I.E paragraph 12: List of discrepant transactions	The list of discrepant transactions for the year 2010, pursuant to 15/CMP.1 annex I.E paragraph 12, has been submitted to the UNFCCC Secretariat electronically (SIAR Reports 2010-NL v1.0.xls Worksheet R2) The contents of the Report R2 can also be found in Annex 6 of this document.
15/CMP.1 annex I.E paragraph 13 & 14: List of CDM notifications	No CDM notifications occurred in 2010.
15/CMP.1 annex I.E paragraph 15: List of non-replacements	No non-replacements occurred in 2010.
15/CMP.1 annex I.E paragraph 16: List of invalid units	No invalid units exist as at 31 December 2010.
15/CMP.1 annex I.E paragraph 17 : Actions and changes to address discrepancies	Under paragraph 14.1 "Previous Review Recommendations" the actions and changes to address discrepancies are discussed.

12.4 Publicly accessible information

Annual Submission Item	Submission
15/CMP.1 annex I.E Publicly accessible information	The information as described in 13/CMP.1 annex II.E paragraphs 44-48 is publicly available at the following internet address (URL); http://www.emissieautoriteit.nl/english/public-information-kyoto All required information for a Party with an active Kyoto registry is provided with the following exceptions;
	paragraph 46 Article 6 Project Information. The Netherlands does not host JI projects as laid down in National legislation. This fact is stated on the mentioned internet address. That the Netherlands does not host JI projects is implied by article 16.46c of the Environment Act (Wet milieubeheer) and explicitly stated in the explanatory memorandum to the act implementing the EC linking Directive (Directive 2004/101/EC, the Directive that links the ETS to the project based activities under the Kyoto Protocol). As is explained in the memorandum, the government decided not to allow JI projects in the Netherlands since it would only increase the existing shortage of emission allowances / assigned amount units.)
	paragraph 47a/d/f/ in/out/current Holding and transaction information is provided on a holding type level, due to more detailed information being declared confidential by EU regulation. This follows from article 10 of EU Regulation 2216/2004/EC, that states that "All information, including the holdings of all accounts and all transactions made, held in the registries and the Community independent transaction log shall be considered confidential for any purpose other than the implementation of the requirements of this Regulation, Directive 2003/87/EC or national law."
	paragraph 47c The Netherlands does not host JI projects as laid down in National legislation. (ref. submission paragraph 46 above)
	paragraph 47e The Netherlands does not perform LULUCF activities and therefore does not issue RMUs
	paragraph 47g No ERUs, CERs, AAUs and RMUs have been cancelled on the basis of activities under Article 3, paragraphs 3 and 4 to date.

Annual Submission Item	Submission
	paragraph 47h No ERUs, CERs, AAUs and RMUs have been cancelled following determination by the Compliance Committee that the Party is not in compliance with its commitment under Article 3, paragraph 1 to date.
	Paragraph 47i The number of other ERUs, CERs, AAUs and RMUs that have been cancelled is published by means of the SEF report.
	paragraph 47j The number of other ERUs, CERs, AAUs and RMUs that have been retired is published by means of the SEF report.
	paragraph 47k There is no previous commitment period to carry ERUs, CERs, and AAUs over from.

12.5 Calculation of the commitment period reserve (CPR)

In April 2008 the Netherlands became eligible under the Kyoto Protocol. Its assigned amount was fixed at 1,001,262,141 tonnes CO_2 equivalent. The CPR was calculated at that point in time at 901,135,927 tonnes CO_2 equivalent. The CPR has not been changed.

12.6 KP-LULUCF accounting

Not applicable, because the Netherlands has chosen for end-of-period accounting for KP-LULUCF

13 Information on changes in national system

Extensive information on the national inventory system is described in this National Inventory Report under the appropriate Sections as required by the UNFCCC guidelines. More extensive background information on the National System is also included in the Netherlands 5th National Communication and in the Initial Report. The Initial Review in 2007 concluded that the Netherlands National System has been established in accordance with the guidelines.

There have been no changes in the National System since the last submission and since the initial report, with the exception of following issues:

- The co-ordination of the Emission Registration Project, in which emissions of about 350 substances are annually calculated, was performed until 1 January 2010 by PBL. As of 1 January 2010, co-ordination has been assigned to RIVM. Processes, protocols and methods remain unchanged. Many of the former experts from PBL have also shifted to RIVM.
- The name of SenterNovem (single national entity/NIE) has changed as of 1 January 2010 to NL Agency.
- The name of the Ministry of Housing, Spatial Planning and the Environment (VROM) has changed as of October 2010 to the Ministry of Infrastructure and the Environment (IenM), as a result of a merger with the Ministry of Transport, Public Works and Water Management.
- The name of the Ministry of Agriculture, Nature and Food Quality (LNV) has changed as of October 2010 to the Ministry of Economic Affairs, Agriculture and Innovation, as a result of a merger with the Ministry of Economic Affairs.

All changes do not have any impact on the functions of the National System.

14 Information on changes in national registry

14.1 Changes to national registry

Reporting Item	Submission
15/CMP.1 annex II.E paragraph 32.(a) Change of name or contact	There is no change in name or contact information of the registry administrator designated by the Netherlands.
15/CMP.1 annex II.E paragraph 32.(b) Change of co-operation arrangement	There is no change in the co-operation arrangement.

Reporting Item	Submission
15/CMP.1 annex II.E paragraph 32.(c) Change to database or the capacity of national registry	In 2010 two registry software version updates have been implemented, namely Greta version 4.3 on 26 March and version 5.1 on 22 December. Both upgrades have incorporated changes that increased the capacity of the Registry. The following capacity-improving measures have been implemented compared to the previously used versions. Update from version 4.2 to version 4.3 With the installation of Greta version 4.2 the database component of the registry has been modernised from Microsoft SQL Server version 2000 to Microsoft SQL Server version 2005. This has bought improvements in relation to Registry performance, reliability and scalability. Update from version 4.3 to version 5.1 Improvements to reconciliation processing. In order to improve performance and reliability, the processing of reconciliation messages was changed from a synchronous to an asynchronous process. This ensures that the Registry responds to ITL messages within an appropriate time period, thus eliminating time-out errors. A windows service is used to process the reconciliation messages; this improves reliability and makes the process more robust by enabling processing failures to be retried. In addition, the reconciliation function was streamlined and is more efficient than in previous versions. This enhances the robustness of the system, necessary as the number and size of transactions increases. Additionally, as referred to in the release notes under Mantis bug number 346, improvements have been made to the handling of transaction messaging. Together these changes have resulted in increased reliability of the registry when operating under a higher work load. This effectively increases the capacity of the registry. Please consult the documents referred to Annex A6.5 for the following: · Release notes version 4.3.23 · Release notes version 5.1.24 These describe the details on the changes compared to Greta version 4.1 used in 2009. Please note that there are no release notes for Greta version 5.0 as this version was not publicly released. The release notes for version 5.1 also covers changes implemented in version 5.0.
15/CMP.1 annex II.E paragraph 32.(d) Change of conformance to technical standards	No change in the registry's conformance to technical standards occurred for the reporting period.
15/CMP.1 annex II.E paragraph 32.(e) Change of discrepancies procedures	As expected previous improvements to the registry have resulted in fewer discrepancies in 2010 compared to the previous year. Only discrepancies with result codes 4003 and 4010 occurred. Compared to 2009 the number of occurrences of 4003 result codes decreased 47% from 882 to 466 per 100.000 transactions. The occurrences of 4010 result codes decreased 20% from 882 to 709 per 100.000 transactions. These remaining discrepancies are inherent to the original transaction message flow as described in the DES. To solve this an improved transaction message flow is supported by ITL since October 2010. Version 5.2, which will be deployed Q1 2011, makes use of this improved transaction message flow and is expected to significantly reduce the remaining occurrences.

Reporting Item	Submission
15/CMP.1 annex II.E paragraph 32.(f) Change of security	During December 2010 the Netherlands Registry implemented the technical infrastructure to enable 2-factor authentication. On 10 January 2-factor authentication has been enabled for all users. Please consult the documents referred to in Annex A6.5 for detailed result of testing the 2-Factor Authentication. Additionally version 5.1 includes changes that reduce the possible vectors of security attacks on the registry. Amongst others improvements have been made in the area's of; · Cross Site Scripting · Auto completion · Cookies · Session Hijacking More details can be found in the release notes as referenced above. Several further security enhancements will be deployed in Q1 2011 with version 5.2. When considering improvements for future releases of Greta security will remain to have a top priority.
15/CMP.1 annex II.E paragraph 32.(g) Change of list of publicly available information	No change in publicly available information occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(h) Change of Internet address	No change of the registry Internet address occurred during the reporting period.
15/CMP.1 annex II.E paragraph 32.(i) Change of data integrity measures	<u>Software improvements</u> Greta version 5.1 implemented changes to streamline the compliance process, so reducing user errors and improving data integrity. <u>Disaster recovery test</u> Netherlands performed a disaster recovery test on 9 February 2010. This was based on updated disaster recovery and test plans drafted in 2009. The test confirmed the communication side of the procedures and demonstrated the ability to move to the secondary site without data loss occurring. Due to an missing entry in the configuration of the VPN, which is shared with the ITL, we were unable to establish a connection with the ITL from the secondary site. This entry has since been added and the proper working will be confirmed during the next disaster recovery test. Please consult the documents referred to in Annex A6.5 for the following: · Updated Disaster Recovery Plan · Updated Disaster Recovery Test Plan · Disaster Recovery Test Results
15/CMP.1 annex II.E paragraph 32.(j) Change of test results	Please consult documents referred to in Annex A6.5 for the following; · Greta test plan and report for version 4.3 · (C)ITL test plan and report for version 4.3 · Certification email from Trasys on behalf of UNFCCC Secretariat and European Commission · Greta test plan and report for version 5.1 · Localisation test plan used for versions 4.3 and 5.1

15 Information on minimisation of adverse impacts in accordance with Article 3, paragraph 14

The Netherlands has reported information on minimisation of adverse impacts in its 5th National Communication, submitted to the UNFCCC in December 2009 and in the NIR 2010. In this chapter new and additional information is presented.

The Kyoto Protocol was adopted in pursuit of the ultimate objective of the Convention. Full implementation by the Netherlands is intended to contribute to preventing dangerous anthropogenic interference with the climate system. Ambitious mitigation goals are necessary to ascertain a future for all countries. In striving to develop policies and measures to reduce greenhouse gas emissions, Parties to the Kyoto Protocol should implement those policies and measures to minimise adverse effects, including the adverse effects of climate change, effects on international trade, and social, environmental and economic impacts on other Parties, especially developing country Parties identified in article 4, paragraphs 8 and 9 of the Convention.

A differentiated approach

The Netherlands has chosen for a differentiated approach to reduce climate change and the adverse impacts on developing countries. There are policies and measures focusing on the national, European and international level. Not only does the Netherlands focus on CO_2 reductions, the Netherlands also pays attention to the reduction of non-CO_2 greenhouse gases. For example the Netherlands has achieved a significant reduction of N_2O in the nitric acid industry.
Impacts on other countries are mostly indirect and can frequently not be attributed to a specific national policy. Through a differentiated approach the Netherlands aims to reduce the chance that adverse impacts for a specific region occurs. When possible economic, social and environmental impacts in developing countries are taken into account.
Nationally, greenhouse gases are reduced through changes in habits (stimulating public transport), technological improvements (LED-lightning and insulating windows), public procurement (taking life cycle energy use into account), obligations (stringent energy performance coefficient in housing) and voluntary agreements (with different – industrial - sectors for GHG reductions), as providing for a renewable energy share in transport. Furthermore the Dutch government implement its policies – where possible – according to the 'the polluter pays' principle.

The European Union is also a Party under the Kyoto protocol and therefore reports its information on minimisation of adverse impacts.

Carbon Capture and Storage

Besides the measures in place to reduce greenhouse gases the Netherlands is developing a demonstration project for CCS. The next decennia we will still be dependent on fossil

fuels. Advanced technologies like CCS can help to reduce these fossil emissions.
The demonstration project is part of the IEEE program. The project receives a grant from this program. The objective of this program is to develop the CCS technology. Part of the program is to share and develop knowledge of the projects. This knowledge will become public.

Biofuels

The Netherlands implements the EU-renewable energy obligation for transport by an obligatory measure, demanding fuel suppliers to make sure that 4.25%, of transport fuels are renewables, gradually increasing to 10% in 2020. If biofuels are used to this end, according to European law, only proven sustainable biofuels count towards the mandate. Sustainability requirements are: a net positive greenhouse gas balance from well (cultivation) to wheel, protection of highly bio diverse areas, protection of areas with a high carbon content and protection of peat lands.

International negotiations; finance, adaptation, technology and market mechanisms

The Netherlands welcomes the Cancun agreements. The Cancun decisions constitute a realistic and necessary step in fighting climate change and are a balanced result of international negotiations so far. They provide a solid basis for further work on an effective international climate regime.

In the international negotiations, the Netherlands has focused strongly on finance, specifically on transparency about fast start financing. This will play a crucial role in building confidence in the international climate change negotiations. It has therefore launched a website, www.faststartfinance.org, which aims to provide transparency about the amount, direction and use of fast start climate finance, in turn building trust in its delivery and impact.

In accordance with the Netherlands' position on finance, the Cancun Agreements have consolidated important elements of the Copenhagen Accord in formal decisions. Next to that, it has been decided to establish a Green Climate Fund, as well as a Transitional Committee and a Standing Committee.

Also, the Cancun Agreements have now formally established the Technology Mechanism, as mentioned in the Copenhagen Accord, to support country-driven action on mitigation and adaptation through a scale up of clean technology and innovation. This mechanism should be operational in 2012.

In the Netherlands' view it is essential to develop and disperse knowledge and capability in the areas of adaptation, disaster prevention and risk management, both among developed countries and between developed and developing countries. It is important to support developing countries with capacity building and knowledge creation. Both technical and financial assistance should be given to the most vulnerable developing countries, provided their adaptation strategies meet certain standards. Adaptation finance should be prioritized to help the most vulnerable countries adapt to climate change.

The Netherlands welcomes the steps that have been taken to address adaptation in the Cancun Agreements, including the establishment of the Cancun Adaptation Framework.

The flexible mechanisms under the Protocol - Emissions Trading, Joint Implementation and the Clean Development Mechanism - are all tools incorporated into the Protocol in order to share efforts in reducing greenhouse gases. This ensures that investment is made where there is optimal greenhouse gas-reducing effects, thus ensuring minimal impact on the world economy.

In the Netherlands' view, the project-based and programmatic Clean Development Mechanism (CDM) should continue but needs to be improved to enhance its environmental integrity and efficiency. In addition, new market-based mechanisms need to be introduced to encourage participation of developing countries in the global carbon market, delivering greater mitigation and other economic benefits. These mechanisms would provide tangible financial assets (reduction credits/ emission units) to support enhanced mitigation actions in developing countries. The Netherlands would like to work with developing countries to set up these new mechanisms.

The Netherlands will continue to promote transparency on finance and participate in activities to enhance market readiness and development of new financial/ market mechanisms.

Co-operating in the technological development of non-energy uses of fossil fuels, and supporting developing country Parties to this end.

The technological development of non-energy use of fossil fuels is not a policy or research priority in the Netherlands.

Assisting developing country Parties to promote renewable energy and renewable energy policies

The Netherlands assists developing country Parties to promote renewable energy and renewable energy policies. The ultimate goal is to support developing countries in following low carbon development pathways.

The Dutch Promoting Renewable Energy Programme consists of four components: 1. direct investments in renewable energy; 2. encouraging sustainable production of biomass for energy; 3. developing capacity and knowledge in the field of renewable energy; and 4. renewable energy policy dialogue with partner countries and multilateral institutes.
The activities are focussed on Sub Sahara Africa and Indonesia. The largest share of activities take place within the Great Lakes area. The Netherlands participates in a regional programme on renewable energy for the Great Lakes region. It contributes among others to rehabilitation of existing hydropower and the improvement of the power grid between Rwanda and Burundi. The Programme also includes reforestation activities and sustainable production of firewood. In Rwanda, the Netherlands contributes to the National Energy Strategy, with a focus on small scale hydropower and biogas. The Netherlands also contributes to the National Strategy for reforestation and sustainable forest management, with a focus on sustainable production of firewood.
In Indonesia a program on renewable energy has been developed. This program includes capacity building, institutional strengthening and implementation of new technologies, such as geothermal energy, biogas, small scale hydropower for rural electrification and sustainable palm oil production. In Indonesia, a number of Dutch energy partners, including NL Agency, are supporting a nationally operating energy program, together with the World Bank and GIZ. As a result, thousands of households are now connected to the electricity network and solar panels and small-scale hydraulic power stations have been installed. Cleaner energy is now also available in the form of biogas and vegetable oils.
In close collaboration with the German Ministry for Development Cooperation the Netherlands contributes to the Energising Development Programme in 18 countries. The aim is to provide access to renewable energy services to 5 million people before 2015.
The Netherlands supports research and investment in the field of sustainable production of biomass for energy purposes in various countries: (Mali, Mozambique, Sierra Leone, South Africa, Tanzania, Zambia, Indonesia, Vietnam, Brazil, Colombia, Mexico, Nicaragua and Panama).
Multilaterally, the Netherlands cooperates with several IFI's on energy. The most important World Bank programs the Netherlands is involved in are 1) the Energy Sector Management Assistance Programme (ESMAP), 2) the Asia Sustainable and Alternative Energy (ASTAE) programme for Southeast Asia, and 3) the Scaling-up Renewable Energy Programme (SREP). The Netherlands also funds programs with the IFC and the Asia Development Bank (ADB). The results of this cooperation include knowledge on the application of energy, strengthening of national energy organisations for energy, and access to renewable energy for the poor. For example, hydraulic power stations have been set up in Zambia, and solar energy programmes in Mongolia. In Southeast Asia energy loans are provided to projects that use renewable energy.
A large number of new initiatives have been developed in cooperation with civil society organisations and the private sector. The Netherlands Development Organisation (SNV) conducts biogas programmes in Asia. Also, SNV and Hivos are setting up biogas programmes in six African countries. The Global Village Energy Partnership strengthens local small-scale private enterprises in developing countries. The Free Energy Foundation works to increase the use of solar power in Africa. Various innovative partnerships with the private sector are ongoing to support a business-wise approach towards the sale of solar lanterns in rural areas and a fee-for-service approach towards Solar Home Systems.

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16 Other information

No other information.

Annexes

Annex 1 Key sources

A1.1 Introduction

As explained in the Good Practice Guidance (IPCC, 2001), a key source category is prioritised within the national inventory system because its estimate has a significant influence on a country's total inventory of direct greenhouse gases in terms of the absolute level of emissions, the trend in emissions, or both.

For the identification of key sources in the Netherlands inventory, we allocated the national emissions according to the Intergovernmental Panel on Climate Change (IPCC) potential key source list, as presented in Table 7.1 in Chapter 7 of the Good Practice Guidance. As suggested in this table, the carbon dioxide (CO_2) emissions from stationary combustion (1A1, 1A2 and 1A4) are aggregated by fuel type. CO_2, methane (CH_4) and nitrous oxide (N_2O) emissions from "Mobile combustion: road vehicles" (1A3) are assessed separately. The CH_4 and N_2O emissions from aircrafts and ships are relatively small (about 1–2 Gg CO_2 equivalents). Other mobile sources are not assessed separately by gas. "Fugitive emissions from oil and gas operations" (1B) is an important source of greenhouse gas emissions in the Netherlands. The most important gas/source combinations in this category are separately assessed. Emissions in other IPCC sectors are disaggregated, as suggested by IPCC.

The IPCC Tier 1 method consists of ranking the list of source category/gas combinations according to their contribution to the national total annual emissions and to the national total trend. The darker green areas at the top of the tables in this Annex are the largest sources, of which the total adds up to 95% of the national total (excluding LULUCF) : 32 sources for annual level assessment (emissions in 2009) and 31 sources for the trend assessment out of a total of 72 sources. Both lists can be combined to obtain an overview of sources that meet any of these two criteria.

The IPCC Tier 2 method for identification of key sources requires the incorporation of the uncertainty in each of these sources before ordering the list of shares. This has been carried out using the uncertainty estimates presented in Annex 7 (for details on the Tier 1 uncertainty analysis see Olivier et al., 2009). The results of the Tier 1 and Tier 2 level and trend assessments are summarised in Table A1.1 and show a total of 44 key sources (excluding LULUCF). Two of these (4A1 CH_4 emissions from enteric fermentation in domestic livestock: mature dairy cattle and 4A1 CH_4 emissions from enteric fermentation in domestic livestock: young cattle) result from the subdivision of 4A1 CH_4 emissions from enteric fermentation in domestic livestock: cattle. This was done to account for the difference in uncertainties between young, mature, dairy and non-dairy cattle concerning activity data and emission factors.

As expected, the Tier 2 level and trend assessment increases the importance of very uncertain sources. It can be concluded that in using the results of a Tier 2 key source assessment, 5 sources are added to the list of 43 Tier 1 level and trend key sources (excluding LULUCF) :

- 1A3 Mobile combustion: road vehicles N_2O (Tier 2 level)
- 1B1b Coke production CO_2 (Tier 2 level)
- 4A8 CH_4 emissions from enteric fermentation in domestic livestock: swine (Tier 2 level)
- 4B Emissions from manure management N_2O (Tier 2 Level and trend)
- 6B Emissions from wastewater handling N_2O (Tier 2 Level).

The share of these sources in the national annual total becomes more important when taking their uncertainty (50%–100%) into account (Table A1.4). We then include the most important Land Use, Land Use Change and Forestry (LULUCF) emission sinks and sources in the Tier 1 and Tier 2 key source calculations to identify the key sources in IPCC Sector 5. This results in 4 additional key sources, giving an overall total of 48 key sources (including LULUCF); see also Table A1.2. In this report, the key source assessment is based on emission figures from Common Reporting Format (CRF) 2010 version 1.1, submitted to the European Union (EU) in January 2010.
Table A1.1. Key source list identified by the Tier 1 level and trend assessments (based on CRF tables 2011 version 1.1. Level assessment for 2009 emissions (excluding LULUCF sources).

Table A1.1 Key source list identified by the Tier 1 level and trend assessments. Level assessment for 2009 emissions (excluding LULUCF sources).

IPCC	Source category	Gas	Key source?	Tier 1 level recent year without LULUCF	Tier 1 trend without LULUCF	Tier 2 level recent year without LULUCF	Tier 2 trend without LULUCF
	ENERGY SECTOR						
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO_2	Key(L1,T1)	1	1	0	0
1A1a	Stationary combustion: Public Electricity and Heat Production: solids	CO_2	Key(L,T1)	1	1	1	0
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO_2	Key(L1,T1)	1	1	0	0
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO_2	Key(L,T)	1	1	1	1
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	Key(L,T)	1	1	1	1
1A1b	Stationary combustion : Petroleum Refining: gases	CO_2	Key(L1,T1)	1	1	0	0
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO_2	Non key	0	0	0	0
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO_2	Key(L,T)	1	1	1	1
1A2	Emissions from stationary combustion : Manufacturing Industries and Construction, liquids	CO_2	Key(L,)	1	0	1	0
1A2	Emissions from stationary combustion : Manufacturing Industries and Construction, solids	CO_2	Key(L,T1)	1	1	1	0
1A2	Emissions from stationary combustion : Manufacturing Industries and Construction, gases	CO_2	Key(L,T)	1	1	1	1
1A3b	Mobile combustion: road vehicles: gasoline	CO_2	Key(L,T1)	1	1	1	0
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	Key(L,T)	1	1	1	1
1A3b	Mobile combustion: road vehicles: LPG	CO_2	Key(L1,T)	1	1	0	1
1A3	Mobile combustion: water-borne navigation	CO_2	Key(L1,)	1	0	0	0
1A3	Mobile combustion: aircraft	CO_2	Non key	0	0	0	0
1A3	Mobile combustion: other (railways)	CO_2	Non key	0	0	0	0
1A3	Mobile combustion: other (non-road)	CH_4	Non key	0	0	0	0
1A3	Mobile combustion: other (non-road)	N_2O	Non key	0	0	0	0
1A3	Mobile combustion: road vehicles	CH_4	Non key	0	0	0	0
1A3	Mobile combustion: road vehicles	N_2O	Key(L2)	0	0	1	0
1A4	Stationary combustion : Other Sectors, solids	CO_2	Non key	0	0	0	0

Table A1.1 Key source list identified by the Tier 1 level and trend assessments. Level assessment for 2009 emissions (excluding LULUCF sources).

IPCC	Source category	Gas	Key source?	Tier 1 level recent year without LULUCF	Tier 1 trend without LULUCF	Tier 2 level recent year without LULUCF	Tier 2 trend without LULUCF
1A4a	Stationary combustion : Other Sectors: Commercial/ Institutional, gases	CO_2	Key(L,T)	1	1	1	1
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO_2	Key(L,T1)	1	1	1	0
1A4c	Stationary combustion : Other Sectors, Agriculture/ Forestry/Fisheries, gases	CO_2	Key(L,T1)	1	1	1	0
1A4c	Stationary combustion : Other Sectors, Agriculture/ Forestry/Fisheries, liquids	CO_2	Key(L,T)	1	1	1	1
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO_2	Key(,T)	0	1	0	1
1A5	Military use of fuels (1A5 Other)	CO_2	Key(,T1)	0	1	0	0
1A	Emissions from stationary combustion: non-CO_2	CH_4	Key(L,T)	1	1	1	1
1A	Emissions from stationary combustion: non-CO_2	N_2O	Non key	0	0	0	0
1B1	Coal mining	CH_4					
1B1b	Coke production	CO_2	Key(L2,)	0	0	1	0
1B2	Fugitive emissions from venting/flaring: CO_2	CO_2	Key(,T)	0	1	0	1
1B2	Fugitive emissions venting/flaring	CH_4	Key(,T)	0	1	0	1
1B2	Fugitive emissions from oil and gas: gas distribution	CH_4	Non key	0	0	0	0
1B2	Fugitive emissions from oil and gas operations: other	CH_4	Non key	0	0	0	0
	INDUSTRIAL PROCESSES						
2A1	Cement production	CO_2	Non key	0	0	0	0
2A3	Limestone and dolomite use	CO_2	Non key	0	0	0	0
2A7	Other minerals	CO_2	Non key	0	0	0	0
2B1	Ammonia production	CO_2	Key(L1,)	1	0	0	0
2B2	Nitric acid production	N_2O	Key(,T)	0	1	0	1
2B5	Caprolactam production	N_2O	Key(L1,)	1	0	0	0
2B5	Other chemical product manufacture	CO_2	Key(L,)	1	0	1	0
2C1	Iron and steel production (carbon inputs)	CO_2	Key(L1,T1)	1	1	0	0
2C3	CO_2 from aluminium production	CO_2	Non key	0	0	0	0
2C3	PFC from aluminium production	PFC	Key(,T)	0	1	0	1
2F	SF_6 emissions from SF_6 use	SF_6	Non key	0	0	0	0
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	Key(L,T)	1	1	1	1
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	Key(,T)	0	1	0	1
2E	HFC by-product emissions from HFC manufacture	HFC	Non key	0	0	0	0
2F	PFC emissions from PFC use	PFC	Non key	0	0	0	0
2G	Other industrial: CO_2	CO_2	Non key	0	0	0	0
2G	Other industrial: CH_4	CH_4	Non key	0	0	0	0
2G	Other industrial: N_2O	N_2O	Non key	0	0	0	0
	SOLVENTS AND OTHER PRODUCT USE						
3	Indirect CO_2 from solvents/product use	CO_2	Non key	0	0	0	0
3	Solvents and other product use	CH_4					
	AGRICULTURAL SECTOR						
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature dairy cattle	CH_4	Key(L,)	1	0	1	0

Table A1.1 Key source list identified by the Tier 1 level and trend assessments. Level assessment for 2009 emissions (excluding LULUCF sources).

IPCC	Source category	Gas	Key source?	Tier 1 level recent year without LULUCF	Tier 1 trend without LULUCF	Tier 2 level recent year without LULUCF	Tier 2 trend without LULUCF
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature non-dairy cattle	CH_4	Non key	0	0	0	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: young cattle	CH_4	Key(L,T)	1	1	1	1
4A8	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	Non key	0	0	0	0
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	Non key	0	0	0	0
4B	Emissions from manure management	N_2O	Key(L2,T2)	0	0	1	1
4B1	Emissions from manure management : cattle	CH_4	Key(L,T2)	1	0	1	1
4B8	Emissions from manure management : swine	CH_4	Key(L,)	1	0	1	0
4B9	Emissions from manure management: poultry	CH_4	Key(,T2)	0	0	0	1
4B	Emissions from manure management : other	CH_4	Non key	0	0	0	0
4C	Rice cultivation	CH_4					
4D1	Direct N_2O emissions from agricultural soils	N_2O	Key(L,T)	1	1	1	1
4D3	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	Key(L,T)	1	1	1	1
4D2	Animal production on agricultural soils	N_2O	Key(L,T)	1	1	1	1
	LULUCF						
5A1	5A1. Forest Land remaining Forest Land	CO_2	Key(L,T2)				
5A2	5A2. Land converted to Forest Land	CO_2	Key(L,T)				
5B2	5B2. Land converted to Cropland	CO_2	Non key				
5C1	5C1. Grassland remaining Grassland	CO_2	Key(L,T)				
5C2	5C2. Land converted to Grassland	CO_2	Key(L,T2)				
5D2	5D2. Land converted to Wetlands	CO_2	Non key				
5E2	5E2. Land converted to Settlements	CO_2	Non key				
5F2	5F2. Land converted to Other Land	CO_2	Non key				
5G	5G. Other (liming of soils)	CO_2	Non key				
	WASTE SECTOR						
6A1	CH_4 emissions from solid waste disposal sites	CH_4	Key(L,T)	1	1	1	1
6B	Emissions from wastewater handling	CH_4	Non key	0	0	0	0
6B	Emissions from wastewater handling	N_2O	Key(L2,)	0	0	1	0
6C	Emissions from waste incineration	all					
	OTHER						
6D	OTHER CH_4	CH_4	Non key	0	0	0	0
3, 6D	OTHER N_2O	N_2O	Non key	0	0	0	0
	1) = 6D Other waste						
	2) = 4D animal production - waste dropped on soils + 3D Solvents						
			SUM	32	31	28	24

Table A1.2 Key source list identified by the Tier 1 level and trend assessments. Level assessment for 2009 emissions (including LULUCF sources).

IPCC	Source category	Gas	Key source?	Tier 1 level recent year with LULUCF	Tier 1 trend with LULUCF	Tier 2 level recent year with LULUCF	Tier 2 trend with LULUCF
	ENERGY SECTOR						
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO_2	Key(L1,T1)	1	1	0	0
1A1a	Stationary combustion: Public Electricity and Heat Production: solids	CO_2	Key(L,T1)	1	1	1	0
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO_2	Key(L1,T1)	1	1	0	0
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO_2	Key(L,T)	1	1	1	1
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	Key(L,T)	1	1	1	1
1A1b	Stationary combustion : Petroleum Refining: gases	CO_2	Key(L1,T1)	1	1	0	0
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO_2	Non key	0	0	0	0
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO_2	Key(L,T)	1	1	1	1
1A2	Emissions from stationary combustion : Manufacturing Industries and Construction, liquids	CO_2	Key(L,)	1	0	1	0
1A2	Emissions from stationary combustion : Manufacturing Industries and Construction, solids	CO_2	Key(L,T1)	1	1	1	0
1A2	Emissions from stationary combustion : Manufacturing Industries and Construction, gases	CO_2	Key(L,T)	1	1	1	1
1A3b	Mobile combustion: road vehicles: gasoline	CO_2	Key(L,T1)	1	1	1	0
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	Key(L,T)	1	1	1	1
1A3b	Mobile combustion: road vehicles: LPG	CO_2	Key(L1,T)	1	1	0	1
1A3	Mobile combustion: water-borne navigation	CO_2	Key(L1,)	1	1	0	0
1A3	Mobile combustion: aircraft	CO_2	Non key	0	0	0	0
1A3	Mobile combustion: other (railways)	CO_2	Non key	0	0	0	0
1A3	Mobile combustion: other (non-road)	CH_4	Non key	0	0	0	0
1A3	Mobile combustion: other (non-road)	N_2O	Non key	0	0	0	0
1A3	Mobile combustion: road vehicles	CH_4	Non key	0	0	0	0
1A3	Mobile combustion: road vehicles	N_2O	Non key	0	0	0	0
1A4	Stationary combustion : Other Sectors, solids	CO_2	Non key	0	0	0	0
1A4a	Stationary combustion : Other Sectors: Commercial/ Institutional, gases	CO_2	Key(L,T)	1	1	1	1
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO_2	Key(L,T1)	1	0	1	0
1A4c	Stationary combustion : Other Sectors, Agriculture/ Forestry/Fisheries, gases	CO_2	Key(L,T1)	1	1	1	0
1A4c	Stationary combustion : Other Sectors, Agriculture/ Forestry/Fisheries, liquids	CO_2	Key(L,T)	1	1	1	1
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO_2	Key(,T)	1	1	0	1
1A5	Military use of fuels (1A5 Other)	CO_2	Key(,T1)	0	1	0	0
1A	Emissions from stationary combustion: non-CO_2	CH_4	Key(L,T)	1	1	1	1
1A	Emissions from stationary combustion: non-CO_2	N_2O	Non key	0	0	0	0
1B1	Coal mining	CH_4					
1B1b	Coke production	CO_2	Key(L2,)	0	0	1	0
1B2	Fugitive emissions from venting/flaring: CO_2	CO_2	Key(,T)	0	1	0	1

Table A1.2 Key source list identified by the Tier 1 level and trend assessments. Level assessment for 2009 emissions (including LULUCF sources).

IPCC	Source category	Gas	Key source?	Tier 1 level recent year with LULUCF	Tier 1 trend with LULUCF	Tier 2 level recent year with LULUCF	Tier 2 trend with LULUCF
1B2	Fugitive emissions venting/flaring	CH_4	Key(,T)	0	1	0	1
1B2	Fugitive emissions from oil and gas: gas distribution	CH_4	Non key	0	0	0	0
1B2	Fugitive emissions from oil and gas operations: other	CH_4	Non key	0	0	0	0
	INDUSTRIAL PROCESSES						
2A1	Cement production	CO_2	Non key	0	0	0	0
2A3	Limestone and dolomite use	CO_2	Non key	0	0	0	0
2A7	Other minerals	CO_2	Non key	0	0	0	0
2B1	Ammonia production	CO_2	Key(L1,)	1	0	0	0
2B2	Nitric acid production	N_2O	Key(,T)	0	1	0	1
2B5	Caprolactam production	N_2O	Key(L1,)	1	0	0	0
2B5	Other chemical product manufacture	CO_2	Key(L,)	1	0	1	0
2C1	Iron and steel production (carbon inputs)	CO_2	Key(L1,T1)	1	1	0	0
2C3	CO_2 from aluminium production	CO_2	Non key	0	0	0	0
2C3	PFC from aluminium production	PFC	Key(,T)	0	1	0	1
2F	SF_6 emissions from SF_6 use	SF_6	Non key	0	0	0	0
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	Key(L,T)	1	1	1	1
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	Key(,T)	0	1	0	1
2E	HFC by-product emissions from HFC manufacture	HFC	Non key	0	0	0	0
2F	PFC emissions from PFC use	PFC	Non key	0	0	0	0
2G	Other industrial: CO_2	CO_2	Non key	0	0	0	0
2G	Other industrial: CH_4	CH_4	Non key	0	0	0	0
2G	Other industrial: N_2O	N_2O	Non key	0	0	0	0
	SOLVENTS AND OTHER PRODUCT USE						
3	Indirect CO_2 from solvents/product use	CO_2	Non key	0	0	0	0
3	Solvents and other product use	CH_4					
	AGRICULTURAL SECTOR						
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature dairy cattle	CH_4	Key(L,)	1	0	1	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature non-dairy cattle	CH_4	Non key	0	0	0	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: young cattle	CH_4	Key(L,T)	1	1	1	1
4A8	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	Non key	0	0	0	0
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	Non key	0	0	0	0
4B	Emissions from manure management	N_2O	Key(L2,T2)	0	0	1	1
4B1	Emissions from manure management : cattle	CH_4	Key(L,T2)	1	1	1	1
4B8	Emissions from manure management : swine	CH_4	Key(L,)	1	0	1	0
4B9	Emissions from manure management: poultry	CH_4	Key(,T2)	0	0	0	1
4B	Emissions from manure management : other	CH_4	Non key	0	0	0	0
4C	Rice cultivation	CH_4					
4D1	Direct N_2O emissions from agricultural soils	N_2O	Key(L,T)	1	1	1	1
4D3	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	Key(L,T)	1	1	1	1
4D2	Animal production on agricultural soils	N_2O	Key(L,T)	1	1	1	1
	LULUCF						

Table A1.2 Key source list identified by the Tier 1 level and trend assessments. Level assessment for 2009 emissions (including LULUCF sources).

IPCC	Source category	Gas	Key source?	Tier 1 level recent year with LULUCF	Tier 1 trend with LULUCF	Tier 2 level recent year with LULUCF	Tier 2 trend with LULUCF
5A1	5A1. Forest Land remaining Forest Land	CO_2	Key(L,T2)	1	0	1	1
5A2	5A2. Land converted to Forest Land	CO_2	Key(L,T)	1	1	1	1
5B2	5B2. Land converted to Cropland	CO_2	Non key	0	0	0	0
5C1	5C1. Grassland remaining Grassland	CO_2	Key(L,T)	1	1	1	1
5C2	5C2. Land converted to Grassland	CO_2	Key(L,T2)	1	0	1	1
5D2	5D2. Land converted to Wetlands	CO_2	Non key	0	0	0	0
5E2	5E2. Land converted to Settlements	CO_2	Non key	0	0	0	0
5F2	5F2. Land converted to Other Land	CO_2	Non key	0	0	0	0
5G	5G. Other (liming of soils)	CO_2	Non key	0	0	0	0
	WASTE SECTOR						
6A1	CH_4 emissions from solid waste disposal sites	CH_4	Key(L,T)	1	1	1	1
6B	Emissions from wastewater handling	CH_4	Non key	0	0	0	0
6B	Emissions from wastewater handling	N_2O	Key(L2,)	0	0	1	0
6C	Emissions from waste incineration	all					
	OTHER						
6D	OTHER CH_4	CH_4	Non key	0	0	0	0
3, 6D	OTHER N_2O	N_2O	Non key	0	0	0	0
	1) = 6D Other waste						
	2) = 4D animal production - waste dropped on soils + 3D Solvents						
			SUM	37	34	32	28

A1.2 Changes in key sources compared to previous submission

Due to the use of emission data for 2009 and the subdivision of category 4A1 CH_4 emissions from enteric fermentation in domestic livestock: cattle in the key source analysis, the following changes have taken place compared to the previous NIR:

- 1A3 Mobile combustion: road vehicles N_2O (Tier 2 level)
- 1A5 Military use of fuels (Tier 1 trend)
- 1B1b Coke production CO_2 (Tier 2 level)
- 4A8 CH_4 emissions from enteric fermentation in domestic livestock: swine (Tier 2 level)
- 4B Emissions from manure management N_2O (Tier 2 Level and trend)
- 6B Emissions from wastewater handling N_2O (Tier 2 Level)

A1.3 Tier 1 key source and uncertainty assessment

In Tables A1.3 and A1.4, the source ranking is done according to the contribution to the 2009 annual emissions total and to the base year to 2009 trend respectively. This resulted in 32 level key sources and 31 trend key sources (indicated in the darker green part at the top, excluding LULUCF). Inclusion of LULUCF sources in the analysis adds 4 additional Tier 1 level and trend key sources (see Table A1.2).

Table A1.3 Source ranking using IPCC Tier 1 level assessment 2009 excluding LULUCF (amounts in Gg CO_2 eq) .

IPCC	Category	Gas	CO_2-eq last year	Share	Cum. Share	Key ?
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO_2	25720	13%	13%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO_2	23621	12%	25%	1
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	19554	10%	35%	1
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO_2	17681	9%	44%	1
1A3b	Mobile combustion: road vehicles: gasoline	CO_2	12810	6%	50%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO_2	12575	6%	56%	1
1A4a	Stationary combustion : Other Sectors: Commercial/ Institutional, gases	CO_2	11113	6%	62%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO_2	8456	4%	66%	1
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	8163	4%	70%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/ Forestry/Fisheries, gases	CO_2	7294	4%	74%	1
6A1	CH_4 emissions from solid waste disposal sites	CH_4	4637	2%	76%	1
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature dairy cattle	CH_4	3971	2%	78%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO_2	3911	2%	80%	1
4D1	Direct N_2O emissions from agricultural soils	N_2O	3514	2%	82%	1
2B1	Ammonia production	CO_2	2857	1%	84%	1
1A1b	Stationary combustion : Petroleum Refining: gases	CO_2	2591	1%	85%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO_2	2531	1%	86%	1
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO_2	1936	1%	87%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/ Forestry/Fisheries, liquids	CO_2	1805	1%	88%	1
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	1798	1%	89%	1
4B1	Emissions from manure management : cattle	CH_4	1693	1%	90%	1
4A1	CH_4 emissions from enteric fermentation in domestic livestock: young cattle	CH_4	1672	1%	91%	1
1A	Emissions from stationary combustion: non-CO_2	CH_4	1565	1%	91%	1
4D3	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	1512	1%	92%	1
4D2	Animal production on agricultural soils	N_2O	1300	1%	93%	1
4B8	Emissions from manure management : swine	CH_4	1126	1%	93%	1
2C1	Iron and steel production (carbon inputs)	CO_2	1054	1%	94%	1
1A3b	Mobile combustion: road vehicles: LPG	CO_2	993	1%	95%	1
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO_2	684	0%	95%	1
2B5	Other chemical product manufacture	CO_2	651	0%	95%	1
1A3	Mobile combustion: water-borne navigation	CO_2	610	0%	95%	1
2B5	Caprolactam production	N_2O	603	0%	96%	1
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO_2	541	0%	96%	0
1B1b	CO_2 from coke production	CO_2	513	0%	96%	0
4B	Emissions from manure management	N_2O	503	0%	97%	0
2B2	Nitric acid production	N_2O	447	0%	97%	0

Table A1.3 Source ranking using IPCC Tier 1 level assessment 2009 excluding LULUCF (amounts in Gg CO_2 eq) .

IPCC	Category	Gas	CO_2-eq last year	Share	Cum. Share	Key ?
6B	Emissions from wastewater handling	N_2O	438	0%	97%	0
1A3	Mobile combustion: road vehicles	N_2O	428	0%	97%	0
2A1	Cement production	CO_2	416	0%	97%	0
4A8	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	384	0%	98%	0
2A7	Other minerals	CO_2	357	0%	98%	0
1B2	Fugitive emissions venting/flaring	CH_4	348	0%	98%	0
1A	Emissions from stationary combustion: non-CO_2	N_2O	335	0%	98%	0
2G	Other industrial: CO_2	CO_2	314	0%	98%	0
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	282	0%	98%	0
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH_4	271	0%	99%	0
2G	Other industrial: CH_4	CH_4	270	0%	99%	0
2A3	Limestone and dolomite use	CO_2	269	0%	99%	0
1A5	Military use of fuels (1A5 Other)	CO_2	267	0%	99%	0
2C3	CO_2 from aluminium production	CO_2	224	0%	99%	0
6B	Emissions from wastewater handling	CH_4	207	0%	99%	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature non-dairy cattle	CH_4	187	0%	99%	0
2F	SF_6 emissions from SF_6 use	SF_6	175	0%	99%	0
1B2	Fugitive emissions from oil and gas operations: other	CH_4	163	0%	99%	0
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	154	0%	100%	0
2F	PFC emissions from PFC use	PFC	125	0%	100%	0
3	Indirect CO_2 from solvents/product use	CO_2	120	0%	100%	0
3, 6D	OTHER N_2O	N_2O	116	0%	100%	0
2E	HFC by-product emissions from HFC manufacture	HFC	109	0%	100%	0
1A3	Mobile combustion: other (railways)	CO_2	66	0%	100%	0
1A3	Mobile combustion: road vehicles	CH_4	56	0%	100%	0
4B9	Emissions from manure management : poultry	CH_4	53	0%	100%	0
1B2	Fugitive emissions venting/flaring: CO_2	CO_2	53	0%	100%	0
2C3	PFC from aluminium production	PFC	43	0%	100%	0
1A3	Mobile combustion: aircraft	CO_2	41	0%	100%	0
1A4	Stationary combustion : Other Sectors, solids	CO_2	31	0%	100%	0
6D	OTHER CH_4	CH_4	20	0%	100%	0
4B	Emissions from manure management : other	CH_4	15	0%	100%	0
2G	Other industrial: N_2O	N_2O	10	0%	100%	0
1A3	Mobile combustion: other (non-road)	N_2O	2	0%	100%	0
1A3	Mobile combustion: other (non-road)	CH_4	1	0%	100%	0
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO_2	0	0%	100%	0
			198357			32

Table A1.3b Source ranking using IPCC Tier 1 level assessment 2009 including LULUCF (amounts in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq last year abs	Share	Cum. Share	Key ?
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO_2	25720	12%	12%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO_2	23621	11%	24%	1
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	19554	9%	33%	1
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO_2	17681	9%	42%	1
1A3b	Mobile combustion: road vehicles: gasoline	CO_2	12810	6%	48%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO_2	12575	6%	54%	1
1A4a	Stationary combustion : Other Sectors: Commercial/ Institutional, gases	CO_2	11113	5%	60%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO_2	8456	4%	64%	1
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	8163	4%	68%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/ Forestry/Fisheries, gases	CO_2	7294	4%	71%	1
6A1	CH_4 emissions from solid waste disposal sites	CH_4	4637	2%	73%	1
5C1	5C1. Grassland remaining Grassland	CO_2	4246	2%	75%	1
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature dairy cattle	CH_4	3971	2%	77%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO_2	3911	2%	79%	1
4D1	Direct N_2O emissions from agricultural soils	N_2O	3514	2%	81%	1
2B1	Ammonia production	CO_2	2857	1%	82%	1
1A1b	Stationary combustion : Petroleum Refining: gases	CO_2	2591	1%	84%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO_2	2531	1%	85%	1
5A1	5A1. Forest Land remaining Forest Land	CO_2	2144	1%	86%	1
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO_2	1936	1%	87%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/ Forestry/Fisheries, liquids	CO_2	1805	1%	88%	1
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	1798	1%	89%	1
4B1	Emissions from manure management : cattle	CH_4	1693	1%	89%	1
4A1	CH_4 emissions from enteric fermentation in domestic livestock: young cattle	CH_4	1672	1%	90%	1
1A	Emissions from stationary combustion: non-CO_2	CH_4	1565	1%	91%	1
4D3	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	1512	1%	92%	1
4D2	Animal production on agricultural soils	N_2O	1300	1%	92%	1
4B8	Emissions from manure management : swine	CH_4	1126	1%	93%	1
2C1	Iron and steel production (carbon inputs)	CO_2	1054	1%	93%	1
1A3b	Mobile combustion: road vehicles: LPG	CO_2	993	0%	94%	1
5A2	5A2. Land converted to Forest Land	CO_2	706	0%	94%	1
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO_2	684	0%	95%	1
2B5	Other chemical product manufacture	CO_2	651	0%	95%	1
1A3	Mobile combustion: water-borne navigation	CO_2	610	0%	95%	1
2B5	Caprolactam production	N_2O	603	0%	95%	1
5C2	5C2. Land converted to Grassland	CO_2	544	0%	96%	1

Table A1.3b Source ranking using IPCC Tier 1 level assessment 2009 including LULUCF (amounts in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq last year abs	Share	Cum. Share	Key ?
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO_2	541	0%	96%	1
1B1b	CO_2 from coke production	CO_2	513	0%	96%	0
4B	Emissions from manure management	N_2O	503	0%	96%	0
2B2	Nitric acid production	N_2O	447	0%	97%	0
6B	Emissions from wastewater handling	N_2O	438	0%	97%	0
1A3	Mobile combustion: road vehicles	N_2O	428	0%	97%	0
2A1	Cement production	CO_2	416	0%	97%	0
4A8	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	384	0%	97%	0
2A7	Other minerals	CO_2	357	0%	98%	0
1B2	Fugitive emissions venting/flaring	CH_4	348	0%	98%	0
1A	Emissions from stationary combustion: non-CO_2	N_2O	335	0%	98%	0
2G	Other industrial: CO_2	CO_2	314	0%	98%	0
5E2	5E2. Land converted to Settlements	CO_2	294	0%	98%	0
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	282	0%	98%	0
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH_4	271	0%	99%	0
2G	Other industrial: CH_4	CH_4	270	0%	99%	0
2A3	Limestone and dolomite use	CO_2	269	0%	99%	0
1A5	Military use of fuels (1A5 Other)	CO_2	267	0%	99%	0
2C3	CO_2 from aluminium production	CO_2	224	0%	99%	0
6B	Emissions from wastewater handling	CH_4	207	0%	99%	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature non-dairy cattle	CH_4	187	0%	99%	0
2F	SF_6 emissions from SF_6 use	SF_6	175	0%	99%	0
1B2	Fugitive emissions from oil and gas operations: other	CH_4	163	0%	99%	0
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	154	0%	99%	0
2F	PFC emissions from PFC use	PFC	125	0%	100%	0
3	Indirect CO_2 from solvents/product use	CO_2	120	0%	100%	0
3, 6D	OTHER N_2O	N_2O	116	0%	100%	0
2E	HFC by-product emissions from HFC manufacture	HFC	109	0%	100%	0
5G	5G. Other (liming of soils)	CO_2	91	0%	100%	0
1A3	Mobile combustion: other (railways)	CO_2	66	0%	100%	0
1A3	Mobile combustion: road vehicles	CH_4	56	0%	100%	0
5D2	5D2. Land converted to Wetlands	CO_2	56	0%	100%	0
4B9	Emissions from manure management : poultry	CH_4	53	0%	100%	0
1B2	Fugitive emissions venting/flaring: CO_2	CO_2	53	0%	100%	0
5B2	5B2. Land converted to Cropland	CO_2	48	0%	100%	0
2C3	PFC from aluminium production	PFC	43	0%	100%	0
1A3	Mobile combustion: aircraft	CO_2	41	0%	100%	0
1A4	Stationary combustion : Other Sectors, solids	CO_2	31	0%	100%	0
5F2	5F2. Land converted to Other Land	CO_2	25	0%	100%	0
6D	OTHER CH_4	CH_4	20	0%	100%	0
4B	Emissions from manure management : other	CH_4	15	0%	100%	0
2G	Other industrial: N_2O	N_2O	10	0%	100%	0
1A3	Mobile combustion: other (non-road)	N_2O	2	0%	100%	0
1A3	Mobile combustion: other (non-road)	CH_4	1	0%	100%	0
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO_2	0	0%	100%	0
			206511			

Table A1.4a Source ranking using IPCC Tier 1 trend assessment 2009 excluding LULUCF (amounts in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq base year	CO_2-eq last year	level assess-ment last year	trend assess-ment	% Contr. to trend	Cumu-lative	Key ?
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO_2	13348	25720	13%	7%	17%	17%	1
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	11832	19554	10%	5%	11%	29%	1
6A1	CH_4 emissions from solid waste disposal sites	CH_4	12011	4637	2%	4%	9%	37%	1
2B2	Nitric acid production	N_2O	6330	447	0%	3%	7%	45%	1
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	5759	154	0%	3%	7%	51%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO_2	19020	12575	6%	3%	7%	58%	1
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO_2	7632	11113	6%	2%	5%	64%	1
1A3b	Mobile combustion: road vehicles: gasoline	CO_2	10902	12810	6%	1%	3%	67%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO_2	601	2531	1%	1%	3%	70%	1
2C3	PFC from aluminium production	PFC	1901	43	0%	1%	2%	72%	1
4D2	Animal production on agricultural soils	N_2O	3150	1300	1%	1%	2%	74%	1
1A1b	Stationary combustion : Petroleum Refining: gases	CO_2	1042	2591	1%	1%	2%	76%	1
4D3	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	3355	1512	1%	1%	2%	78%	1
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	247	1798	1%	1%	2%	80%	1
1A3b	Mobile combustion: road vehicles: LPG	CO_2	2738	993	1%	1%	2%	82%	1
2C1	Iron and steel production (carbon inputs)	CO_2	2514	1054	1%	1%	2%	84%	1
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	9999	8163	4%	1%	2%	86%	1
1A	Emissions from stationary combustion: non-CO_2	CH_4	572	1565	1%	1%	1%	87%	1
1B2	Fugitive emissions venting/flaring	CH_4	1252	348	0%	0%	1%	88%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO_2	5033	3911	2%	0%	1%	89%	1
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO_2	1356	541	0%	0%	1%	90%	1
1B2	Fugitive emissions venting/flaring: CO_2	CO_2	775	53	0%	0%	1%	91%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, liquids	CO_2	2587	1805	1%	0%	1%	92%	1
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO_2	1526	1936	1%	0%	1%	92%	1
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO_2	207	684	0%	0%	1%	93%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gases	CO_2	7330	7294	4%	0%	1%	94%	1
4A1	CH_4 emissions from enteric fermentation in domestic livestock: young cattle	CH_4	2264	1672	1%	0%	1%	94%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO_2	25776	23621	12%	0%	1%	95%	1
4D1	Direct N_2O emissions from agricultural soils	N_2O	4138	3514	2%	0%	0%	95%	1
1A5	Military use of fuels (1A5 Other)	CO_2	566	267	0%	0%	0%	96%	1
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO_2	18696	17681	9%	0%	0%	96%	1
1A3	Mobile combustion: water-borne navigation	CO_2	405	610	0%	0%	0%	96%	0
4B1	Emissions from manure management : cattle	CH_4	1574	1693	1%	0%	0%	97%	0
4B9	Emissions from manure management : poultry	CH_4	273	53	0%	0%	0%	97%	0

Table A1.4a Source ranking using IPCC Tier 1 trend assessment 2009 excluding LULUCF (amounts in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq base year	CO_2-eq last year	level assess-ment last year	trend assess-ment	% Contr. to trend	Cumu-lative	Key ?
1A3	Mobile combustion: road vehicles	N_2O	271	428	0%	0%	0%	97%	0
3	Indirect CO_2 from solvents/product use	CO_2	316	120	0%	0%	0%	97%	0
1A4	Stationary combustion : Other Sectors, solids	CO_2	189	31	0%	0%	0%	97%	0
2C3	CO_2 from aluminium production	CO_2	395	224	0%	0%	0%	98%	0
1B1b	CO_2 from coke production	CO_2	403	513	0%	0%	0%	98%	0
4B	Emissions from manure management	N_2O	678	503	0%	0%	0%	98%	0
1A	Emissions from stationary combustion: non-CO_2	N_2O	225	335	0%	0%	0%	98%	0
3, 6D	OTHER N_2O	N_2O	250	116	0%	0%	0%	98%	0
2B5	Caprolactam production	N_2O	766	603	0%	0%	0%	98%	0
2F	SF_6 emissions from SF_6 use	SF_6	301	175	0%	0%	0%	99%	0
2A7	Other minerals	CO_2	275	357	0%	0%	0%	99%	0
2E	HFC by-product emissions from HFC manufacture	HFC	12	109	0%	0%	0%	99%	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature dairy cattle	CH_4	4356	3971	2%	0%	0%	99%	0
2F	PFC emissions from PFC use	PFC	37	125	0%	0%	0%	99%	0
1A3	Mobile combustion: road vehicles	CH_4	157	56	0%	0%	0%	99%	0
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO_2	8975	8456	4%	0%	0%	99%	0
4B8	Emissions from manure management : swine	CH_4	1140	1126	1%	0%	0%	99%	0
6B	Emissions from wastewater handling	CH_4	290	207	0%	0%	0%	100%	0
2A3	Limestone and dolomite use	CO_2	232	269	0%	0%	0%	100%	0
2B5	Other chemical product manufacture	CO_2	649	651	0%	0%	0%	100%	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature non-dairy cattle	CH_4	163	187	0%	0%	0%	100%	0
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH_4	255	271	0%	0%	0%	100%	0
2B1	Ammonia production	CO_2	3096	2857	1%	0%	0%	100%	0
2G	Other industrial: CO_2	CO_2	304	314	0%	0%	0%	100%	0
2A1	Cement production	CO_2	416	416	0%	0%	0%	100%	0
4A8	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	438	384	0%	0%	0%	100%	0
6D	OTHER CH_4	CH_4	1	20	0%	0%	0%	100%	0
1A3	Mobile combustion: other (railways)	CO_2	91	66	0%	0%	0%	100%	0
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	319	282	0%	0%	0%	100%	0
1B2	Fugitive emissions from oil and gas operations: other	CH_4	166	163	0%	0%	0%	100%	0
2G	Other industrial: N_2O	N_2O	3	10	0%	0%	0%	100%	0
2G	Other industrial: CH_4	CH_4	297	270	0%	0%	0%	100%	0
4B	Emissions from manure management : other	CH_4	11	15	0%	0%	0%	100%	0
6B	Emissions from wastewater handling	N_2O	466	438	0%	0%	0%	100%	0
1A3	Mobile combustion: aircraft	CO_2	41	41	0%	0%	0%	100%	0
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO_2	2	0	0%	0%	0%	100%	0
1A3	Mobile combustion: other (non-road)	N_2O	1	2	0%	0%	0%	100%	0
1A3	Mobile combustion: other (non-road)	CH_4	1	1	0%	0%	0%	100%	0
			212698	198357					31

Table A1.4b Source ranking using IPCC Tier 1 trend assessment 2009, including LULUCF (amounts in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq base year abs	CO_2-eq last year abs	level assess-ment last year	trend assess-ment	% Contr. to trend	Cumu-lative	Key ?
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO_2	13348	25720	12%	7%	17%	17%	1
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	11832	19554	9%	4%	11%	28%	1
6A1	CH_4 emissions from solid waste disposal sites	CH_4	12011	4637	2%	3%	9%	36%	1
2B2	Nitric acid production	N_2O	6330	447	0%	3%	7%	44%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO_2	19020	12575	6%	3%	7%	50%	1
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	5759	154	0%	3%	7%	57%	1
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO_2	7632	11113	5%	2%	5%	62%	1
1A3b	Mobile combustion: road vehicles: gasoline	CO_2	10902	12810	6%	1%	3%	66%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO_2	601	2531	1%	1%	3%	68%	1
2C3	PFC from aluminium production	PFC	1901	43	0%	1%	2%	70%	1
4D2	Animal production on agricultural soils	N_2O	3150	1300	1%	1%	2%	72%	1
4D3	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	3355	1512	1%	1%	2%	75%	1
1A1b	Stationary combustion : Petroleum Refining: gases	CO_2	1042	2591	1%	1%	2%	77%	1
1A3b	Mobile combustion: road vehicles: LPG	CO_2	2738	993	0%	1%	2%	79%	1
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	247	1798	1%	1%	2%	81%	1
2C1	Iron and steel production (carbon inputs)	CO_2	2514	1054	1%	1%	2%	82%	1
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	9999	8163	4%	1%	2%	84%	1
1A	Emissions from stationary combustion: non-CO_2	CH_4	572	1565	1%	1%	1%	85%	1
1B2	Fugitive emissions venting/flaring	CH_4	1252	348	0%	0%	1%	86%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO_2	5033	3911	2%	0%	1%	87%	1
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO_2	1356	541	0%	0%	1%	88%	1
5A2	5A2. Land converted to Forest Land	CO_2	3	706	0%	0%	1%	89%	1
1B2	Fugitive emissions venting/flaring: CO_2	CO_2	775	53	0%	0%	1%	90%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, liquids	CO_2	2587	1805	1%	0%	1%	91%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO_2	25776	23621	11%	0%	1%	92%	1
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO_2	1526	1936	1%	0%	1%	92%	1
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO_2	207	684	0%	0%	1%	93%	1
4A1	CH_4 emissions from enteric fermentation in domestic livestock: young cattle	CH_4	2264	1672	1%	0%	1%	93%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gases	CO_2	7330	7294	4%	0%	1%	94%	1
4D1	Direct N_2O emissions from agricultural soils	N_2O	4138	3514	2%	0%	0%	94%	1
5C1	5C1. Grassland remaining Grassland	CO_2	4246	4246	2%	0%	0%	95%	1
1A5	Military use of fuels (1A5 Other)	CO_2	566	267	0%	0%	0%	95%	1

Table A1.4b Source ranking using IPCC Tier 1 trend assessment 2009, including LULUCF (amounts in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq base year abs	CO_2-eq last year abs	level assess-ment last year	trend assess-ment	% Contr. to trend	Cumu-lative	Key ?
1A3	Mobile combustion: water-borne navigation	CO_2	405	610	0%	0%	0%	95%	1
4B1	Emissions from manure management : cattle	CH_4	1574	1693	1%	0%	0%	96%	1
4B9	Emissions from manure management : poultry	CH_4	273	53	0%	0%	0%	96%	0
5C2	5C2. Land converted to Grassland	CO_2	391	544	0%	0%	0%	96%	0
3	Indirect CO_2 from solvents/product use	CO_2	316	120	0%	0%	0%	96%	0
1A3	Mobile combustion: road vehicles	N_2O	271	428	0%	0%	0%	97%	0
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO_2	18696	17681	9%	0%	0%	97%	0
1A4	Stationary combustion : Other Sectors, solids	CO_2	189	31	0%	0%	0%	97%	0
2C3	CO_2 from aluminium production	CO_2	395	224	0%	0%	0%	97%	0
5A1	5A1. Forest Land remaining Forest Land	CO_2	2434	2144	1%	0%	0%	97%	0
1B1b	CO_2 from coke production	CO_2	403	513	0%	0%	0%	98%	0
4B	Emissions from manure management	N_2O	678	503	0%	0%	0%	98%	0
1A	Emissions from stationary combustion: non-CO_2	N_2O	225	335	0%	0%	0%	98%	0
3, 6D	OTHER N_2O	N_2O	250	116	0%	0%	0%	98%	0
2B5	Caprolactam production	N_2O	766	603	0%	0%	0%	98%	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature dairy cattle	CH_4	4356	3971	2%	0%	0%	98%	0
2F	SF_6 emissions from SF_6 use	SF_6	301	175	0%	0%	0%	99%	0
2A7	Other minerals	CO_2	275	357	0%	0%	0%	99%	0
2E	HFC by-product emissions from HFC manufacture	HFC	12	109	0%	0%	0%	99%	0
5E2	5E2. Land converted to Settlements	CO_2	210	294	0%	0%	0%	99%	0
1A3	Mobile combustion: road vehicles	CH_4	157	56	0%	0%	0%	99%	0
2F	PFC emissions from PFC use	PFC	37	125	0%	0%	0%	99%	0
5G	5G. Other (liming of soils)	CO_2	183	91	0%	0%	0%	99%	0
6B	Emissions from wastewater handling	CH_4	290	207	0%	0%	0%	99%	0
4B8	Emissions from manure management : swine	CH_4	1140	1126	1%	0%	0%	99%	0
2A3	Limestone and dolomite use	CO_2	232	269	0%	0%	0%	99%	0
2B1	Ammonia production	CO_2	3096	2857	1%	0%	0%	100%	0
2B5	Other chemical product manufacture	CO_2	649	651	0%	0%	0%	100%	0
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO_2	8975	8456	4%	0%	0%	100%	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature non-dairy cattle	CH_4	163	187	0%	0%	0%	100%	0
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH_4	255	271	0%	0%	0%	100%	0
2G	Other industrial: CO_2	CO_2	304	314	0%	0%	0%	100%	0
4A8	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	438	384	0%	0%	0%	100%	0
2A1	Cement production	CO_2	416	416	0%	0%	0%	100%	0
1A3	Mobile combustion: other (railways)	CO_2	91	66	0%	0%	0%	100%	0
6D	OTHER CH_4	CH_4	1	20	0%	0%	0%	100%	0
5D2	5D2. Land converted to Wetlands	CO_2	40	56	0%	0%	0%	100%	0
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	319	282	0%	0%	0%	100%	0
5B2	5B2. Land converted to Cropland	CO_2	34	48	0%	0%	0%	100%	0
5F2	5F2. Land converted to Other Land	CO_2	18	25	0%	0%	0%	100%	0

Table A1.4b Source ranking using IPCC Tier 1 trend assessment 2009, including LULUCF (amounts in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq base year abs	CO_2-eq last year abs	level assess-ment last year	trend assess-ment	% Contr. to trend	Cumu-lative	Key ?
2G	Other industrial: CH_4	CH_4	297	270	0%	0%	0%	100%	0
2G	Other industrial: N_2O	N_2O	3	10	0%	0%	0%	100%	0
1B2	Fugitive emissions from oil and gas operations: other	CH_4	166	163	0%	0%	0%	100%	0
4B	Emissions from manure management : other	CH_4	11	15	0%	0%	0%	100%	0
1A3	Mobile combustion: aircraft	CO_2	41	41	0%	0%	0%	100%	0
6B	Emissions from wastewater handling	N_2O	466	438	0%	0%	0%	100%	0
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO_2	2	0	0%	0%	0%	100%	0
1A3	Mobile combustion: other (non-road)	N_2O	1	2	0%	0%	0%	100%	0
1A3	Mobile combustion: other (non-road)	CH_4	1	1	0%	0%	0%	100%	0
			220258	206511					34

A1.4 Tier 2 key source assessment

Using the uncertainty estimate for each key source as a weighting factor (see Annex 7), the key source assessment was performed again. This is called the Tier 2 key source assessment. The results of this assessment are presented in Tables A1.5 and A1.6 for the contribution to the 2009 annual emissions total and to the trend respectively. Comparison with the Tier 1 assessment presented in Tables A1.3 and A1.4 show less level and trend key sources (28 and 24 respectively instead of 32 and 31). Inclusion of LULUCF sources in the analysis adds 4 additional Tier 2 level and trend key sources (see Table A1.2).

Table A1.5 Source ranking using IPCC Tier 2 level assessment 2009 excluding LULUCF (in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq last year	Share	Uncer-tainty estimate	Level * Uncer-tainty	Share L*U	Cum. Share L*U	Key ?
4D3	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	1512	1%	206%	2%	11%	11%	1
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO_2	11113	6%	20%	1%	8%	20%	1
4D1	Direct N_2O emissions from agricultural soils	N_2O	3514	2%	61%	1%	8%	27%	1
4B1	Emissions from manure management : cattle	CH_4	1693	1%	100%	1%	6%	34%	1
6A1	CH_4 emissions from solid waste disposal sites	CH_4	4637	2%	34%	1%	6%	39%	1
4D2	Animal production on agricultural soils	N_2O	1300	1%	100%	1%	5%	44%	1
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	8163	4%	14%	1%	4%	48%	1
4B8	Emissions from manure management : swine	CH_4	1126	1%	100%	1%	4%	53%	1
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	19554	10%	5%	1%	4%	57%	1
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	1798	1%	51%	0%	3%	60%	1
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO_2	17681	9%	5%	0%	3%	63%	1
1A	Emissions from stationary combustion: non-CO_2	CH_4	1565	1%	50%	0%	3%	66%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO_2	23621	12%	3%	0%	3%	69%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gases	CO_2	7294	4%	10%	0%	3%	71%	1
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature dairy cattle	CH_4	3971	2%	16%	0%	2%	74%	1
4B	Emissions from manure management	N_2O	503	0%	100%	0%	2%	76%	1
2B5	Other chemical product manufacture	CO_2	651	0%	71%	0%	2%	77%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO_2	8456	4%	5%	0%	2%	79%	1
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO_2	1936	1%	21%	0%	1%	80%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO_2	3911	2%	10%	0%	1%	82%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, liquids	CO_2	1805	1%	20%	0%	1%	83%	1
1A3b	Mobile combustion: road vehicles: gasoline	CO_2	12810	6%	3%	0%	1%	84%	1
4A1	CH_4 emissions from enteric fermentation in domestic livestock: young cattle	CH_4	1672	1%	21%	0%	1%	86%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO_2	2531	1%	11%	0%	1%	87%	1
1B1b	CO_2 from coke production	CO_2	513	0%	50%	0%	1%	88%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO_2	12575	6%	2%	0%	1%	89%	1
6B	Emissions from wastewater handling	N_2O	438	0%	54%	0%	1%	90%	1
1A3	Mobile combustion: road vehicles	N_2O	428	0%	50%	0%	1%	90%	1
4A8	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	384	0%	50%	0%	1%	91%	0
2B5	Caprolactam production	N_2O	603	0%	30%	0%	1%	92%	0
1A	Emissions from stationary combustion: non-CO_2	N_2O	335	0%	50%	0%	1%	92%	0
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO_2	25720	13%	1%	0%	1%	93%	0
2G	Other industrial: CH_4	CH_4	270	0%	51%	0%	1%	93%	0

Table A1.5 Source ranking using IPCC Tier 2 level assessment 2009 excluding LULUCF (in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq last year	Share	Uncer-tainty estimate	Level * Uncer-tainty	Share L*U	Cum. Share L*U	Key ?
1A3	Mobile combustion: water-borne navigation	CO_2	610	0%	20%	0%	0%	94%	0
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO_2	541	0%	20%	0%	0%	94%	0
1A3b	Mobile combustion: road vehicles: LPG	CO_2	993	1%	10%	0%	0%	95%	0
2F	SF_6 emissions from SF_6 use	SF_6	175	0%	56%	0%	0%	95%	0
2A7	Other minerals	CO_2	357	0%	25%	0%	0%	95%	0
1B2	Fugitive emissions from oil and gas operations: other	CH_4	163	0%	54%	0%	0%	96%	0
1B2	Fugitive emissions venting/flaring	CH_4	348	0%	25%	0%	0%	96%	0
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	282	0%	30%	0%	0%	96%	0
2A3	Limestone and dolomite use	CO_2	269	0%	25%	0%	0%	96%	0
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO_2	684	0%	10%	0%	0%	97%	0
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH_4	271	0%	25%	0%	0%	97%	0
6B	Emissions from wastewater handling	CH_4	207	0%	32%	0%	0%	97%	0
2G	Other industrial: CO_2	CO_2	314	0%	21%	0%	0%	97%	0
2B1	Ammonia production	CO_2	2857	1%	2%	0%	0%	98%	0
3, 6D	OTHER N_2O	N_2O	116	0%	54%	0%	0%	98%	0
2C1	Iron and steel production (carbon inputs)	CO_2	1054	1%	6%	0%	0%	98%	0
1A5	Military use of fuels (1A5 Other)	CO_2	267	0%	20%	0%	0%	98%	0
4B9	Emissions from manure management : poultry	CH_4	53	0%	100%	0%	0%	99%	0
2A1	Cement production	CO_2	416	0%	11%	0%	0%	99%	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature non-dairy cattle	CH_4	187	0%	21%	0%	0%	99%	0
2B2	Nitric acid production	N_2O	447	0%	8%	0%	0%	99%	0
3	Indirect CO_2 from solvents/product use	CO_2	120	0%	27%	0%	0%	99%	0
2F	PFC emissions from PFC use	PFC	125	0%	25%	0%	0%	99%	0
1A3	Mobile combustion: road vehicles	CH_4	56	0%	50%	0%	0%	99%	0
1B2	Fugitive emissions venting/flaring: CO_2	CO_2	53	0%	50%	0%	0%	99%	0
2E	HFC by-product emissions from HFC manufacture	HFC	109	0%	22%	0%	0%	100%	0
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	154	0%	14%	0%	0%	100%	0
1A3	Mobile combustion: aircraft	CO_2	41	0%	50%	0%	0%	100%	0
1A4	Stationary combustion : Other Sectors, solids	CO_2	31	0%	50%	0%	0%	100%	0
4B	Emissions from manure management : other	CH_4	15	0%	100%	0%	0%	100%	0
1A1b	Stationary combustion : Petroleum Refining: gases	CO_2	2591	1%	1%	0%	0%	100%	0
2C3	CO_2 from aluminium production	CO_2	224	0%	5%	0%	0%	100%	0
2C3	PFC from aluminium production	PFC	43	0%	20%	0%	0%	100%	0
2G	Other industrial: N_2O	N_2O	10	0%	71%	0%	0%	100%	0
6D	OTHER CH_4	CH_4	20	0%	32%	0%	0%	100%	0
1A3	Mobile combustion: other (railways)	CO_2	66	0%	5%	0%	0%	100%	0
1A3	Mobile combustion: other (non-road)	N_2O	2	0%	112%	0%	0%	100%	0
1A3	Mobile combustion: other (non-road)	CH_4	1	0%	112%	0%	0%	100%	0
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO_2	0	0%	20%	0%	0%	100%	0
			198357						28

Table A1.5b Source ranking using IPCC Tier 2 level assessment 2009 including LULUCF (in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq last year abs	Share	Uncer-tainty estimate	Level * Uncer-tainty	Share L*U	Cum. Share L*U	Key ?
4D3	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	1512	1%	206%	1,51%	10%	10%	1
5C1	5C1. Grassland remaining Grassland	CO_2	4246	2%	56%	1,15%	7%	17%	1
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO_2	11113	5%	20%	1,08%	7%	24%	1
4D1	Direct N_2O emissions from agricultural soils	N_2O	3514	2%	61%	1,03%	7%	31%	1
4B1	Emissions from manure management : cattle	CH_4	1693	1%	100%	0,82%	5%	36%	1
6A1	CH_4 emissions from solid waste disposal sites	CH_4	4637	2%	34%	0,75%	5%	41%	1
5A1	5A1. Forest Land remaining Forest Land	CO_2	2144	1%	67%	0,69%	4%	45%	1
4D2	Animal production on agricultural soils	N_2O	1300	1%	100%	0,63%	4%	49%	1
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	8163	4%	14%	0,56%	4%	53%	1
4B8	Emissions from manure management : swine	CH_4	1126	1%	100%	0,55%	4%	57%	1
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	19554	9%	5%	0,51%	3%	60%	1
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	1798	1%	51%	0,44%	3%	63%	1
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO_2	17681	9%	5%	0,43%	3%	66%	1
1A	Emissions from stationary combustion: non-CO_2	CH_4	1565	1%	50%	0,38%	2%	68%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO_2	23621	11%	3%	0,36%	2%	70%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gases	CO_2	7294	4%	10%	0,35%	2%	73%	1
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature dairy cattle	CH_4	3971	2%	16%	0,30%	2%	75%	1
4B	Emissions from manure management	N_2O	503	0%	100%	0,24%	2%	76%	1
2B5	Other chemical product manufacture	CO_2	651	0%	71%	0,22%	1%	78%	1
5A2	5A2. Land converted to Forest Land	CO_2	706	0%	63%	0,22%	1%	79%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO_2	8456	4%	5%	0,21%	1%	80%	1
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO_2	1936	1%	21%	0,19%	1%	82%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO_2	3911	2%	10%	0,19%	1%	83%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, liquids	CO_2	1805	1%	20%	0,18%	1%	84%	1
1A3b	Mobile combustion: road vehicles: gasoline	CO_2	12810	6%	3%	0,18%	1%	85%	1
4A1	CH_4 emissions from enteric fermentation in domestic livestock: young cattle	CH_4	1672	1%	21%	0,17%	1%	86%	1
5C2	Land converted to Grassland	CO_2	544	0%	56%	0,15%	1%	87%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO_2	2531	1%	11%	0,14%	1%	88%	1
1B1b	CO_2 from coke production	CO_2	513	0%	50%	0,12%	1%	89%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO_2	12575	6%	2%	0,12%	1%	90%	1
6B	Emissions from wastewater handling	N_2O	438	0%	54%	0,11%	1%	90%	1
1A3	Mobile combustion: road vehicles	N_2O	428	0%	50%	0,10%	1%	91%	1
4A8	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	384	0%	50%	0,09%	1%	92%	0
2B5	Caprolactam production	N_2O	603	0%	30%	0,09%	1%	92%	0
1A	Emissions from stationary combustion: non-CO_2	N_2O	335	0%	50%	0,08%	1%	93%	0

Table A1.5b Source ranking using IPCC Tier 2 level assessment 2009 including LULUCF (in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq last year abs	Share	Uncer-tainty estimate	Level * Uncer-tainty	Share L*U	Cum. Share L*U	Key ?
5E2	5E2. Land converted to Settlements	CO_2	294	0%	56%	0,08%	1%	93%	0
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO_2	25720	12%	1%	0,07%	0%	94%	0
2G	Other industrial: CH_4	CH_4	270	0%	51%	0,07%	0%	94%	0
1A3	Mobile combustion: water-borne navigation	CO_2	610	0%	20%	0,06%	0%	94%	0
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO_2	541	0%	20%	0,05%	0%	95%	0
1A3b	Mobile combustion: road vehicles: LPG	CO_2	993	0%	10%	0,05%	0%	95%	0
2F	SF_6 emissions from SF_6 use	SF_6	175	0%	56%	0,05%	0%	95%	0
2A7	Other minerals	CO_2	357	0%	25%	0,04%	0%	96%	0
1B2	Fugitive emissions from oil and gas operations: other	CH_4	163	0%	54%	0,04%	0%	96%	0
1B2	Fugitive emissions venting/flaring	CH_4	348	0%	25%	0,04%	0%	96%	0
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	282	0%	30%	0,04%	0%	97%	0
2A3	Limestone and dolomite use	CO_2	269	0%	25%	0,03%	0%	97%	0
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO_2	684	0%	10%	0,03%	0%	97%	0
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH_4	271	0%	25%	0,03%	0%	97%	0
6B	Emissions from wastewater handling	CH_4	207	0%	32%	0,03%	0%	97%	0
2G	Other industrial: CO_2	CO_2	314	0%	21%	0,03%	0%	98%	0
2B1	Ammonia production	CO_2	2857	1%	2%	0,03%	0%	98%	0
3, 6D	OTHER N_2O	N_2O	116	0%	54%	0,03%	0%	98%	0
2C1	Iron and steel production (carbon inputs)	CO_2	1054	1%	6%	0,03%	0%	98%	0
1A5	Military use of fuels (1A5 Other)	CO_2	267	0%	20%	0,03%	0%	98%	0
4B9	Emissions from manure management : poultry	CH_4	53	0%	100%	0,03%	0%	98%	0
2A1	Cement production	CO_2	416	0%	11%	0,02%	0%	99%	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature non-dairy cattle	CH_4	187	0%	21%	0,02%	0%	99%	0
2B2	Nitric acid production	N_2O	447	0%	8%	0,02%	0%	99%	0
3	Indirect CO_2 from solvents/product use	CO_2	120	0%	27%	0,02%	0%	99%	0
2F	PFC emissions from PFC use	PFC	125	0%	25%	0,02%	0%	99%	0
5D2	5D2. Land converted to Wetlands	CO_2	56	0%	56%	0,02%	0%	99%	0
1A3	Mobile combustion: road vehicles	CH_4	56	0%	50%	0,01%	0%	99%	0
5B2	5B2. Land converted to Cropland	CO_2	48	0%	56%	0,01%	0%	99%	0
1B2	Fugitive emissions venting/flaring: CO_2	CO_2	53	0%	50%	0,01%	0%	99%	0
2E	HFC by-product emissions from HFC manufacture	HFC	109	0%	22%	0,01%	0%	99%	0
5G	5G. Other (liming of soils)	CO_2	91	0%	25%	0,01%	0%	100%	0
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	154	0%	14%	0,01%	0%	100%	0
1A3	Mobile combustion: aircraft	CO_2	41	0%	50%	0,01%	0%	100%	0
1A4	Stationary combustion : Other Sectors, solids	CO_2	31	0%	50%	0,01%	0%	100%	0
4B	Emissions from manure management : other	CH_4	15	0%	100%	0,01%	0%	100%	0
1A1b	Stationary combustion : Petroleum Refining: gases	CO_2	2591	1%	1%	0,01%	0%	100%	0
5F2	5F2. Land converted to Other Land	CO_2	25	0%	56%	0,01%	0%	100%	0
2C3	CO_2 from aluminium production	CO_2	224	0%	5%	0,01%	0%	100%	0
2C3	PFC from aluminium production	PFC	43	0%	20%	0,00%	0%	100%	0

Table A1.5b Source ranking using IPCC Tier 2 level assessment 2009 including LULUCF (in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq last year abs	Share	Uncer-tainty estimate	Level * Uncer-tainty	Share L*U	Cum. Share L*U	Key ?
2G	Other industrial: N_2O	N_2O	10	0%	71%	0,00%	0%	100%	0
6D	OTHER CH_4	CH_4	20	0%	32%	0,00%	0%	100%	0
1A3	Mobile combustion: other (railways)	CO_2	66	0%	5%	0,00%	0%	100%	0
1A3	Mobile combustion: other (non-road)	N_2O	2	0%	112%	0,00%	0%	100%	0
1A3	Mobile combustion: other (non-road)	CH_4	1	0%	112%	0,00%	0%	100%	0
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO_2	0	0%	20%	0,00%	0%	100%	0
			206511						32

With respect to Tier 2 level key sources, and perhaps surprisingly, the energy industries, with the highest share (30%) in the national total are not number one when uncertainty estimates are included. As Table A1.5 shows, two large but quite uncertain N_2O sources are now in the top five list of level key sources:

- indirect N_2O emissions from nitrogen used in agriculture;
- direct N_2O emissions from agricultural soils.

The uncertainty in these emissions is estimated at 50% to 200%, with indirect N_2O emissions having an uncertainty of a factor of two; one or two orders of magnitude higher than the 4% uncertainty estimated for CO_2 from the energy industries.

Table A1.6 Source ranking using IPCC Tier 2 trend assessment excluding LULUCF (in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq base year	CO_2-eq last year	level assess-ment last year	trend assess-ment	Uncer-tainty esti-mate	Trend * uncer-tainty	% Contr. to trend	Cumu-lative	Key ?
4D3	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	3355	1512	1%	1%	206%	2%	22%	22%	1
6A1	CH_4 emissions from solid waste disposal sites	CH_4	12011	4637	2%	4%	34%	1%	15%	37%	1
4D2	Animal production on agricultural soils	N_2O	3150	1300	1%	1%	100%	1%	11%	48%	1
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	247	1798	1%	1%	51%	0%	5%	53%	1
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO_2	7632	11113	6%	2%	20%	0%	5%	58%	1
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	5759	154	0%	3%	14%	0%	5%	63%	1
1A	Emissions from stationary combustion: non-CO_2	CH_4	572	1565	1%	1%	50%	0%	3%	67%	1
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	11832	19554	10%	5%	5%	0%	3%	70%	1
2B2	Nitric acid production	N_2O	6330	447	0%	3%	8%	0%	3%	72%	1
2C3	PFC from aluminium production	PFC	1901	43	0%	1%	20%	0%	2%	75%	1
1B2	Fugitive emissions venting/flaring: CO_2	CO_2	775	53	0%	0%	50%	0%	2%	77%	1
4B1	Emissions from manure management : cattle	CH_4	1574	1693	1%	0%	100%	0%	2%	79%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO_2	601	2531	1%	1%	11%	0%	1%	80%	1
4D1	Direct N_2O emissions from agricultural soils	N_2O	4138	3514	2%	0%	61%	0%	1%	81%	1
1B2	Fugitive emissions venting/flaring	CH_4	1252	348	0%	0%	25%	0%	1%	83%	1
4B9	Emissions from manure management : poultry	CH_4	273	53	0%	0%	100%	0%	1%	84%	1
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	9999	8163	4%	1%	14%	0%	1%	85%	1
1A3b	Mobile combustion: road vehicles: LPG	CO_2	2738	993	1%	1%	10%	0%	1%	86%	1
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO_2	1356	541	0%	0%	20%	0%	1%	87%	1
4B	Emissions from manure management	N_2O	678	503	0%	0%	100%	0%	1%	88%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/ Fisheries, liquids	CO_2	2587	1805	1%	0%	20%	0%	1%	89%	1
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO_2	1526	1936	1%	0%	21%	0%	1%	90%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO_2	19020	12575	6%	3%	2%	0%	1%	90%	1

IPCC	Category	Gas	CO_2-eq base year	CO_2-eq last year	level assess-ment last year	trend assess-ment	Uncer-tainty esti-mate	Trend * uncer-tainty	% Contr. to trend	Cumu-lative	Key ?
4A1	CH_4 emissions from enteric fermentation in domestic livestock: young cattle	CH_4	2264	1672	1%	0%	21%	0%	1%	91%	1
1A3	Mobile combustion: road vehicles	N_2O	271	428	0%	0%	50%	0%	1%	91%	0
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO_2	5033	3911	2%	0%	10%	0%	1%	92%	0
2C1	Iron and steel production (carbon inputs)	CO_2	2514	1054	1%	1%	6%	0%	0%	93%	0
1A3b	Mobile combustion: road vehicles: gasoline	CO_2	10902	12810	6%	1%	3%	0%	0%	93%	0
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO_2	13348	25720	13%	7%	1%	0%	0%	93%	0
1A4	Stationary combustion : Other Sectors, solids	CO_2	189	31	0%	0%	50%	0%	0%	94%	0
1B1b	CO_2 from coke production	CO_2	403	513	0%	0%	50%	0%	0%	94%	0
4B8	Emissions from manure management : swine	CH_4	1140	1126	1%	0%	100%	0%	0%	95%	0
3, 6D	OTHER N_2O	N_2O	250	116	0%	0%	54%	0%	0%	95%	0
1A	Emissions from stationary combustion: non-CO_2	N_2O	225	335	0%	0%	50%	0%	0%	96%	0
2F	SF_6 emissions from SF_6 use	SF_6	301	175	0%	0%	56%	0%	0%	96%	0
1A5	Military use of fuels (1A5 Other)	CO_2	566	267	0%	0%	20%	0%	0%	96%	0
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO_2	207	684	0%	0%	10%	0%	0%	97%	0
3	Indirect CO_2 from solvents/product use	CO_2	316	120	0%	0%	27%	0%	0%	97%	0
1A3	Mobile combustion: water-borne navigation	CO_2	405	610	0%	0%	20%	0%	0%	97%	0
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/ Fisheries, gases	CO_2	7330	7294	4%	0%	10%	0%	0%	98%	0
1A3	Mobile combustion: road vehicles	CH_4	157	56	0%	0%	50%	0%	0%	98%	0
2B5	Caprolactam production	N_2O	766	603	0%	0%	30%	0%	0%	98%	0
2B5	Other chemical product manufacture	CO_2	649	651	0%	0%	71%	0%	0%	98%	0
2A7	Other minerals	CO_2	275	357	0%	0%	25%	0%	0%	99%	0
2F	PFC emissions from PFC use	PFC	37	125	0%	0%	25%	0%	0%	99%	0
2E	HFC by-product emissions from HFC manufacture	HFC	12	109	0%	0%	22%	0%	0%	99%	0
6B	Emissions from wastewater handling	CH_4	290	207	0%	0%	32%	0%	0%	99%	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature dairy cattle	CH_4	4356	3971	2%	0%	16%	0%	0%	99%	0
2A3	Limestone and dolomite use	CO_2	232	269	0%	0%	25%	0%	0%	99%	0
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO_2	25776	23621	12%	0%	3%	0%	0%	99%	0

Table A1.6 Source ranking using IPCC Tier 2 trend assessment excluding LULUCF (in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq base year	CO_2-eq last year	level assess-ment last year	trend assess-ment	Uncer-tainty esti-mate	Trend * uncer-tainty	% Contr. to trend	Cumu-lative	Key ?
4A8	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	438	384	0%	0%	50%	0%	0%	99%	0
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO_2	18696	17681	9%	0%	5%	0%	0%	99%	0
1A1b	Stationary combustion : Petroleum Refining: gases	CO_2	1042	2591	1%	1%	1%	0%	0%	100%	0
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH_4	255	271	0%	0%	25%	0%	0%	100%	0
2C3	CO_2 from aluminium production	CO_2	395	224	0%	0%	5%	0%	0%	100%	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature non-dairy cattle	CH_4	163	187	0%	0%	21%	0%	0%	100%	0
6D	OTHER CH_4	CH_4	1	20	0%	0%	32%	0%	0%	100%	0
2G	Other industrial: CO_2	CO_2	304	314	0%	0%	21%	0%	0%	100%	0
4B	Emissions from manure management : other	CH_4	11	15	0%	0%	100%	0%	0%	100%	0
2G	Other industrial: N_2O	N_2O	3	10	0%	0%	71%	0%	0%	100%	0
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	319	282	0%	0%	30%	0%	0%	100%	0
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO_2	8975	8456	4%	0%	5%	0%	0%	100%	0
1B2	Fugitive emissions from oil and gas operations: other	CH_4	166	163	0%	0%	54%	0%	0%	100%	0
2G	Other industrial: CH_4	CH_4	297	270	0%	0%	51%	0%	0%	100%	0
2A1	Cement production	CO_2	416	416	0%	0%	11%	0%	0%	100%	0
6B	Emissions from wastewater handling	N_2O	466	438	0%	0%	54%	0%	0%	100%	0
1A3	Mobile combustion: aircraft	CO_2	41	41	0%	0%	50%	0%	0%	100%	0
1A3	Mobile combustion: other (railways)	CO_2	91	66	0%	0%	5%	0%	0%	100%	0
2B1	Ammonia production	CO_2	3096	2857	1%	0%	2%	0%	0%	100%	0
1A3	Mobile combustion: other (non-road)	N_2O	1	2	0%	0%	112%	0%	0%	100%	0
1A3	Mobile combustion: other (non-road)	CH_4	1	1	0%	0%	112%	0%	0%	100%	0
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO_2	2	0	0%	0%	20%	0%	0%	100%	0
			212698	198357							24

Table A1.6b Source ranking using IPCC Tier 2 trend assessment including LULUCF (in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq base year	CO_2-eq last year	level assess-ment last year	trend assess-ment	Uncer-tainty esti-mate	Trend * uncer-tainty	% Contr. to trend	Cumu-lative	Key ?
4D3	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	3355	1512	1%	1%	206%	2%	21%	21%	1
6A1	CH_4 emissions from solid waste disposal sites	CH_4	12011	4637	2%	3%	34%	1%	14%	35%	1
4D2	Animal production on agricultural soils	N_2O	3150	1300	1%	1%	100%	1%	10%	45%	1
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	247	1798	1%	1%	51%	0%	5%	50%	1
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO_2	7632	11113	5%	2%	20%	0%	5%	55%	1
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	5759	154	0%	3%	14%	0%	5%	60%	1
1A	Emissions from stationary combustion: non-CO_2	CH_4	572	1565	1%	1%	50%	0%	3%	63%	1
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	11832	19554	9%	4%	5%	0%	3%	66%	1
5A2	5A2. Land converted to Forest Land	CO_2	3	706	0%	0%	63%	0%	3%	69%	1
2B2	Nitric acid production	N_2O	6330	447	0%	3%	8%	0%	3%	71%	1
2C3	PFC from aluminium production	PFC	1901	43	0%	1%	20%	0%	2%	73%	1
1B2	Fugitive emissions venting/flaring: CO_2	CO_2	775	53	0%	0%	50%	0%	2%	76%	1
4D1	Direct N_2O emissions from agricultural soils	N_2O	4138	3514	2%	0%	61%	0%	1%	77%	1
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO_2	601	2531	1%	1%	11%	0%	1%	78%	1
4B1	Emissions from manure management : cattle	CH_4	1574	1693	1%	0%	100%	0%	1%	80%	1
1B2	Fugitive emissions venting/flaring	CH_4	1252	348	0%	0%	25%	0%	1%	81%	1
4B9	Emissions from manure management : poultry	CH_4	273	53	0%	0%	100%	0%	1%	82%	1
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	9999	8163	4%	1%	14%	0%	1%	83%	1
1A3b	Mobile combustion: road vehicles: LPG	CO_2	2738	993	0%	1%	10%	0%	1%	84%	1
5C1	5C1. Grassland remaining Grassland	CO_2	4246	4246	2%	0%	56%	0%	1%	85%	1
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO_2	1356	541	0%	0%	20%	0%	1%	86%	1
4B	Emissions from manure management	N_2O	678	503	0%	0%	100%	0%	1%	87%	1
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/ Fisheries, liquids	CO_2	2587	1805	1%	0%	20%	0%	1%	88%	1
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO_2	19020	12575	6%	3%	2%	0%	1%	88%	1
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO_2	1526	1936	1%	0%	21%	0%	1%	89%	1

Table A1.6b Source ranking using IPCC Tier 2 trend assessment including LULUCF (in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq base year	CO_2-eq last year	level assess-ment last year	trend assess-ment	Uncer-tainty esti-mate	Trend * uncer-tainty	% Contr. to trend	Cumu-lative	Key ?
5C2	5C2. Land converted to Grassland	CO_2	391	544	0%	0%	56%	0%	1%	90%	1
4A1	CH_4 emissions from enteric fermentation in domestic livestock: young cattle	CH_4	2264	1672	1%	0%	21%	0%	1%	90%	1
5A1	5A1. Forest Land remaining Forest Land	CO_2	2434	2144	1%	0%	67%	0%	1%	91%	1
1A3	Mobile combustion: road vehicles	N_2O	271	428	0%	0%	50%	0%	1%	91%	0
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO_2	5033	3911	2%	0%	10%	0%	1%	92%	0
2C1	Iron and steel production (carbon inputs)	CO_2	2514	1054	1%	1%	6%	0%	0%	92%	0
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO_2	13348	25720	12%	7%	1%	0%	0%	93%	0
1A4	Stationary combustion : Other Sectors, solids	CO_2	189	31	0%	0%	50%	0%	0%	93%	0
1A3b	Mobile combustion: road vehicles: gasoline	CO_2	10902	12810	6%	1%	3%	0%	0%	94%	0
1B1b	CO_2 from coke production	CO_2	403	513	0%	0%	50%	0%	0%	94%	0
3, 6D	OTHER N_2O	N_2O	250	116	0%	0%	54%	0%	0%	95%	0
1A	Emissions from stationary combustion: non-CO_2	N_2O	225	335	0%	0%	50%	0%	0%	95%	0
2F	SF_6 emissions from SF_6 use	SF_6	301	175	0%	0%	56%	0%	0%	95%	0
4B8	Emissions from manure management : swine	CH_4	1140	1126	1%	0%	100%	0%	0%	96%	0
5E2	5E2. Land converted to Settlements	CO_2	210	294	0%	0%	56%	0%	0%	96%	0
1A5	Military use of fuels (1A5 Other)	CO_2	566	267	0%	0%	20%	0%	0%	96%	0
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO_2	207	684	0%	0%	10%	0%	0%	97%	0
3	Indirect CO_2 from solvents/product use	CO_2	316	120	0%	0%	27%	0%	0%	97%	0
1A3	Mobile combustion: water-borne navigation	CO_2	405	610	0%	0%	20%	0%	0%	97%	0
1A3	Mobile combustion: road vehicles	CH_4	157	56	0%	0%	50%	0%	0%	98%	0
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/ Fisheries, gases	CO_2	7330	7294	4%	0%	10%	0%	0%	98%	0
2B5	Caprolactam production	N_2O	766	603	0%	0%	30%	0%	0%	98%	0
2B5	Other chemical product manufacture	CO_2	649	651	0%	0%	71%	0%	0%	98%	0
2A7	Other minerals	CO_2	275	357	0%	0%	25%	0%	0%	98%	0
2F	PFC emissions from PFC use	PFC	37	125	0%	0%	25%	0%	0%	99%	0
2E	HFC by-product emissions from HFC manufacture	HFC	12	109	0%	0%	22%	0%	0%	99%	0
6B	Emissions from wastewater handling	CH_4	290	207	0%	0%	32%	0%	0%	99%	0
5G	5G. Other (liming of soils)	CO_2	183	91	0%	0%	25%	0%	0%	99%	0

Table A1.6b Source ranking using IPCC Tier 2 trend assessment including LULUCF (in Gg CO_2 eq).

IPCC	Category	Gas	CO_2-eq base year	CO_2-eq last year	level assess-ment last year	trend assess-ment	Uncer-tainty esti-mate	Trend * uncer-tainty	% Contr. to trend	Cumu-lative	Key ?
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature dairy cattle	CH_4	4356	3971	2%	0%	16%	0%	0%	99%	0
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO_2	25776	23621	11%	0%	3%	0%	0%	99%	0
4A8	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	438	384	0%	0%	50%	0%	0%	99%	0
2A3	Limestone and dolomite use	CO_2	232	269	0%	0%	25%	0%	0%	99%	0
5D2	5D2. Land converted to Wetlands	CO_2	40	56	0%	0%	56%	0%	0%	99%	0
1A1b	Stationary combustion : Petroleum Refining: gases	CO_2	1042	2591	1%	1%	1%	0%	0%	99%	0
5B2	5B2. Land converted to Cropland	CO_2	34	48	0%	0%	56%	0%	0%	99%	0
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH_4	255	271	0%	0%	25%	0%	0%	100%	0
2C3	CO_2 from aluminium production	CO_2	395	224	0%	0%	5%	0%	0%	100%	0
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO_2	18696	17681	9%	0%	5%	0%	0%	100%	0
4A1	CH_4 emissions from enteric fermentation in domestic livestock: mature non-dairy cattle	CH_4	163	187	0%	0%	21%	0%	0%	100%	0
6D	OTHER CH_4	CH_4	1	20	0%	0%	32%	0%	0%	100%	0
2G	Other industrial: CO_2	CO_2	304	314	0%	0%	21%	0%	0%	100%	0
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	319	282	0%	0%	30%	0%	0%	100%	0
2G	Other industrial: N_2O	N_2O	3	10	0%	0%	71%	0%	0%	100%	0
4B	Emissions from manure management : other	CH_4	11	15	0%	0%	100%	0%	0%	100%	0
5F2	5F2. Land converted to Other Land	CO_2	18	25	0%	0%	56%	0%	0%	100%	0
2G	Other industrial: CH_4	CH_4	297	270	0%	0%	51%	0%	0%	100%	0
1B2	Fugitive emissions from oil and gas operations: other	CH_4	166	163	0%	0%	54%	0%	0%	100%	0
2A1	Cement production	CO_2	416	416	0%	0%	11%	0%	0%	100%	0
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO_2	8975	8456	4%	0%	5%	0%	0%	100%	0
1A3	Mobile combustion: aircraft	CO_2	41	41	0%	0%	50%	0%	0%	100%	0
2B1	Ammonia production	CO_2	3096	2857	1%	0%	2%	0%	0%	100%	0
1A3	Mobile combustion: other (railways)	CO_2	91	66	0%	0%	5%	0%	0%	100%	0
6B	Emissions from wastewater handling	N_2O	466	438	0%	0%	54%	0%	0%	100%	0
1A3	Mobile combustion: other (non-road)	N_2O	1	2	0%	0%	112%	0%	0%	100%	0
1A3	Mobile combustion: other (non-road)	CH_4	1	1	0%	0%	112%	0%	0%	100%	0
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO_2	2	0	0%	0%	20%	0%	0%	100%	0
			220258	206511							28

Annex 2 Detailed discussion of methodology and data for estimating CO_2 emissions from fossil fuel combustion

The Netherlands list of fuels and standard CO_2 emission factors was originally approved in 2004 by the Steering Committee Emission Registration, and is revised following decisions on the CO_2 emission factor for natural gas by this Steering Group in its meetings 25 April 2006 and 21 April 2009.

On 21 April 2009, Steering Committee Emission Registration delegated the authority to decide on revisions of the list to the Working Group Emission Monitoring (WEM). On 20 January 2011 the present document (version January 2011) was approved by the WEM.

For a description of the methodology and activity data used for the calculation of CO_2 emissions from fossil fuel combustion we refer to the monitoring protocols (see Annex 6, protocols 0042 for stationary sources and protocols 0044-0051 for mobile sources).

A2.1 Introduction

For national monitoring of greenhouse gas emissions under the framework of the UN Climate Change Convention (UNFCCC) and monitoring at corporate level for the European CO_2 emissions trade, international agreements state that each country must draw up a national list of defined fuels and standard CO_2 emission factors. This is based on the IPCC list (with default CO_2 emission factors), but should include national values that reflect the specific national situation. This list will also be used by the Netherlands in the e-MJV (electronic) annual environmental report), because these are used for the national monitoring.

The Netherlands list of energy carriers and standard CO_2 emission factors (further referred to as "the Netherlands list") is now available in the form of:

a table containing the names (in Dutch and English) of the energy carrier and the accompanying standard energy content and CO_2 emissions factor;

1. a fact sheet per energy carrier, substantiating the values given, presenting similar names and possible specifications, and providing an overview of the codes that organizations use for the individual energy carriers.

This Annex is for people using the Netherlands list. It contains the starting points for this list and indicates how it should be used for various objectives, for example, national monitoring of greenhouse gas emissions, the European CO_2 emissions trade and the e-MJV. It also includes background information. The list, plus this document and the background documents for substantiating the specific Netherlands values can be found on the website: www.greenhousegases.nl / www.broeikasgassen.nl.

Based on new scientific knowledge in 2006 the CO_2 emission factor for natural gas has been changed for the period 1990-2006.
From 2007 onwards, the CO_2 emission factor for natural gas has been assessed annually. In this document, the CO_2 emission factor for natural gas for 2009 has been determined.

A2.2 Starting points for the Netherlands list

The following starting points were used to draw up the Netherlands list:
1. The list contains all the fuels, as included in the IPCC guidelines (Revised 1996 Intergovernmental Panel on Climate Change (IPCC) for national greenhouse gas inventories, further known as the "1996 IPCC guidelines"), Table 1-1 (in Chapter 1 of the Reference Manual, Volume 3 of the 1996 IPCC guidelines) and the differentiation thereof in the Workbook Table 1.2 (Module 1 of the Workbook, Volume 2 of the 1996 IPCC guidelines). The 1996 IPCC guidelines are applicable to the national monitoring of greenhouse gas emissions under the UNFCCC framework.
2. The list contains all fuels, as included in European Commission (EC) Directive 2004/156/EG on reporting CO_2 emissions trading ("... defining guidelines for monitoring and reporting greenhouse gas emissions..."), Appendix 1, Chapter 8.
3. The definition of fuels is based on the definition used by the CBS (Statistics Netherlands) when collating energy statistics.
   As a result of the 1996 IPCC guidelines and the EC Directive 2004/156/EG mentioned in 1 and 2 above, the CO_2 emission factors are accurate to one digit after the decimal point.
4. The list assumes the standard CO_2 emission factors as used in the 1996 IPCC guidelines and the EC Directive 2004/156/EG but, where the Netherlands' situation deviates from this norm, specific standard values for the Netherlands are used, which are documented and substantiated.

A2.3 The Netherlands list

A study was carried out in 2002 with respect to specific Netherlands CO_2 emission factors (TNO, 2002). This study showed that, for a limited number of Dutch fuels, their situations deviated such that national values needed to be determined. For a number of fuels, the previously defined national values (Emission Registration, 2002) could be updated but for others new values were required.

A *specific Netherlands standard CO_2 emissions factor* has been determined for the following fuels, which does not appear in the 1996 IPCC Guidelines or in the EC Directive 2007/589/EG, but has been added as specification for one of the following fuels in:
1. petrol/gasoline
2. gas and diesel oil
3. LPG
4. coke coals (coke ovens and blast furnaces)
5. other bituminous coal
6. coke ovens/gas cokes
7. coke oven gas
8. blast furnace gas
9. oxygen furnace gas
10. phosphorus furnace gas
11. natural gas.

For industrial gases, chemical waste gas is also differentiated from refinery gas. For the IPCC main group "other fuels", only non-biogenic waste is differentiated.

Coking Coal
For coking coal the standard CO_2 emissions factor is also a weighed average, for example of coke coals used in coke ovens and in blast furnaces.

Natural gas
In 2006, a study was commissioned to research methods to determine the CO_2 emission factor for natural gas (TNO, 2006). This resulted in an advice to use natural gas a country specific factor from the year 1990 onwards (SenterNovem, 2006). In its meeting 25 April 2006, the Steering Committee Emission Registration agreed with this advice and approved an update of the National list for the period 1990-2006.

From 2007 onwards, the CO_2 emission factor for natural gas has been assessed annually. In the meeting of the Steering Committee Emission Registration of 21 April 2009, the procedure was approved for the annual update of the emission factor of natural gas. In this document (version January 2011) the emission factor of natural gas for 2009 and 2010 was determined according to this procedure.

Waste
From 2009 onwards, on the Netherlands list the fuel Waste (non-biogenic) is replaced by the fuel Waste. This fuel concerns all waste that is incinerated in the Netherlands, both residential waste and other waste. In addition, from 2009 onwards the heating value and the emission factor will be determined annually on the Netherlands list. These values are not used as input for the calculation of greenhouse gas emissions under the framework of the UN Climate Change Convention (UNFCCC), but are the result

Table A2.1 Netherlands fuels and standard CO_2 emission factors, version January 2011.

Main group (Dutch)	Main group (English) IPCC (supplemented)	Unit	Heating value (MJ/unit)	CO_2 EF (kg/GJ)
	A. Liquid Fossil, Primary Fuels			
Ruwe aardolie	Crude oil	kg	42.7	73.3
Orimulsion	Orimulsion	kg	27.5	80.7
Aardgascondensaat	Natural Gas Liquids	kg	44.0	63.1
	Liquid Fossil, Secondary Fuels/ Products			
Motorbenzine	Petrol/gasoline	kg	44.0	72.0
Kerosine luchtvaart	Jet Kerosene	kg	43.5	71.5
Petroleum	Other Kerosene	kg	43.1	71.9
Leisteenolie	Shale oil	kg	36.0	73.3
Gas-/dieselolie	Gas/ Diesel oil	kg	42.7	74.3
Zware stookolie	Residual Fuel oil	kg	41.0	77.4
LPG	LPG	kg	45.2	66.7
Ethaan	Ethane	kg	45.2	61.6
Nafta's	Naphtha	kg	44.0	73.3
Bitumen	Bitumen	kg	41.9	80.7
Smeeroliën	Lubricants	kg	41.4	73.3
Petroleumcokes	Petroleum Coke	kg	35.2	100.8
Raffinaderij grondstoffen	Refinery Feedstocks	kg	44.8	73.3
Raffinaderijgas	Refinery Gas	kg	45.2	66.7
2B Chemisch restgas	12B Chemical Waste Gas	kg	45.2	66.7
Overige oliën	Other Oil	kg	40.2	73.3
	B. Solid Fossil, Primary Fuels			
Antraciet	Anthracite	kg	26.6	98.3
Cokeskolen	Coking Coal	kg	28.7	94.0
Cokeskolen (cokeovens)	Coking Coal (used in coke oven)	kg	28.7	95.4_4
Cokeskolen (basismetaal)	Coking Coal (used in blast furnaces)	kg	28.7	89.8
(Overige bitumineuze) steenkool	Other Bituminous Coal	kg	24.5	94.7
Sub-bitumineuze kool	Sub-bituminous Coal	kg	20.7	96.1
Bruinkool	Lignite	kg	20.0	101.2
Bitumineuze Leisteen	Oil Shale	kg	9.4	106.7
Turf	Peat	kg	10.8	106.0
	Solid Fossil, Secondary Fuels			
Steenkool- en bruinkoolbriketten	BKB & Patent Fuel	kg	23.5	94.6
Cokesoven/ gascokes	Coke Oven/Gas Coke	kg	28.5	111.9
Cokesovengas	Coke Oven gas	MJ	1.0	41.2
Hoogovengas	Blast Furnace Gas	MJ	1.0	247.4
Oxystaalovengas	Oxy Gas	MJ	1.0	191.9
Fosforovengas	3B Phosphor Gas	Nm^3	11.6	149.5
	C. Gaseous Fossil Fuels			
Aardgas	Natural Gas (dry)	Nm^3 ae	31.65	56.6[a]
Koolmonoxide	Carbon Monoxide	Nm^3	12.6	155.2
Methaan	Methane	Nm^3	35.9	54.9
Waterstof	Hydrogen	Nm^3	10.8	0.0
	Biomass[b]			
4B Biomassa vast	5B Solid Biomass	kg	15.1	109.6
Biomassa vloeibaar	Liquid Biomass	kg	39.4	71.2
Biomassa gasvormig	Gas Biomass	Nm^3	21.8	90.8
RWZI biogas	6 BWastewater biogas	Nm^3	23.3	84.2
Stortgas	7B Landfill gas	Nm^3	19.5	100.7
Industrieel fermentatiegas	Industrial organic waste gas	Nm^3	23.3	84.2
	D. Other fuels			
Afval[c]	Waste	kg	10.0	105.7

a The emission factor for natural gas in this table (56.6 kg CO_2/GJ) is applicable for the calculation of the emissions in the emission years 2009 (Zijlema, 2010a) and 2010 (Zijlema, 2010b). The emission factor for natural gas was 56.7 kg CO_2/GJ in the emission years 2007 (Zijlema, 2008) and 2008 (Zijlema, 2009) For the period 1990–2006 the emission factor remains unchanged (56.8 kg CO_2/GJ). In the future the emission factor for natural gas will be updated annually.

b Biomass: the value of the CO_2 emission factor is shown as a memo item in reports for the climate change convention; the value is zero for emissions trading and for the Kyoto Protocol.

c The values are applicable for the emission year 2009. The percentage biogenic in the heating value is 51%. The percentage biogenic in the emission factor is 62%. In the emission year 2008 the heating value was 10.3 MJ/kg (49% biogenic) and the emission factor was 97.5 kg/GJ (63% biogenic).

of these calculations (see Renewable Energy Monitoring Protocol, NL Agency, 2010). In the e-MJV these value can be used by companies that incinerate waste.

In this document (version January 2011) the heating value and the emission factor of Waste are determined for 2009. The incinerated waste is a mix of biogenic and non-biogenic waste. Therefore, the percentage biogenic is given for both the heating value and the emission factor.

Biomass
The list also includes biomass as a fuel, with accompanying specific Netherlands CO_2 emission factors. Biomass emissions are reported separately in the national monitoring of greenhouse gas emissions under the UNFCCC framework (as memo element) and are not included in the national emissions figures. For the European CO_2 emissions trading, the emissions are not included because an emissions factor of zero is used for biomass.

The CO_2 emissions factor for wood is used for solid biomass, and that of palm oil is used for liquid biomass[1]. A weighed average of three specified biogases is used as the standard factor for gaseous biomass:
1. sewage treatment facility (WWTP) biogas
2. landfill gas
3. industrial organic waste gas.

The heating values are the same as those used by the CBS for observed fuels in its surveys for collating energy statistics.

A2.4 Fact sheets

A fact sheet (consisting of at least two sections) has been drawn up for each fuel:

1) General information
   a. Name of the fuel, in Dutch and English
   b. Other names used (Dutch and English)
   c. Description
   d. Codes (in Dutch) used to specify the fuel
   e. Unit

2) Specific values and substantiation
   a. Heating value
   b. Carbon content
   c. CO_2 emissions factor
   d. Density (if relevant), converting from weight to volume or converting from gases to m^3 standard natural gas equivalents
   e. Substantiating the choices, plus accurate referral to references and/or specific text sections within the reference
   f. Year and/or period for which the specific values apply.

If a standard Dutch value for a fuel exists, this has been added to the fact sheet (as a third section containing the same information as that described under 1) and 2) above).

A2.5 Using the Netherlands list in national monitoring, European CO_2 emissions trade and in the e-MJV National monitoring

National monitoring
The 1996 IPCC Guidelines are among those valid for national monitoring under the UNFCCC framework, which is reported annually in the NIR (National Inventory Report). This includes the default CO_2 emission factors shown in Table 1-1 (Chapter 1 of the Reference Manual, volume 3 of the 1996 IPCC Guidelines) and Table 1-2 (Module 1 of the Workbook, volume 2 of the 1996 IPCC Guidelines). With respect to the specification at national level: '...default assumptions and data should be used only when national assumptions and data are not available.' (Overview of the Reporting Instructions, volume 1 of the 1996 IPCC Guidelines) and '...because fuel qualities and emission factors may differ markedly between countries, sometimes by as much as 10% for nominally similar fuels, national inventories should be prepared using local emission factors and energy data where possible.' (Chapter 1, Section 1.1 of the Reference Manual, volume 3 of the 1996 IPCC Guidelines).

With respect to documentation: 'When countries use local values for the carbon emission factors they should note the differences from the default values and provide documentation supporting the values used in the national inventory calculations' (Chapter 1, Section 1.4.1.1 of the Reference Manual, volume 3 of the 1996 IPCC Guidelines). Exactly when and how the Netherlands list should be used in the national monitoring process is further described in the 1996 IPCC Guidelines. The Netherlands list is included in the country's national report to the UNFCCC on greenhouse gas emissions.

Monitoring European CO_2 emissions trade
The EC Directive 2007/589/EG covers monitoring under the

[1] The heating value and the emission factor of liquid biomass are not used in the calculations of the national transport emissions for biofuels. For an explanation, see Klein, 2011 (Table 1.31)

framework of the European CO_2 emissions trade. This Directive serves as a starting point for the Netherlands monitoring system for trading in emission allowances. With respect to the CO_2 emission factors and the calculations of CO_2 emissions at level 2a, the Directive states: 'The operator should use the relevant fuel caloric values that apply in that Member State, for example as indicated in the relevant Member State's latest national inventory, which has been submitted to the secretariat of the UNFCCC (EC Directive 2007/589/EC, Appendix II, Section 2.1.1.1).

With respect to the reports, this states that: 'Fuels, and the resulting emissions must be reported in accordance with the IPCC format for fuels (...) this is based on the definitions set out by the IEA (International Energy Agency). If the Member State (relevant to the operator) has already published a list of fuel categories, including definitions and emission factors, which is consistent with the latest national inventory such as submitted to the UNFCCC secretariat, these categories and the accompanying emission factors should be used, if these have been approved within the framework of the relevant monitoring methodology.' (EC Directive 2007/589/EG, Appendix I, Section 5).
When and how the Netherlands list should be used in the monitoring process under the framework of the EU CO_2 emissions trading is further explained in EC Directive 2007/589/EG and the Netherlands system for monitoring the trade in emission allowances.

e-MJV
Within the UNFCCC framework, the national monitoring of greenhouse gases is partly based on the information provided in the MJVs (annual environmental reports). Information on CO_2 emissions trading is (also) reported in the MJV, which is why the Netherlands list is also used in the e-MJV. Since the monitoring of the energy covenant known as MJA (long-term energy agreement) can be carried out via the e-MJV, the Netherlands list is also used to compile these reports. Exactly how the Netherlands list should be used in the e-MJV is further described in the e-MJV itself.

Use of the Netherlands list by other stakeholders in the Netherlands
The Netherlands list can also be used for other purposes (e.g., monitoring energy covenants, predicting future CO_2 emissions). Selections can be taken from the list, depending on the application. This usage is not defined in the legislation, but offers the advantage of harmonising the national monitoring under the UNFCCC framework. Whenever CO_2 emissions are defined for the Government, the Netherlands list will be used wherever possible.

A2.6 Defining and maintaining the Netherlands list

The Ministry of Infrastructure and the Environment initiated the compilation of the Netherlands list, as it is responsible for the national monitoring of greenhouse gas emissions under the UNFCCC framework. This list has been prepared in consultation with those national institutes involved in national monitoring activities, such as PBL, CBS and NL Agency, and other relevant organisations, such as the e-MJV, CO_2 emissions trade and ECN. The Steering Committee Emission Registration (the collaborative agencies implementing the national monitoring) compiled the list during its meeting in October 2004.

The list will be maintained within the National System, the organisational structure that coordinates national greenhouse gas monitoring under the UNFCCC framework. The Netherlands list, this document and the background documents are all publicly accessible from the Dutch website (www.broeikasgassen.nl or the English version, www.greenhousegases.nl). As part of the quality monitoring system for national monitoring of greenhouse gases, this list will be evaluated every three years.

This document was updated in November 2005 with some editorial changes. This document and the Netherlands list were updated in 2006 based on research for methods to determine the CO_2 emission factor for natural gas in the Netherlands for the period 1990-2006.

From 2007 onwards, the CO_2 emission factor for natural gas has been assessed annually, based on measurement by Gasunie and Zebragas. On 21 April 2009, this procedure was approved by the Steering Committee Emission Registration.

On 21 April 2009, Steering Committee Emission Registration delegated the authority to decide on revisions of the list to the Working Group Emission Monitoring (WEM). On 8 December 2009, the present document (version December 2009) was approved by the WEM.
On 20 January 2011 the present document (version January 2011) was approved by the WEM. In this document, the CO_2 emission factor for natural gas for the emission years 2009 and 2010 has been determined. Besides, for the fuel Waste the heating value and emission factor for the emission year 2009 were determined, including the percentage biogenic in both parameters.

A2.7 Application of the Netherlands standard and source-specific CO_2 emission factors in the national emission inventory

For the most common fuels (natural gas, coal, coal products, diesel and petrol), country-specific standard CO_2 emission factors are used; otherwise default IPCC emission factors are used (see Table A2.1). However, for some of the derived fuels the chemical composition and thus the CO_2 emission factor is highly variable between source categories and over time.

Thus, for blast furnace gas and oxygen furnace gas, refinery gas, chemical waste gas (liquids and solids treated separately) and solid waste (the biogenic and fossil carbon part treated separately), mostly source-specific (or plant-specific) emission factors have been used, that may also change over time. In addition, for raw natural gas combustion by the oil and gas production industry a source-specific (or company-specific) CO_2 emission factor is used. This refers to the “own use” of unprocessed natural gas used by the gas and oil production industry, of which the composition may differ significantly from that of treated standard natural gas supplied to end-users. These emission factors are based on data submitted by industries in their Annual Environmental Reports (MJVs). These fuels are used in the subcategories “Public electricity and heat production” (1A1a), “Refineries” (1A1b) and “Other energy industries” included in 1A1c.

Fossil-based CO_2 emissions from waste incineration are calculated from the total amount of waste that is incinerated, split into six waste types per waste stream, each with a specific carbon content and fraction of fossil carbon in total carbon (see Section 8.4.2 for more details). More details on methodologies, data sources used and country-specific source allocation issues are provided in the monitoring protocols (see Annex 6).

Annex 3 Other detailed methodological descriptions for individual source or sink categories

A detailed description of methodologies per source/ sink category can be found in protocols on the website www.greenhousegases.nl, including country-specific emission factors. Annex 6 provides an overview of the available monitoring protocols at this site.

Annex 4 CO_2 Reference Approach and comparison with Sectoral Approach

A4.1 Comparison of CO_2 emissions

The IPCC Reference Approach (RA) for CO_2 from energy use uses apparent consumption data per fuel type to estimate CO_2 emissions from fossil fuel use. This has been used as a means of verifying the sectoral total CO_2 emissions from fuel combustion (IPCC, 2001). For the Reference Approach energy statistics (production, imports, export, stock changes) were provided by Statistics Netherlands (CBS); national default, partly country-specific, CO_2 emission factors (see Annex 2.1, Tables A2.1 and A2.2) and constant carbon storage fractions based on the average of annual carbon storage fractions calculated per fossil fuel type for 1995-2002 from reported CO_2 emissions in the sectoral approach. Also, bunker fuels were corrected for the modification made to include fisheries, internal navigation, military aviation and shipping in domestic consumption instead of included in the bunker total in the original national
energy statistics (see Annex 2.1, Tables A2.1 - A2.3).

Table A4.1 presents the results of the Reference Approach calculation for 1990-2009 and compared with the official national total emissions reported as fuel combustion (source category 1A). The annual difference calculated from the direct comparison varies between 0.4% for 2006 and 8.6% for 2009.

The Reference Approach (RA) and National Approach (NA) data show a 12% RA vs. 7% NA increase in emissions from liquid fuels (1990-2009) and a 13% RA vs. 15% NA increase from gaseous fuels; CO_2 emissions from solid fuels decreased in this period by 14% in the RA vs. an decrease of 11% in the NA. The emissions from others (fossil carbon in waste), which is only included in the NA increased from 0.6 Tg in 1990 to 2.5 Tg CO_2 in 2009. However, as will be discussed below, these numbers cannot be compared well since the RA includes sources not in included in the NA and vice versa.

A4.2 Causes of differences between the two approaches

There are five main reasons for differences in the two approaches, of which two are *inherent to the comparison method* itself (see Table A4.2):

1. The CO_2 from *incineration of waste* that contains fossil carbon (reported under 1A1a) is not included in the Reference Approach.
2. The fossil-fuel related emissions reported as *process emissions* (sector 2) and *fugitive emissions* (Sector 1B), which are not included in the Sectoral Approach total of Sector 1A. The most significant are gas used as feedstock in ammonia production (2B1) and losses from coke/coal inputs in blast furnaces (2C1).

Table A4.1 Comparison of CO_2 emissions: Reference Approach (RA) [1] versus National Approach (NA) (in Tg)

	1990	1995	2000	2005	2006	2007	2008	2009
Reference Approach								
Liquid fuels [1]	49.7	51.4	53.8	55.2	54.6	58.2	55.9	55.7
Solid fuels [1]	34.0	34.7	30.5	32.2	30.2	33.2	31.4	29.4
Gaseous fuels	71.9	79.9	81.0	81.8	79.6	77.1	80.6	81.3
Others	NA	NA	NA	NA	NA	NA	NA	NA
Total RA	**155.6**	**166.0**	**165.3**	**169.2**	**164.4**	**168.5**	**167.9**	**166.4**
National Approach								
Liquid fuels	49.7	52.5	54.6	56.4	56.0	56.1	56.2	53.0
Solid fuels	31.0	32.4	28.8	30.1	28.6	30.7	30.1	27.6
Gaseous fuels	68.6	76.0	76.7	78.5	77.0	74.5	78.4	78.9
Others [2]	0.6	0.8	1.6	2.1	2.1	2.2	2.2	2.5
Total NA	**149.9**	**161.6**	**161.8**	**167.0**	**163.7**	**163.5**	**166.9**	**162.0**
Difference [3] (%)								
Liquid fuels	0.0%	-1.9%	-1.5%	-2.1%	-2.5%	3.7%	-0.4%	5.2%
Solid fuels	9.8%	7.2%	6.1%	6.9%	5.8%	8.2%	4.2%	6.6%
Gaseous fuels	4.8%	5.2%	5.5%	4.2%	3.4%	3.4%	2.8%	3.0%
Other	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
Total	**3.8%**	**2.7%**	**2.2%**	**1.3%**	**0.4%**	**3.0%**	**0.6%**	**2.7%**

[1] Specification of national fuel types used in the IPCC fuel type categories:
Gasoline: jet fuel, gasoline basis; aviation gasoline; motor gasoline; *Other Kerosene*: petroleum; Other Oil: oil aromates; other light oils; other oil products; *Other Bituminous Coal*: all hard coal; lignite/brown coal; *BKB and Patent Fuel*: coal derivatives.
[2] Fossil-fuel component of waste combustion in waste incineration that also produce heat and electricity for energy purposes.
[3] Defined as: (RA-NA)/NA.

and others are country-specific:

3. In addition, the country-specific carbon storage factors used in the Reference Approach are multi-annual averages, so the RA calculation for a specific year will deviate somewhat from the factors that could be calculated from the specific mix of feedstock/non-energy uses of different fuels.
4. The use of plant-specific emission factors in the NA vs. national defaults in the RA.
5. Other differences could – in principle – be due to the presence of statistical differences between apparent consumption and total sectoral fuel use and/or to differences between total sectoral fuel use as used in the emission inventory and as included in the national energy statistics in cases where plant-specific fuel use data have been used.

However, the latter is not applicable to the Netherlands. National statistics are compiled in such a way that no statistical difference occurs (initial differences are removed by shifting to the most uncertain fuel entry). Moreover, the calculations are all based on the official sectoral energy statistics from Statistics Netherlands (CBS), which guarantees that the activity data in the inventory are identical to the national energy statistics.

Correction of inherent differences

The correction terms for the RA/NA total are for the Netherlands:

1. waste incineration (in the Netherlands included in 1A1a, as 'other fuels');
2. selected CRF Sector 2 components listed in Table A4.2 and selected fugitive CO_2 emissions included in CRF Sector 1B.

If the RA is corrected by including the fossil waste and the NA by including selected Sector 1B and Sector 2 emissions that should be added to the 1A total before the comparison is made (see Table A4.2), then a much smaller difference remains between the approaches. Remaining differences are generally below ±2%.
Remaining differences must be due to the use of one multi-annual average carbon storage factor per fuel type for all years (see Section A4.3) and plant-specific emission factors in some cases as discussed in Section A4.4 (for more details, see Annex 2, Table A2.2).

Table A4.2 Corrections of Reference Approach and National Approach for a proper comparison (in Tg)

RA,NA, correction term	1990	1995	2000	2005	2006	2007	2008	2009
Difference RA-NA	5.7	4.4	3.6	2.1	0.7	4.9	1.0	4.4
Reference Approach:	155.6	166.0	165.3	169.2	164.4	168.5	167.9	166.4
Other: fossil waste cf. NA	0.6	0.8	1.6	2.1	2.1	2.2	2.2	2.5
RA incl. fossil waste:	156.2	166.9	166.9	171.3	166.6	170.7	170.2	168.9
Diff. RA incl. Waste-NA:	5.1	3.6	2.0	0.1	-1.4	2.8	-1.3	1.9
National Approach:	149.9	161.6	161.8	167.0	163.7	163.5	166.9	162.0
CO_2 fossil in Sector 1B:								
1B1b. Solid Fuel Transf.	0.4	0.5	0.4	0.7	0.6	0.3	0.8	0.5
1B2c Flaring	0.4	0.3	0.2	0.1	0.1	0.1	0.0	0.0
1B2a-iv Oil refining	0.0	0.0	0.0	0.9	0.9	1.0	0.8	1.0
CO_2 fossil in Sector 2:	6.0	5.8	5.1	5.0	4.9	5.0	4.2	4.2
A. Mineral Products								
Soda Ash Production	0.1	0.3	0.1	0.1	0.1	0.1	0.1	0.0
B. Chemical industry								
1. Ammonia production	3.1	3.6	3.6	3.1	3.1	3.0	2.9	2.9
5. Other, excl. act. carbon	0.4	0.2	0.2	0.4	0.4	0.3	0.4	0.3
C. Metal industry								
1. Inputs in blast furnace	2.2	1.5	1.0	1.2	1.1	1.4	0.7	0.8
D. Other Production								
2. Food and Drink	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
G. Other (please specify)								
Other economic sectors **	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Not in NA-1A:	6.9	6.6	5.7	5.7	5.6	5.5	5.0	4.8
NA+1B+Ind. Proc.	156.8	168.2	167.5	172.7	169.3	169.0	172.0	166.8
RA+Fossil waste:	156.2	166.9	166.9	171.3	166.6	170.7	170.2	168.9
New difference (abs)	-0.5	-1.4	-0.6	-1.5	-2.7	1.7	-1.8	2.2
New difference (%)	-0.3%	-0.9%	-0.4%	-0.9%	-1.7%	1.0%	-1.1%	1.4%

** Comprises lubricants and waxes.

A4.3 Other country-specific data used in the Reference Approach

Apart from different *storage fractions* of non-energy use of fuels as presented in Table A4.5, other country-specific information used in the RA is found in:

Carbon contents (CO_2 emission factors) used
For the fuels used in the Reference Approach, the factors used are listed in Table A.2.1. These are the national defaults. For 'other bituminous coal' and "BKB & Patent fuel" the values are used of bituminous coal and coal bitumen respectively;

Fuel consumption in international marine and aviation bunkers
Some changes were made in the national energy statistics of total apparent consumption, mainly for diesel, jet kerosene and residual fuel oil, due the reallocation for the emissions inventory of part of the bunker fuels to domestic consumption (e.g., fisheries and inland navigation). This explains the difference between the original bunker statistics in the national energy statistics (and as reported to international agencies such as the IEA) and the bunker fuel data used in the Reference Approach calculation.

A4.4 Feedstock component in the CO_2 Reference Approach

Feedstock/non-energy uses of fuels in the energy statistics are also part of the IPCC Reference Approach for CO_2 from fossil fuel use. The fraction of carbon not oxidised during the use of these fuels during product manufacture or other uses is subtracted from total carbon contained in total apparent fuel consumption by fuel type. The fractions stored/oxidised have been calculated as three average values, one for gas, liquid and solid fossil fuels:

- 77.7±2% for liquid fuels
- 55.5±13% for solid fuels
- 38.8±4% for natural gas.

These were calculated from all processes for which emissions are calculated in the NA, either by assuming a fraction oxidised, for example ammonia, or by accounting for by-product gases (excluding emissions from blast furnaces and coke ovens). (In Table A.4.4 of the NIR 2005, the calculation of annual oxidation fractions for 1995-2002 are presented and the average values derived from them.) It shows indeed that the factors show significant inter-annual variation, in particular for solid fuels.

The use of one average oxidation factor per fuel type for all years, whereas in the derivation of the annual oxidation figures differences up to a few per cent points can be observed, are one reason for differences between the RA and the corrected NA.

In the Netherlands about 10 to 25% of all carbon in the apparent consumption of fossil fuels is stored.

Annex 5 Assessment of completeness and (potential) sources and sinks

The Netherlands emissions inventory focuses on completeness and improving accuracy in the most relevant sources. This means that for all ‘NE’ sources, it is investigated what information is available and whether it could be assumed that a source is a really (very) small/negligible. For those sources that were not small, during the improvement programme, methods for estimating the emissions were developed.
As a result of this process, it was decided to keep only for very few sources as ’NE’, since data for estimating emissions are not available and the source is very small. Of course, on regular basis it is being checked/re-assessed whether there are developments in NE sources that indicate (major) increase in emissions or new data sources for estimating emissions. For all except biofuels, this is the case for the ‘NE’ sources the ERT is referring to. For biofuels we are planning to incorporate activity data and emissions.

Following the 2009 review, one NE sources has been reviewed for the potential magnitude and then an estimate was made and included in the inventory. As result oil transprt (1B2a) is no longer included in this Annex.
The Netherlands greenhouse gas emission inventory includes all sources identified by the Revised IPCC Guidelines (IPCC, 1996) – with the exception of the following (very) minor sources:

- Charcoal production (1B2), due to missing activity data
  As indicated in the NIR 2008, there is information indicating that one company might produce charcoal. The production started after 1990. At this time,the production capacity is about 11,000 ton/year. Production levels are not known. The company is using the “Twin-retort” carbonisation process to produce charcoal. Compared to traditional charcoal production processes, CH_4 emissions from the Twin-retort system are far lower (Reumerman and Frederiks, 2002). CH_4 emissions from charcoal production are not estimated since these emissions are negligible.
- Charcoal use (1A4) , due to missing activity data;
  Emissions from charcoal are only expected from barbecuing in the residential en services sector during the summer period. As indicated in the NIR 2008, there is no information on activity data on the actual charcoal use in 1A4 (other sectors), but it is assumed that these emissions are negligible. For these reasons the very low emissions are not estimated.
- CO_2 from asphalt roofing (2A5) and CO_2 from road paving (2A6), due to missing activity data;
  Information on the use of bitumen is only available for two groups: the chemical industry and all others. There is no information on the amount of asphalt roofing production and also no information on road paving with asphalt. The statistical information on sales (value) of asphalt roofing and asphalt for road paving was finalised by 2002.

Based on this information it was assumed that emissions related to this two categories are very low/undetectable and that effort in generating activity data would, therefore, not be cost effective. So not only the missing activity data but also the very limited amount of emissions was the rationale of the decision to not estimate these emissions.
As follow up on the 2008 review, information has been collected from the branch organisation of roofing indicating that the number of producers of asphalt roofing declined from about 15 in 1990 to less than 5 in 2008 and that the import of asphalt roofing increased. Also, information has been researched on asphalt production (for road paving) as reported in the progress of the voluntary agreements for energy efficiency. A first estimate indicates that the CO_2 emissions could be around 0.5 kton.

- CH_4 from Enteric fermentation poultry (4A9), due to missing emission factors;
  For this source category no IPCC default emission factor is available.
- N_2O from Industrial wastewater (6B1), due to negligible amounts.
  As presented in the NIR 2008, page 194, the annual source for activity data are yearly questionnaires which cover all urban WWTPs and all anaerobic industrial WWTPs. For these industrial WWTPs, CH_4 emissions are estimated based on the design capacity of the installations (47 plants) and reported. CH_4 emissions reported for 2006 were 0.33 Gg CH_4. From this anaerobic pre-treatment, there is no N_2O emission.

  In 2000, the Netherlands investigated not previously estimated sources for non-CO_2 emissions. One of these sources was the wastewater handling (DHV, 2000). As a result of this study, emissions were estimated (Oonk, 2004) and the methods are presented in the protocols CH_4, N_2O from wastewater treatment (6B).
  We are not able to estimate N_2O emissions from aerobic industrial WWTPs, as there is no information available on these installations. In the priority setting for allocation of budgets for improvements in emission estimates, we did consider this as a source for which it could not be argued that a new data collection process or a new statistic was a priority. Arguments for this decision include:
  - The majority of the small and medium enterprises are linked to the municipal wastewater treatment plants (for which we made emission estimates) and do not have an their own wastewater treatment;
  - The anaerobic pre-treatment reduces the N load to the aerobic final treatment;
  - Aerobic (post) treatment is done for several of the industrial companies in the municipal WWTPs;
  - The composition of the industrial wastewater is mainly process water and although we have no specific information on the N-content of the influent, it is assumed that it is low N content.

  In addition, there are indications that the number of industrial wastewater treatment plants will reduce in the near future and this will also further minimise the minor effect of not estimating this source.
- Part of CH_4 from industrial waste water (6B1b Sludge), due to negligible amounts
  For industrial waste water treatment the situation is follows:
  - The major part of the Dutch industry emit in the sewer system, which is connected to municipal waste water treatment. These emissions are included in the category: Domestic and commercial waste water.
  - In case of anaerobic waste water treatment, the emissions from sludge handling are included in the emissions from industrial anaerobic waste water handling.
  - Among the aerobic waste water handling systems used in Industry, there are only 2 plants operating a separate anaerobic sludge digester and CH_4 emissions from these two plants are not estimated. Within other industrial WWTP, the sludge undergoes simultaneous stabilisation in the aerobic waste water reactors. The industrial sludge produced is therefore already very stable in terms of digestible matter. CH_4 emissions therefore are considered to be very low and don't justify the set up a yearly monitoring and estimation method.

Precursor emissions (i.e. CO, NO_x, NMVOC and SO2) from Memo item international bunkers (international transport) have not been included.

Annex 6
Additional information to be considered as part of the NIR submission

The following information should be considered as part of this NIR submission:

A6.1 List of protocols

Table A6.1 Methodological description (monitoring protocols 2010, from 15 April 2010 available at the website).

Protocol	IPCC code	Description	Gases
11-001	All	Reference approach	CO_2
11-002	1A1 1A2 1A4	Stationary combustion (fossil) *	CO_2 N_2O CH_4
11-003	1A1b 1B1b 1B2aiv 2A4i 2B1 2B4i 2B5i 2B5vii 2B5viii 2C1vi 2D2 2Giv	Process emissions (fossil)	CO_2 N_2O CH_4
11-004	1A2f 1A4c	Mobile equipment	CO_2 N_2O CH_4
11-005	1A3a	Inland aviation	CO_2 N_2O CH_4
11-006	1A3b	Road transport	CO_2
11-007	1A3b	Road transport	N_2O CH_4
11-008	1A3c	Rail transport	CO_2 N_2O CH_4
11-009	1A3d	Inland navigation	CO_2 N_2O CH_4
11-010	1A4c	Fisheries	CO_2 N_2O CH_4
11-011	1A5	Defence	CO_2 N_2O CH_4
11-012	1B2	Oil & gas production	CO_2 CH_4
11-013	1B2	Oil & gas distribution/transport	CO_2 CH_4
11-014	2A1 2A2 2A3 2A4ii 2A7i 2B5ix 2C1i 2C1vii 2C3 2Gi 2Gii 2Giii 2Gv 3A 3B 3C 3D	Process emissions (non-fossil)	CO_2 N_2O CH_4
11-015	2B2	Nitric acid	N_2O
11-016	2B5	Caprolactam	N_2O
11-017	2C3	Aluminium production	PFC
11-018	2E1	HCFC-22 production	HFC
11-019	2E3	HFC byproduct emissions	HFC
11-020	2F1	Stationary refrigeration	HFC
11-021	2F1	Mobile refrigeration	HFC
11-022	2F2	Hard foams	HFC
11-023	2F4	Aerosols	HFC
11-024	2F8	Sound proof windows	SF_6
11-025	2F8	Semi-conductors	SF_6 PFC
11-026	2F8	Electrical equipment	SF_6
11-027	4A	Enteric fermentation,	CH_4
11-028	4B	Manure management	N_2O
11-029	4B	Manure management	CH_4
11-030	4D	Agricultural soils, indirect	N_2O
11-031	4D	Agricultural soils, direct	N_2O
11-032	5A	Forest	CO_2
11-033	5D-5G	Soil	CO_2
11-034	6A1	Waste disposal	CH_4
11-035	6B	Waste water treatment	CH_4 N_2O
11-036	6D	Large-scale composting	CH_4 N_2O
11-037	Memo item	International bunker emissions	CO_2 N_2O CH_4
11-038	1A, (CO_2 memo item)	Biomass	CO_2 CH_4 N_2O
11-039	5 (KP-I KP-II)	KP LULUCF	CO_2 CH_4 N_2O

A6.2 Documentation of uncertainties used in IPCC Tier 1 uncertainty assessments and Tier 2 key source identification

- Olivier, J.G.J., L.J. Brandes, R.A.B. te Molder, 2009: Estimate of annual and trend uncertainty for Dutch sources of greenhouse gas emissions using the IPCC Tier 1 approach. PBL Report 500080013, PBL, Bilthoven.
- Olsthoorn, X. and A. Pielaat, 2003: Tier-2 uncertainty analysis of the Dutch greenhouse gas emissions 1999. Institute for Environmental Studies (IVM), Free University, Amsterdam. IVM Report no. R03-06.
- Ramírez-Ramírez, A., C. de Keizer and J.P. van der Sluijs, 2006: Monte Carlo Analysis of Uncertainties in the Netherlands Greenhouse Gas Emission Inventory for 1990–2004, report NWS-E-2006-58, Department of Science, Technology and Society, Copernicus Institute for Sustainable Development and Innovation, Utrecht University, Utrecht, the Netherlands.

A6.3 Background documents and uncertainty discussion papers

- Van Amstel, A.R., J.G.J. Olivier and P.G. Ruyssenaars (eds.), 2000a: Monitoring of Greenhouse Gases in the Netherlands: Uncertainty and Priorities for Improvement. Proceedings of a National Workshop held in Bilthoven, the Netherlands, 1 September 1999. WIMEK report/RIVM report no. 773201 003. Bilthoven, May 2000.
- Kuikman, P.J., J.J.H van den Akker and F. de Vries, 2005: Lachgasemissie uit organische landbouwbodems. Alterra, Wageningen. Alterra rapport 1035-II.
- Hoek, K. W. van der and M. W. van Schijndel, 2006: Methane and nitrous oxide emissions from animal manure management, including an overview of emissions 1990-2003. Background document for the Dutch National Inventory Report. RIVM report 680.125.002, Bilthoven.
- Hoek, K.W. van der, M.W. van Schijndel, P.J. Kuikman, 2007. Direct and indirect nitrous oxide emissions from agricultural soils, 1990 - 2003. Background document on the calculation method for the Dutch National Inventory Report. RIVM Report No. 68012.003./2007 MNP Report No. 500080003/2007 Bilthoven, the Netherlands.
- 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 - version 1.0 for 1990–2002. Alterra, Wageningen. Alterra rapport 1035-I.
- Van den Wyngaert, I.J.J., Kramer, H., Kuikman, P., Nabuurs, G.J. (2009) Greenhouse gas reporting of the LULUCF sector, revisions and updates related to the Dutch NIR 2009. Alterra report1035.7, Alterra, Wageningen.

A6.4 Documentation of Quality Assurance and Quality Control for national greenhouse gas inventory compilation and reporting

- DHV, 2002: Quality Assurance and Quality Control for the Dutch National Inventory Report; report on phase 1, January 2002, report no. ML-BB-20010367. DHV, Amersfoort.
- PBL, 2008. Werkplan EmissieRegistratie ronde 2009 – 2010. PBL, Bilthoven, 2009.
- Agentschap NL, The Netherlands National System:QA/QC programme 2010/2011 Version 6.0

A6.5 Documentation of Changes to the National Registry

- Release Notes, Greta Emissions Trading Registry Version 4.0.14, Date: 30th March 2009, SFW Limited, Southern House Station Approach Woking Surrey GU22 7UY
- Release Notes, Greta Emissions Trading Registry Version 4.1.16, Date: 18th June 2009, SFW Limited, Southern House Station Approach Woking Surrey GU22 7UY
- Release Notes, Greta Emissions Trading Registry Version 4.2.21, Date: 6th October 2009, SFW Limited, Southern House Station Approach Woking Surrey GU22 7UY
- Test report, Greta Registry Release V4.1, QME201 Version 2.0, Date of creation: 20 Jul 2009, SFW Limited, Southern House Station Approach Woking Surrey GU22 7UY
- Test report, Greta Registry Release V4.2, QME201 Version 2.0, Date of creation: 11 Nov 2009, SFW Limited, Southern House Station Approach Woking Surrey GU22 7UY
- ETS Testing Plan, EUROPEAN COMMISSION, DG ENVIRONMENT, D irectorate C - Climate Change & Air, ENV.C.2 - Market based instruments including Greenhouse gas emissions trading, Brussels, ENV C2/
- Test approval of a E new reconciliation for NL in the Registry Test Environment, E-mail Registry Test Environment. Application manager for the CITL, 17th June 2009

Registry Information

Report R1

Party	Netherlands
Submission year	2011
Reported year	2010
Commitment period	1

Table 1. Total quantities of Kyoto Protocol units by account type at beginning of reported year

Account type	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Party holding accounts	842767016	917099	NO	12458380	NO	NO
Entity holding accounts	85495450	120109	NO	4782736	NO	NO
Article 3.3/3.4 net source cancellation accounts	NO	NO	NO	NO		
Non-compliance cancellation accounts	NO	NO	NO	NO		
Other cancellation accounts	NO	NO	NO	20	NO	NO
Retirement account	83512630	NO	NO	NO	NO	NO
tCER replacement account for expiry	NO	NO	NO	NO	NO	
lCER replacement account for expiry	NO	NO	NO	NO		
lCER replacement account for reversal of storage	NO	NO	NO	NO		NO
lCER replacement account for non-submission of certification report	NO	NO	NO	NO		NO
Total	1011775096	1037208	NO	17241136	NO	NO

Party	Netherlands
Submission year	2011
Reported year	2010
Commitment period	1

Table 2 (a). Annual internal transactions

Transaction type	Additions						Subtractions					
	Unit type						Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Article 6 issuance and conversion												
Party-verified projects		NO					NO		NO			
Independently verifed projects		NO					NO		NO			
Article 3.3 and 3.4 issuance or cancellation												
3.3 Afforestation and reforestation			NO				NO	NO	NO	NO		
3.3 Deforestation			NO				NO	NO	NO	NO		
3.4 Forest management			NO				NO	NO	NO	NO		
3.4 Cropland management			NO				NO	NO	NO	NO		
3.4 Grazing land management			NO				NO	NO	NO	NO		
3.4 Revegetation			NO				NO	NO	NO	NO		
Article 12 afforestation and reforestation												
Replacement of expired tCERs							NO	NO	NO	NO	NO	
Replacement of expired lCERs							NO	NO	NO	NO		
Replacement for reversal of storage							NO	NO	NO	NO		NO
Replacement for non-submission of certification report							NO	NO	NO	NO		NO
Other cancellation							500	NO	NO	1000	NO	NO
Sub-total		NO	NO				500	NO	NO	1000	NO	NO

Transaction type	Retirement					
	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Retirement	204469645	NO	NO	NO	NO	NO

Party	Netherlands
Submission year	2011
Reported year	2010
Commitment period	1

Table 2 (b). Annual external transactions

	Additions						Subtractions					
	Unit type						Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Transfers and acquisitions												
CDM	NO	NO	NO	4469013	NO	NO	NO	NO	NO	NO	NO	NO
AT	540001	165055	NO	315000	NO	NO	540637	40000	NO	110920	NO	NO
BE	3448480	NO	NO	100000	NO	NO	8929360	32155	NO	717793	NO	NO
BG	741319	816313	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CZ	2292859	93313	NO	NO	NO	NO	3241595	NO	NO	519528	NO	NO
DK	38951877	369971	NO	3818602	NO	NO	12356174	151454	NO	11924906	NO	NO
EE	38171	150190	NO	NO	NO	NO	81995	NO	NO	NO	NO	NO
FI	100200	56988	NO	135500	NO	NO	100803	169876	NO	16000	NO	NO
FR	29113975	659268	NO	6237145	NO	NO	21568226	315000	NO	3255790	NO	NO
DE	20204354	386897	NO	6008113	NO	NO	24230041	1069369	NO	5008538	NO	NO
GR	129255	NO	NO	15000	NO	NO	60000	NO	NO	NO	NO	NO
HU	153520	435393	NO	NO	NO	NO	469402	NO	NO	4901	NO	NO
IE	248018	NO	NO	NO	NO	NO	312800	7440	NO	296133	NO	NO
IT	25509439	NO	NO	160804	NO	NO	35315377	NO	NO	347981	NO	NO
JP	NO	NO	NO	19113	NO	NO	NO	NO	NO	200683	NO	NO
LV	591911	NO	NO	NO	NO	NO	302798	9215	NO	20859	NO	NO
LI	1091147	NO	NO	340000	NO	NO	4819054	NO	NO	663000	NO	NO
LT	3700409	900982	NO	156000	NO	NO	1323212	389000	NO	432041	NO	NO
LU	12548	NO	NO	NO	NO	NO	68000	24138	NO	281944	NO	NO
NZ	NO	120000	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
NO	22005	NO	NO	NO	NO	NO	18312	NO	NO	263500	NO	NO
PL	1324322	NO	NO	100000	NO	NO	1690779	20800	NO	335000	NO	NO
PT	283210	NO	NO	2781029	NO	NO	224163	NO	NO	824000	NO	NO
RO	873954	NO	NO	NO	NO	NO	817996	NO	NO	30000	NO	NO
SK	871025	NO	NO	NO	NO	NO	418000	NO	NO	8000	NO	NO
SI	415006	19000	NO	828	NO	NO	179527	110000	NO	43565	NO	NO
ES	3105302	8082	NO	21124	NO	NO	1666060	8082	NO	3533949	NO	NO
SE	3557996	NO	NO	NO	NO	NO	5050200	1823	NO	52000	NO	NO
CH	NO	932385	NO	9650705	NO	NO	NO	368676	NO	9583697	NO	NO
UA	34660	1421179	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
GB	32759546	689068	NO	19366593	NO	NO	28003797	1773516	NO	11625425	NO	NO
Sub-total	170114509	7224084	NO	53694569	NO	NO	151788308	4490544	NO	50100153	NO	NO

Additional information

Independently verified ERUs								NO				

Table 2 (c). Total annual transactions

Total (Sum of tables 2a and 2b)	170114509	7224084	NO	53694569	NO	NO	151788808	4490544	NO	50101153	NO	NO

	Expiry, cancellation and requirement to replace		Replacement					
	Unit type		Unit type					
Transaction or event type	tCERs	ICERs	AAUs	ERUs	RMUs	CERs	tCERs	ICERs
Temporary CERs (tCERS)								
Expired in retirement and replacement accounts	NO							
Replacement of expired tCERs			NO	NO	NO	NO	NO	
Expired in holding accounts	NO							
Cancellation of tCERs expired in holding accounts	NO							
Long-term CERs (ICERs)								
Expired in retirement and replacement accounts		NO						
Replacement of expired ICERs			NO	NO	NO	NO		
Expired in holding accounts		NO						
Cancellation of ICERs expired in holding accounts		NO						
Subject to replacement for reversal of storage		NO						
Replacement for reversal of storage			NO	NO	NO	NO		NO
Subject to replacement for non-submission of certification report		NO						
Replacement for non-submission of certification report			NO	NO	NO	NO		NO
Total			NO	NO	NO	NO	NO	NO

Party Netherlands
Submission year 2011
Reported year 2010
Commitment period 1

Table 4. Total quantities of Kyoto Protocol units by account type at end of reported year

Account type	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Party holding accounts	626814684	2602173	NO	15103900	NO	NO
Entity holding accounts	115303838	1168575	NO	5730632	NO	NO
Article 3.3/3.4 net source cancellation accounts	NO	NO	NO	NO		
Non-compliance cancellation accounts	NO	NO	NO	NO		
Other cancellation accounts	500	NO	NO	1020	NO	NO
Retirement account	287982275	NO	NO	NO	NO	NO
tCER replacement account for expiry	NO	NO	NO	NO	NO	
lCER replacement account for expiry	NO	NO	NO	NO		
lCER replacement account for reversal of storage	NO	NO	NO	NO		NO
lCER replacement account for non-submission of certification report	NO	NO	NO	NO		NO
Total	1030101297	3770748	NO	20835552	NO	NO

Party Netherlands
Submission year 2011
Reported year 2010
Commitment period 1

Table 5 (a). Summary information on additions and subtractions

	Additions						Subtractions					
	Unit type						Unit type					
Starting values	AAUs	ERUs	RMUs	CERs	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Issuance pursuant to Article 3.7 and 3.8	1001262141											
Non-compliance cancellation							NO	NO	NO	NO		
Carry-over	NO	NO		NO								
Sub-total	1001262141	NO		NO			NO	NO	NO	NO		
Annual transactions												
Year 0 (2007)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 1 (2008)	87571284	NO	NO	39222701	NO	NO	83469551	NO	NO	22711813	NO	NO
Year 2 (2009)	209068825	1400858	NO	73230286	NO	NO	202657603	363650	NO	72500058	NO	NO
Year 3 (2010)	170114509	7224084	NO	53694569	NO	NO	151788808	4490544	NO	50101153	NO	NO
Year 4 (2011)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 5 (2012)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 6 (2013)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 7 (2014)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Year 8 (2015)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Sub-total	466754618	8624942	NO	166147556	NO	NO	437915962	4854194	NO	145313024	NO	NO
Total	1468016759	8624942	NO	166147556	NO	NO	437915962	4854194	NO	145313024	NO	NO

Table 5 (b). Summary information on replacement

	Requirement for replacement		Replacement					
	Unit type		Unit type					
	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Previous CPs			NO	NO	NO	NO	NO	NO
Year 1 (2008)		NO	NO	NO	NO	NO	NO	NO
Year 2 (2009)		NO	NO	NO	NO	NO	NO	NO
Year 3 (2010)		NO	NO	NO	NO	NO	NO	NO
Year 4 (2011)		NO	NO	NO	NO	NO	NO	NO
Year 5 (2012)	NO	NO	NO	NO	NO	NO	NO	NO
Year 6 (2013)	NO	NO	NO	NO	NO	NO	NO	NO
Year 7 (2014)	NO	NO	NO	NO	NO	NO	NO	NO
Year 8 (2015)	NO	NO	NO	NO	NO	NO	NO	NO
Total	NO	NO	NO	NO	NO	NO	NO	NO

Table 5 (c). Summary information on retirement

Year	Retirement					
	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs
Year 1 (2008)	NO	NO	NO	NO	NO	NO
Year 2 (2009)	83512630	NO	NO	NO	NO	NO
Year 3 (2010)	204469645	NO	NO	NO	NO	NO
Year 4 (2011)	NO	NO	NO	NO	NO	NO
Year 5 (2012)	NO	NO	NO	NO	NO	NO
Year 6 (2013)	NO	NO	NO	NO	NO	NO
Year 7 (2014)	NO	NO	NO	NO	NO	NO
Year 8 (2015)	NO	NO	NO	NO	NO	NO
Total	287982275	NO	NO	NO	NO	NO

Party	Netherlands
Submission year	2011
Reported year	2010
Commitment period	1

Table 6 (a). Memo item: Corrective transactions relating to additions and subtractions

	Additions						Subtractions					
	Unit type						Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs

Table 6 (b). Memo item: Corrective transactions relating to replacement

	Requirement for replacement		Replacement					
	Unit type		Unit type					
	tCERs	lCERs	AAUs	ERUs	RMUs	CERs	tCERs	lCERs

Table 6 (c). Memo item: Corrective transactions relating to retirement

	Retirement					
	Unit type					
	AAUs	ERUs	RMUs	CERs	tCERs	lCERs

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DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
4003	466,44	881.58								
			NL-13273	2010–01–15 17:58:39	External Transfer	Terminated				
								AT-1574305675-1574309189	AAU	3515
								AT-1574309190-1574310017	AAU	828
								CZ-1279337356-1279340172	AAU	2817
								CZ-1279497577-1279500394	AAU	2818
								CZ-1279507395-1279510394	AAU	3000
								CZ-1287607940-1287610344	AAU	2405
								CZ-1304824714-1304827981	AAU	3268
								CZ-1332185753-1332188708	AAU	2956
								CZ-1332188709-1332191664	AAU	2956
								DE-1526928327-1526929326	AAU	1000
								DK-1709900498-1709902685	AAU	2188
								ES-1688231718-1688235446	AAU	3729
								ES-1792094706-1792097505	AAU	2800
								ES-1891476820-1891481763	AAU	4944
								ES-1976462677-1976463480	AAU	804
								FR-3155370788-3155374787	AAU	4000
								FR-3155383788-3155385787	AAU	2000
								FR-3289149490-3289152178	AAU	2689
								FR-3289164490-3289166779	AAU	2290
								FR-3289167325-3289169634	AAU	2310
								FR-3289169635-3289172634	AAU	3000
								FR-3296430702-3296432844	AAU	2143
								FR-3303328586-3303329606	AAU	1021
								FR-3303344586-3303346111	AAU	1526
								FR-3303357638-3303359637	AAU	2000
								FR-3303359638-3303360090	AAU	453
								FR-3317262450-3317267449	AAU	5000
								FR-3397997112-3398000111	AAU	3000
								FR-3398006654-3398011097	AAU	4444
								FR-3410521093-3410521737	AAU	645
								GB-3974788787-3974792786	AAU	4000
								GB-3975517787-3975520786	AAU	3000
								GB-3976065787-3976085786	AAU	20000
								HU-592634877-592637876	AAU	3000
								HU-594230785-594230945	AAU	161
								HU-594230946-594233945	AAU	3000
								HU-595969132-595972131	AAU	3000
								HU-602232597-602237314	AAU	4718
								IE-466273702-466276701	AAU	3000
								IT-2717714212-2717717230	AAU	3019
								IT-2722335151-2722340150	AAU	5000
								IT-2828567952-2828570214	AAU	2263
								IT-2828570215-2828572951	AAU	2737
								IT-2861457534-2861458198	AAU	665
								IT-2861459164-2861462128	AAU	2965

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								IT-2894546862-2894551142	AAU	4281
								IT-2894551143-2894555642	AAU	4500
								IT-2930340614-2930343143	AAU	2530
								LT-227967099-227969158	AAU	2060
								LT-261786741-261790395	AAU	3655
								LV-128909557-128912556	AAU	3000
								NL-3205215801-3205219800	AAU	4000
								NL-3205220801-3205223800	AAU	3000
								NL-3266915041-3266918049	AAU	3009
								NL-3266918050-3266923049	AAU	5000
								NL-3266923050-3266928049	AAU	5000
								NL-3266928050-3266933049	AAU	5000
								PL-2978156506-2978158505	AAU	2000
								PL-2978158506-2978161504	AAU	2999
								PL-3213859298-3213861521	AAU	2224
								PL-3214237522-3214240521	AAU	3000
								PL-3214382522-3214385421	AAU	2900
								PL-3214387522-3214389274	AAU	1753
								PL-3214854286-3214856297	AAU	2012
								RO-2577108517-2577109516	AAU	1000
			NL-13274	2010–01–15 18:20:17	External Transfer	Terminated				
								AT-1574305675-1574309189	AAU	3515
								AT-1574309190-1574310017	AAU	828
								CZ-1279337356-1279340172	AAU	2817
								CZ-1279497577-1279500394	AAU	2818
								CZ-1279507395-1279510394	AAU	3000
								CZ-1287607940-1287610344	AAU	2405
								CZ-1304824714-1304827981	AAU	3268
								CZ-1332185753-1332188708	AAU	2956
								CZ-1332188709-1332191664	AAU	2956
								DE-1526928327-1526929326	AAU	1000
								DK-1709900498-1709902685	AAU	2188
								ES-1688231718-1688235446	AAU	3729
								ES-1792094706-1792097505	AAU	2800
								ES-1891476820-1891481763	AAU	4944
								ES-1976462677-1976463480	AAU	804
								FR-3155370788-3155374787	AAU	4000
								FR-3155383788-3155385787	AAU	2000
								FR-3289149490-3289152178	AAU	2689
								FR-3289164490-3289166779	AAU	2290
								FR-3289167325-3289169634	AAU	2310
								FR-3289169635-3289172634	AAU	3000
								FR-3296430702-3296432844	AAU	2143
								FR-3303328586-3303329606	AAU	1021
								FR-3303344586-3303346111	AAU	1526
								FR-3303357638-3303359637	AAU	2000
								FR-3303359638-3303360090	AAU	453
								FR-3317262450-3317267449	AAU	5000
								FR-3397997112-3398000111	AAU	3000
								FR-3398006654-3398011097	AAU	4444

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								FR-3410521093-3410521737	AAU	645
								GB-3974788787-3974792786	AAU	4000
								GB-3975517787-3975520786	AAU	3000
								GB-3976065787-3976085786	AAU	20000
								GB-3976093927-3976096786	AAU	2860
								HU-592634877-592637876	AAU	3000
								HU-594230785-594230945	AAU	161
								HU-594230946-594233945	AAU	3000
								HU-595969132-595972131	AAU	3000
								HU-602232597-602237314	AAU	4718
								IE-466273702-466276701	AAU	3000
								IT-2717714212-2717717230	AAU	3019
								IT-2722335151-2722340150	AAU	5000
								IT-2828567952-2828570214	AAU	2263
								IT-2828570215-2828572951	AAU	2737
								IT-2861457534-2861458198	AAU	665
								IT-2861459164-2861462128	AAU	2965
								IT-2894546862-2894551142	AAU	4281
								IT-2894551143-2894555642	AAU	4500
								IT-2930340614-2930343143	AAU	2530
								LT-227967099-227969158	AAU	2060
								LT-257538603-257543602	AAU	5000
								LT-261786741-261790395	AAU	3655
								LV-128909557-128912556	AAU	3000
								NL-3205215801-3205219800	AAU	4000
								NL-3205220801-3205223800	AAU	3000
								NL-3266915041-3266918049	AAU	3009
								NL-3266918050-3266923049	AAU	5000
								NL-3266923050-3266928049	AAU	5000
								NL-3266928050-3266933049	AAU	5000
								NL-3266933050-3266952040	AAU	18991
								PL-2978156506-2978158505	AAU	2000
								PL-2978158506-2978161504	AAU	2999
								PL-3213859298-3213861521	AAU	2224
								PL-3214237522-3214240521	AAU	3000
								PL-3214382522-3214385421	AAU	2900
								PL-3214387522-3214389274	AAU	1753
								PL-3214854286-3214856297	AAU	2012
								PL-3214856298-3214856521	AAU	224
								PL-3215034522-3215036781	AAU	2260
								PL-3215269522-3215274521	AAU	5000
								PL-3215298522-3215302003	AAU	3482
								PL-3215754782-3215756290	AAU	1509
								PL-3215756291-3215757521	AAU	1231
								PL-3215924522-3215927521	AAU	3000
								PL-3216514423-3216519422	AAU	5000
								PL-3335785230-3335785316	AAU	87
								PL-3335785317-3335787674	AAU	2358
								PL-3335792230-3335794417	AAU	2188
								PL-3335800230-3335802674	AAU	2445

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								PL-3335829230-3335832229	AAU	3000
								PL-3336108321-3336110829	AAU	2509
								PL-3336110830-3336113210	AAU	2381
								RO-2532394307-2532398980	AAU	4674
								RO-2532400933-2532403980	AAU	3048
								RO-2577088517-2577093516	AAU	5000
								RO-2577108517-2577109516	AAU	1000
								RO-2577401517-2577404516	AAU	3000
								RO-2585882031-2585887030	AAU	5000
								RO-2585892031-2585893021	AAU	991
								RO-2585893022-2585897030	AAU	4009
								SE-429125479-429128417	AAU	2939
								SK-275805442-275808441	AAU	3000
								SK-421262988-421265435	AAU	2448
								SK-448564012-448566377	AAU	2366
			NL-13275	2010–01–15 18:24:09	External Transfer	Terminated				
								FR-3289149490-3289152178	AAU	2689
								FR-3289164490-3289166779	AAU	2290
								FR-3289167325-3289169634	AAU	2310
								FR-3289169635-3289172634	AAU	3000
								FR-3296430702-3296432844	AAU	2143
								FR-3303328586-3303329606	AAU	1021
								FR-3303344586-3303346111	AAU	1526
								FR-3303357638-3303359637	AAU	2000
								FR-3303359638-3303360090	AAU	453
								FR-3317262450-3317267449	AAU	5000
								FR-3397997112-3398000111	AAU	3000
								FR-3398006654-3398011097	AAU	4444
								FR-3410521093-3410521737	AAU	645
								GB-3974788787-3974792786	AAU	4000
								GB-3975517787-3975520786	AAU	3000
								GB-3976065787-3976085786	AAU	20000
								GB-3976093927-3976096786	AAU	2860
								NL-3266927390-3266928049	AAU	660
								NL-3266928050-3266933049	AAU	5000
								NL-3266933050-3266952040	AAU	18991
								PL-3335785230-3335785316	AAU	87
								PL-3335785317-3335787674	AAU	2358
								PL-3335792230-3335794417	AAU	2188
								PL-3335800230-3335802674	AAU	2445
								PL-3335829230-3335832229	AAU	3000
								PL-3336108321-3336110829	AAU	2509
								PL-3336110830-3336113210	AAU	2381
			NL-13276	2010–01–15 18:27:04	External Transfer	Terminated				
								FR-3397997112-3398000111	AAU	3000
								FR-3398006654-3398011097	AAU	4444
								FR-3410521093-3410521737	AAU	645
								GB-3974788787-3974792786	AAU	4000
								GB-3975517787-3975520786	AAU	3000

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								GB-3976065787-3976085786	AAU	20000
								GB-3976093927-3976096786	AAU	2860
								PL-3335792702-3335794417	AAU	1716
								PL-3335800230-3335802674	AAU	2445
								PL-3335829230-3335832229	AAU	3000
								PL-3336108321-3336110829	AAU	2509
								PL-3336110830-3336113210	AAU	2381
			NL-13277	2010–01–15 18:31:12	External Transfer	Terminated				
								FR-3410521598-3410521737	AAU	140
								GB-3974788787-3974792786	AAU	4000
								GB-3975517787-3975520786	AAU	3000
								GB-3976065787-3976085786	AAU	20000
								GB-3976093927-3976096786	AAU	2860
			NL-13278	2010–01–15 18:43:44	External Transfer	Terminated				
								FR-3397997112-3398000111	AAU	3000
								FR-3398006654-3398011097	AAU	4444
								FR-3410521093-3410521597	AAU	505
								FR-3410521598-3410521737	AAU	140
								GB-3974788787-3974792786	AAU	4000
								GB-3975517787-3975520786	AAU	3000
								GB-3976065787-3976085786	AAU	20000
								GB-3976093927-3976096786	AAU	2860
								PL-3335792702-3335794417	AAU	1716
								PL-3335800230-3335802674	AAU	2445
								PL-3335829230-3335832229	AAU	3000
								PL-3336108321-3336110829	AAU	2509
								PL-3336110830-3336113210	AAU	2381
			NL-13282	2010–01–18 10:34:04	External Transfer	Terminated				
								AT-1574305675-1574309189	AAU	3515
								AT-1574309190-1574310017	AAU	828
								CZ-1279337356-1279340172	AAU	2817
								CZ-1279497577-1279500394	AAU	2818
								CZ-1279507395-1279510394	AAU	3000
								CZ-1287607940-1287610344	AAU	2405
								CZ-1304824714-1304827981	AAU	3268
								CZ-1332185753-1332188708	AAU	2956
								CZ-1332188709-1332191664	AAU	2956
								DE-1526928327-1526929326	AAU	1000
								DK-1709900498-1709902685	AAU	2188
								ES-1688231718-1688235446	AAU	3729
								ES-1792094706-1792097505	AAU	2800
								ES-1891476820-1891481763	AAU	4944
								ES-1976462677-1976463480	AAU	804
								FR-3155370788-3155374787	AAU	4000
								FR-3155383788-3155385787	AAU	2000
								FR-3289149490-3289152178	AAU	2689
								FR-3289164490-3289166779	AAU	2290
								FR-3289167325-3289169634	AAU	2310

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								FR-3289169635-3289172634	AAU	3000
								FR-3296430702-3296432844	AAU	2143
								FR-3303328586-3303329606	AAU	1021
								FR-3303344586-3303346111	AAU	1526
								FR-3303357638-3303359637	AAU	2000
								FR-3303359638-3303360090	AAU	453
								FR-3317262450-3317267449	AAU	5000
								FR-3397997112-3398000111	AAU	3000
								FR-3398006654-3398011097	AAU	4444
								FR-3410521093-3410521597	AAU	505
								FR-3410521598-3410521737	AAU	140
								FR-3410521738-3410526048	AAU	4311
								GB-3690728918-3690729606	AAU	689
								GB-3974788787-3974792786	AAU	4000
								GB-3975517787-3975520786	AAU	3000
								GB-3975890787-3975900786	AAU	10000
								GB-3975910787-3975915786	AAU	5000
								GB-3976042476-3976045786	AAU	3311
								GB-3976065787-3976085786	AAU	20000
								GB-3976091787-3976093926	AAU	2140
								GB-3976093927-3976096786	AAU	2860
								GB-3994337798-3994340272	AAU	2475
								GB-3994340434-3994342507	AAU	2074
								HU-602235968-602237314	AAU	1347
								IT-2717714212-2717717230	AAU	3019
								IT-2722335151-2722340150	AAU	5000
								IT-2828567952-2828570214	AAU	2263
								IT-2828570215-2828572951	AAU	2737
								IT-2861457534-2861458198	AAU	665
								IT-2861459164-2861462128	AAU	2965
								IT-2894546862-2894551142	AAU	4281
								IT-2894551143-2894555642	AAU	4500
								IT-2930340614-2930343143	AAU	2530
								NL-3205215801-3205219800	AAU	4000
								NL-3205220801-3205223800	AAU	3000
								NL-3266915041-3266918049	AAU	3009
								NL-3266918050-3266923049	AAU	5000
								NL-3266923050-3266927389	AAU	4340
								NL-3266927390-3266928049	AAU	660
								NL-3266928050-3266933049	AAU	5000
								NL-3266933050-3266952040	AAU	18991
								PL-2978156506-2978158505	AAU	2000
								PL-2978158506-2978161504	AAU	2999
								PL-3213859298-3213861521	AAU	2224
								PL-3214237522-3214240521	AAU	3000
								PL-3214382522-3214385421	AAU	2900
								PL-3214387522-3214389274	AAU	1753
								PL-3214854286-3214856297	AAU	2012
								PL-3214856298-3214856521	AAU	224
								PL-3215034522-3215036781	AAU	2260

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								PL-3215269522-3215274521	AAU	5000
								PL-3215298522-3215302003	AAU	3482
								PL-3215754782-3215756290	AAU	1509
								PL-3215756291-3215757521	AAU	1231
								PL-3215924522-3215927521	AAU	3000
								PL-3216514423-3216519422	AAU	5000
								PL-3335785230-3335785316	AAU	87
								PL-3335785317-3335787674	AAU	2358
								PL-3335792230-3335792701	AAU	472
								PL-3335792702-3335794417	AAU	1716
								PL-3335800230-3335802674	AAU	2445
								PL-3335829230-3335832229	AAU	3000
								PL-3336108321-3336110829	AAU	2509
								PL-3336110830-3336113210	AAU	2381
								RO-2532394307-2532398980	AAU	4674
								RO-2532400933-2532403980	AAU	3048
								RO-2577088517-2577093516	AAU	5000
								RO-2577108517-2577109516	AAU	1000
								RO-2577401517-2577404516	AAU	3000
								RO-2585882031-2585887030	AAU	5000
								RO-2585892031-2585893021	AAU	991
								RO-2585893022-2585897030	AAU	4009
			NL-13283	2010–01–18 10:36:22	External Transfer	Terminated				
								GB-3975518647-3975520786	AAU	2140
								GB-3975890787-3975900786	AAU	10000
								GB-3975910787-3975915786	AAU	5000
								GB-3976042476-3976045786	AAU	3311
								GB-3976065787-3976085786	AAU	20000
								GB-3976091787-3976093926	AAU	2140
								GB-3976093927-3976096786	AAU	2860
								GB-3994337798-3994340272	AAU	2475
								GB-3994340434-3994342507	AAU	2074
			NL-13284	2010–01–18 10:40:57	External Transfer	Terminated				
								GB-3976085336-3976085786	AAU	451
								GB-3976091787-3976093926	AAU	2140
								GB-3976093927-3976096786	AAU	2860
								GB-3994337798-3994340272	AAU	2475
								GB-3994340434-3994342507	AAU	2074
			NL-13286	2010–01–18 10:58:57	External Transfer	Terminated				
								GB-3976085336-3976085786	AAU	451
								GB-3976091787-3976093926	AAU	2140
								GB-3976093927-3976096786	AAU	2860
								GB-3994337798-3994340272	AAU	2475
								GB-3994340434-3994342507	AAU	2074
			NL-13311	2010–01–19 13:38:22	Internal Transfer	Terminated				
								IN-7213607-7214014	CER	408
								IN-7214015-7224014	CER	10000
								IN-7260015-7264014	CER	4000

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								PK-459593-460139	CER	547
								PK-525140-526139	CER	1000
								PK-526140-529139	CER	3000
								PK-529140-531184	CER	2045
								PK-534140-537139	CER	3000
			NL-13312	2010–01–19 13:58:17	Internal Transfer	Terminated				
								IN-7213607-7214014	CER	408
								IN-7214015-7224014	CER	10000
								IN-7260015-7264014	CER	4000
								PK-459593-460139	CER	547
								PK-525140-526139	CER	1000
								PK-526140-529139	CER	3000
								PK-529140-531184	CER	2045
								PK-534140-537139	CER	3000
			NL-14230	2010–03–12 12:01:55	Internal Transfer	Terminated				
								ES-2066864684-2066873333	AAU	8650
								GB-3405945505-3405954204	AAU	8700
								GB-3581369486-3581375943	AAU	6458
								GB-3690373918-3690381204	AAU	7287
								GB-3690381205-3690382611	AAU	1407
								IT-2884516421-2884525152	AAU	8732
								RO-2424516383-2424524867	AAU	8485
								RO-2429855951-2429856231	AAU	281
			NL-14503	2010–03–23 11:49:23	Internal Transfer	Terminated				
								AT-1529130531-1529131530	AAU	1000
								AT-1533833555-1533835122	AAU	1568
								CZ-1050436425-1050437395	AAU	971
								CZ-1281141456-1281141476	AAU	21
								CZ-1291455019-1291456018	AAU	1000
								ES-1829692369-1829693368	AAU	1000
								ES-1829803369-1829804932	AAU	1564
								ES-2013824266-2013825232	AAU	967
								ES-2013941231-2013941779	AAU	549
								ES-2066617499-2066618496	AAU	998
								ES-2074075607-2074083606	AAU	8000
								GB-3654148773-3654150325	AAU	1553
								HU-571573845-571574200	AAU	356
								IT-2852767287-2852768236	AAU	950
								IT-2895122549-2895123548	AAU	1000
								IT-3063665342-3063666341	AAU	1000
								RO-2600715571-2600716515	AAU	945
								RO-2606829206-2606830763	AAU	1558
			NL-14704	2010–03–31 15:35:49	External Transfer	Terminated				
								BE-431449587-431450586	AAU	1000
								CZ-1190448345-1190450273	AAU	1929
								CZ-1195277102-1195283835	AAU	6734
								CZ-1363954484-1363955571	AAU	1088
								DE-1532053415-1532055169	AAU	1755

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								DE-1532055170-1532055680	AAU	511
								DK-1689140496-1689141495	AAU	1000
								DK-1689141496-1689142691	AAU	1196
								DK-1709489523-1709491443	AAU	1921
								EE-242759881-242761774	AAU	1894
								ES-1778790656-1778791696	AAU	1041
								ES-1789016080-1789017667	AAU	1588
								ES-1813608633-1813609632	AAU	1000
								ES-1845097058-1845098057	AAU	1000
								ES-1900437115-1900437914	AAU	800
								ES-1904690087-1904691180	AAU	1094
								ES-1946102229-1946103687	AAU	1459
								ES-1967648735-1967649745	AAU	1011
								ES-1971075586-1971077307	AAU	1722
								ES-1990807440-1990809183	AAU	1744
								ES-2013723143-2013724869	AAU	1727
								ES-2014858567-2014859566	AAU	1000
								ES-2021640959-2021641962	AAU	1004
								ES-2066616499-2066617498	AAU	1000
								ES-2067162017-2067163027	AAU	1011
								GB-3405786432-3405786640	AAU	209
								GB-3405786641-3405787680	AAU	1040
								GB-3487830709-3487831647	AAU	939
								GB-3487840885-3487842647	AAU	1763
								GB-3554028186-3554029348	AAU	1163
								GB-3654133510-3654133705	AAU	196
								GB-3654691645-3654692844	AAU	1200
								GB-3690689706-3690691409	AAU	1704
								GB-3759715874-3759717124	AAU	1251
								GB-3761754434-3761755350	AAU	917
								GB-3962606724-3962616723	AAU	10000
								GB-3974071591-3974072590	AAU	1000
								GR-268286435-268288263	AAU	1829
								GR-271129302-271131220	AAU	1919
								GR-339159375-339160374	AAU	1000
								GR-412434103-412435102	AAU	1000
								HU-580051225-580052095	AAU	871
								IT-2098022985-2098023882	AAU	898
								IT-2727622321-2727623320	AAU	1000
								IT-2730390175-2730392039	AAU	1865
								IT-2748487517-2748489436	AAU	1920
								IT-2905173696-2905174695	AAU	1000
								IT-2989708430-2989709884	AAU	1455
								IT-3016149936-3016150935	AAU	1000
								IT-3081355428-3081356427	AAU	1000
								LT-225155006-225156959	AAU	1954
								NO-227479319-227480318	AAU	1000
								PL-2983349209-2983350208	AAU	1000
								PL-2983508643-2983510522	AAU	1880
								PL-3202530707-3202533402	AAU	2696

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								PL-3268026304-3268027609	AAU	1306
								PL-3297146869-3297150172	AAU	3304
								PT-2213482517-2213484332	AAU	1816
								RO-2429723099-2429724098	AAU	1000
								RO-2429746099-2429747098	AAU	1000
								RO-2429747099-2429748098	AAU	1000
								RO-2432410360-2432411359	AAU	1000
								RO-2432411360-2432412614	AAU	1255
								RO-2566799017-2566799574	AAU	558
								RO-2600716516-2600718449	AAU	1934
								SE-411949384-411951312	AAU	1929
			NL-15107	2010–04–20 10:40:38	External Transfer	Terminated				
								CZ-1257210835-1257215574	AAU	4740
								ES-2066607680-2066612419	AAU	4740
								ES-2074902889-2074907648	AAU	4760
								GB-3984939080-3984943860	AAU	4781
								GR-339196958-339201737	AAU	4780
								PL-3260575769-3260580754	AAU	4986
								PL-3268341044-3268343254	AAU	2211
								RO-2570551784-2570555285	AAU	3502
			NL-15110	2010–04–20 10:43:47	External Transfer	Terminated				
								CZ-1257210835-1257215574	AAU	4740
								ES-2066607680-2066612419	AAU	4740
								ES-2074902889-2074907648	AAU	4760
								GB-3984939080-3984943860	AAU	4781
								GR-339196958-339201737	AAU	4780
								PL-3260575769-3260580754	AAU	4986
								PL-3268341044-3268343254	AAU	2211
								RO-2570551784-2570555285	AAU	3502
			NL-15135	2010–04–20 12:10:04	External Transfer	Terminated				
								DE-1745360362-1745379913	AAU	19552
								ES-1840095865-1840098697	AAU	2833
								PL-3201009594-3201013208	AAU	3615
								PL-3238359680-3238365495	AAU	5816
								PL-3239475268-3239475294	AAU	27
								PL-3239482138-3239485294	AAU	3157
			NL-16005	2010–05–20 16:04:10	Internal Transfer	Terminated				
								AT-1573193645-1573197644	AAU	4000
								BE-247715086-247717429	AAU	2344
								BE-251354756-251356778	AAU	2023
								BE-251356779-251357477	AAU	699
								BE-287176816-287177745	AAU	930
								BE-287177746-287178282	AAU	537
								BE-431845627-431845938	AAU	312
								BE-431845939-431848289	AAU	2351
								BE-433051426-433054425	AAU	3000
								BE-433065838-433067752	AAU	1915
								BE-433068638-433068825	AAU	188

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								BE-433083520-433083676	AAU	157
								BE-433083677-433084676	AAU	1000
								BE-433112255-433114828	AAU	2574
								BE-433122255-433124753	AAU	2499
								BE-433124754-433124828	AAU	75
								CZ-1115668562-1115669926	AAU	1365
								CZ-1126020575-1126022149	AAU	1575
								CZ-1130532546-1130534633	AAU	2088
								CZ-1263887965-1263889568	AAU	1604
								CZ-1279338173-1279340172	AAU	2000
								CZ-1279497577-1279500394	AAU	2818
								CZ-1286482280-1286484944	AAU	2665
								CZ-1288242940-1288243265	AAU	326
								CZ-1363415233-1363416175	AAU	943
								DE-3619883924-3619888888	AAU	4965
								DE-3619898889-3619898923	AAU	35
								DE-3619898924-3619903888	AAU	4965
								DE-3631627016-3631630176	AAU	3161
								DE-3631630177-3631637015	AAU	6839
								DE-3632817865-3632835864	AAU	18000
								DE-3632839167-3632840289	AAU	1123
								DE-3632840865-3632841166	AAU	302
								FR-3110995234-3110997233	AAU	2000
								FR-3110998230-3110999229	AAU	1000
								FR-3303382523-3303387522	AAU	5000
								GB-3308571094-3308571909	AAU	816
								GB-3510233113-3510233385	AAU	273
								GB-3686240055-3686241054	AAU	1000
								GB-3686245055-3686247215	AAU	2161
								GB-3686247216-3686250054	AAU	2839
								GB-3701274195-3701275538	AAU	1344
								GB-3701275539-3701277377	AAU	1839
								GB-3701277378-3701278194	AAU	817
								GB-3773820575-3773822574	AAU	2000
								GB-3773822575-3773822883	AAU	309
								GB-3792813726-3792815260	AAU	1535
								GB-3972654629-3972655685	AAU	1057
								GB-3972655686-3972659036	AAU	3351
								GB-3973932349-3973936487	AAU	4139
								GB-3984756000-3984759942	AAU	3943
								GB-3984759943-3984760803	AAU	861
								GB-3995393578-3995395349	AAU	1772
								GB-3995395350-3995397917	AAU	2568
								GR-343381015-343382014	AAU	1000
								LT-230747572-230751571	AAU	4000
								LT-230751572-230758774	AAU	7203
								LT-230758775-230761571	AAU	2797
								LV-118969984-118970107	AAU	124
								NL-3107066233-3107067232	AAU	1000
								PL-2739866377-2739876376	AAU	10000

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								PL-2739876377-2739886376	AAU	10000
								PL-2739886377-2739896376	AAU	10000
								PL-2739906377-2739916376	AAU	10000
								PL-2740213377-2740216376	AAU	3000
								PL-3130506839-3130507677	AAU	839
								PL-3130507678-3130507712	AAU	35
								RO-2566501178-2566507177	AAU	6000
			NL-16759	2010–09–03 15:24:18	External Transfer	Terminated				
								IL-20828-20834	CER	7
								IL-253636-254754	CER	1119
								IL-303372-308031	CER	4660
								KR-44386593-44393567	CER	6975
								KR-52613832-52639070	CER	25239
			NL-16760	2010–09–03 15:42:08	External Transfer	Terminated				
								IL-20828-20834	CER	7
								IL-253636-254754	CER	1119
								IL-303372-308031	CER	4660
								KR-44386593-44393567	CER	6975
								KR-52613832-52639070	CER	25239
			NL-16762	2010–09–03 16:09:51	External Transfer	Terminated				
								KR-52638071-52639070	CER	1000
			NL-17125	2010–10–26 15:42:43	External Transfer	Terminated				
								ES-2089844958-2089845957	AAU	1000
4010	709,80	881.58								
			NL-13273	2010–01–15 17:58:39	External Transfer	Terminated				
								AT-1574305675-1574309189	AAU	3515
								AT-1574309190-1574310017	AAU	828
								CZ-1279337356-1279340172	AAU	2817
								CZ-1279497577-1279500394	AAU	2818
								CZ-1279507395-1279510394	AAU	3000
								CZ-1287607940-1287610344	AAU	2405
								CZ-1304824714-1304827981	AAU	3268
								CZ-1332185753-1332188708	AAU	2956
								CZ-1332188709-1332191664	AAU	2956
								DE-1526928327-1526929326	AAU	1000
								DK-1709900498-1709902685	AAU	2188
								ES-1688231718-1688235446	AAU	3729
								ES-1792094706-1792097505	AAU	2800
								ES-1891476820-1891481763	AAU	4944
								ES-1976462677-1976463480	AAU	804
								FR-3155370788-3155374787	AAU	4000
								FR-3155383788-3155385787	AAU	2000
								FR-3289149490-3289152178	AAU	2689
								FR-3289164490-3289166779	AAU	2290
								FR-3289167325-3289169634	AAU	2310
								FR-3289169635-3289172634	AAU	3000
								FR-3296430702-3296432844	AAU	2143

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								FR-3303328586-3303329606	AAU	1021
								FR-3303344586-3303346111	AAU	1526
								FR-3303357638-3303359637	AAU	2000
								FR-3303359638-3303360090	AAU	453
								FR-3317262450-3317267449	AAU	5000
								FR-3397997112-3398000111	AAU	3000
								FR-3398006654-3398011097	AAU	4444
								FR-3410521093-3410521737	AAU	645
								GB-3974788787-3974792786	AAU	4000
								GB-3975517787-3975520786	AAU	3000
								GB-3976065787-3976085786	AAU	20000
								HU-592634877-592637876	AAU	3000
								HU-594230785-594230945	AAU	161
								HU-594230946-594233945	AAU	3000
								HU-595969132-595972131	AAU	3000
								HU-602232597-602237314	AAU	4718
								IE-466273702-466276701	AAU	3000
								IT-2717714212-2717717230	AAU	3019
								IT-2722335151-2722340150	AAU	5000
								IT-2828567952-2828570214	AAU	2263
								IT-2828570215-2828572951	AAU	2737
								IT-2861457534-2861458198	AAU	665
								IT-2861459164-2861462128	AAU	2965
								IT-2894546862-2894551142	AAU	4281
								IT-2894551143-2894555642	AAU	4500
								IT-2930340614-2930343143	AAU	2530
								LT-227967099-227969158	AAU	2060
								LT-261786741-261790395	AAU	3655
								LV-128909557-128912556	AAU	3000
								NL-3205215801-3205219800	AAU	4000
								NL-3205220801-3205223800	AAU	3000
								NL-3266915041-3266918049	AAU	3009
								NL-3266918050-3266923049	AAU	5000
								NL-3266923050-3266928049	AAU	5000
								NL-3266928050-3266933049	AAU	5000
								PL-2978156506-2978158505	AAU	2000
								PL-2978158506-2978161504	AAU	2999
								PL-3213859298-3213861521	AAU	2224
								PL-3214237522-3214240521	AAU	3000
								PL-3214382522-3214385421	AAU	2900
								PL-3214387522-3214389274	AAU	1753
								PL-3214854286-3214856297	AAU	2012
								RO-2577108517-2577109516	AAU	1000
			NL-13274	2010–01–15 18:20:17	External Transfer	Terminated				
								AT-1574305675-1574309189	AAU	3515
								AT-1574309190-1574310017	AAU	828
								CZ-1279337356-1279340172	AAU	2817
								CZ-1279497577-1279500394	AAU	2818
								CZ-1279507395-1279510394	AAU	3000
								CZ-1287607940-1287610344	AAU	2405

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								CZ-1304824714-1304827981	AAU	3268
								CZ-1332185753-1332188708	AAU	2956
								CZ-1332188709-1332191664	AAU	2956
								DE-1526928327-1526929326	AAU	1000
								DK-1709900498-1709902685	AAU	2188
								ES-1688231718-1688235446	AAU	3729
								ES-1792094706-1792097505	AAU	2800
								ES-1891476820-1891481763	AAU	4944
								ES-1976462677-1976463480	AAU	804
								FR-3155370788-3155374787	AAU	4000
								FR-3155383788-3155385787	AAU	2000
								FR-3289149490-3289152178	AAU	2689
								FR-3289164490-3289166779	AAU	2290
								FR-3289167325-3289169634	AAU	2310
								FR-3289169635-3289172634	AAU	3000
								FR-3296430702-3296432844	AAU	2143
								FR-3303328586-3303329606	AAU	1021
								FR-3303344586-3303346111	AAU	1526
								FR-3303357638-3303359637	AAU	2000
								FR-3303359638-3303360090	AAU	453
								FR-3317262450-3317267449	AAU	5000
								FR-3397997112-3398000111	AAU	3000
								FR-3398006654-3398011097	AAU	4444
								FR-3410521093-3410521737	AAU	645
								GB-3974788787-3974792786	AAU	4000
								GB-3975517787-3975520786	AAU	3000
								GB-3976065787-3976085786	AAU	20000
								GB-3976093927-3976096786	AAU	2860
								HU-592634877-592637876	AAU	3000
								HU-594230785-594230945	AAU	161
								HU-594230946-594233945	AAU	3000
								HU-595969132-595972131	AAU	3000
								HU-602232597-602237314	AAU	4718
								IE-466273702-466276701	AAU	3000
								IT-2717714212-2717717230	AAU	3019
								IT-2722335151-2722340150	AAU	5000
								IT-2828567952-2828570214	AAU	2263
								IT-2828570215-2828572951	AAU	2737
								IT-2861457534-2861458198	AAU	665
								IT-2861459164-2861462128	AAU	2965
								IT-2894546862-2894551142	AAU	4281
								IT-2894551143-2894555642	AAU	4500
								IT-2930340614-2930343143	AAU	2530
								LT-227967099-227969158	AAU	2060
								LT-257538603-257543602	AAU	5000
								LT-261786741-261790395	AAU	3655
								LV-128909557-128912556	AAU	3000
								NL-3205215801-3205219800	AAU	4000
								NL-3205220801-3205223800	AAU	3000
								NL-3266915041-3266918049	AAU	3009

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								NL-3266918050-3266923049	AAU	5000
								NL-3266923050-3266928049	AAU	5000
								NL-3266928050-3266933049	AAU	5000
								NL-3266933050-3266952040	AAU	18991
								PL-2978156506-2978158505	AAU	2000
								PL-2978158506-2978161504	AAU	2999
								PL-3213859298-3213861521	AAU	2224
								PL-3214237522-3214240521	AAU	3000
								PL-3214382522-3214385421	AAU	2900
								PL-3214387522-3214389274	AAU	1753
								PL-3214854286-3214856297	AAU	2012
								PL-3214856298-3214856521	AAU	224
								PL-3215034522-3215036781	AAU	2260
								PL-3215269522-3215274521	AAU	5000
								PL-3215298522-3215302003	AAU	3482
								PL-3215754782-3215756290	AAU	1509
								PL-3215756291-3215757521	AAU	1231
								PL-3215924522-3215927521	AAU	3000
								PL-3216514423-3216519422	AAU	5000
								PL-3335785230-3335785316	AAU	87
								PL-3335785317-3335787674	AAU	2358
								PL-3335792230-3335794417	AAU	2188
								PL-3335800230-3335802674	AAU	2445
								PL-3335829230-3335832229	AAU	3000
								PL-3336108321-3336110829	AAU	2509
								PL-3336110830-3336113210	AAU	2381
								RO-2532394307-2532398980	AAU	4674
								RO-2532400933-2532403980	AAU	3048
								RO-2577088517-2577093516	AAU	5000
								RO-2577108517-2577109516	AAU	1000
								RO-2577401517-2577404516	AAU	3000
								RO-2585882031-2585887030	AAU	5000
								RO-2585892031-2585893021	AAU	991
								RO-2585893022-2585897030	AAU	4009
								SE-429125479-429128417	AAU	2939
								SK-275805442-275808441	AAU	3000
								SK-421262988-421265435	AAU	2448
								SK-448564012-448566377	AAU	2366
			NL-13275	2010–01–15 18:24:09	External Transfer	Terminated				
								FR-3289149490-3289152178	AAU	2689
								FR-3289164490-3289166779	AAU	2290
								FR-3289167325-3289169634	AAU	2310
								FR-3289169635-3289172634	AAU	3000
								FR-3296430702-3296432844	AAU	2143
								FR-3303328586-3303329606	AAU	1021
								FR-3303344586-3303346111	AAU	1526
								FR-3303357638-3303359637	AAU	2000
								FR-3303359638-3303360090	AAU	453
								FR-3317262450-3317267449	AAU	5000
								FR-3397997112-3398000111	AAU	3000

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								FR-3398006654-3398011097	AAU	4444
								FR-3410521093-3410521737	AAU	645
								GB-3974788787-3974792786	AAU	4000
								GB-3975517787-3975520786	AAU	3000
								GB-3976065787-3976085786	AAU	20000
								GB-3976093927-3976096786	AAU	2860
								NL-3266927390-3266928049	AAU	660
								NL-3266928050-3266933049	AAU	5000
								NL-3266933050-3266952040	AAU	18991
								PL-3335785230-3335785316	AAU	87
								PL-3335785317-3335787674	AAU	2358
								PL-3335792230-3335794417	AAU	2188
								PL-3335800230-3335802674	AAU	2445
								PL-3335829230-3335832229	AAU	3000
								PL-3336108321-3336110829	AAU	2509
								PL-3336110830-3336113210	AAU	2381
			NL-13276	2010–01–15 18:27:04	External Transfer	Terminated				
								FR-3397997112-3398000111	AAU	3000
								FR-3398006654-3398011097	AAU	4444
								FR-3410521093-3410521737	AAU	645
								GB-3974788787-3974792786	AAU	4000
								GB-3975517787-3975520786	AAU	3000
								GB-3976065787-3976085786	AAU	20000
								GB-3976093927-3976096786	AAU	2860
								PL-3335792702-3335794417	AAU	1716
								PL-3335800230-3335802674	AAU	2445
								PL-3335829230-3335832229	AAU	3000
								PL-3336108321-3336110829	AAU	2509
								PL-3336110830-3336113210	AAU	2381
			NL-13277	2010–01–15 18:31:12	External Transfer	Terminated				
								FR-3410521598-3410521737	AAU	140
								GB-3974788787-3974792786	AAU	4000
								GB-3975517787-3975520786	AAU	3000
								GB-3976065787-3976085786	AAU	20000
								GB-3976093927-3976096786	AAU	2860
			NL-13278	2010–01–15 18:43:44	External Transfer	Terminated				
								FR-3397997112-3398000111	AAU	3000
								FR-3398006654-3398011097	AAU	4444
								FR-3410521093-3410521597	AAU	505
								FR-3410521598-3410521737	AAU	140
								GB-3974788787-3974792786	AAU	4000
								GB-3975517787-3975520786	AAU	3000
								GB-3976065787-3976085786	AAU	20000
								GB-3976093927-3976096786	AAU	2860
								PL-3335792702-3335794417	AAU	1716
								PL-3335800230-3335802674	AAU	2445
								PL-3335829230-3335832229	AAU	3000
								PL-3336108321-3336110829	AAU	2509

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								PL-3336110830-3336113210	AAU	2381
			NL-13311	2010–01–19 13:38:22	Internal Transfer	Terminated				
								IN-7213607-7214014	CER	408
								IN-7214015-7224014	CER	10000
								IN-7260015-7264014	CER	4000
								PK-459593-460139	CER	547
								PK-525140-526139	CER	1000
								PK-526140-529139	CER	3000
								PK-529140-531184	CER	2045
								PK-534140-537139	CER	3000
			NL-13312	2010–01–19 13:58:17	Internal Transfer	Terminated				
								IN-7213607-7214014	CER	408
								IN-7214015-7224014	CER	10000
								IN-7260015-7264014	CER	4000
								PK-459593-460139	CER	547
								PK-525140-526139	CER	1000
								PK-526140-529139	CER	3000
								PK-529140-531184	CER	2045
								PK-534140-537139	CER	3000
			NL-14230	2010–03–12 12:01:55	Internal Transfer	Terminated				
								ES-2066864684-2066873333	AAU	8650
								GB-3405945505-3405954204	AAU	8700
								GB-3581369486-3581375943	AAU	6458
								GB-3690373918-3690381204	AAU	7287
								GB-3690381205-3690382611	AAU	1407
								IT-2884516421-2884525152	AAU	8732
								RO-2424516383-2424524867	AAU	8485
								RO-2429855951-2429856231	AAU	281
			NL-14299	2010–03–16 12:05:56	External Transfer	Terminated				
								FI-463094210-463100329	AAU	6120
								GB-3405954205-3405958386	AAU	4182
								GB-3405958387-3405960504	AAU	2118
								GB-3771769925-3771776473	AAU	6549
								HU-592904465-592910563	AAU	6099
								IT-2989542394-2989543941	AAU	1548
								LT-224722292-224728476	AAU	6185
								LT-225078191-225084499	AAU	6309
								SK-394252793-394255695	AAU	2903
								SK-394255696-394259204	AAU	3509
								SK-396031507-396035984	AAU	4478
			NL-14300	2010–03–16 12:09:38	External Transfer	Terminated				
								FI-463095826-463100329	AAU	4504
								GB-3405954205-3405958386	AAU	4182
								GB-3405958387-3405960504	AAU	2118
								GB-3771769925-3771776473	AAU	6549
								HU-592904465-592910563	AAU	6099
								IT-2989542394-2989543941	AAU	1548

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
			NL-14301	2010–03–16 12:13:13	External Transfer	Terminated				
								GB-3405957054-3405958386	AAU	1333
								GB-3405958387-3405960504	AAU	2118
								GB-3771769925-3771776473	AAU	6549
			NL-14302	2010–03–16 12:16:14	External Transfer	Terminated				
								GB-3405957054-3405958386	AAU	1333
								GB-3405958387-3405960504	AAU	2118
								GB-3771769925-3771776473	AAU	6549
			NL-14303	2010–03–16 12:22:14	External Transfer	Terminated				
								GB-3771771474-3771776473	AAU	5000
			NL-14305	2010–03–16 12:24:46	External Transfer	Terminated				
								GB-3771775474-3771776473	AAU	1000
			NL-14306	2010–03–16 12:27:42	External Transfer	Terminated				
								GB-3771771474-3771775473	AAU	4000
								GB-3771775474-3771776473	AAU	1000
			NL-14307	2010–03–16 12:29:16	Internal Transfer	Terminated				
								FI-463094210-463095825	AAU	1616
								FI-463095826-463100329	AAU	4504
								GB-3405954205-3405957053	AAU	2849
								GB-3405957054-3405958386	AAU	1333
								GB-3405958387-3405960504	AAU	2118
								GB-3771769925-3771771473	AAU	1549
								GB-3771771474-3771775473	AAU	4000
								GB-3771775474-3771776473	AAU	1000
								HU-592904465-592910563	AAU	6099
								IT-2989542394-2989543941	AAU	1548
								SK-396032601-396035984	AAU	3384
			NL-14308	2010–03–16 12:35:54	External Transfer	Terminated				
								GB-3771771474-3771775473	AAU	4000
								GB-3771775474-3771776473	AAU	1000
			NL-14309	2010–03–16 12:39:13	Internal Transfer	Terminated				
								FI-463094210-463095825	AAU	1616
								FI-463095826-463100329	AAU	4504
								GB-3405954205-3405957053	AAU	2849
								GB-3405957054-3405958386	AAU	1333
								GB-3405958387-3405960504	AAU	2118
								GB-3771769925-3771771473	AAU	1549
								GB-3771771474-3771775473	AAU	4000
								GB-3771775474-3771776473	AAU	1000
								HU-592904465-592910563	AAU	6099
								IT-2989542394-2989543941	AAU	1548
								LT-224722292-224728476	AAU	6185
								LT-225078191-225084499	AAU	6309
								SK-394252793-394255695	AAU	2903
								SK-394255696-394259204	AAU	3509

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								SK-396031507-396032600	AAU	1094
								SK-396032601-396035984	AAU	3384
			NL-14310	2010–03–16 12:42:30	External Transfer	Terminated				
								FI-463095826-463100329	AAU	4504
			NL-14311	2010–03–16 12:46:12	External Transfer	Terminated				
								FI-463094210-463095825	AAU	1616
								FI-463095826-463100329	AAU	4504
								GB-3405954205-3405957053	AAU	2849
								GB-3405957054-3405958386	AAU	1333
								GB-3405958387-3405960504	AAU	2118
								GB-3771769925-3771771473	AAU	1549
								GB-3771771474-3771775473	AAU	4000
								GB-3771775474-3771776473	AAU	1000
								HU-592904465-592910563	AAU	6099
								IT-2989542394-2989543941	AAU	1548
								LT-224722292-224728476	AAU	6185
								LT-225078191-225084499	AAU	6309
								SK-394252793-394255695	AAU	2903
								SK-394255696-394259204	AAU	3509
								SK-396031507-396032600	AAU	1094
								SK-396032601-396035984	AAU	3384
			NL-14312	2010–03–16 12:50:09	External Transfer	Terminated				
								GB-3405954205-3405957053	AAU	2849
								GB-3405957054-3405958386	AAU	1333
								GB-3405958387-3405960504	AAU	2118
								GB-3771769925-3771771473	AAU	1549
								GB-3771771474-3771775473	AAU	4000
								GB-3771775474-3771776473	AAU	1000
								HU-592904961-592910563	AAU	5603
								IT-2989542394-2989543941	AAU	1548
			NL-14313	2010–03–16 13:05:54	External Transfer	Terminated				
								FI-463094210-463095825	AAU	1616
								FI-463095826-463100329	AAU	4504
								GB-3405954205-3405957053	AAU	2849
								GB-3405957054-3405958386	AAU	1333
								GB-3405958387-3405960504	AAU	2118
								GB-3771769925-3771771473	AAU	1549
								GB-3771771474-3771775473	AAU	4000
								GB-3771775474-3771776473	AAU	1000
								HU-592904465-592904960	AAU	496
								HU-592904961-592910563	AAU	5603
								IT-2989542394-2989543941	AAU	1548
								LT-224722292-224728476	AAU	6185
								LT-225078191-225084499	AAU	6309
								SK-394252793-394255695	AAU	2903
								SK-394255696-394259204	AAU	3509
								SK-396031507-396032600	AAU	1094
								SK-396032601-396035984	AAU	3384

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
			NL-14316	2010–03–16 13:14:11	External Transfer	Terminated				
								FI-463094210-463095825	AAU	1616
								FI-463095826-463100329	AAU	4504
								GB-3405954205-3405957053	AAU	2849
								GB-3405957054-3405958386	AAU	1333
								GB-3405958387-3405960504	AAU	2118
								GB-3771769925-3771771473	AAU	1549
								GB-3771771474-3771775473	AAU	4000
								GB-3771775474-3771776473	AAU	1000
								HU-592904465-592904960	AAU	496
								HU-592904961-592910563	AAU	5603
								IT-2989542394-2989543941	AAU	1548
								LT-224722292-224728476	AAU	6185
								LT-225078191-225084499	AAU	6309
								SK-394252793-394255695	AAU	2903
								SK-394255696-394259204	AAU	3509
								SK-396031507-396032600	AAU	1094
								SK-396032601-396035984	AAU	3384
			NL-14319	2010–03–16 13:41:46	External Transfer	Terminated				
								FI-463094210-463095825	AAU	1616
								FI-463095826-463100329	AAU	4504
								GB-3405954205-3405957053	AAU	2849
								GB-3405957054-3405958386	AAU	1333
								GB-3405958387-3405960504	AAU	2118
								GB-3771769925-3771771473	AAU	1549
								GB-3771771474-3771775473	AAU	4000
								GB-3771775474-3771776473	AAU	1000
								HU-592904465-592904960	AAU	496
								HU-592904961-592910563	AAU	5603
								IT-2989542394-2989543941	AAU	1548
								LT-224722292-224728476	AAU	6185
								LT-225078191-225084499	AAU	6309
								SK-394252793-394255695	AAU	2903
								SK-394255696-394259204	AAU	3509
								SK-396031507-396032600	AAU	1094
								SK-396032601-396035984	AAU	3384
			NL-14503	2010–03–23 11:49:23	Internal Transfer	Terminated				
								AT-1529130531-1529131530	AAU	1000
								AT-1533833555-1533835122	AAU	1568
								CZ-1050436425-1050437395	AAU	971
								CZ-1281141456-1281141476	AAU	21
								CZ-1291455019-1291456018	AAU	1000
								ES-1829692369-1829693368	AAU	1000
								ES-1829803369-1829804932	AAU	1564
								ES-2013824266-2013825232	AAU	967
								ES-2013941231-2013941779	AAU	549
								ES-2066617499-2066618496	AAU	998
								ES-2074075607-2074083606	AAU	8000

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								GB-3654148773-3654150325	AAU	1553
								HU-571573845-571574200	AAU	356
								IT-2852767287-2852768236	AAU	950
								IT-2895122549-2895123548	AAU	1000
								IT-3063665342-3063666341	AAU	1000
								RO-2600715571-2600716515	AAU	945
								RO-2606829206-2606830763	AAU	1558
			NL-14704	2010–03–31 15:35:49	External Transfer	Terminated				
								BE-431449587-431450586	AAU	1000
								CZ-1190448345-1190450273	AAU	1929
								CZ-1195277102-1195283835	AAU	6734
								CZ-1363954484-1363955571	AAU	1088
								DE-1532053415-1532055169	AAU	1755
								DE-1532055170-1532055680	AAU	511
								DK-1689140496-1689141495	AAU	1000
								DK-1689141496-1689142691	AAU	1196
								DK-1709489523-1709491443	AAU	1921
								EE-242759881-242761774	AAU	1894
								ES-1778790656-1778791696	AAU	1041
								ES-1789016080-1789017667	AAU	1588
								ES-1813608633-1813609632	AAU	1000
								ES-1845097058-1845098057	AAU	1000
								ES-1900437115-1900437914	AAU	800
								ES-1904690087-1904691180	AAU	1094
								ES-1946102229-1946103687	AAU	1459
								ES-1967648735-1967649745	AAU	1011
								ES-1971075586-1971077307	AAU	1722
								ES-1990807440-1990809183	AAU	1744
								ES-2013723143-2013724869	AAU	1727
								ES-2014858567-2014859566	AAU	1000
								ES-2021640959-2021641962	AAU	1004
								ES-2066616499-2066617498	AAU	1000
								ES-2067162017-2067163027	AAU	1011
								GB-3405786432-3405786640	AAU	209
								GB-3405786641-3405787680	AAU	1040
								GB-3487830709-3487831647	AAU	939
								GB-3487840885-3487842647	AAU	1763
								GB-3554028186-3554029348	AAU	1163
								GB-3654133510-3654133705	AAU	196
								GB-3654691645-3654692844	AAU	1200
								GB-3690689706-3690691409	AAU	1704
								GB-3759715874-3759717124	AAU	1251
								GB-3761754434-3761755350	AAU	917
								GB-3962606724-3962616723	AAU	10000
								GB-3974071591-3974072590	AAU	1000
								GR-268286435-268288263	AAU	1829
								GR-271129302-271131220	AAU	1919
								GR-339159375-339160374	AAU	1000
								GR-412434103-412435102	AAU	1000
								HU-580051225-580052095	AAU	871

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								IT-2098022985-2098023882	AAU	898
								IT-2727622321-2727623320	AAU	1000
								IT-2730390175-2730392039	AAU	1865
								IT-2748487517-2748489436	AAU	1920
								IT-2905173696-2905174695	AAU	1000
								IT-2989708430-2989709884	AAU	1455
								IT-3016149936-3016150935	AAU	1000
								IT-3081355428-3081356427	AAU	1000
								LT-225155006-225156959	AAU	1954
								NO-227479319-227480318	AAU	1000
								PL-2983349209-2983350208	AAU	1000
								PL-2983508643-2983510522	AAU	1880
								PL-3202530707-3202533402	AAU	2696
								PL-3268026304-3268027609	AAU	1306
								PL-3297146869-3297150172	AAU	3304
								PT-2213482517-2213484332	AAU	1816
								RO-2429723099-2429724098	AAU	1000
								RO-2429746099-2429747098	AAU	1000
								RO-2429747099-2429748098	AAU	1000
								RO-2432410360-2432411359	AAU	1000
								RO-2432411360-2432412614	AAU	1255
								RO-2566799017-2566799574	AAU	558
								RO-2600716516-2600718449	AAU	1934
								SE-411949384-411951312	AAU	1929
			NL-15107	2010–04–20 10:40:38	External Transfer	Terminated				
								CZ-1257210835-1257215574	AAU	4740
								ES-2066607680-2066612419	AAU	4740
								ES-2074902889-2074907648	AAU	4760
								GB-3984939080-3984943860	AAU	4781
								GR-339196958-339201737	AAU	4780
								PL-3260575769-3260580754	AAU	4986
								PL-3268341044-3268343254	AAU	2211
								RO-2570551784-2570555285	AAU	3502
			NL-15110	2010–04–20 10:43:47	External Transfer	Terminated				
								CZ-1257210835-1257215574	AAU	4740
								ES-2066607680-2066612419	AAU	4740
								ES-2074902889-2074907648	AAU	4760
								GB-3984939080-3984943860	AAU	4781
								GR-339196958-339201737	AAU	4780
								PL-3260575769-3260580754	AAU	4986
								PL-3268341044-3268343254	AAU	2211
								RO-2570551784-2570555285	AAU	3502
			NL-15135	2010–04–20 12:10:04	External Transfer	Terminated				
								DE-1745360362-1745379913	AAU	19552
								ES-1840095865-1840098697	AAU	2833
								PL-3201009594-3201013208	AAU	3615
								PL-3238359680-3238365495	AAU	5816
								PL-3239475268-3239475294	AAU	27

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								PL-3239482138-3239485294	AAU	3157
			NL-16005	2010–05–20 16:04:10	Internal Transfer	Terminated				
								AT-1573193645-1573197644	AAU	4000
								BE-247715086-247717429	AAU	2344
								BE-251354756-251356778	AAU	2023
								BE-251356779-251357477	AAU	699
								BE-287176816-287177745	AAU	930
								BE-287177746-287178282	AAU	537
								BE-431845627-431845938	AAU	312
								BE-431845939-431848289	AAU	2351
								BE-433051426-433054425	AAU	3000
								BE-433065838-433067752	AAU	1915
								BE-433068638-433068825	AAU	188
								BE-433083520-433083676	AAU	157
								BE-433083677-433084676	AAU	1000
								BE-433112255-433114828	AAU	2574
								BE-433122255-433124753	AAU	2499
								BE-433124754-433124828	AAU	75
								CZ-1115668562-1115669926	AAU	1365
								CZ-1126020575-1126022149	AAU	1575
								CZ-1130532546-1130534633	AAU	2088
								CZ-1263887965-1263889568	AAU	1604
								CZ-1279338173-1279340172	AAU	2000
								CZ-1279497577-1279500394	AAU	2818
								CZ-1286482280-1286484944	AAU	2665
								CZ-1288242940-1288243265	AAU	326
								CZ-1363415233-1363416175	AAU	943
								DE-3619883924-3619888888	AAU	4965
								DE-3619898889-3619898923	AAU	35
								DE-3619898924-3619903888	AAU	4965
								DE-3631627016-3631630176	AAU	3161
								DE-3631630177-3631637015	AAU	6839
								DE-3632817865-3632835864	AAU	18000
								DE-3632839167-3632840289	AAU	1123
								DE-3632840865-3632841166	AAU	302
								FR-3110995234-3110997233	AAU	2000
								FR-3110998230-3110999229	AAU	1000
								FR-3303382523-3303387522	AAU	5000
								GB-3308571094-3308571909	AAU	816
								GB-3510233113-3510233385	AAU	273
								GB-3686240055-3686241054	AAU	1000
								GB-3686245055-3686247215	AAU	2161
								GB-3686247216-3686250054	AAU	2839
								GB-3701274195-3701275538	AAU	1344
								GB-3701275539-3701277377	AAU	1839
								GB-3701277378-3701278194	AAU	817
								GB-3773820575-3773822574	AAU	2000
								GB-3773822575-3773822883	AAU	309
								GB-3792813726-3792815260	AAU	1535
								GB-3972654629-3972655685	AAU	1057

DES Response Code	Average number of occurrences per transaction (X 100.000)		Transaction Number	Proposal Date Time	Transaction Type	Final State	Explanation	Units Involved Abbreviated		
	Reported Year	Prior to the Reported Year						Serial Number	Unit Type	Quantity
								GB-3972655686-3972659036	AAU	3351
								GB-3973932349-3973936487	AAU	4139
								GB-3984756000-3984759942	AAU	3943
								GB-3984759943-3984760803	AAU	861
								GB-3995393578-3995395349	AAU	1772
								GB-3995395350-3995397917	AAU	2568
								GR-343381015-343382014	AAU	1000
								LT-230747572-230751571	AAU	4000
								LT-230751572-230758774	AAU	7203
								LT-230758775-230761571	AAU	2797
								LV-118969984-118970107	AAU	124
								NL-3107066233-3107067232	AAU	1000
								PL-2739866377-2739876376	AAU	10000
								PL-2739876377-2739886376	AAU	10000
								PL-2739886377-2739896376	AAU	10000
								PL-2739906377-2739916376	AAU	10000
								PL-2740213377-2740216376	AAU	3000
								PL-3130506839-3130507677	AAU	839
								PL-3130507678-3130507712	AAU	35
								RO-2566501178-2566507177	AAU	6000
			NL-16759	2010–09–03 15:24:18	External Transfer	Terminated				
								IL-20828-20834	CER	7
								IL-253636-254754	CER	1119
								IL-303372-308031	CER	4660
								KR-44386593-44393567	CER	6975
								KR-52613832-52639070	CER	25239
			NL-16760	2010–09–03 15:42:08	External Transfer	Terminated				
								IL-20828-20834	CER	7
								IL-253636-254754	CER	1119
								IL-303372-308031	CER	4660
								KR-44386593-44393567	CER	6975
								KR-52613832-52639070	CER	25239
			NL-16762	2010–09–03 16:09:51	External Transfer	Terminated				
								KR-52638071-52639070	CER	1000
			NL-17125	2010–10–26 15:42:43	External Transfer	Terminated				
								ES-2089844958-2089845957	AAU	1000

Annex 7 Tables 6.1 and 6.2 of the IPCC Good Practice guidance

As described in Section 1.7, a Tier 1 uncertainty assessment was made to estimate the uncertainty in total national greenhouse gas emissions and in their trend. Tier 1 here means that non-Gaussian uncertainty distributions and correlations between sources have been neglectedF[1]F. The uncertainty estimates for activity data and emission factors as listed in Table A7.2 were also used for a Tier 1 trend uncertainty assessment, as shown in Table A7.1. Uncertainties for the activity data and emission factors are derived from a mixture of empirical data and expert judgment and presented here as half the 95% confidence interval. The reason for halving the 95% confidence interval is that the value then corresponds to the familiar plus or minus value when uncertainties are loosely quoted as "plus or minus x%".

Table A7.1 Uncertainty estimates for Tier 1 trend.

	Uncertainty in emission level	Uncertainty in emission trend
CO_2 eq	± 3%	± 3%-points of 7% decrease
CO_2	± 2%	± 3%-points of 7% increase
CH_4	± 17%	± 9%-points of 34% decrease
N_2O	± 44%[1]	± 8%-points of 53% decrease
F-gases	± 50%	± 11%-points of 71% decrease

* The uncertainty is higher compared to last submission as a result of the changes in methodology for the calculations of the emissions from manure management.

Details on this calculation can be found in Table A7.2 and in Olivier et al. (2009). It should be stressed that most uncertainty estimates are ultimately based on collective expert judgment and therefore also rather uncertain (usually of the order of 50%). However, the reason to make these estimates is to identify the relatively most important uncertain sources. For this purpose, a reasonable order-of-magnitude estimate of the uncertainty in activity data and in emission factors is usually sufficient: uncertainty estimates are a means to identify and prioritize inventory improvement activities, rather than an objective in itself.

This result may be interpreted in two ways: part of the uncertainty is due to inherent lack of knowledge on the sources that cannot be improved. Another part, however,

[1] We note that a Tier 2 uncertainty assessment and a comparison with a Tier 1 uncertainty estimate based on similar data showed that in the Dutch circumstances the errors made in the simplified Tier 1 approach for estimating uncertainties are quite small (Olsthoorn and Pielaat, 2003; and Ramírez-Ramírez et al., 2006). This conclusion holds for both annual uncertainties and the trend uncertainty (see Section 1.7 for more details).

can be attributed to elements of the inventory of which the uncertainty could be reduced in the course of time. The latter may be a result of either dedicated research initiated by the Inventory Agency or by other researchers. When this type of uncertainty is in sources that are expected to be relevant for emission reduction policies, the effectiveness of the policy package could be in jeopardy if the unreduced emissions turn out to be much less than originally estimated.

The results of this uncertainty assessment for the list of potential key sources can also be used to refine the Tier 1 key source assessment discussed above.

Table A7.2 Tier 1 level and trend uncertainty assessment 1990–2009 (for F-gases with base year 1995) with the categories of the IPCC potential key source list (without adjustment for correlation sources).

IPCC	Category	Gas	CO2-eq base year abs	CO2-eq last year abs	AD unc	EF unc	Uncertainty estimate	Combined Uncertainty as % of total national emissions	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by emission factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
4D3	Indirect N2O emissions from nitrogen used in agriculture	N2O	3.355	1.512	50%	200%	206%	1,5%	-0,7%	1%	-1,5%	0,5%	1,6%
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO2	7.632	11.113	20%	0%	20%	1,1%	1,8%	5%	0,0%	1,4%	1,4%
6A1	CH4 emissions from solid waste disposal sites	CH4	12011	4637	30%	15%	34%	0,8%	-3,0%	2%	-0,5%	0,9%	1,0%
4D2	Animal production on agricultural soils	N2O	3150	1300	10%	100%	100%	0,6%	-0,8%	1%	-0,8%	0,1%	0,8%
5C1	5C1. Grassland remaining Grassland	CO2	4.246	4.246	25%	50%	56%	1,1%	0,1%	2%	0,1%	0,7%	0,7%
1A3b	Mobile combustion: road vehicles: diesel oil	CO2	11.832	19.554	5%	2%	5%	0,5%	3,8%	9%	0,1%	0,6%	0,6%
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO2	18.696	17.681	5%	0%	5%	0,4%	0,1%	8%	0,0%	0,6%	0,6%
1A1b	Stationary combustion : Petroleum Refining: liquids	CO2	9.999	8.163	10%	10%	14%	0,6%	-0,5%	4%	-0,1%	0,5%	0,5%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gases	CO2	7.330	7.294	10%	0%	10%	0,4%	0,2%	3%	0,0%	0,5%	0,5%
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	247	1.798	10%	50%	51%	0,4%	0,7%	1%	0,4%	0,1%	0,4%
5A1	5A1. Forest Land remaining Forest Land	CO2	2.434	2.144	25%	62%	67%	0,7%	-0,1%	1%	0,0%	0,3%	0,3%
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO2	1.526	1.936	20%	5%	21%	0,2%	0,2%	1%	0,0%	0,2%	0,2%
4D1	Direct N2O emissions from agricultural soils	N2O	4.138	3.514	10%	60%	61%	1,0%	-0,2%	2%	-0,1%	0,2%	0,2%
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	5.759	154	10%	10%	14%	0,0%	-2,4%	0%	-0,2%	0,0%	0,2%
1A	Emissions from stationary combustion: non-CO2	CH4	572	1.565	3%	50%	50%	0,4%	0,5%	1%	0,2%	0,0%	0,2%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, liquids	CO2	2.587	1.805	20%	2%	20%	0,2%	-0,3%	1%	0,0%	0,2%	0,2%
5A2	5A2. Land converted to Forest Land	CO2	3	706	25%	58%	63%	0,2%	0,3%	0%	0,2%	0,1%	0,2%
2B5	Other chemical product manufacture	CO2	649	651	50%	50%	70%	0,2%	0,0%	0%	0,0%	0,2%	0,2%
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO2	601	2.531	10%	5%	11%	0,1%	0,9%	1%	0,0%	0,2%	0,2%
1A3b	Mobile combustion: road vehicles: gasoline	CO2	10.902	12.810	2%	2%	3%	0,2%	1,2%	6%	0,0%	0,2%	0,2%
1B1b	CO2 from coke production	CO2	403	513	50%	2%	50%	0,1%	0,1%	0%	0,0%	0,2%	0,2%
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO2	19.020	12.575	2%	0%	2%	0,1%	-2,4%	6%	0,0%	0,2%	0,2%
2C3	PFC from aluminium production	PFC	1.901	43	2%	20%	20%	0,0%	-0,8%	0%	-0,2%	0,0%	0,2%
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO2	25.776	23.621	1%	3%	3%	0,4%	-0,2%	11%	0,0%	0,2%	0,2%
2B2	Nitric acid production	N2O	6.330	447	5%	6%	8%	0,0%	-2,5%	0%	-0,1%	0,0%	0,2%
4B1	Emissions from manure management : cattle	CH4	1.574	1.693	10%	100%	100%	0,8%	0,1%	1%	0,1%	0,1%	0,1%
4A1	CH4 emissions from enteric fermentation in domestic livestock: mature dairy cattle	CH4	4.356	3.971	5%	15%	16%	0,3%	-0,1%	2%	0,0%	0,1%	0,1%
5C2	5C2. Land converted to Grassland	CO2	391	544	25%	61%	66%	0,2%	0,1%	0%	0,0%	0,1%	0,1%
1B2	Fugitive emissions venting/flaring	CH4	1.252	348	2%	25%	25%	0,0%	-0,4%	0%	-0,1%	0,0%	0,1%
4B9	Emissions from manure management : poultry	CH4	273	53	10%	100%	100%	0,0%	-0,1%	0%	-0,1%	0,0%	0,1%
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO2	13.348	25.720	1%	0%	1%	0,1%	6,0%	12%	0,0%	0,1%	0,1%
2B5	Caprolactam production	N2O	766	603	20%	23%	30%	0,1%	-0,1%	0%	0,0%	0,1%	0,1%
1A3	Mobile combustion: water-borne navigation	CO2	405	610	20%	0%	20%	0,1%	0,1%	0%	0,0%	0,1%	0,1%
4B8	Emissions from manure management : swine	CH4	1.140	1.126	10%	100%	100%	0,5%	0,0%	1%	0,0%	0,1%	0,1%
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO2	1.356	541	20%	2%	20%	0,1%	-0,3%	0%	0,0%	0,1%	0,1%
4B	Emissions from manure management	N2O	678	503	10%	100%	100%	0,2%	-0,1%	0%	-0,1%	0,0%	0,1%
4A1	CH4 emissions from enteric fermentation in domestic livestock: young cattle	CH4	2.264	1.672	5%	20%	21%	0,2%	-0,2%	1%	0,0%	0,1%	0,1%
1A3b	Mobile combustion: road vehicles: LPG	CO2	2.738	993	10%	2%	10%	0,0%	-0,7%	0%	0,0%	0,1%	0,1%
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO2	5.033	3.911	2%	10%	10%	0,2%	-0,4%	2%	0,0%	0,1%	0,1%
2F	SF6 emissions from SF6 use	SF6	301	175	50%	25%	56%	0,0%	0,0%	0%	0,0%	0,1%	0,1%
2A7	Other minerals	CO2	275	357	25%	5%	25%	0,0%	0,0%	0%	0,0%	0,1%	0,1%
6B	Emissions from wastewater handling	N2O	466	438	20%	50%	54%	0,1%	0,0%	0%	0,0%	0,1%	0,1%
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO2	8.975	8.456	1%	5%	5%	0,2%	0,0%	4%	0,0%	0,1%	0,1%
5E2	5E2. Land converted to Settlements	CO2	210	294	25%	50%	56%	0,1%	0,0%	0%	0,0%	0,1%	0,1%
2A3	Limestone and dolomite use	CO2	232	269	25%	5%	25%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
1A3	Mobile combustion: road vehicles	N2O	271	428	5%	50%	50%	0,1%	0,1%	0%	0,0%	0,0%	0,0%
2B1	Ammonia production	CO2	3.096	2.857	2%	1%	2%	0,0%	0,0%	1%	0,0%	0,0%	0,0%
2C1	Iron and steel production (carbon inputs)	CO2	2.514	1.054	3%	5%	6%	0,0%	-0,6%	0%	0,0%	0,0%	0,0%
1A5	Military use of fuels (1A5 Other)	CO2	566	267	20%	2%	20%	0,0%	-0,1%	0%	0,0%	0,0%	0,0%
3, 6D	OTHER N2O	N2O	250	116	20%	50%	54%	0,0%	-0,1%	0%	0,0%	0,0%	0,0%
1A	Emissions from stationary combustion: non-CO2	N2O	225	335	3%	50%	50%	0,1%	0,1%	0%	0,0%	0,0%	0,0%
6B	Emissions from wastewater handling	CH4	290	207	20%	25%	32%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO2	207	684	1%	10%	10%	0,0%	0,2%	0%	0,0%	0,0%	0,0%
1B2	Fugitive emissions from oil and gas operations: other	CH4	166	163	20%	50%	54%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
3	Indirect CO2 from solvents/product use	CO2	316	120	25%	10%	27%	0,0%	-0,1%	0%	0,0%	0,0%	0,0%
1A3	Mobile combustion: road vehicles	CH4	157	56	3%	50%	50%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
1B2	Fugitive emissions venting/flaring: CO2	CO2	775	53	50%	2%	50%	0,0%	-0,3%	0%	0,0%	0,0%	0,0%
2G	Other industrial: CH4	CH4	297	270	10%	50%	51%	0,1%	0,0%	0%	0,0%	0,0%	0,0%
5G	5G. Other (liming of soils)	CO2	183	91	25%	1%	25%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
4A8	CH4 emissions from enteric fermentation in domestic livestock: swine	CH4	438	384	5%	50%	50%	0,1%	0,0%	0%	0,0%	0,0%	0,0%
2A1	Cement production	CO2	416	416	5%	10%	11%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
1A3	Mobile combustion: aircraft	CO2	41	41	50%	1%	50%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
2E	HFC by-product emissions from HFC manufacture	HFC	12	109	10%	20%	22%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
2F	PFC emissions from PFC use	PFC	37	125	5%	25%	25%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
1A4	Stationary combustion : Other Sectors, solids	CO2	189	31	50%	5%	50%	0,0%	-0,1%	0%	0,0%	0,0%	0,0%
2G	Other industrial: CO2	CO2	304	314	5%	20%	21%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
5D2	5D2. Land converted to Wetlands	CO2	40	56	25%	50%	56%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
4A	CH4 emissions from enteric fermentation in domestic livestock: other	CH4	319	282	5%	30%	30%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
1A1b	Stationary combustion : Petroleum Refining: gases	CO2	1.042	2.591	1%	0%	1%	0,0%	0,7%	1%	0,0%	0,0%	0,0%
5B2	5B2. Land converted to Cropland	CO2	34	48	25%	50%	56%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
4A1	CH4 emissions from enteric fermentation in domestic livestock: mature non-dairy cattle	CH4	163	187	5%	20%	21%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH4	255	271	2%	25%	25%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
5F2	5F2. Land converted to Other Land	CO2	18	25	25%	50%	56%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
2C3	CO2 from aluminium production	CO2	395	224	2%	5%	5%	0,0%	-0,1%	0%	0,0%	0,0%	0,0%
2G	Other industrial: N2O	N2O	3	10	50%	50%	71%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
6D	OTHER CH4	CH4	1	20	20%	25%	32%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
4B	Emissions from manure management : other	CH4	11	15	10%	100%	100%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
1A3	Mobile combustion: other (railways)	CO2	91	66	5%	0%	5%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
1A3	Mobile combustion: other (non-road)	N2O	1	2	50%	100%	112%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
1A3	Mobile combustion: other (non-road)	CH4	1	1	50%	100%	112%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO2	2	0	20%	2%	20%	0,0%	0,0%	0%	0,0%	0,0%	0,0%
	TOTAL							3,2%					2,9%
	Procental change in emission from bases year to latest reported year				-6%								

Table A7.3 Emissions (Gg) and uncertainty estimates for the subcategories of Sector 5 LULUCF, as used in the Tier 1 uncertainty analysis.

IPCC	Category	Gas	CO_2 eq 1990	CO_2 eq 2009	AD uncert.	EF uncert.	EM uncertainty estimate
5A1	5A1. Forest Land remaining Forest Land	CO_2	-2.434	-2.144	25,0%	61,8%	67%
5A2	5A2. Land converted to Forest Land	CO_2	-3	-706	25,0%	57,9%	63%
5B2	5B2. Land converted to Cropland	CO_2	34	48	25,0%	50,0%	56%
5C1	5C1. Grassland remaining Grassland	CO_2	4.246	4.246	25,0%	50,0%	56%
5C2	5C2. Land converted to Grassland	CO_2	391	544	25,0%	50,0%	56%
5D2	5D2. Land converted to Wetlands	CO_2	40	56	25,0%	50,0%	56%
5E2	5E2. Land converted to Settlements	CO_2	210	294	25,0%	50,0%	56%
5F2	5F2. Land converted to Other Land	CO_2	18	25	25,0%	50,0%	56%
5G	5G. Other (liming of soils)	CO_2	183	91	25,0%	1,0%	25%

Annex 8 Emission Factors and Activity Data Agriculture

For years in between see NIR 2009.

Table A8.1 Animal numbers.

	1990	1995	2000	2005	2007	2008	2009
Cattle for breeding							
Female young stock under 1 yr	752,658	696,063	562,563	499,937	509,863	532,259	577,084
Male young stock under 1 yr	53,229	44,163	37,440	33,778	32,470	33,545	32,976
Female young stock, 1-2 yrs	734,078	682,888	594,100	515,972	494,853	509,763	527,537
Male young stock, 1-2 yrs	34,635	33,118	26,328	18,149	13,627	14,939	14,244
Female young stock, 2 yrs and over	145,648	124,970	104,633	74,180	69,110	79,489	85,381
Cows in milk and in calf	1,877,684	1,707,875	1,504,097	1,433,202	1,413,166	1,466,134	1,489,071
Bulls for service 2 yrs and over	8,762	8,674	10,410	12,391	10,028	7,718	8,119
Cattle for fattening							
Meat calves, for rosé veal production	28,876	85,803	145,828	204,227	261,620	272,117	269,306
Meat calves, for white veal production	572,709	583,516	636,907	624,513	598,252	626,596	624,942
Female young stock < 1 yr	53,021	57,218	41,300	43,313	44,671	42,657	41,113
Male young stock (incl. young bullocks) < 1 yr	255,375	188,193	83,447	66,655	55,008	53,875	52,764
Female young stock, 1-2 yrs	56,934	66,653	44,807	43,452	41,102	44,005	45,130
Male young stock (incl. young bullocks), 1-2 yrs	178,257	169,546	88,669	52,788	49,280	52,029	48,183
Female young stock, 2 yrs and over	42,555	48,365	16,917	15,260	16,056	18,755	19,935
Male young stock (incl. young bullocks) ≥ 2 yrs	12,073	10,969	9,397	9,346	9,713	9,334	8,512
Suckling cows (incl. fattening/grazing ≥ 2 yrs)	119,529	146,181	163,397	151,641	143,965	126,980	123,302

Table A8.1 Animal numbers (continued).

	1990	1995	2000	2005	2007	2008	2009
Pigs							
Piglets	5,190,749	5,596,117	5,102,434	4,562,991	4,837,355	4,965,922	5,068,497
Fattening pigs	7,025,102	7,123,923	6,504,540	5,504,295	5,558,828	5,838,974	5,872,351
Gilts not yet in pig	385,502	357,520	339,570	274,085	285,361	231,500	249,118
Sows	1,272,215	1,287,224	1,129,174	946,466	966,439	977,983	985,244
Young boars	13,893	11,382	6,917	6,486	4,192	4,335	3,550
Boars for service	27,587	21,297	35,182	17,235	10,479	7,753	7,693
Poultry							
Broilers	41,172,110	43,827,286	50,936,625	44,496,116	43,351,898	44,357,773	43,285,129
Broilers parents under 18 weeks	2,882,250	3,065,170	3,644,120	2,191,650	2,808,924	2,386,073	2,645,986
Broilers parents 18 weeks and over	4,389,830	4,506,840	5,397,520	3,596,700	4,260,360	4,862,707	4,287,967
Laying hens < 18 weeks, liq. manure	7,339,708	4,889,555	2,865,850	1,035,581	512,062	586,885	578,681
Laying hens < 18 weeks, solid manure	3,781,062	4,000,545	8,597,550	9,751,719	9,528,360	10,920,673	10,768,005
Laying hens ≥ 18 weeks, liq. manure	19,919,466	12,294,122	7,166,060	2,292,654	775,182	806,067	847,049
Laying hens ≥ 18 weeks, solid manure	13,279,644	16,977,598	25,406,940	29,549,756	31,524,073	32,780,059	34,446,667
Ducks for slaughter	1,085,510	868,965	958,466	1,030,867	1,134,146	1,063,799	1,156,699
Turkeys for slaughter	1,003,350	1,175,527	1,543,830	1,245,420	1,232,354	1,044,315	1,059,693
Turkeys parents under 7 months	28,550	13,930					
Turkeys parents 7 months and over	20,460	17,290					
Rabbits (mother animals)	105,246	64,234	52,252	48,034	49,413	41,410	40,760
Minks (mother animals)	543,969	456,104	584,806	691,862	802,853	848,664	869,941
Foxes (mother animals)	10,029	7,102	3,816	5,240	4,860		
Other grazing animals							
Sheep (ewes)	789,691	770,730	681,441	648,235	644,799	583,408	538,279
Goats (mothers)	37,472	43,231	98,077	172,159	188,676	207,882	231,090
Horses	369,592	405,004	428,244	448,321	450,524	462,078	463,924

Table A8.2 Gross energy intake (MJ/head.day) for cattle.

	1990	1995	2000	2005	2007	2008	2009
Cattle for breeding							
Female young stock under 1 yr	73.6	75.6	75.0	75.8	77.0	75.5	74.4
Male young stock under 1 yr	86.1	86.7	85.1	89.1	89.8	89.8	85.5
Female young stock, 1-2 yrs	139.5	142.5	139.5	144.6	149.1	147.1	146.0
Male young stock, 1-2 yrs	151.1	162.2	155.9	154.1	155.8	154.7	152.3
Female young stock, 2 yrs and over	139.4	142.5	139.5	144.6	149.1	147.1	146.0
Cows in milk and in calf	279.6	292.1	306.8	321.2	333.2	332.1	329.9
Bulls for service 2 yrs and over	151.1	162.2	155.9	154.1	155.8	154.7	152.3
Cattle for fattening							
Meat calves, for rosé veal production	77.9	77.9	95.5	82.8	82.8	82.8	82.8
Meat calves, for white veal production	30.9	32.7	35.6	34.8	37.2	37.2	37.2
Female young stock < 1 yr	73.6	75.5	74.9	75.8	76.7	75.3	74.1
Male young stock (incl. young bullocks) < 1 yr	82.3	87.6	88.8	86.7	85.7	86.2	85.6
Female young stock, 1-2 yrs	139.5	142.4	139.3	144.4	148.9	147.0	146.0
Male young stock (incl. young bullocks), 1-2 yrs	167.3	164.1	154.1	157.5	156.0	156.7	155.8
Female young stock, 2 yrs and over	139.5	142.5	139.4	144.5	149.0	147.1	146.0
Male young stock (incl. young bullocks) ≥ 2 yrs	167.3	164.1	154.1	157.5	156.0	156.7	155.8
Suckling cows (incl. fattening/grazing ≥ 2 yrs)	165.0	167.1	169.1	180.0	184.0	184.9	183.7

Table A8.3 Emission factors enteric fermentation for cattle kg/animal. year.

	1990	1995	2000	2005	2007	2008	2009
Cattle for breeding							
Female young stock under 1 yr	29.0	29.8	29.5	29.8	30.3	29.7	29.3
Male young stock under 1 yr	33.9	34.1	33.5	35.0	35.3	35.3	33.7
Female young stock, 1-2 yrs	54.9	56.1	54.9	56.9	58.7	57.9	57.4
Male young stock, 1-2 yrs	59.5	63.8	61.3	60.7	61.3	60.9	59.9
Female young stock, 2 yrs and over	54.9	56.1	54.9	56.9	58.7	57.9	57.5
Cows in milk and in calf	110.5	115.8	120.0	126.3	129.4	128.3	127.0
Bulls for service 2 yrs and over	59.5	63.8	61.3	60.7	61.3	60.9	59.9
Cattle for fattening							
Meat calves, for rosé veal production	30.6	30.6	37.6	32.6	32.6	32.6	32.6
Meat calves, for white veal production	8.1	8.6	9.3	9.1	9.8	9.8	9.8
Female young stock < 1 yr	29.0	29.7	29.5	29.8	30.2	29.6	29.2
Male young stock (incl. young bullocks) < 1 yr	32.4	34.5	34.9	34.1	33.7	33.9	33.7
Female young stock, 1-2 yrs	54.9	56.0	54.8	56.8	58.6	57.9	57.4
Male young stock (incl. young bullocks), 1-2 yrs	65.8	64.6	60.7	62.0	61.4	61.7	61.3
Female young stock, 2 yrs and over	54.9	56.1	54.9	56.9	58.6	57.9	57.4
Male young stock (incl. young bullocks) ≥ 2 yrs	65.8	64.6	60.7	62.0	61.4	61.7	61.3
Suckling cows (incl. fattening/grazing ≥ 2 yrs)	64.9	65.8	66.6	70.8	72.4	72.8	72.3

Table A8.4 Volatile Solids (= Organic Matter) per 1000 kg manure.

		1990	1995	2000	2005	2007	2008	2009
Cattle for breeding								
Female young stock under 1 yr	Liquid manure	60	66	64	64	64	64	64
Male young stock under 1 yr	Liquid manure	60	66	64	64	64	64	64
Female young stock, 1-2 yrs	Liquid manure	60	66	64	64	64	64	64
Male young stock, 1-2 yrs	Liquid manure	60	66	64	64	64	64	64
Female young stock, 2 yrs and over	Liquid manure	60	66	64	64	64	64	64
Cows in milk and in calf	Liquid manure	60	66	64	64	64	64	64
Bulls for service 2 yrs and over	Liquid manure	60	66	64	64	64	64	64
Cattle for fattening								
Meat calves, for rosé veal production	Liquid manure	22.5	22.5	22.5	22.5	22.5	22.5	22.5
Meat calves, for white veal production	Liquid manure	15	15	15	15	15	15	15
Female young stock < 1 yr	Liquid manure	60	66	64	64	64	64	64
Male young stock (incl. young bullocks) < 1 yr	Liquid manure	60	66	64	64	64	64	64
Female young stock, 1-2 yrs	Liquid manure	60	66	64	64	64	64	64
Male young stock (incl. young bullocks), 1-2 yrs	Liquid manure	60	66	64	64	64	64	64
Female young stock, 2 yrs and over	Liquid manure	60	66	64	64	64	64	64
Male young stock (incl. young bullocks) ≥ 2 yrs	Liquid manure	60	66	64	64	64	64	64
Suckling cows (incl. fattening/grazing ≥ 2 yrs)	Solid manure	140	153	150	150	150	150	150
Cattle for breeding								
Female young stock under 1 yr	Pasture	60	66	64	64	64	64	64
Male young stock under 1 yr								
Female young stock, 1-2 yrs	Pasture	60	66	64	64	64	64	64
Male young stock, 1-2 yrs								
Female young stock, 2 yrs and over	Pasture	60	66	64	64	64	64	64
Cows in milk and in calf	Pasture	60	66	64	64	64	64	64
Bulls for service 2 yrs and over								
Cattle for fattening								
Meat calves, for rosé veal production								
Meat calves, for white veal production								
Female young stock < 1 yr	Pasture	60	66	64	64	64	64	64
Male young stock (incl. young bullocks) < 1 yr								
Female young stock, 1-2 yrs	Pasture	60	66	64	64	64	64	64
Male young stock (incl. young bullocks), 1-2 yrs								
Female young stock, 2 yrs and over	Pasture	60	66	64	64	64	64	64
Male young stock (incl. young bullocks) ≥ 2 yrs								
Suckling cows (incl. fattening/grazing ≥ 2 yrs)	Pasture	60	66	64	64	64	64	64

Table A8.4 Volatile Solids (= Organic Matter) per 1000 kg manure (continued).

		1990	1995	2000	2005	2007	2008	2009
Pigs								
Piglets								
Fattening pigs	Liquid manure	50	60	60	60	60	60	60
Gilts not yet in pig	Liquid manure	35	35	35	35	35	35	35
Sows	Liquid manure	35	35	35	35	35	35	35
Young boars	Liquid manure	35	35	35	35	35	35	35
Boars for service	Liquid manure	35	35	35	35	35	35	35
Poultry								
Broilers	Solid manure	508	508	508	508	508	508	508
Broilers parents under 18 weeks	Solid manure	423	423	423	423	423	423	423
Broilers parents 18 weeks and over	Solid manure	423	423	423	423	423	423	423
Laying hens < 18 weeks, liq. manure	Liquid manure	90	93	93	93	93	93	93
Laying hens < 18 weeks, solid manure	Solid manure	350	350	350	350	350	350	350
Laying hens ≥ 18 weeks, liq. manure	Liquid manure	90	93	93	93	93	93	93
Laying hens ≥ 18 weeks, solid manure	Solid manure	350	350	350	350	350	350	350
Ducks for slaughter	Solid manure	209	209	209	209	209	209	209
Turkeys for slaughter	Solid manure	464	464	464	464	464	464	464
Turkeys parents under 7 months	Solid manure	464	464	464	464	464	464	464
Turkeys parents 7 months and over	Solid manure	464	464	464	464	464	464	464
Rabbits (mother animals)	Solid manure	367	367	367	367	367	367	367
Minks (mother animals)	Solid manure	185	185	185	185	185	185	185
Foxes (mother animals)	Solid manure	185	185	185	185	185	185	185
Ruminants, not cattle								
Sheep (ewes)	Solid manure	205	205	205	205	205	205	205
Goats (mothers)	Solid manure	182	182	182	182	182	182	182
Horses	Solid manure	250	250	250	250	250	250	250
Ponies	Solid manure	250	250	250	250	250	250	250
Ruminants, not cattle								
Sheep (ewes)	Pasture	60	66	64	64	64	64	64
Goats (mothers)								
Horses	Pasture	60	66	64	64	64	64	64
Ponies	Pasture	60	66	64	64	64	64	64

Table A8.5 Methane conversion factor for pigs and poultry.

		1990	1995	2000	2005	2007	2008	2009
Pigs								
Piglets								
Fattening pigs	Liquid manure	0.34	0.36	0.39	0.39	0.39	0.39	0.39
Gilts not yet in pig	Liquid manure	0.34	0.36	0.39	0.39	0.39	0.39	0.39
Sows	Liquid manure	0.34	0.36	0.39	0.39	0.39	0.39	0.39
Young boars	Liquid manure	0.34	0.36	0.39	0.39	0.39	0.39	0.39
Boars for service	Liquid manure	0.34	0.36	0.39	0.39	0.39	0.39	0.39
Poultry								
Broilers	Solid manure	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Broilers parents under 18 weeks	Solid manure	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Broilers parents 18 weeks and over	Solid manure	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Laying hens < 18 weeks, liq. manure	Liquid manure	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Laying hens < 18 weeks, solid manure	Solid manure	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Laying hens ≥ 18 weeks, liq. manure	Liquid manure	0.39	0.39	0.39	0.39	0.39	0.39	0.39
Laying hens ≥ 18 weeks, solid manure	Solid manure	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Ducks for slaughter	Solid manure	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Turkeys for slaughter	Solid manure	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Turkeys parents under 7 months	Solid manure	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Turkeys parents 7 months and over	Solid manure	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Rabbits (mother animals)	Solid manure	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Minks (mother animals)	Solid manure	0.015	0.015	0.015	0.015	0.015	0.015	0.015
Foxes (mother animals)	Solid manure	0.015	0.015	0.015	0.015	0.015	0.015	0.015

Table A8.6 Methane conversion factor for cattle and ruminants and ultimate CH_4 production (B0 in m^3 CH_4/kg VS).

		MCF	B0			MCF	B0
Cattle for breeding				Pigs			
Female young stock under 1 yr	Liquid manure	0.17	0.25	Piglets			
Male young stock under 1 yr	Liquid manure	0.17	0.25	Fattening pigs	Liquid manure		0.34
Female young stock, 1-2 yrs	Liquid manure	0.17	0.25	Gilts not yet in pig	Liquid manure		0.34
Male young stock, 1-2 yrs	Liquid manure	0.17	0.25	Sows	Liquid manure		0.34
Female young stock, 2 yrs and over	Liquid manure	0.17	0.25	Young boars	Liquid manure		0.34
Cows in milk and in calf	Liquid manure	0.17	0.25	Boars for service	Liquid manure		0.34
Bulls for service 2 yrs and over	Liquid manure	0.17	0.25				
Cattle for fattening	Liquid manure			Poultry			
Meat calves, for rosé veal production	Liquid manure	0.14	0.25	Broilers	Solid manure		0.34
Meat calves, for white veal production	Liquid manure	0.14	0.25	Broilers parents under 18 weeks	Solid manure		0.34
Female young stock < 1 yr	Liquid manure	0.17	0.25	Broilers parents 18 weeks and over	Solid manure		0.34
Male young stock (incl. young bullocks) < 1 yr	Liquid manure	0.17	0.25	Laying hens < 18 weeks, liq. manure	Liquid manure		0.34
Female young stock, 1-2 yrs	Liquid manure	0.17	0.25	Laying hens < 18 weeks, solid manure	Solid manure		0.34
Male young stock (incl. young bullocks), 1-2 yrs	Liquid manure	0.17	0.25	Laying hens ≥ 18 weeks, liq. manure	Liquid manure		0.34
Female young stock, 2 yrs and over	Liquid manure	0.17	0.25	Laying hens ≥ 18 weeks, solid manure	Solid manure		0.34
Male young stock (incl. young bullocks) ≥ 2 yrs	Liquid manure	0.17	0.25	Ducks for slaughter	Solid manure		0.34
Suckling cows (incl. fattening/ grazing ≥ 2 yrs)	Solid manure	0.015	0.25	Turkeys for slaughter	Solid manure		0.34
				Turkeys parents under 7 months	Solid manure		0.34
Cattle for breeding				Turkeys parents 7 months and over	Solid manure		0.34
Female young stock under 1 yr	Pasture	0.01	0.25	Rabbits (mother animals)	Solid manure		0.34
Male young stock under 1 yr				Minks (mother animals)	Solid manure		0.34
Female young stock, 1-2 yrs	Pasture	0.01	0.25	Foxes (mother animals)	Solid manure		0.34
Male young stock, 1-2 yrs							
Female young stock, 2 yrs and over	Pasture	0.01	0.25	Ruminants, not cattle			
Cows in milk and in calf	Pasture	0.01	0.25	Sheep (ewes)	Solid manure	0.015	0.25
Bulls for service 2 yrs and over				Goats (mothers)	Solid manure	0.015	0.25
Cattle for fattening				Horses	Solid manure	0.015	0.25
Meat calves, for rosé veal production				Ponies	Solid manure	0.015	0.25
Meat calves, for white veal production							
Female young stock < 1 yr	Pasture	0.01	0.25	Ruminants, not cattle			
Male young stock (incl. young bullocks) < 1 yr				Sheep (ewes)	Pasture	0.01	0.25
Female young stock, 1-2 yrs	Pasture	0.01	0.25	Goats (mothers)			
Male young stock (incl. young bullocks), 1-2 yrs				Horses	Pasture	0.01	0.25
Female young stock, 2 yrs and over	Pasture	0.01	0.25	Ponies	Pasture	0.01	0.25
Male young stock (incl. young bullocks) ≥ 2 yrs							
Suckling cows (incl. fattening/ grazing ≥ 2 yrs)	Pasture	0.01	0.25				

Table A8.7 Emission factors for methane from manure in CH_4/kg manure. year.

		1990	1995	2000	2005	2007	2008	2009
Cattle for breeding								
Female young stock under 1 yr	Liquid manure	0.00169	0.00186	0.00180	0.00180	0.00180	0.00180	0.00180
Male young stock under 1 yr	Liquid manure	0.00169	0.00186	0.00180	0.00180	0.00180	0.00180	0.00180
Female young stock, 1-2 yrs	Liquid manure	0.00169	0.00186	0.00180	0.00180	0.00180	0.00180	0.00180
Male young stock, 1-2 yrs	Liquid manure	0.00169	0.00186	0.00180	0.00180	0.00180	0.00180	0.00180
Female young stock, 2 yrs and over	Liquid manure	0.00169	0.00186	0.00180	0.00180	0.00180	0.00180	0.00180
Cows in milk and in calf	Liquid manure	0.00169	0.00186	0.00180	0.00180	0.00180	0.00180	0.00180
Bulls for service 2 yrs and over	Liquid manure	0.00169	0.00186	0.00180	0.00180	0.00180	0.00180	0.00180
Cattle for fattening								
Meat calves, for rosé veal production	Liquid manure	0.00052	0.00052	0.00052	0.00052	0.00052	0.00052	0.00052
Meat calves, for white veal production	Liquid manure	0.00035	0.00035	0.00035	0.00035	0.00035	0.00035	0.00035
Female young stock < 1 yr	Liquid manure	0.00169	0.00186	0.00180	0.00180	0.00180	0.00180	0.00180
Male young stock (incl. young bullocks) < 1 yr	Liquid manure	0.00169	0.00186	0.00180	0.00180	0.00180	0.00180	0.00180
Female young stock, 1-2 yrs	Liquid manure	0.00169	0.00186	0.00180	0.00180	0.00180	0.00180	0.00180
Male young stock (incl. young bullocks), 1-2 yrs	Liquid manure	0.00169	0.00186	0.00180	0.00180	0.00180	0.00180	0.00180
Female young stock, 2 yrs and over	Liquid manure	0.00169	0.00186	0.00180	0.00180	0.00180	0.00180	0.00180
Male young stock (incl. young bullocks) ≥ 2 yrs	Liquid manure	0.00169	0.00186	0.00180	0.00180	0.00180	0.00180	0.00180
Suckling cows (incl. fattening/ grazing ≥ 2 yrs)	Solid manure	0.00035	0.00038	0.00037	0.00037	0.00037	0.00037	0.00037
Cattle for breeding								
Female young stock under 1 yr	Pasture	0.00010	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
Male young stock under 1 yr								
Female young stock, 1-2 yrs	Pasture	0.00010	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
Male young stock, 1-2 yrs								
Female young stock, 2 yrs and over	Pasture	0.00010	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
Cows in milk and in calf	Pasture	0.00010	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
Bulls for service 2 yrs and over								
Cattle for fattening								
Meat calves, for rosé veal production								
Meat calves, for white veal production								
Female young stock < 1 yr	Pasture	0.00010	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
Male young stock (incl. young bullocks) < 1 yr								
Female young stock, 1-2 yrs	Pasture	0.00010	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
Male young stock (incl. young bullocks), 1-2 yrs								
Female young stock, 2 yrs and over	Pasture	0.00010	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
Male young stock (incl. young bullocks) ≥ 2 yrs								
Suckling cows (incl. fattening/ grazing ≥ 2 yrs)	Pasture	0.00010	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011

Table A8.7 Emission factors for methane from manure in CH_4/kg manure. year (continued).

		1990	1995	2000	2005	2007	2008	2009
Pigs								
Piglets								
Fattening pigs	Liquid manure	0.00383	0.00486	0.00527	0.00527	0.00527	0.00527	0.00527
Gilts not yet in pig	Liquid manure	0.00268	0.00284	0.00307	0.00307	0.00307	0.00307	0.00307
Sows	Liquid manure	0.00268	0.00284	0.00307	0.00307	0.00307	0.00307	0.00307
Young boars	Liquid manure	0.00268	0.00284	0.00307	0.00307	0.00307	0.00307	0.00307
Boars for service	Liquid manure	0.00268	0.00284	0.00307	0.00307	0.00307	0.00307	0.00307
Poultry								
Broilers	Solid manure	0.00172	0.00172	0.00172	0.00172	0.00172	0.00172	0.00172
Broilers parents under 18 weeks	Solid manure	0.00143	0.00143	0.00143	0.00143	0.00143	0.00143	0.00143
Broilers parents 18 weeks and over	Solid manure	0.00143	0.00143	0.00143	0.00143	0.00143	0.00143	0.00143
Laying hens < 18 weeks, liq. manure	Liquid manure	0.00790	0.00816	0.00816	0.00816	0.00816	0.00816	0.00816
Laying hens < 18 weeks, solid manure	Solid manure	0.00118	0.00118	0.00118	0.00118	0.00118	0.00118	0.00118
Laying hens ≥ 18 weeks, liq. manure	Liquid manure	0.00790	0.00816	0.00816	0.00816	0.00816	0.00816	0.00816
Laying hens ≥ 18 weeks, solid manure	Solid manure	0.00118	0.00118	0.00118	0.00118	0.00118	0.00118	0.00118
Ducks for slaughter	Solid manure	0.00071	0.00071	0.00071	0.00071	0.00071	0.00071	0.00071
Turkeys for slaughter	Solid manure	0.00157	0.00157	0.00157	0.00157	0.00157	0.00157	0.00157
Turkeys parents under 7 months	Solid manure	0.00157	0.00157	0.00157	0.00157	0.00157	0.00157	0.00157
Turkeys parents 7 months and over	Solid manure	0.00157	0.00157	0.00157	0.00157	0.00157	0.00157	0.00157
Rabbits (mother animals)	Solid manure	0.00124	0.00124	0.00124	0.00124	0.00124	0.00124	0.00124
Minks (mother animals)	Solid manure	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062
Foxes (mother animals)	Solid manure	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062
Ruminants, not cattle								
Sheep (ewes)	Solid manure	0.00051	0.00051	0.00051	0.00051	0.00051	0.00051	0.00051
Goats (mothers)	Solid manure	0.00045	0.00045	0.00045	0.00045	0.00045	0.00045	0.00045
Horses	Solid manure	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062
Ponies	Solid manure	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062	0.00062
Ruminants, not cattle								
Sheep (ewes)	Pasture	0.00010	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
Goats (mothers)								
Horses	Pasture	0.00010	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011
Ponies	Pasture	0.00010	0.00011	0.00011	0.00011	0.00011	0.00011	0.00011

Table A8.8 Manure production kg /animal. year.

		1990	1995	2000	2005	2007	2008	2009
Cattle for breeding								
Female young stock under 1 yr	Liquid manure	3,500	3,500	3,500	3,500	3,500	4,000	4,000
Male young stock under 1 yr	Liquid manure	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Female young stock, 1-2 yrs	Liquid manure	6,000	6,000	6,000	6,000	6,000	6,500	8,000
Male young stock, 1-2 yrs	Liquid manure	11,500	11,500	11,500	11,500	11,500	11,500	12,000
Female young stock, 2 yrs and over	Liquid manure	6,000	6,000	6,000	6,000	6,000	6,500	8,000
Cows in milk and in calf	Liquid manure	16,000	16,000	18,000	20,500	21,500	20,500	23,000
Bulls for service 2 yrs and over	Liquid manure	11,500	11,500	11,500	11,500	11,500	11,500	12,000
Cattle for fattening								
Meat calves, for rosé veal production	Liquid manure	5,000	5,000	5,000	5,000	4,300	4,300	4,500
Meat calves, for white veal production	Liquid manure	3,500	3,500	3,500	3,000	3,000	3,000	2,800
Female young stock < 1 yr	Liquid manure	3,500	3,500	3,500	3,500	3,500	4,000	4,000
Male young stock (incl. young bullocks) < 1 yr	Liquid manure	4,500	4,500	4,500	4,500	4,500	4,500	4,500
Female young stock, 1-2 yrs	Liquid manure	6,000	6,000	6,000	6,000	6,000	6,500	8,000
Male young stock (incl. young bullocks), 1-2 yrs	Liquid manure	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Female young stock, 2 yrs and over	Liquid manure	6,000	6,000	6,000	6,000	6,000	6,500	8,000
Male young stock (incl. young bullocks) ≥ 2 yrs	Liquid manure	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Suckling cows (incl. fattening/grazing ≥ 2 yrs)	Solid manure	7,000	7,000	7,000	7,000	7,000	7,000	7,000
Cattle for breeding								
Female young stock under 1 yr	Pasture	1,500	1,500	1,500	1,500	1,500	1,000	1,000
Male young stock under 1 yr								
Female young stock, 1-2 yrs	Pasture	5,500	5,500	5,500	5,500	5,500	5,000	4,000
Male young stock, 1-2 yrs								
Female young stock, 2 yrs and over	Pasture	5,500	5,500	5,500	5,500	5,500	5,000	4,000
Cows in milk and in calf	Pasture	7,000	7,000	7,000	5,500	4,500	5,500	3,000
Bulls for service 2 yrs and over								
Cattle for fattening								
Meat calves, for rosé veal production								
Meat calves, for white veal production								
Female young stock < 1 yr	Pasture	1,500	1,500	1,500	1,500	1,500	1,000	1,000
Male young stock (incl. young bullocks) < 1 yr								
Female young stock, 1-2 yrs	Pasture	5,500	5,500	5,500	5,500	5,500	5,000	4,000
Male young stock (incl. young bullocks), 1-2 yrs								
Female young stock, 2 yrs and over	Pasture	5,500	5,500	5,500	5,500	5,500	5,000	4,000
Male young stock (incl. young bullocks) ≥ 2 yrs								
Suckling cows (incl. fattening/grazing ≥ 2 yrs)	Pasture	8,000	8,000	8,000	8,000	8,000	8,000	8,000

Table A8.8 Manure production kg /animal. year (continued).

		1990	1995	2000	2005	2007	2008	2009
Pigs								
Piglets								
Fattening pigs	Liquid manure	1,300	1,250	1,200	1,200	1,200	1,200	1,200
Gilts not yet in pig	Liquid manure	1,300	1,300	1,300	1,300	1,300	1,300	1,300
Sows	Liquid manure	5,200	5,200	5,100	5,100	5,100	5,100	5,100
Young boars	Liquid manure	1,300	1,300	1,300	1,300	1,300	1,300	1,300
Boars for service	Liquid manure	3,200	3,200	3,200	3,200	3,200	3,200	3,200
Poultry								
Broilers	Solid manure	10.0	11.0	11.0	10.9	10.9	10.9	10.9
Broilers parents under 18 weeks	Solid manure	15.4	13.4	13.4	8.2	8.2	8.2	8.2
Broilers parents 18 weeks and over	Solid manure	25.3	23.0	23.0	20.6	20.6	20.6	20.6
Laying hens < 18 weeks, liq. manure	Liquid manure	25.4	25.4	25.4	22.5	22.5	22.5	22.5
Laying hens < 18 weeks, solid manure	Solid manure	10.0	10.0	9.0	7.6	7.6	7.6	7.6
Laying hens ≥ 18 weeks, liq. manure	Liquid manure	63.5	63.5	63.5	53.4	53.4	53.4	53.4
Laying hens ≥ 18 weeks, solid manure	Solid manure	22.5	23.5	24.0	18.9	18.9	18.9	18.9
Ducks for slaughter	Solid manure	86.3	70.0	70.0	70.0	70.0	70.0	70.0
Turkeys for slaughter	Solid manure	37.9	45.0	45.0	45.0	45.0	45.0	45.0
Turkeys parents under 7 months	Solid manure	49.4	49.4					
Turkeys parents 7 months and over	Solid manure	78.6	78.6					
Rabbits (mother animals)	Solid manure	377	377	377	377	377	377	377
Minks (mother animals)	Solid manure	104	104	104	104	104	104	104
Foxes (mother animals)	Solid manure	272	272	272	272	272		
Ruminants, not cattle								
Sheep (ewes)	Solid manure	325	325	325	325	325	325	140
Goats (mothers)	Solid manure	1,300	1,300	1,300	1,300	1,300	1,300	1,300
Horses	Solid manure	5,200	5,200	5,200	5,200	5,200	5,200	5,200
Ponies	Solid manure	2,100	2,100	2,100	2,100	2,100	2,100	2,100
Ruminants, not cattle								
Sheep (ewes)	Pasture	2,000	2,000	2,000	2,000	2,000	2,000	2,400
Goats (mothers)								
Horses	Pasture	3,300	3,300	3,300	3,300	3,300	3,300	3,300
Ponies	Pasture	2,100	2,100	2,100	2,100	2,100	2,100	2,100

Table A8.9 N excretion (kg/animal. yr).

		1990	1995	2000	2005	2007	2008	2009
Cattle for breeding								
Female young stock under 1 yr	Liquid manure	26.5	29.8	29.0	23.0	24.6	29.2	28.8
Male young stock under 1 yr	Liquid manure	39.6	40.8	37.0	37.0	36.6	35.9	33.2
Female young stock, 1-2 yrs	Liquid manure	43.1	48.4	46.4	42.7	42.5	45.8	45.0
Male young stock, 1-2 yrs	Liquid manure	90.6	101.9	96.8	88.5	89.6	86.0	84.4
Female young stock, 2 yrs and over	Liquid manure	43.0	48.4	46.3	42.7	42.5	45.8	45.0
Cows in milk and in calf, winter	Liquid manure	60.8	69.0	71.0	66.0	70.2	68.3	66.0
Cows in milk and in calf, summer	Liquid manure	35.1	35.0	26.2	37.2	40.6	34.9	38.2
Bulls for service 2 yrs and over	Liquid manure	90.6	101.9	96.8	88.5	89.6	86.0	84.4
Cattle for fattening								
Meat calves, for rosé veal production	Liquid manure	28.9	28.9	34.1	27.2	28.1	27.4	28.0
Meat calves, for white veal production	Liquid manure	10.6	11.6	11.9	10.6	11.0	10.7	10.6
Female young stock < 1 yr	Liquid manure	26.2	29.4	28.6	22.8	24.4	28.8	28.4
Male young stock (incl. young bullocks) < 1 yr	Liquid manure	28.9	29.5	26.6	27.0	26.6	26.0	26.9
Female young stock, 1-2 yrs	Liquid manure	43.0	48.2	46.0	42.4	42.4	45.0	44.1
Male young stock (incl. young bullocks), 1-2 yrs	Liquid manure	72.6	64.7	56.1	56.8	54.5	53.8	54.9
Female young stock, 2 yrs and over	Liquid manure	43.1	48.4	46.1	42.5	42.4	44.9	44.1
Male young stock (incl. young bullocks) ≥ 2 yrs	Liquid manure	72.6	64.7	56.1	56.8	54.5	53.8	54.9
Suckling cows (incl. fattening/grazing ≥ 2 yrs)	Solid manure	42.3	48.0	42.4	39.1	39.4	38.7	37.9
Cattle for breeding								
Female young stock under 1 yr	Pasture	15.3	14.4	13.0	17.0	14.3	7.5	7.1
Male young stock under 1 yr								
Female young stock, 1-2 yrs	Pasture	51.2	47.5	42.9	33.1	32.2	29.0	28.2
Male young stock, 1-2 yrs								
Female young stock, 2 yrs and over	Pasture	51.2	47.5	42.9	33.1	32.2	29.0	28.2
Cows in milk and in calf	Pasture	52.6	52.5	39.3	30.8	25.7	31.3	22.8
Bulls for service 2 yrs and over								
Cattle for fattening								
Meat calves, for rosé veal production								
Meat calves, for white veal production								
Female young stock < 1 yr	Pasture	15.2	14.3	12.8	16.9	14.0	7.4	7.0
Male young stock (incl. young bullocks) < 1 yr								
Female young stock, 1-2 yrs	Pasture	51.2	47.5	42.9	33.1	32.0	29.4	28.6
Male young stock (incl. young bullocks), 1-2 yrs								
Female young stock, 2 yrs and over	Pasture	51.2	47.5	42.9	33.1	32.0	29.4	28.6
Male young stock (incl. young bullocks) ≥ 2 yrs								
Suckling cows (incl. fattening/grazing ≥ 2 yrs)	Pasture	68.4	63.1	52.7	45.8	43.4	46.2	44.9

Table A8.9 N excretion (kg/animal.yr) (continued).

		1990	1995	2000	2005	2007	2008	2009
Pigs								
Piglets								
Fattening pigs	Liquid manure	14.3	14.5	12.3	12.3	12.6	12.9	12.7
Gilts not yet in pig	Liquid manure	14.0	14.4	14.2	14.3	14.2	13.5	13.6
Sows	Liquid manure	33.8	31.4	30.9	30.7	31.5	30.8	30.3
Young boars	Liquid manure	14.0	14.4	14.2	14.3	14.2	13.5	13.6
Boars for service	Liquid manure	25.0	24.6	22.9	23.7	23.3	23.5	23.2
Poultry								
Broilers	Solid manure	0.61	0.63	0.51	0.55	0.53	0.53	0.54
Broilers parents under 18 weeks	Solid manure	0.52	0.45	0.37	0.32	0.33	0.33	0.34
Broilers parents 18 weeks and over	Solid manure	1.33	1.29	1.13	1.10	1.13	1.12	1.14
Laying hens < 18 weeks	Liq. /solid manure	0.38	0.36	0.31	0.32	0.34	0.34	0.33
Laying hens ≥ 18 weeks	Liq./solid manure	0.75	0.81	0.67	0.71	0.74	0.75	0.77
Ducks for slaughter	Solid manure	1.12	1.09	0.99	0.89	0.85	0.76	0.78
Turkeys for slaughter	Solid manure	1.98	1.97	1.85	1.81	1.69	1.71	1.98
Turkeys parents under 7 months	Solid manure	2.38	2.78					
Turkeys parents 7 months and over	Solid manure	3.17	3.04					
Rabbits (mother animals)	Solid manure	8.7	8.1	7.6	8.2	8.0	7.9	7.7
Minks (mother animals)	Solid manure	4.08	4.08	3.5	2.7	2.5	2.4	1.9
Foxes (mother animals)	Solid manure	13.9	13.9	8.3	6.9	6.4		
Ruminants, not cattle								
Sheep (ewes)	Solid manure	3.9	4.0	3.9	2.6	2.6	2.5	1.4
Goats (mothers)	Solid manure	19.9	21.5	19.4	17.7	15.8	16.0	16.1
Horses	Solid manure	33.3	33.3	33.3	33.3	32.1	30.3	30.3
Ponies	Solid manure	14.4	14.4	14.4	14.4	13.8	13.2	13.2
Ruminants, not cattle								
Sheep (ewes)	Pasture	21.1	20.3	19.5	12.2	11.1	11.9	12.5
Goats (mothers)								
Horses	Pasture	30.2	30.2	30.2	30.2	29.4	28.2	28.2
Ponies	Pasture	19.9	19.9	19.9	19.9	19.4	18.9	18.9

Table A8.9 Fraction liquid manure.

	1990	1995	2000	2005	2007	2008	2009
Cattle for breeding							
Female young stock under 1 yr	0.56	0.56	0.56	0.56	0.56	0.56	0.56
Male young stock under 1 yr	0.56	0.56	0.56	0.56	0.56	0.56	0.56
Female young stock, 1-2 yrs	0.85	0.88	0.91	0.94	0.95	0.95	0.95
Male young stock, 1-2 yrs	0.85	0.88	0.91	0.94	0.95	0.95	0.95
Female young stock, 2 yrs and over	0.85	0.88	0.91	0.94	0.95	0.95	0.95
Cows in milk and in calf, winter	0.89	0.92	0.96	0.97	0.98	0.98	0.98
Cows in milk and in calf, summer	0.98	0.99	0.99	1.00	1.00	1.00	1.00
Bulls for service 2 yrs and over	0.78	0.78	0.78	0.78	0.78	0.78	0.78
Cattle for fattening							
Meat calves, for rosé veal production	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Meat calves, for white veal production	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Female young stock < 1 yr	0.66	0.66	0.66	0.66	0.66	0.66	0.66
Male young stock (incl. young bullocks) < 1 yr	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Female young stock, 1-2 yrs	0.66	0.66	0.66	0.66	0.66	0.66	0.66
Male young stock (incl. young bullocks), 1-2 yrs	0.67	0.67	0.67	0.67	0.67	0.67	0.67
Female young stock, 2 yrs and over	0.66	0.66	0.66	0.66	0.66	0.66	0.66
Male young stock (incl. young bullocks) ≥ 2 yrs	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Suckling cows (incl. fattening/grazing ≥ 2 yrs)	0.69	0.69	0.69	0.69	0.69	0.69	0.69
Pigs							
Piglets							
Fattening pigs	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Gilts not yet in pig	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sows	1.00	1.00	1.00	1.00	0.95	0.95	0.95
Young boars	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Boars for service	1.00	1.00	1.00	1.00	0.81	0.81	0.81
Poultry							
Broilers	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Broilers parents under 18 weeks	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Broilers parents 18 weeks and over	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Laying hens < 18 weeks	0.66	0.55	0.25	0.10	0.05	0.05	0.05
Laying hens ≥ 18 weeks	0.60	0.42	0.22	0.07	0.02	0.02	0.02
Ducks for slaughter	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkeys for slaughter	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Turkeys parents under 7 months	0.00	0.00					
Turkeys parents 7 months and over	0.00	0.00					
Rabbits (mother animals)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Minks (mother animals)	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Foxes (mother animals)	1.00	1.00	1.00	1.00	1.00		
Ruminants, not cattle							
Sheep (ewes)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Goats (mothers)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Horses	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ponies	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A8.10 Crop Area.

	1990	1995	2000	2005	2007	2008	2009
Winter wheat	13,510,369	12,559,909	12,050,981	11,603,963	12,442,902	14,061,700	12,889,423
Spring wheat	549,904	981,302	1,617,586	2,067,009	1,689,184	1,589,326	2,208,756
Winter barley	994,082	309,977	363,547	296,950	426,303	466,894	487,279
Spring barley	3,044,693	3,248,038	4,353,676	4,761,972	4,172,914	4,556,486	3,959,131
Rye	860,386	817,514	596,058	253,457	284,508	211,740	231,967
Oats	340,128	291,431	240,390	169,744	170,278	149,107	158,456
Triticale		257,947	664,635	408,259	388,865	319,918	273,462
Dried and green peas	1,090,832	69,149	75,204	192,508	60,594	39,448	52,106
Peas (green to harvest)	766,724	713,143	586,657	509,139	602,662	596,872	485,535
Marrowfats	79,350	36,732	38,849	39,585	27,846	52,318	69,187
Kidney beans	373,005	222,094	112,590	109,903	109,374	91,081	138,311
Broad and field beans	316,912	53,220	67,916	44,111	52,429	60,723	59,160
Grass seed	2,631,440	2,189,274	2,196,001	2,763,858	2,010,683	1,566,102	1,772,897
Rape seed	841,501	149,268	85,416	209,640	335,790	246,658	266,705
Caraway seed	34,158	121,059	13,806	9,034	3,905	3,646	9,341
Pop seed	26,356	141,119	58,806	28,286	50,295	84,182	67,873
Flax seed	553,468	440,738	437,930	473,339	345,633	261,793	216,061
Seed potatoes on sand or peat	548,553	536,058	709,599	352,313	332,014	322,942	341,500
Seed potatoes on clay	3,010,113	3,243,815	3,470,553	3,573,898	3,340,892	3,330,423	3,472,669
Potatoes on sand or peat	1,602,484	1,845,122	2,563,153	1,926,935	2,042,278	1,903,856	2,109,757
Potatoes on clay	6,086,924	6,170,599	6,180,900	4,656,037	5,204,137	5,026,336	4,942,270
Industrial potatoes	6,283,773	6,134,453	5,095,818	5,069,191	4,798,038	4,603,383	4,656,973
Sugar beets	12,499,462	11,608,057	11,099,810	9,131,265	8,202,608	7,223,132	7,270,147
Fodder beets	302,286	157,602	89,094	53,195	33,121	35,320	32,887
Lucerne	596,017	583,627	661,606	587,842	589,808	491,808	571,237
Green maize	20,181,089	21,921,725	20,532,074	23,508,819	22,155,358	24,344,498	24,197,217
Green manure	728,159	1,224,765	261,452	3,101,990	1,490,368	501,069	501,069*
Grain maize		900,542	2,029,838	2,074,849	1,934,033	2,213,225	1,890,381
Corn cob mix		500,473	721,918	667,841	719,952	759,763	764,480
Chicory			475,596	433,848	258,617	340,924	441,616
Hemp			79,197	10,043	13,515	27,832	89,199
Onions	1,282,770	1,608,194	1,997,942	2,252,034	2,617,775	2,614,035	2,602,629
Other horticultural crops	808,437	598,220	1,088,320	1,186,888	973,379	929,158	660,398*

Table A8.10 Crop Area (continued).

	1990	1995	2000	2005	2007	2008	2009
Strawberry	186,688	176,313	174,568	230,089	296,381	292,561	305,475
Endive	23,392	27,629	25,198	27,971	33,169	28,795	21,044
Asparagus	266,313	232,356	208,408	233,366	238,333	247,717	261,998
Gherkin	25,738				25,293	41,912	48,593
Cabbage for preservation	157,620	178,353	152,753	139,794			
Cauliflower	236,792	242,970	216,038	239,408	263,256	253,917	240,026
Broccoli		53,379	84,602	131,115	158,682	173,165	197,874
Cabbage (spring and autumn)	100,151	113,850	101,629	107,505	286,360	306,418	278,903
Celeriac	136,263	141,421	128,519	112,772	138,531	132,991	122,325
Beetroot		35,349	29,015	27,619	36,976	40,473	41,527
Lettuce	95,475	104,217	108,978	130,353	191,860	207,633	195,592
Leeks	287,307	385,356	318,448	272,537	306,271	301,226	292,615
Scorzonera	139,536	148,006	113,796	86,697	99,631	95,895	111,817
Spinach	115,291	96,500	120,827	91,431	130,226	117,525	138,357
Brussels sprouts	480,319	438,811	483,409	309,508	335,223	324,297	299,714
Industrial French beans	369,501	467,764	362,736	425,410	375,083	342,903	291,995
Runner beans	22,493				6,842	7,090	5,935
Broad beans green	117,770	87,716	69,416	78,984	154,794	183,795	159,738
Carrot	302,983	327,442	298,512	255,140	264,776	265,776	268,781
Winter carrot (Danvers)	295,050	467,490	472,875	470,043	547,765	528,567	574,224
Witloof	591,896	388,881	419,858	342,321	347,839	316,209	301,247
Other outside horticultural crops	277,358	286,665	317,125	431,248	366,919	362,021	315,016*

* preliminary data

Table A8.11 N content per crop, crop residue and N fixation for crops.

	N content	Crop residue	N fixation
	kg N/ha	Frac	
Winter wheat	28	0.1	
Spring wheat	28	0.1	
Winter barley	19	0.1	
Spring barley	19	0.1	
Rye	16	0.1	
Oats	19	0.1	
Triticale	24	0.1	
Dried and green peas	74	1.0	164
Peas (green to harvest)	194	1.0	164
Marrowfats	74	1.0	164
Kidney beans	74	1.0	164
Broad and field beans	16	1.0	325
Grass seed	28	1.0	
Rape seed	42	1.0	
Caraway seed	37	1.0	
Pop seed	20	1.0	
Flax seed	23	1.0	
Seed potatoes on sand or peat	26	1.0	
Seed potatoes on clay	26	1.0	
Potatoes on sand or peat	26	1.0	
Potatoes on clay	26	1.0	
Industrial potatoes	26	1.0	
Sugar beets	174	1.0	
Fodder beets	92	1.0	
Lucerne	23	1.0	422
Green maize	22	0.1	
Green manure	80	1.0	
Grain maize	70	1.0	
Corn cob mix	70	1.0	
Chicory	40	1.0	
Hemp	40	1.0	
Onions	4	1.0	
Other horticultural crops	40	1.0	
Strawberry	23	1.0	
Endive	78	1.0	
Asparagus	24	1.0	
Gherkin	78	1.0	
Cabbage for preservation	206	1.0	
Cauliflower	89	1.0	
Broccoli	89	1.0	
Cabbage (spring and autumn)	206	1.0	
Celeriac	78	1.0	
Beetroot	78	1.0	
Lettuce	25	1.0	
Leeks	62	1.0	
Scorzonera	78	1.0	
Spinach	62	1.0	
Brussels sprouts	206	1.0	
Industrial French beans	61	1.0	75
Runner beans	61	1.0	75
Broad beans green	13	1.0	185
Carrot	99	1.0	
Winter carrot (Danvers)	99	1.0	
Witloof	78	1.0	
Other outside horticultural crops	78	1.0	

Annex 9 Chemical compounds, global warming potentials, units and conversion factors

A9.1 Chemical compounds

CF_4	Perfluoromethane (tetrafluoromethane)
C_2F_6	Perfluoroethane (hexafluoroethane)
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
HNO_3	Nitric Acid
NH_3	Ammonia
NO_x	Nitrogen oxide (NO and NO_2), expressed as NO_2
N_2O	Nitrous oxide
NMVOC	Non-Methane Volatile Organic Compounds
PFCs	Perfluorocarbons
SF_6	Sulphur hexafluoride
????$_2$	Sulphur dioxide
VOC	Volatile Organic Compounds (may include or exclude methane)

A9.2 Global Warming Potentials for selected greenhouse gases

Gas	Atmospheric lifetime	20-year GWP	100-year GWP[1)]	500-year GWP
CO_2	Variable (50-200)	1	1	1
CH_4 [2)]	12±3	56	21	6.5
N_2O	120	280	310	170
HFCs [3)]:				
HFC-23	264	9100	11700	9800
HFC-32	5.6	2100	650	200
HFC-125	32.6	4600	2800	920
HFC-134a	10.6	3400	1300	420
HFC-143a	48.3	5000	3800	1400
HFC-152a	1.5	460	140	42
HFC-227ea	36.5	4300	2900	950
HFC-236fa	209	5100	6300	4700
HFC-245ca	6.6	1800	560	170
PFCs [3)]:				
CF_4	50000	4400	6500	10000
C_2F_6	10000	6200	9200	14000
C_3F_8	2600	4800	7000	10100
C_4F_{10}	2600	4800	7000	10100
C_6F_{14}	3200	5000	7400	10700
SF_6	3200	16300	23900	34900

Source: IPCC (1996)

[1)] GWPs calculated with a 100-year time horizon (indicated in the shaded column) and from the SAR are used in this report (thus not of the Third Assessment Report), in compliance with the UNFCCC Guidelines for reporting (UNFCCC, 1999). Gases indicated in italics are not emitted in the Netherlands.

[2)] The GWP of methane includes the direct effects and the indirect effects due to the production of tropospheric ozone and stratospheric water vapour; the indirect effect due to the production of CO_2 is not included.

[3)] The average GWP-100 of emissions reported as 'HFC unspecified' and 'PFC unspecified' is 3000 and 8$_4$00, respectively.

A9.3 Units

MJ	Mega Joule (10^6 Joule)
GJ	Giga Joule (10^9 Joule)
TJ	Tera Joule (10^{12} Joule)
PJ	Peta Joule (10^{15} Joule)
Mg	Mega gramme (10^6 gramme)
Gg	Giga gramme (10^9 gramme)
Tg	Tera gramme (10^{12} gramme)
Pg	Peta gramme (10^{15} gramme)
ton	metric ton (= 1 000 kilogramme = 1 Mg)
kton	kiloton (= 1 000 metric ton = 1 Gg)
Mton	Megaton (= 1 000 000 metric ton = 1 Tg)
ha	hectare (= 10^4 m^2)
kha	kilo hectare (= 1 000 hectare = 10^7 m^2 = 10 km^2)
mln	million (= 10^6)
mld	milliard (= 10^9)

A9.4 Other conversion factors for emissions

From element basis to full molecular mass:		From full molecular mass to element basis	
C → CO_2 :	x 44/12 = 3.67	CO_2 → C :	x 12/44 = 0.27
C → CH_4 :	x 16/12 = 1.33	CH_4 → C :	x 12/16 = 0.75
C → CO :	x 28/12 = 2.33	CO → C :	x 12/28 = 0.43
N → N_2O :	x 44/28 = 1.57	N_2O → N :	x 28/44 = 0.64
N → NO :	x 30/14 = 2.14	NO → N :	x 14/30 = 0.47
N → NO_2 :	x 46/14 = 3.29	NO_2 → N :	x 14/46 = 0.30
N → NH_3 :	x 17/14 = 1.21	NH_3 → N :	x 14/17 = 0.82
N → HNO_3 :	x 63/14 = 4.50	HNO_3 → N :	x 14/63 = 0.22
S → $_2$:	x 64/32 = 2.00	$_2$ → S :	x 32/64 = 0.50

Annex 10
List of abbreviations

AD	Activity Data
AE	Anode Effect
AWMS	Animal Waste Management Systems
BAK	Monitoring report of gas consumption of small users
BEES	Order governing combustion plant emissions requirements (1992) (in Dutch: “Besluit Emissie-Eisen Stookinstallaties”)
BEK	Monitoring report of electricity consumption of small users
BF	Blast Furnace (gas)
BOD	Biological Oxygen Demand
C	Confidential (notation key in CRF)
CO	Coke Oven (gas)
CS	Country-Specific (notation key in CRF)
Cap	capita (person)
CBS	Statistics Netherlands
CDM	Clean Development Mechanism (one of three mechanisms of the Kyoto Protocol)
CHP	Combined Heat and Power
CLRTAP	Convention on Long-range Transboundary Air Pollution (UN-ECE)
CORINAIR	CORe INventory AIR emissions
CRF	Common Reporting Format (of emission data files, annexed to an NIR)
CRT	Continuous Regeneration Trap
DLO	Former name of part of Wageningen University and Research Centre (Wageningen UR)
DM	Dry Matter
DOC	Degradable Organic Carbon
DOCF	Degradable Organic Carbon Fraction
EC-LNV	National Reference Centre for Agriculture
ECE	Economic Commission for Europe (UN)
ECN	Energy Research Centre of the Netherlands
EEA	European Environment Agency
EF	Emission Factor
EGR	Exhaust Gas Recirculation
EIT	Economies-In-Transition (countries from the former SU and Eastern Europe)
EL&I	Ministry of Economic affairs, Agriculture and Innovation
EMEP	European program for Monitoring and Evaluation of long-range transmission of air Pollutants
EMS	Emission Monitor Shipping
EMSG	Emissions Registration Steering Group
ENINA	Task Group Energy, Industry and Waste Handling
EPA	US Environmental Protection Agency
ER-I	Emission Registration-Individual firms
ERT	Expert Review Team
ET	Emissions Trading
ETC/ACC	European Topic Centre on Air and Climate Change
ETS	Emission Trading System
EU	European Union

EZ	Ministry of Economic Affairs (from 2010 on, integrated in EL&I)
FAD	Forest According to Definition
FAO	Food and Agricultural Organization (UN)
F-gases	Group of fluorinated compounds comprising HFCs, PFCs and SF_6
FGD	Flue Gas Desulphurization
FO-I	Dutch Facilitating Organization for Industry
GE	Gross Energy
GHG	Greenhouse Gas
GPG	Good Practice Guidance
GIS	Gas Insulated Switchgear
GWP	Global Warming Potential
HBO	Heating Oil
HDD	Heating-Degree Day
HFO	Heavy Fuel Oil
HOSP	Timber Production Statistics and Forecast (in Dutch: “Hout Oogst Statistiek en Prognose oogstbaar hout”)
IE	Included Elsewhere (notation key in CRF)
IEA	International Energy Agency
IEF	Implied Emission Factor
IenM	Ministry of Infrastructure and Environment (f.n.a. VROM)
INK	Dutch Institute for Quality Management
IPCC	Intergovernmental Panel on Climate Change
KNMI	Royal Netherlands Meteorological Institute
LEI	Agricultural Economics Institute
LHV	Lower Heating Value
LNV	Ministry of Agriculture, Nature and Food Quality (from 2010 on, integrated in EL&I)
LPG	Liquefied Petroleum Gas
LTO	Landing and Take-Off
LUCF	Land Use Change and Forestry
LULUCF	Land Use, Land Use Change and Forestry
MCF	Methane Conversion Factor
MEP	TNO Environment, Energy and Process Innovation
MFV	Measuring Network Functions (in Dutch: “Meetnet Functievervulling”)
MJV	Annual Environmental Report
MNP	Netherlands Environmental Assessment Agency (in Dutch: “Milieu- en Natuur Planbureau”)
MR	Methane Recovery
MSW	Municipal Solid Waste
MW	Mega Watt
NA	Not Available; Not Applicable (notation key in CRF); also: National Approach
NACE	Statistical Classification of Economic Activities from the European Union: Nomenclature générale des Activités économiques dans les Communautés Européennes.
NAM	Nederlandse Aardolie Maatschappij
NAV	Dutch Association of Aerosol Producers
ND	No Data
NDF	Neutral Detergent Fiber
NE	Not Estimated (notation key in CRF)
NEAT	Non-Energy CO_2 emissions Accounting Tables (model of NEU-CO_2 Group)
NEC	National Emission Ceilings
NGL	Natural Gas Liquids
NIE	National Inventory Entity
NIR	National Inventory Report (annual greenhouse gas inventory report to UNFCCC)
NLR	National Aerospace Laboratory
NOGEPA	Netherlands Oil and Gas Exploration and Production Association
NOP-MLK	National Research Program on Global Air Pollution and Climate Change
NS	Dutch Railways
ODS	Ozone Depleting Substances
ODU	Oxidized During Use (of direct non-energy use of fuels or of petrochemical product)
OECD	Organization for Economic Co-operation and Development
OM	Organic Matter
OX	Oxygen Furnace (gas)
PBL	Netherlands Environmental Assessment Agency
PRTR	Pollutant Release and Transfer Register
QA	Quality Assurance
QC	Quality Control
RA	Reference Approach (vs. Sectoral or National Approach)
RIVM	National Institute for Public Health and the Environment
RIZA	National Institute of Water Management and Waste Treatment
ROB	Reduction Program on Other Greenhouse Gases
SA	Sectoral Approach; also: National Approach (vs. Reference Approach)
SBI	Standaard bedrijven indeling (NACE)
SCR	Selective Catalytic Reduction
SBSTA	Subsidiary Body for Scientific and Technological Advice (of Parties to the UNFCCC)
SGHP	Shell Gasification and Hydrogen Production
SNCR	Selective Non-Catalytic Reduction
SW	Streefwaarde (Dutch for “target value”)
SWDS	Solid Waste Disposal Site
TNO	Netherlands Organization for Applied Scientific Research
TBFRA	Temperate and Boreal Forest Resources Assessment (ECE-FAO)
TOF	Trees outside Forests
UN	United Nations
UNECE	United Nations Economic Commission for Europe

UNEP	United Nations Environment Program
UNFCCC	United Nation's Framework Convention on Climate Change
VOC	Volatile Organic Compound
VROM	Ministry of Housing, Spatial Planning and the Environment (from 2010 on, integrated in IenM)
VS	Volatile Solids
V&W	Ministry of Transport, Public Works and Water Management (from 2010 on, integrated in IenM)
WBCSD	World Business Council for Sustainable Development
WEB	Working Group Emission Monitoring of Greenhouse Gases
WEM	Working Group Emission Monitoring
WIP	Waste Incineration Plant
WUR	Wageningen University and Research Centre (or: Wageningen UR)
WWTP	Wastewater Treatment Plant

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The total greenhouse gas emission from the Netherlands in 2009 decreased by approximately 3% compared to the emission in 2008. This decrease is a result of the economic crisis especially due to the decrease in the industrial production. In 2009, total direct greenhouse gas emissions (excluding emissions from LULUCF – land use, land use change and forestry) in the Netherlands amount to 198.9Tg CO_2 eq. This is nearly 7% below the emissions in the base year (213.2 Tg CO_2 eq).

This report documents the 2011 Netherlands' annual submission of its greenhouse gas emission inventory in accordance with the guidelines provided by the United Nations Framework Convention on Climate Change (UNFCCC), the Kyoto Protocol and the European Union's Greenhouse Gas Monitoring Mechanism.

The report comprises explanations of observed trends in emissions; a description of an assessment of key sources and their uncertainty; documentation of methods, data sources and emission factors applied; and a description of the quality assurance system and the verification activities performed on the data.

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