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Greenhouse Gas Emissions in the Netherlands 1990-2005

National Inventory Report 2007

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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 2005]

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Many colleagues from a number of organizations (CBS, EC-LNV, LEI, SenterNovem, MNP and TNO) have been involved in the annual update of the Netherlands Pollutant Emission Register (PER), also called the Emission Registration (ER) system, which contains emissions data on about 170 pollutants. This annual project is led by the Netherlands Environmental Assessment Agency (MNP). The emission calculations, including those for greenhouse gas emissions, are performed by members of so-called 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 is converted into the IPCC source categories contained in the CRF files, which form a supplement to this report.
The description of sources, analysis of trends and uncertainty estimates in emissions (see chapters 3 to 8) of the various sources has been made in cooperation with the following emission experts: Mr Guus van den Berghe (SenterNovem) (waste), Mr Gert-Jan van der Born (land use), Mr Anco Hoen (transport, bunkers), Mr Romuald te Molder (trends, key sources), Mr Durk Nijdam (small combustion, solvent and product use), Mr Jos Olivier (energy), Mr Kees Peek (fugitive, industrial processes, other waste), Mr Kees Baas (CBS) (wastewater handling), Mrs Marian van Schijndel and Ms 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 Mr Dirk Wever and Mr Jeroen Peters, for their contribution to data processing 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

Broeikasgasemissies in Nederland 1990-2005

Dit rapport over de Nederlandse inventarisatie van broeikasgasemissies is op verzoek van het ministerie van VROM opgesteld om te voldoen aan de nationale rapportageverplichtingen in 2007 van het Klimaatverdrag van de Verenigde Naties (UNFCCC) en van het Bewakingsmechanisme Broeikasgassen van de Europese Unie. Dit rapport bevat de volgende informatie:

- trendanalyses voor de emissies van broeikasgassen in de periode 1990-2005;
- een analyse van zogenaamde sleutelbronnen en de onzekerheid in hun emissies volgens de 'Tier 1'-methodiek van het IPCC-rapport over 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.

Geconcludeerd wordt dat de emissies van de zes broeikasgassen, uitgedrukt in CO_2-equivalenten, in 2005 in totaal met circa 1% gedaald zijn ten opzichte van het basisjaar [1990 voor CO_2, CH_4, N_2O en 1995 voor HFK's, PFK's en SF_6 (F-gassen); exclusief de bos- en landgebruik (LULUCF)]. Emissie van CO_2 exclusief LULUCF is in de periode 1990-2005 met 10% gestegen, terwijl de emissies van CH_4 en N_2O met respectievelijk 34% en 17% zijn gedaald over dezelfde periode. De emissies van F-gassen zijn in de periode 1995-2005 met gemiddeld 76% afgenomen. De emissie van HFK's en PFK's daalde in die periode met respectievelijk 78% en 86%. De SF_6 emissies stegen met 12%.

Ten opzichte van 2004 zijn de totale broeikasgasemissies gedaald met circa 3%, voornamelijk als gevolg van lagere emissies in de energiesector en de doorgaande daling van CH_4 emissie in de sector afvalverwerking.

Trefwoorden: Broeikasgassen, emissies, trends, methodiek, klimaat

CONTENTS

SAMENVATTING **9**

INLEIDING 9
NATIONAL INVENTORY REPORT (NIR) 9
ONTWIKKELING VAN DE BROEIKASGASEMISSIES 9
METHODEN 11
BELANGRIJKSTE METHODISCHE WIJZIGINGEN TEN OPZICHTE VAN DE NIR 2006 11

EXECUTIVE SUMMARY **13**

ES1 BACKGROUND INFORMATION ON GREENHOUSE GAS INVENTORIES AND CLIMATE CHANGE 13
ES2 SUMMARY OF NATIONAL EMISSION AND REMOVAL RELATED TRENDS 15
ES3 OVERVIEW OF SOURCE AND SINK CATEGORY EMISSION ESTIMATES AND TRENDS 16
ES4 OTHER INFORMATION 17

1. INTRODUCTION **21**

1.1 BACKGROUND INFORMATION ON GREENHOUSE GAS INVENTORIES AND CLIMATE CHANGE 21
1.2 INSTITUTIONAL ARRANGEMENTS FOR INVENTORY PREPARATION 22
1.3 A BRIEF DESCRIPTION OF HOW THE INVENTORY IS PREPARED 23
1.4 BRIEF GENERAL DESCRIPTION OF METHODOLOGIES AND DATA SOURCES USED 25
1.5 A BRIEF DESCRIPTION OF THE KEY SOURCE CATEGORIES 26
1.6 INFORMATION ON THE QA/QC PLAN 27
1.7 EVALUATING GENERAL UNCERTAINTY 29
1.8 GENERAL ASSESSMENT OF THE COMPLETENESS 32

2. TRENDS IN GREENHOUSE GAS EMISSIONS **33**

2.1 EMISSION TRENDS FOR AGGREGATED GREENHOUSE GAS EMISSIONS 33
2.2 EMISSION TRENDS BY GAS 34
2.3 EMISSION TRENDS SPECIFIED BY SOURCE CATEGORY 39
2.4 EMISSION TRENDS FOR INDIRECT GREENHOUSE GASES AND SO_2 40

3. ENERGY [CRF SECTOR 1] **41**

3.1 OVERVIEW OF SECTOR 41
3.2 FUEL COMBUSTION ACTIVITIES [1A] 45
3.3 ENERGY INDUSTRIES [1A1] 46
3.4 MANUFACTURING INDUSTRIES AND CONSTRUCTION [1A2] 54
3.5 TRANSPORT [1A3] 62
3.6 OTHER SECTORS [1A4] 69
3.7 OTHERS [1A5] 74
3.8 INTERNATIONAL BUNKER FUELS 75
3.9 CO_2 EMISSIONS FROM BIOMASS 77
3.10 COMPARISON OF THE SECTORAL APPROACH WITH THE REFERENCE APPROACH FOR CO_2 79
3.11 FEEDSTOCKS AND OTHER NON-ENERGY USE OF FOSSIL FUELS 80
3.12 FUGITIVE EMISSIONS FROM FUELS [1B] 84
3.13 SOLID FUELS [CRF CATEGORY 1B1] 85
3.14 OIL AND NATURAL GAS [CRF CATEGORY 1B2] 86

4. INDUSTRIAL PROCESSES [CRF SECTOR 2] **89**

4.1 OVERVIEW OF SECTOR 89
4.2 MINERAL PRODUCTS [2A] 91
4.3 CHEMICAL INDUSTRY [2B] 93
4.4 METAL PRODUCTION [2C] 97
4.5 FOOD AND DRINK PRODUCTION [2D] 100
4.6 PRODUCTION OF HALOCARBONS AND SF6 [2E] 101
4.7 CONSUMPTION OF HALOCARBONS AND SF6 [2F] 102
4.8 OTHER INDUSTRIAL PROCESSES [2G] 104

5. SOLVENT AND OTHER PRODUCT USE [CRF SECTOR 3] 107

5.1 OVERVIEW OF SECTOR 107
5.2 INDIRECT CO_2 EMISSIONS FROM *SOLVENTS AND PRODUCT USE* (*PAINT APPLICATION* [3A], *DEGREASING AND DRY CLEANING* [3B] AND *OTHER* [3D]) 108
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]) 109

6. AGRICULTURE [CRF SECTOR 4] 111

6.1 OVERVIEW OF THE SECTOR 111
6.2 ENTERIC FERMENTATION [4A] 115
6.3 MANURE MANAGEMENT [4B] 120
6.4 AGRICULTURAL SOILS [4D] 125

7. LAND USE, LAND USE CHANGE AND FORESTRY [CRF SECTOR 5] 131

7.1 OVERVIEW OF SECTOR 131
7.2 FOREST LAND [5A] 133
7.3 CROPLAND [5B] 137
7.4 GRASSLAND [5C] 138
7.5 WETLAND [5D] 140
7.6 SETTLEMENT [5E] 140
7.7 OTHER LAND [5F] 141
7.8 OTHER [5G] 142

8. WASTE [CRF SECTOR 6] 145

8.1 OVERVIEW OF SECTOR 145
8.2 SOLID WASTE DISPOSAL ON LAND [6A] 147
8.3 WASTEWATER HANDLING [6B] 149
8.4 WASTE INCINERATION [6C] 151
8.5 OTHER WASTE HANDLING [6D] 153

9. OTHER [CRF SECTOR 7] 155

10. RE-CALCULATIONS AND IMPROVEMENTS 157

10.1 EXPLANATION AND JUSTIFICATION FOR THE RE-CALCULATIONS 157
10.2 IMPLICATIONS FOR EMISSION LEVELS 158
10.3 IMPLICATIONS FOR EMISSION TRENDS, INCLUDING TIME-SERIES CONSISTENCY 158
10.4 RE-CALCULATIONS, RESPONSE TO THE REVIEW PROCESS AND PLANNED IMPROVEMENTS 159

REFERENCES 163

ANNEX 1. KEY SOURCES 167

A1.1 INTRODUCTION 167
A1.2 TIER 1 KEY SOURCE AND UNCERTAINTY ASSESSMENT 169
A1.3 TIER 2 KEY SOURCE ASSESSMENT 172

ANNEX 2. DETAILED DISCUSSION OF METHODOLOGY AND DATA FOR ESTIMATING CO_2 EMISSIONS FROM FOSSIL FUEL COMBUSTION 174

A2.1 INTRODUCTION 174
A2.2 STARTING POINTS FOR THE NETHERLANDS' LIST 174
A2.2.1 THE NETHERLANDS' LIST 175
A2.2.2 FACT SHEETS 175
A2.2.3 THE NETHERLANDS LIST IN NATIONAL MONITORING, EUROPEAN CO_2 EMISSIONS TRADE AND IN E-MJV 176
A2.2.4 DEFINING AND MAINTAINING THE NETHERLANDS LIST 178

ANNEX 3. OTHER DETAILED METHODOLOGICAL DESCRIPTIONS FOR INDIVIDUAL SOURCE OR SINK CATEGORIES 181

ANNEX 4. CO_2 REFERENCE APPROACH AND COMPARISON WITH SECTORAL APPROACH 182

A4.1 COMPARISON OF CO_2 EMISSIONS IN THE NATIONAL APPROACH AND REFERENCE APPROACH 182
A4.2 CAUSES OF DIFFERENCES BETWEEN THE TWO APPROACHES 183
A4.3 FEEDSTOCK COMPONENT IN THE CO2 REFERENCE APPROACH 185

ANNEX 5. ASSESSMENT OF COMPLETENESS AND (POTENTIAL) SOURCES AND SINKS 186

ANNEX 6. ADDITIONAL INFORMATION TO BE CONSIDERED AS PART OF THE NIR SUBMISSION 187

A6.1 DOCUMENTATION OF UNCERTAINTIES USED IN IPCC TIER 1 UNCERTAINTY ASSESSMENTS AND TIER 2 KEY SOURCE IDENTIFICATION 188
A6.2 BACKGROUND DOCUMENTS AND UNCERTAINTY DISCUSSION PAPERS 188
A6.3 DOCUMENTATION OF PRESENT QUALITY ASSURANCE AND QUALITY CONTROL FOR NATIONAL GREENHOUSE GAS INVENTORY COMPILATION AND REPORTING 188

ANNEX 7. TABLES 6.1 AND 6.2 OF THE IPCC GOOD PRACTICE GUIDANCE 189

ANNEX 8. CRF SUMMARY TABLES 193

A8.1 IPCC TABLE 7A FOR BASE YEARS 1990, 1995 AND FOR 2005 193
A8.2 RECALCULATION TABLES FOR BASE YEARS 1990 AND 2004 199
A8.3 CRF TREND TABLES 10: GREENHOUSE GAS EMISSIONS AND BY SOURCE AND SINK CATEGORIES. 200
A8.4 TREND TABLES FOR THE PRECURSOR GASES AND SO_2 210

ANNEX 9. CHEMICAL COMPOUNDS, UNITS, GLOBAL WARMING POTENTIALS, OTHER CONVERSION FACTORS AND INTERNET LINKS 211

A9.1 CHEMICAL COMPOUNDS 211
A9.2 GLOBAL WARMING POTENTIALS FOR SELECTED GREENHOUSE GASES 211
A9.3 UNITS 211
A9.4 OTHER CONVERSION FACTORS FOR EMISSIONS 212

ANNEX 10. LIST OF ABBREVIATIONS 213

ANNEX 11. VOLUNTARY SUPPLEMENTATORY INFORMATION FOR ARTICLE 3.3 AND 3.4 OF THE KYOTO PROCOCOL 215

Samenvatting

Inleiding

Het National Inventory Report (NIR) 2007 bevat de rapportage van broeikasgasemissies (CO_2, N_2O, CH_4 en de F-gassen) over de periode 1990 tot en met 2005.

De emissiecijfers in de NIR 2007 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.

National Inventory Report (NIR)

Dit rapport over de Nederlandse inventarisatie van broeikasgasemissies is op verzoek van het ministerie van VROM opgesteld om te voldoen aan de nationale rapportageverplichtingen in 2007 van het Klimaatverdrag van de Verenigde Naties (UNFCCC) en van het Bewakingsmechanisme Broeikasgassen van de Europese Unie. Dit rapport bevat de volgende informatie:

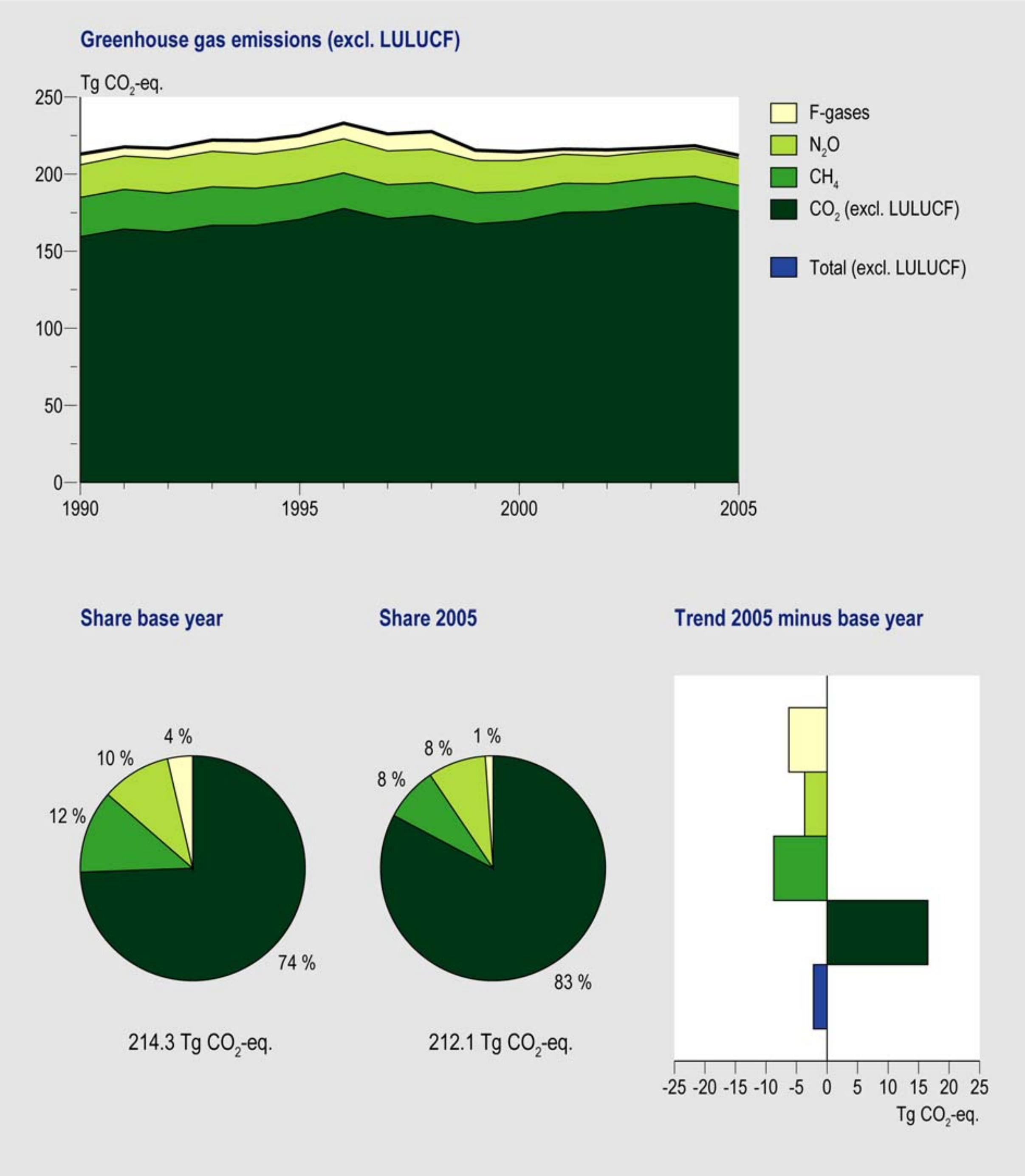
- trendanalyses voor de emissies van broeikasgassen in de periode 1990-2005;
- een analyse van zogenaamde sleutelbronnen en de onzekerheid in hun emissies volgens de ‘Tier 1’-methodiek van het IPCC-rapport over Good Practice guidance;
- documentatie van gebruikte berekeningsmethoden, databronnen en toegepaste emissiefactoren;
- een overzicht van het kwaliteitssysteem en de validatie van de emissiecijfers voor de Nederlandse Emissieregistratie.

Een aparte annex bij dit rapport bevat elektronische data over (met name) emissies in het zogenaamde Common Reporting Format (CRF), waar door het secretariaat van het VN-Klimaatverdrag om wordt verzocht. In de bijlagen bij dit rapport zijn de samenvattende emissie- en trendtabellen ‘7A’ en 10 op basis van het CRF opgenomen voor 1990-2005. Daarnaast bevatten de bijlagen ondermeer een overzicht van sleutelbronnen en onzekerheden. Ook wordt in de bijlagen bij dit rapport specifiek ingegaan op de activiteiten onder artikel 3.3 en 3.4 van het Kyoto Protocol; ofwel de activiteiten op gebied van bebossing, herbebossing, ontbossing en landgebruiksactiviteiten zoals gedefinieerd onder het Kyoto Protocol.
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 jaarlijkse Milieubalans en de vierde Nationale Communicatie onder het Klimaatverdrag, die begin 2006 is verschenen.

Ontwikkeling van de broeikasgasemissies

De emissieontwikkeling in Nederland wordt beschreven en toegelicht in dit National Inventory Report (NIR 2007). Figuur ES.1 geeft het emissieverloop over de periode 1990-2005 weer. De totale emissies bedroegen in 2005 circa 212,1 Tg (Mton ofwel miljard kg) CO_2-equivalenten en waren daarmee ongeveer één procent lager *(*Box ES.1*)* dan de emissies in het basisjaar (214,3 Tg CO_2-eq.). De hier gepresenteerde emissies zijn exclusief de emissies van landgebruik en bossen (LULUCF); deze emissies tellen pas mee vanaf 2008 onder het Kyoto Protocol. De emissie van CO_2 is sinds 1990 met circa 10% toegenomen, terwijl de emissies van de andere broeikasgassen met circa 34% zijn afgenomen ten opzichte van het basisjaar.

De CO_2-emissie van de energieproductie is in 2005 met circa 3 Tg afgenomen ten opzichte van 2004, omdat er minder elektriciteit is geproduceerd in Nederland en meer is geïmporteerd. Daarnaast zijn er meer duurzame energiebronnen (biomassa, wind) ingezet bij de Nederlandse elektriciteitsproductie (+ 40 procent). De totale CO_2-uitstoot van huishoudens en van handel, diensten en overheid was ruim 2 Tg lager dan in het jaar daarvoor. Deze daling heeft onder andere te maken met het minder koude stookseizoen en meer HR-ketels. De uitstoot van de overige broeikasgassen is met ongeveer 1 Tg gedaald, zodat in 2005 de totale uitstoot van broeikasgassen circa 3% lager ligt dan in 2004. Of er sprake is van een trendbreuk, is op basis van deze waarnemingen niet te zeggen.



Figuur ES.1. Broeikasgassen: emissieniveaus, bijdragen per gas en emissietrends, 1990-2005.

Box ES.1 onzekerheden

De emissies van broeikasgassen kunnen niet exact worden gemeten of berekend. Onzekerheden zijn daarom onvermijdelijk. Het MNP schat de onzekerheid in de jaarlijkse totale broeikasgasemissies op circa 5%. 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 201 en 223 Tg (Mton). De onzekerheid in de emissietrend tussen het basisjaar (1990/1995) en 2005 is geschat op circa 3%-punt; dat wil zeggen dat de emissietrend met 95% betrouwbaarheid ligt tussen de -4 tot +2%.
In het verrekeningssysteem onder het Kyoto Protocol worden emissies bepaald op een van tevoren afgesproken wijze (vastgelegd in protocollen) en wordt een Partij daarop uiteindelijk ook afgerekend.

Methoden

De methoden die Nederland hanteert voor de berekening van de broeikasgasemissies zijn vastgelegd in protocollen, te vinden op www.broeikasgassen.nl. De protocollen zijn opgesteld door SenterNovem, 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 ER (december 2005), zijn de protocollen vastgelegd in een wettelijke regeling door het ministerie van VROM. 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. Deze vastgestelde methoden zullen de komende jaren (tot 2014) worden gehanteerd; tenzij er grote veranderingen plaatsvinden in bijvoorbeeld de basisdata-beschikbaarheid of de implementatie van beleidsmaatregelen aanleiding geeft de methoden aan te passen.

Voor de definitieve bepaling van het basisjaar, zal begin april 2007 het nationaal systeem worden gereviewd onder artikel 8 van het Kyoto Protocol. Hoewel er geen harde garanties gegeven kunnen worden over de uitkomst van deze review, zijn de methoden naar de mening van de nationale deskundigen op dit moment 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.

Belangrijkste methodische wijzigingen ten opzichte van de NIR 2006

De methoden, die afgelopen jaren aan de IPCC Good Practice zijn aangepast, werden al toegepast voor- en gedocumenteerd in de NIR 2006. Er zijn geen methodewijzigingen doorgevoerd in deze NIR. Wel zijn enkele verbeteringen in de basisdata doorgevoerd. Deze hadden echter geen invloed op de emissies in het basisjaar.

Wijzigingen in basisdata
De belangrijkste wijziging is het gebruik van CO_2-emissiecijfers zoals de raffinaderijen rapporteerden in Milieujaarverslagen (categorie 1A1b van het CRF). De CO_2-emissies namen in de jaren sinds 2002 met 0,4 - 1 Tg toe (ten opzichte van de rapportage van vorig jaar). Daarnaast is voor de jaren vanaf 2003 de emissiefactor voor het eigen energiegebuik (ruw aardgas) in de olie- en gaswinning aangepast op basis van informatie uit Milieujaarverslagen. In de vorige rapportage werd gebruikt gemaakt van de standaard emissiefactor voor aardgas (56,8).

Allocatie
Een deel van de emissies die voorheen waren toegewezen aan verbrandingsemissies van raffinaderijen (categorie 1A1b), zijn nu verplaatst naar categorie 1B2: procesemissies van raffinaderijen. Deze verandering is gebaseerd op gedetailleerde informatie uit Milieujaarverslagen.

Foutcorrectie
Tijdens het opstellen van de CRF-tabellen is een verwerkingsfout gevonden in een cijferreeks die gebruikt is bij de NIR/CRF's van 2006: in categorie 1B2, distributie van olie en gas is de hele tijdreeks met één jaar verplaatst (met uitzondering van 1990). In categorie 2E3 en 2F9 zijn de HFK-emissies iets aangepast vanaf 2003 door het beschikbaar komen van nieuwe activiteitendata.

Executive Summary

ES1 Background information on greenhouse gas inventories and climate change

This report documents the 2007 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) 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) 2007 therefore provides explanations of the trends in greenhouse gas emissions, activity data and (implied) emission factors for the period 1990-2005. It also summarises 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: 'Milieubalans') prepared by the Netherlands' Environmental Assessment Agency (MNP) and the 4th National Communication (NC4) prepared by the government of the Netherlands.
So-called 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.

Climate Convention and Kyoto Protocol
Although this *NIR 2007* is prepared as a commitment under the UNFCCC, it is also an important report in the context of the Kyoto Protocol. Because the Protocol has entered into force, ratifying Parties will have to start fulfilling commitments under the 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 shall comply with the IPCC guidelines as mentioned earlier. A party may enter the Protocol after review of its national system and the national inventory based on this system, and after solving any problems of implementation.
This NIR 2007 is based upon the envisaged National System of the Netherlands under article 5.1 of the Protocol, as developed in the period 2000-2005 and finalised by December 2005.

Key sources
For identification of so-called 'key sources' according to the IPCC Good Practice approach the national emissions are allocated according to the IPCC potential key source 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 29 sources for annual level assessment and 28 sources for the trend assessment, out of a total of 72 sources. Both lists can be combined to get an overview of sources, which meet any of these two criteria. Next, the IPCC Tier 2 method for identification of key sources is used, which requires the incorporation of the uncertainty to each of these sources before ordering the list of shares. The result is a list of 39 source categories out of a total of 72 that could be identified as 'key sources' according to the definition of the IPCC Good Practice Guidance report. Finally, three key sources are found in the LULUCF sector (sector 5), after inclusion of 9 LULUCF subcategories in the key source analysis.

Institutional arrangements for inventory preparation
The greenhouse gas inventory of the Netherlands is based on the national Pollutant Emission Register (PER). The general process of inventory preparation exists many years and is organised as a project with an annual cycle. In 2000, an improvement programme was initiated (under the lead of SenterNovem) to transform the general process of the greenhouse gas inventory of the PER into a National System, according to the requirements under article 5.1 of the Kyoto Protocol.
The Netherlands Environmental Assessment Agency (MNP) has been contracted by the Ministry of Housing, Spatial Planning and the Environment (VROM) to compile and maintain the PER and to co-ordinate the preparation of the NIR and filling the CRF (see Figure ES.2). In December 2005, SenterNovem was designated by law as the National Inventory Entity (NIE). The tasks of SenterNovem include the overall co-ordination of QA/QC activities and co-ordination of 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 where needed. The present CRF/NIR is based on the improved methodologies. Monitoring protocols describing the methodology, 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 format for the NIR, starting with an introductory chapter 1, containing background information on the Netherlands' process of inventory preparation and reporting; key sources 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 the emissions in different sectors. Chapter 10 presents information on recalculations, improvements and response to issues raised in external reviews on the NIR 2006 and on the draft version of the NIR 2007. In addition, the report provides more detailed information on key sources, methodologies, other relevant reports and summary emission tables selected from the CRF files (IPCC Tables 7A and 10) in 10 Annexes. This year also an Annex 11 is added, including information related to art. 3.3 and 3.4 of the Kyoto Protocol.

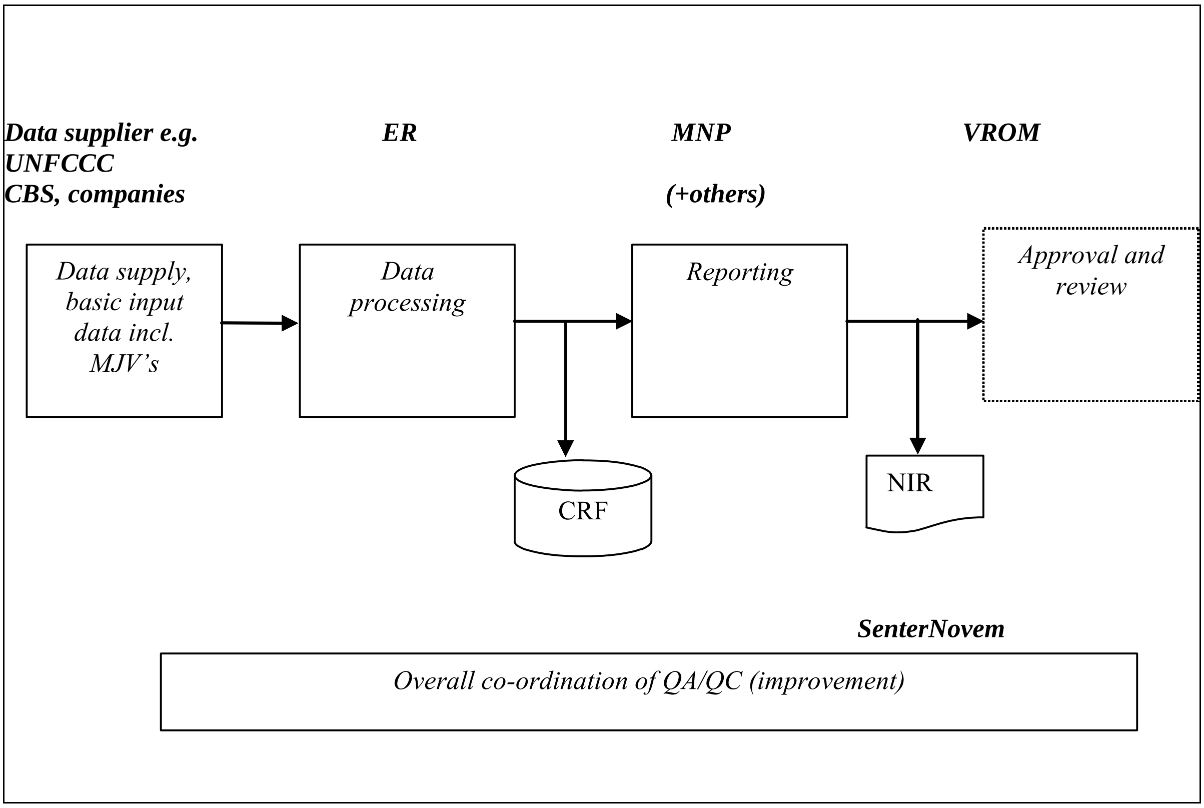


Figure ES.2. Main elements in the greenhouse gas inventory compilation process.

ES2 Summary of national emission and removal related trends

Figure ES.1 (see Dutch Summary) provides an overview of the emission trends for greenhouse gas emissions since 1990.

In 2005, total direct greenhouse gas emissions (excluding emissions from LULUCF) in the Netherlands are estimated at 212.1 Tg CO_2-equivalents (CO_2-eq.). This is one percent below the emissions in the base year (214.3 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 10% from 1990 to 2005, mainly due to the increase in the emissions in the 1A1a Public electricity sector (+28%) and 1A3 Transport sector (+33%). CH_4 emissions decreased by 34% in 2005 compared to the 1990 level, mainly due to decrease in the waste sector (-50%), the agricultural sector (-16%) and fugitive emissions in the energy sector (-53%). N_2O emissions decreased by about 16% in 2005 compared to 1990, mainly due to the decrease in the emissions from agriculture (-18%) and from industrial processes (-18%), which partly compensated increases of emissions from fossil fuel combustion (mainly from transport). Of the fluorinated greenhouse gases, emissions of HFCs and PFCs decreased in 2005 by about 78% and 86%, respectively, while SF_6 emissions increased by 12%. Total emissions of all F-gases decreased by about 76% compared to the 1995 level (chosen as the base year).

Between 2004 and 2005, total greenhouse gas emissions dropped by about 3% (-6.3 Tg CO_2-eq.). CO_2 emissions dropped by 5.4 Tg mainly due to the increased use of biomass fuel for electricity generation, less energy use by households and the commercial/institutional sector for heating during a relatively warm winter, and by increased import of electricity. Furthermore, CH_4 emissions from solid waste disposal on land (landfills) showed an ongoing decrease (-0.6 Tg CO_2-eq.).

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. It clearly shows the Energy sector (category 1) to be by far the largest contributor to national total greenhouse gas emissions. In contrast, emissions of the other sectors decreased compared to the base year, the largest being those of Industrial Processes, Waste and Agriculture.

Sectors showing the largest growth in CO_2-equivalent emissions since the base year (1990/1995) are Transport (1A3) and Energy industries (1A1) (both about 30%). However, half of 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 1990’s (1A2). Clear exceptions to the growth in the Energy sector are the Waste sector (6), Industrial Processes (2) and Agriculture (4).

Table ES.1. Summary of emission trend per gas and source category (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 1)
Base year	NA	159.4	25.4	21.2	6.0	1.9	0.3	NA	214.3
1990	161.8	159.4	25.4	21.2	4.4	2.3	0.2	215.4	213.0
1991	166.7	164.4	25.7	21.6	3.5	2.2	0.1	219.9	217.6
1992	164.6	162.4	25.2	22.4	4.4	2.0	0.1	218.8	216.6
1993	169.0	166.8	24.9	23.1	5.0	2.1	0.1	224.2	222.0
1994	168.9	166.7	24.1	22.3	6.5	2.0	0.2	223.9	221.8
1995	172.8	170.6	23.8	22.4	6.0	1.9	0.3	227.3	225.1
1996	179.9	177.7	23.0	22.2	7.7	2.2	0.3	235.3	233.0
1997	173.5	171.1	22.0	21.9	8.3	2.3	0.3	228.5	226.0
1998	175.6	173.2	21.2	21.7	9.3	1.8	0.3	229.9	227.6
1999	170.0	167.7	20.1	20.9	4.9	1.5	0.3	217.8	215.4
2000	172.0	169.6	19.3	19.9	3.8	1.6	0.3	216.9	214.4
2001	177.6	175.2	18.9	18.8	1.5	1.5	0.4	218.6	216.2
2002	178.1	175.7	18.0	18.0	1.5	2.2	0.3	218.1	215.7
2003	182.0	179.6	17.5	17.4	1.4	0.6	0.3	219.2	216.8
2004	183.6	181.3	17.3	17.7	1.5	0.3	0.3	220.8	218.4
2005	178.2	175.9	16.7	17.6	1.4	0.3	0.3	214.5	212.1

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

	1. Energy	2. Industrial Processes 2)	3. Solvent and Other Product Use	4. Agri-culture	5. LU-LUCF	6. Waste	7. Other 3)	Total incl. LULUCF	Total excl. LULUCF 1)
Base year	154.0	25.0	0.5	22.0	NA	12.8	NA	NA	214.3
1990	154.0	23.6	0.5	22.0	2.4	12.8	NA	215.4	213.0
1991	159.0	22.7	0.5	22.4	2.3	13.0	NA	219.9	217.6
1992	157.7	23.0	0.4	22.8	2.2	12.7	NA	218.8	216.6
1993	162.4	23.9	0.4	23.0	2.2	12.4	NA	224.2	222.0
1994	161.6	25.6	0.4	22.2	2.2	11.9	NA	223.9	221.8
1995	165.5	24.8	0.4	23.0	2.2	11.3	NA	227.3	225.1
1996	173.3	26.0	0.4	22.4	2.2	11.0	NA	235.3	233.0
1997	165.6	27.3	0.3	22.2	2.4	10.6	NA	228.5	226.0
1998	167.9	27.6	0.4	21.5	2.3	10.2	NA	229.9	227.6
1999	162.2	22.5	0.4	21.0	2.3	9.4	NA	217.8	215.4
2000	164.2	21.3	0.3	19.8	2.4	8.9	NA	216.9	214.4
2001	170.3	17.7	0.3	19.5	2.4	8.4	NA	218.6	216.2
2002	170.9	18.1	0.2	18.4	2.4	8.0	NA	218.1	215.7
2003	174.7	16.2	0.2	18.2	2.4	7.5	NA	219.2	216.8
2004	176.3	16.5	0.2	18.2	2.4	7.3	NA	220.8	218.4
2005	170.9	16.2	0.2	18.2	2.3	6.6	NA	214.5	212.1

1) The national total does not include the CO_2 emissions reported under category 5 (LULUCF).

2) Emissions from the use of the F-gases HFCs, PFCs and SF_6 are according to the IPCC reporting guidelines all reported under source category 2 Industrial processes.

3) NA in Base year and category 7 = Not Applicable, others: Not Available.

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 (based on CRF tables submitted to the UNFCCC in April 2006). The Tier 1 estimation of ***annual uncertainty*** in CO_2-eq. emissions results in an overall uncertainty of 4%, based on calculated uncertainties of 2%, 17%, 45% and 31% 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 MNP at:

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

Table A1.4 of Annex 1 summarises the estimate of the trend uncertainty 1990-2005 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 -2005 (1995 for F-gases) of ±3% points. This means that the decrease in total CO_2-eq. emissions between 1990 and 2005, which is calculated to be 1%, will be between -4% and +2%. 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 ±2.5%, ±10%, ±15% and ±7% 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 1996 IPCC Guidelines (IPCC, 1996), except for the following (very) minor sources:

- Oil transport (1B2a3), due to missing activity data;
- Charcoal production (1B2) and use (1A4) , due to missing activity data;
- CO_2 from lime production (2A2), 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 Slugdge application on land (4D4), due to missing activity data;
- CH_4 from poultry (4A9), due to missing emission factors;
- N_2O from Industrial wastewater (6B1), due to negligible amounts.
- A survey to check on unidentified sources of non-CO_2 emissions in the Netherlands showed that some minor sources of PFCs and SF_6 are not included in the present greenhouse gas inventory (DHV, 2000).

The above mentioned sources have been examined by the Dutch Working Group Emission Monitoring of Greenhouse Gases and only negleglible amounts have been found. Since no regular monitoring data are available, these sources are not included.

- Precursor emissions (i.e. CO, NO_x, NMVOC and SO_2) from Memo item international bunkers (international transport) have not been estimated.

Methodological changes, recalculations and improvements
This NIR 2007 is based upon the envisaged National System of the Netherlands under article 5.1 of the Kyoto Protocol, as developed in the past few years and finalised by December 2005. In past years the results of various improvement actions are implemented in the methodologies and processes of the preparation of the greenhouse gas inventory of the Netherlands. Compared to the NIR/CRF 2006 some small recalculations were undertaken for the submission of 2007, specially focussing on key sources.

Compared to the NIR/CRF 2006, the following changes were made in the greenhouse gas inventory:
1. The following methodological changes were implemented related to data improvement:

- Re-calculation of CO_2 emissions from 1A1b Petroleum Refining for the years 2002–2004, based on emission and activity data provided by the companies, will result in 0.4 to 1.1 Tg higher CO_2 emissions in the next submission, depending on the year (see table below);
- In category 1A1c, Manufacture of solid fuels and other energy industries information from the annual environmental reports was used to determine the emission factor of 'own energy use' in oil and gas production from 2003 onwards (in the precedent NIR, the general emission factor for natural gas of 56.8 was applied).

3. The source allocation was improved for:

- part of the emissions formerly allocated in category 1Ab1, are now allocated in category 1B2. This change is based on detailed information from annual environmental reports of refineries;

4. Error corrections including:

- in category 1B2, distribution of oil and gas, the whole time series (except 1990) was corrected (shifted one year);
- in categories 2E3 and 2F9, some minor errors in the use of HFCs (activity data) were corrected for a number of years.

These changes do not affect the base year.

Table ES.3 provides the results of recalculations in the NIR 2007 compared to the NIR 2006.

Table ES.3 Differences between NIR 2006 and NIR 2007 for 1990-2004 due to recalculations (Unit: Tg CO_2-eq., F-gases: Gg CO_2-eq.).

Gas	Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO_2 Incl.	NIR06	161.8	166.7	164.6	169.0	168.9	172.8	179.9	173.5	175.6	170.0	172.0	177.6	177.3	180.9	183.3
LUCF	NIR07	161.8	166.7	164.6	169.0	168.9	172.8	179.9	173.5	175.6	170.0	172.0	177.6	178.1	182.0	183.6
	Diff.	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**1.1**	**0.3**
CO_2 Excl.	NIR06	159.4	164.4	162.4	166.8	166.7	170.6	177.7	171.1	173.2	167.7	169.6	175.2	174.9	178.5	180.9
LUCF	NIR07	159.4	164.4	162.4	166.8	166.7	170.6	177.7	171.1	173.2	167.7	169.6	175.2	175.7	179.6	181.3
	Diff.	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**1.1**	**0.4**
CH_4	NIR06	**25.4**	25.7	25.2	24.9	24.1	23.8	23.0	22.0	21.2	20.1	19.3	18.9	18.0	17.5	17.3
	NIR07	**25.4**	25.7	25.2	24.9	24.1	23.8	23.0	22.0	21.2	20.1	19.3	18.9	18.0	17.5	17.3
	Diff.	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N_2O	NIR06	**21.2**	21.6	22.4	23.1	22.3	22.4	22.2	21.9	21.7	20.9	19.9	18.8	18.0	17.4	17.7
	NIR07	**21.2**	21.6	22.4	23.1	22.3	22.4	22.2	21.9	21.7	20.9	19.9	18.8	18.0	17.4	17.7
	Diff.	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
PFCs	NIR06	2,264	2,245	2,043	2,068	1,990	**1,938**	2,155	2,344	1,829	1,471	1,581	1,489	2,186	620	285
Gg	NIR07	2,264	2,245	2,043	2,068	1,990	**1,938**	2,155	2,344	1,829	1,471	1,581	1,489	2,186	620	285
	Diff.	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
HFCs	NIR06	4,432	3,452	4,447	4,998	6,480	**6,020**	7,678	8,300	9,341	4,859	3,824	1,469	1,541	1,319	1477
Gg	NIR07	4,432	3,452	4,447	4,998	6,480	**6,020**	7,678	8,300	9,341	4,859	3,824	1,469	1,541	1,319	1,477
	Diff.	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
SF_6	NIR06	217	134	143	150	191	**301**	312	345	329	317	335	356	332	309	328
Gg	NIR07	217	134	143	150	191	**301**	312	345	329	317	335	356	332	309	328
	Diff.	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Incl.	NIR06	215.4	219.9	218.8	224.2	223.9	227.3	235.3	228.5	229.9	217.8	216.8	218.6	217.3	218.1	220.4
LUCF	NIR07	215.4	219.9	218.8	224.2	223.9	227.3	235.3	228.5	229.9	217.8	216.8	218.6	218.1	219.2	220.8
	Diff.	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**1.1**	**0.4**
Total Excl.	NIR06	213.0	217.6	216.6	222.0	221.8	225.1	233.0	226.0	227.6	215.4	214.4	216.2	214.9	215.7	218.1
LUCF	NIR07	213.0	217.6	216.6	222.0	221.8	225.1	233.0	226.0	227.6	215.4	214.4	216.2	215.7	216.8	218.4
	Diff.	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**1.1**	**0.3**

Notes: base year values are indicated in bold.

Improving the QA/QC system

The QA/QC programme is up to date and all procedures and processes are established to meet the National System requirements (amongst others as part of the annual activity programme of the Netherlands PER). QA/QC activities to be undertaken as part of the National System have been described in chapter 1. Some actions which remained since the NIR 2006, are now carried out:

- The update of the description of QA/QC of outside agencies;
- Results of a TIER 2 uncertainty analysis are now available. The results will be taken into account in next years QA/QC programme and included in the monitoring protocols.

Emission trends for indirect greenhouse gases and SO_2

Compared to 1990, the CO and NMVOC emissions were reduced in 2005 by 53% and 62%, respectively. For SO_2 this is even 69%, and for NO_x, the 2005 emissions are 38% lower than the 1990 level. Table ES.4 provides trend data.

In contrast with 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 changing methodologies), have only been performed for 1990, 1995, 2000, 2003, 2004 and 2005 for all sources.For that reason the precursor gas emissions in other years are interpolated.

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

	NOx	CO	NMVOC	SO_2
1990	559.3	1137.3	465.8	190.1
1991	460.9	1026.3	412.1	140.5
1992	447.1	981.9	388.8	133.5
1993	429.3	925.3	361.2	126.0
1994	412.4	896.4	339.9	118.5
1995	470.2	862.0	332.7	128.1
1996	456.6	850.8	293.3	121.3
1997	417.2	772.4	263.6	102.0
1998	405.6	759.4	262.6	93.7
1999	411.1	738.7	248.7	87.8
2000	396.4	715.6	234.6	71.6
2001	385.2	680.1	212.6	73.4
2002	377.5	647.5	202.0	66.7
2003	375.5	626.8	187.0	62.8
2004	354.8	617.2	180.0	63.6
2005	344.9	538.1	176.5	58.5

1. INTRODUCTION

1.1 Background information on greenhouse gas inventories and climate change

1.1.1 General issues

The United Nations Framework Convention on Climate Change (UNFCCC) was ratified by the Netherlands in 1994 and came 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 report documents the 2007 Greenhouse Gas Emission Inventory for the Netherlands. The estimates provided in the report are consistent with the 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, the reader is referred to the annual Environmental Balance (MNP 2006, in Dutch), the Fourth Netherlands' National Communication under the United Nations Framework Convention on Climate Change (VROM, 2006a) and the Netherlands' Report on demonstrable Progress under article 3.2 of the Kyoto Protocol (VROM, 2006b). The Common Reporting Format (CRF) spreadsheet files accompany this report as electronic annexes (The CRF files are compressed into four zip files for this submission: crf-nld-2007-v-1-3-90-93.zip; crf-nld-2007-v-1-3-94-97.zip; crf-nld-2007-v-1-3-98-01.zip; crf-nld-2007-v-1-3-02-05.zip). These files contain data on emissions, activities and implied emission factors. 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. In addition, trend tables and check tables compiled from CRF data as well as other information, such as protocols of the methods used to estimate emissions, are available on this website.

The Netherlands also reports emissions under other international agreements, such as the UNECE Convention on Long Range Transboundary Air Pollutants (CLRTAP) and the European Union's National Emission Ceilings (NEC) directive. These estimates are provided by the Netherlands' Pollution Emission Register (PER), which is also compiled by the Environmental Assessment Agency. The greenhouse gas inventory and the PER share the same underlying data, which ensures consistency between the inventories and the internationally reported data. Several institutes are involved in the process of compiling the greenhouse gas inventory (see also section 1.3).

The 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). The 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 wel as sulphur oxides (SO_x).

This report provides explanations of the trends in greenhouse gas emissions per gas and per sector for the 1990–2005 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.

As a part of the National System under article 5.1 of the Kyoto Protocol, methodologies were established (and documented) in monitoring protocols. These monitoring protocols and the general description of the National System are available on the website www.greenhousegases.nl. The emissions reported in the NIR 2007 are based on these methodologies, which have been incorporated in the National System for greenhouse gases.

A small number of changes have been implemented in the NIR 2007 relative to the NIR of the preceding year. An overview of these changes is provided in section 10.1.

The structure of this report complies with the format required by the UNFCCC (FCCC/SBTSA/2004/8). Emissions of greenhouse gases presented in this report are given in Gigagrammes (Gg) and Teragrammes (Tg), and both the units and conversion factors used are given in Annex 9. Global warming potential (GWP)-weighed emissions of the greenhouse gases are also provided (in CO_2-equivalents). In accordance with the Kyoto Protocol, the IPPC GWP for a time horizon of 100 years is used. The GWP of each individual greenhouse gas is provided individually in Annex 9.

1.1.2 CRF files: greenhouse gas emissions and background data

The CRF files contain detailed information on greenhouse gas emissions, activity data and (implied) emission factors specified by sector, source category and greenhouse gas. Detailed information on specific source categories can be found in the CRF files. Some summary tables are included in this report. Annex 8 of this report contains a summary of the following CRF files:

- IPCC summary Table 7A for 1990, 1995, 2000, 2004 and 2005 (CRF Summaries 1);
- trend Table 10 for each gas individually, and for all gases and sources in CO_2-equivalents.

Section 10.4 provides details on the extent to which the CRF data files for 1990–2005 have been completed. For the final NIR 2007 report, a special effort will be made to:

- further improvement on the notation keys included, where applicable;
- complete time series for precursor emissions.

1.1.3 Geographical coverage of the Netherlands' inventory

The reported emissions 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 as are emissions from all electricity-generating activities in the Netherlands, including the electricity fraction that is exported. The Netherlands imported about 10% of its electricity up to 1999, but following the liberalisation of the European electricity markets in that year, the net import increased by 55%. Emissions from the fishing fleet registered in the Netherlands, but sailing outside Dutch coastal waters for the most part, are included in the national total.

1.2 Institutional arrangements for inventory preparation

1.2.1 Overall responsibility

The Ministry of Housing, Spatial Planning and the Environment (VROM) has overall responsibility for climate change policy issues. The ministry is also responsible for forwarding the NIR and CRF to the EU and UNFCCC. The Netherlands Environmental Assessment Agency (MNP) has been contracted by the Ministry of VROM to compile and maintain the pollutants emission register/ inventory (PER system) and to co-ordinate the preparation of the NIR and filling the CRF.

1.2.2 Responsibility for 'designing the National System'

In August 2004 the Ministry of VROM assigned SenterNovem executive tasks bearing on the National Inventory Entity (NIE), the single national entity required under the Kyoto Protocol; in December 2005, SenterNovem was designated by law as the NIE. In addition to co-ordinating the establishment of a National System, the tasks of SenterNovem include the overall co-ordination of (improved) QC/QA activities as part of the National System and co-ordination of the support/response to the UNFCCC review process. The National System is described in more detail in SenterNovem et al. (2005c).

1.2.3 Responsibility for emission estimates

A Pollutant Emission Register (PER) has been in operation in the Netherlands since 1974. This system encompasses the process of data collection, data processing and the registering and reporting of emission data for some 170 policy-relevant compounds and compound groups that are present in the air, water and soil. The emission data are produced in an annual (project) cycle (MNP, 2005). This system is also the basis for the national greenhouse gas inventory. In April 2004 full co-ordination of the PER was outsourced by the Ministry of VROM to the MNP. This has resulted in a clearer definition and separation of responsibilities as well as a clustering of tasks.

The main objective of the PER is to produce an annual set of unequivocal emission data that are up-to-date, complete, transparent, comparable, consistent and accurate. In addition to MNP, various external agencies contribute to the PER by performing calculations or submitting activity data (see following section), these include: CBS (Statistics Netherlands), TNO (Netherlands Organisation for Applied Scientific Research), SenterNovem, RIZA (Institute for Inland Water Management) and several institutes related to the Wageningen University and Research Centre (WUR).

1.2.4 Responsibility for reporting

The NIR is prepared by MNP. Since mid-2005, the NIR has been part of the PER project. Most institutes involved in the PER also contribute to the NIR (including CBS and TNO, among others). In addition, SenterNovem is involved in its role as NIE.

1.3 A brief description of how the inventory is prepared

1.3.1 Introduction

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.

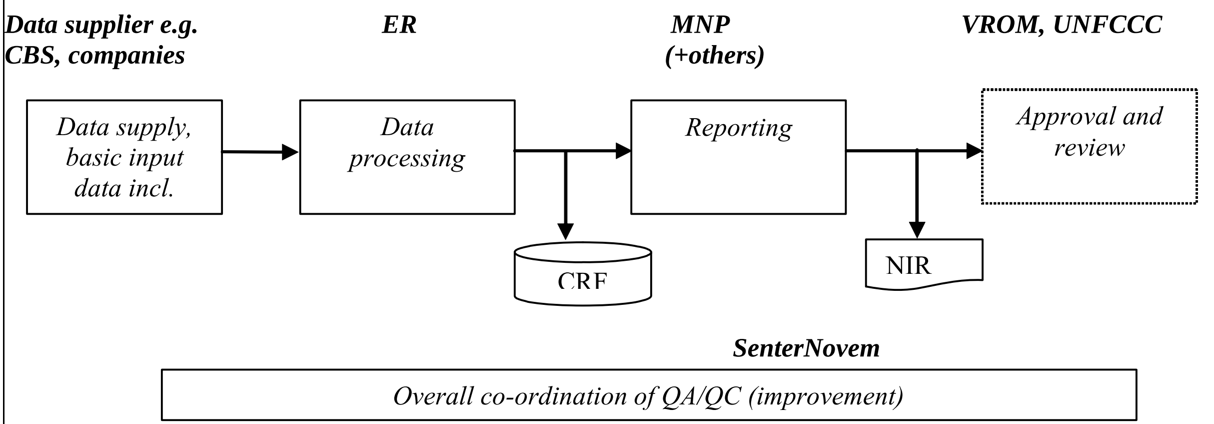


Figure 1.1 Main elements in the greenhouse gas inventory process.

1.3.2 Data supply and collection

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

- *Statistical data*
  Statistical data are provided under various (i.e. 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 and an Order in Decree, the latter of which is under preparation by the Ministry of VROM. For greenhouse gases, relevant agreements with respect to waste management are in place with CBS (general statistics) and SenterNovem. An agreement with the Ministry of Agriculture, Nature and Food Security (LNV) and related institutions was established in 2005.

- *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 a 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 so-called BEES/A regulation. Some companies provide data voluntarily, within the framework of environmental covenants. The data in these MJVs are primarily used for verifying the calculated CO_2 emissions from energy statistics for industry, energy and refineries. If reports from major industries contain plant-specific information on activity data and emission factors of sufficient quality and transparency, these data are used in the calculation of 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. 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.
- *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 MNP) with, for example, various agricultural institutes and TNO. In addition, SenterNovem contracts out various tasks to consultants (collecting information on F-gas emissions from cooling and product use, on improvement actions, etc.). During 2004, the Ministry of LNV 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 MNP, these activities are also part of the PER.

1.3.3 Data processing and storage

Data processing and storage are co-ordinated by MNP; these processes consist most notably of the elaboration of emission estimates and data preparation in the CRF. The emission data are stored in a central database, thereby satisfying – in an efficient and effective manner – (inter)national criteria on emission reporting.

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 2006, in addition to the MNP, these included TNO, CBS, RIZA, FO-I (the Facilitating Organisation for Industry, which co-ordinates annual environmental reporting by companies), SenterNovem (Waste Management division) and various agricultural research institutes, one of which was Alterra (sinks). The task forces are responsible for assessing emission estimates based on the input data and emission factors provided. MNP commissioned TNO to carry out the task of collecting data from the various task forces and to compile these into the CRF.

The methodologies and procedures used for the collection and processing of the data from which the emissions are estimated are defined in the monitoring protocols (see: www.greenhousegases.nl).

These were elaborated, together with relevant experts and institutes, as part of the monitoring improvement programme.

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

The NIR is prepared by MNP with input from the experts in the relevant PER task forces and from SenterNovem. This step includes documentation and archiving. The Ministry of VROM formally approves the NIR before it is submitted; in some cases approval follows consultation with other ministries.

SenterNovem is responsible for coordinating QA/QC and responses to the EU and for providing additional information requested by the UNFCCC after the NIR and CRF have been submitted. SenterNovem is also responsible (in collaboration with MNP) for coordinating the submission of supporting data to the UNFCCC review process.

1.4 Brief general description of methodologies and data sources used

1.4.1 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.

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

1.4.2 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) agricultural gas and diesel consumption (LEI);
- residential biofuel data: (1) annual survey of residential woodstove and fireplace penetration from the Association for Comfortable Living (Vereniging Comfortabel Wonen); (2) a 1996 survey on wood consumption by owners of residential woodstoves and fireplaces from the Stove and Stack Association (Vereniging van Haard en Rookkanaal, VHR);
- 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 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-DLO agricultural database, plus data from the annual agricultural census;
- manure production and handling: from the CBS/LEI-DLO national statistics;
- fertiliser statistics: from the LEI-DLO agricultural statistics;

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,T2,T3**	**CS,D,PS**	**CS,T1,T1b, T2,T3**	**CS,D,PS**	**CS,T1,T2**	**CS,D**						
A. Fuel Combustion	CS,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	CS,D						
3. Transport	CS,T2	CS	CS,T2,T3	CS,D	CS,T2	CS,D						
4. Other Sectors	T2	CS,D	T1,T2	CS,D	T1	D						
5. Other	T2	D	T2	CS	T2	CS						
B. Fugitive Emissions from Fuels	CS,T2,T3	CS,PS	T1b,T2,T3	CS,D,PS	NA	NA						
1. Solid Fuels	T2	CS	T1b	D	NA	NA						
2. Oil and Natural Gas	CS,T2,T3	CS,PS	T1b,T2,T3	CS,D,PS	NA	NA						
2. Industrial Processes	**CS,T1a,T1b, T2**	**CS,D,PS**	**CS,T1,T2**	**CS,D**	**CS,T1b,T2**	**CS,D,PS**	**T2**	**CS,PS**	**CS,T2**	**PS**	**CS,T2**	**D,PS**
A. Mineral Products	CS	CS,D,PS	NA	NA	NA	NA						
B. Chemical Industry	CS,T1b	CS,PS	T1,T2	D	T2	PS					NA	NA
C. Metal Production	T1a,T2	CS	NA	NA	NA	NA	NA	NA	T2	PS	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							T2	CS	CS,T2	PS	CS,T2	D,PS
G. Other	CS,T1b	CS,D	CS	CS	CS,T1b	CS,D	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,T2**	**CS,D**	**NA**	**NA**	**NA**	**NA**						
A. Forest Land	CS,T2	CS	NA	NA	NA	NA						
B. Cropland			NA	NA	NA	NA						
C. Grassland			NA	NA	NA	NA						
D. Wetlands	NA	NA	NA	NA	NA	NA						
E. Settlements	CS	CS	NA	NA	NA	NA						
F. Other Land	CS	CS	NA	NA	NA	NA						
G. Other			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**

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.

Data sources (continued)

- forest and wood statistics: (1) forest surface area 1980, 2000 and after 2000: CBS (1985), Dirkse et al. (2003), supplemented with agricultural statistics on orchards and nurseries from LEI/CBS (2000); CBS (1985, 1989), Daamen (1998) and Edelenbosch (1996) for the intermediary years; (2) stem-volume, annual growth and fellings: Dirksen et al. (2003);
- area of organic soils: De Vries (2004);
- soil maps: De Groot et al. (2005);
- waste production and handling: Working Group on Waste Registration (WAR), SenterNovem and CBS;
- methane recovery from landfills: Association of Waste Handling Companies (VVAV).

Many recent statistics are available on the internet at CBS's statistical website Statline and CBS/MNP environmental data compendium. However, it should be noted that the units and definitions used for domestic purposes occasionally differ from those used in this report. In particular, CO_2 data are given, with or without temperature correction, with or without the inclusion of organic CO_2 and with or without LULUCF sinks and sources.

1.5 A brief description of the key source categories

The analysis of key sources is performed in accordance with the IPCC Good Practice Guidance (IPCC, 2001). As a means 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. The key source assessment presented in Annex 1 is based on emission figures in CRF version 1.2, submitted to EU in March 2007. Per sector, the key sources are also listed in the Introduction of each of chapters 3–8.
The following changes are found compared to the key source analysis for the NIR 2006:

- N_2O emissions from 1A3 Mobile combustion: road vehicles: now non-key;
- CO_2 emissions from 1A3 Mobile combustion: water-borne navigation: now non-key;
- CO_2 emissions from 1B1b Coke production: now non-key.

1.6 Information on the QA/QC plan

As one of the results of a comprehensive inventory improvement programme, a National System fully in line with the Kyoto requirements was finalised and established by the end of 2005. As part of this system also an Act on Monitoring of Greenhouse Gases has become effective in December 2005. This Act determines the establishment of the National System for monitoring of greenhouse gases and empowers the Minister of Housing, Spatial Planning and the Environment (VROM) 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. With a regulation following to that the Minister has appointed SenterNovem as NIE (national inventory entity) 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 programme. This programme is yearly assessed and updated, if needed. The key elements of the current programme (SenterNovem, 2006) are briefly summarised in this chapter, notably those related to the current NIR.

1.6.1 QA/QC activities for the CRF/NIR 2007

- 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. For the NIR 2007 only some minor (editorial) changes were incorporated and references were updated The National System website (www.greenhousegases.nl) provides additional information on the protocols and relevant background documents.
- General QC checks are performed. To facilitate these general QC checks, a checklist was developed and implemented. A number of general QC checks have also been introduced as part of the annual work plan of the PER respectively of the monitoring protocols.The QC checks build into the work plan aim at covering such issues as consistency, completeness, correctness of the CRF data, among others.
  The general QC for the present inventory is largely performed in the PER, as an integrated part of the working processes. The PER task forces fill in a standard-format database with emission data for 1990–2005. After a first check of the emission files by MNP and TNO for completeness, the (corrected) data are available for 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 is fixed, a trend verification workshop is organised by MNP (see Box 1.1).
- Quality Assurance for the current NIR includes the following activities:
  - A peer and public review on the basis of the draft NIR in January 2006. 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 Synthesis and Assessment Report of NIR 2006 – have been taken into account in chapters 3–8 to the extent possible.
  - As part of the evaluation process of the previous cycle, internal audits were performed through SenterNovem on the use of the protocols and the implementation of QC checks. These audits showed that the monitoring protocols could be well implemented and did not provide major problems. Also the designed QC procedures were basically considered appropriate and well workable.

Box 1.1. Trend verification workshops.

Several weeks in advance of a trend analysis meeting, a snapshot from the database is made available by MNP in a webbased application (Emission Explorer, EmEx) for checks by the involved institutes and experts (PER task forces). In this way the task forces can check for level errors and consistency in the algorithm/method used for calculations throughout the time series. The task forces perform checks for CO_2, CH_4 and N_2O emissions, among others, 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 the subject of discussion at the trend analysis workshop and subsequently documented.

Furthermore, TNO provides the task forces with time series of emissions per substance for the individual target sectors and the CRF. The task forces examine these time series. During the trend analysis the greenhouse gas emissions for all of the years between 1990 and 2005 were checked in two ways: emissions from 1990 – 2004 should (with some exeptions) be identical to those reported last year; besides the data for 2005 were compared with the trend development for each gas since 1990. The checks of outliers were carried out on a more detailed level of the sub-sources of all sector background tables:

- annual changes in emissions of all greenhouse gasses;
- 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 have to be processed within 2 weeks or be dealt with in next year's inventory.

1.6.2 QA/QC plan, as part of the National System

The QA/QC activities generally aim at a high-quality output of the PER and the National System, taking into account the ISO 9001/2000 certification of MNP and the international QA/QC requirements (IPPC Good Practice). Furthermore, the system should operate within the available means (capacity, finances). Within those boundaries, the main focal points of the QA/QC activities are:

- The QA/QC programme (SenterNovem, 2006, updated version of the 2005 programme) that has been developed and implemented as part of the National System. This programme includes quality objectives for the National System, the QA/QC plan and a time schedule for implementation of the activities. It will updated annually as part of a yearly 'evaluation and improvement cycle' for the inventory and National System and be held available for review.
- The annual activity programme of the PER (MNP, 2006) that is part of the requirements under the MNP ISO 9001/200 certification. The work plan describes tasks and responsibilities of the parties involved in the PER process, products and the time schedule (planning), emission estimation methods – among which are the monitoring protocols for the greenhouse gases – as well as 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 1.6.1).
- 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 PER 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 MNP and institutes ('outside agencies') that are involved in the annual PER process. The general agreement is that by accepting the annual work plan, the involved institutes 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 PER 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 programme 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 PER 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 1.6.1). Documentation is obliged 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 the SenterNovem (assigned as NIE) and institutions not basically involved in the PER process.
- Public review of the draft NIR: SenterNovem 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 upon that the involved institutions of the PER inform MNP on possible internal audits. Furthermore, SenterNovem is assigned the task of organising audits, if needed, of relevant processes or organisational issues within the National System. In 2006 such an audit was performed (see the previous section).
- Archiving and documentation: internal procedures are agreed upon (amongst others in the PER annual activity programme) for general data collection and the storage of fixed datasets in the MNP database, including the documentation/archiving of QC checks. The improved monitoring protocols have been documented and will be published on the website www.greenhousegases.nl. To improve transparency, the newly 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. SenterNovem (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 yearly to evaluate the process. In this review, 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 programme (including the improvement programme) and the annual work plan. The (monitoring) improvement plan is 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 programme. Because it did not seem possible to considerably reduce uncertainties by independent verification (measurements) – at least not on the national scale – this issue has received less priority. In the context of a large research programme on climate change in the Netherlands, the issue is being studied once again at the present time. To some extent (for example, in the Transport sector) comparisons can be made on the basis of independent data sets (see section 3.4.4.).

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. Secondly, these uncertainty estimates can be 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 Data used

The following information sources were used for estimating the uncertainty in activity data and emission factors (Olivier and Brandes, 2007):

- 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 2000);
- RIVM fact sheets on calculation methodology and data uncertainty (RIVM, 1999);
- other recent information on the quality of data (Boonekamp et al., 2001).

These data sources were supplemented with expert judgements from MNP and CBS emission experts (also for the new key sources). This was followed by an estimation of the uncertainty in the emissions in 1990 and 2005 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 with 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.

1.7.2 Results

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 4% in 2005, based on calculated uncertainties of 1.8%, 17%, 45% and 31% for CO_2 (excluding LULUCF), CH_4, N_2O and F-gases, respectively. The uncertainty in CO_2 emissions including emissions from LULUCF is calculated to be 2.4%. 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 uncertainty of total ***annual*** emissions per compound and of the total will be somewhat higher; see Table 1.2 for the currently estimated values.

Table 1.2 Uncertainty of total annual emissions.

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

Table 1.3 shows the top ten sources contributing most to total ***annual uncertainty*** in 2005, after ranking the sources according to their contribution to the uncertainty in total national emissions (using the column ‘Combined Uncertainty as a percentage of total national emissions in 2005’ in Table A7.1).

Table 1.3 Top ten sources contributing most to total annual uncertainty in 2005.

IPCC category	Category	Gas	Combined uncertainty as a percentage of total national emissions in 2005
4D3	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	3.1%
4D1	Direct N2O emissions from agricultural soils	N_2O	1.4%
2B2	Nitric acid production	N_2O	1.4%
6A1	CH_4 emissions from solid waste disposal sites	CO_2	0.9%
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CH_4	0.9%
4B1	Emissions from manure management : cattle	CH_4	0.7%
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	0.7%
4A1	CH_4 emissions from enteric fermentation in domestic livestock: cattle	N_2O	0.6%
2G	Indirect N_2O from N_2O from combustion and industrial processes	CH_4	0.5%
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	0.5%

Table A7.1 of Annex 7 summarises the estimate of the **trend uncertainty** 1990–2005 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 1990–2005 (1995 for F-gases) of ±3% points. This means that the increase in total CO_2-eq. emissions between 1990 and 2005, which is calculated to be -1%, will be between –4% and +2%.

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 ±2.5%, ±10%, ±15% and ±7% points, respectively. More details on the level and trend uncertainty assessment can be found in Annex 7. Table 1.4 shows the top ten sources contributing most to **trend uncertainty** in the national total (using the column ‘Uncertainty introduced into the trend in total national emissions’ in Table A7.1).

Table 1.4 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 N_2O emissions from nitrogen used in agriculture	N_2O	1.9%
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO_2	1.3%
6A1	CH_4 emissions from solid waste disposal sites	CH_4	1.2%
1A3b	Mobile combustion: road vehicles: diesel oil	CO_2	0.7%
1A1b	Stationary combustion : Petroleum Refining: liquids	CO_2	0.6%
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO_2	0.6%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gases	CO_2	0.5%
2B2	Nitric acid production	N_2O	0.4%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, liquids	CO_2	0.3%
4D1	Direct N_2O emissions from agricultural soils	N_2O	0.3%

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

1.7.3 Limitations

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) 2σ smaller than 60%; (c) independent (not-correlated) sector-to-sector and substance-to-substance. For a number of sources, it is clear that activity data or emission factors are correlated, which may change the overall uncertainty of the sum to an unknown extent. For some sources, it is also known that the uncertainty is not distributed normally; in particular, when uncertainties are very high (on an order of 100%) it is clear that the distribution will be positively skewed.

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 judgement of the expert. On occasion there is only limited reference to actual data for the Netherlands is 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 in the Netherlands.

Furthermore, in 2006 a Tier 2 uncertainty assessment was carried out (Ramirez 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 1.5 and 1.6). Further, the Tier 2 uncertainty for 1990 emissions is slightly higher (about 1.5%- points) 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.

Table 1.5 Effects of simplifying Tier 1 assumptions on the uncertainties of emissions for 2004 (without LULUCF).

Greenhouse gas	Tier 1 annual uncertainty [1)]	Tier 2 annual uncertainty [2)]
Carbon dioxide	1.9%	1.5%
Methane	18%	15.1%
Nitrous oxide	45%	42.0%
F-gases	27%	28.1%
Total	**4.3%**	**3.9%**

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

Table 1.6 Effects of simplifying Tier 1 assumtions 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%	11.3%	14.6%
Nitrous oxide	-16%	15.0%	27.9%
F-gases	-75%	7.0%	9.1%
Total	+1.6%	3.2%	4.5%

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

As part of the above mentioned study, the expert judgements 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) in particular. The correlations that have been assumed in the various European Tier 2 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. 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, but 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 by, 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 Programme on Global Air Pollution and Climate Change (NOP-MLK) or by the Dutch Reduction Programme 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 programme 'Climate changes spatial planning' started aiming to stenghten the knowledge on the relation between greenhouse gas emissions and land-use and spatial planning.

1.8 General assessment of the completeness

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

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 1990–2005, by both, greenhouse gas and by sector. Detailed explanations of these trends are provided in chapters 3–8. Emission trends specified per source category are published on the website www.greenhousegases.nl and provide emission trends of the direct greenhouse gases specified by gas and by source category.

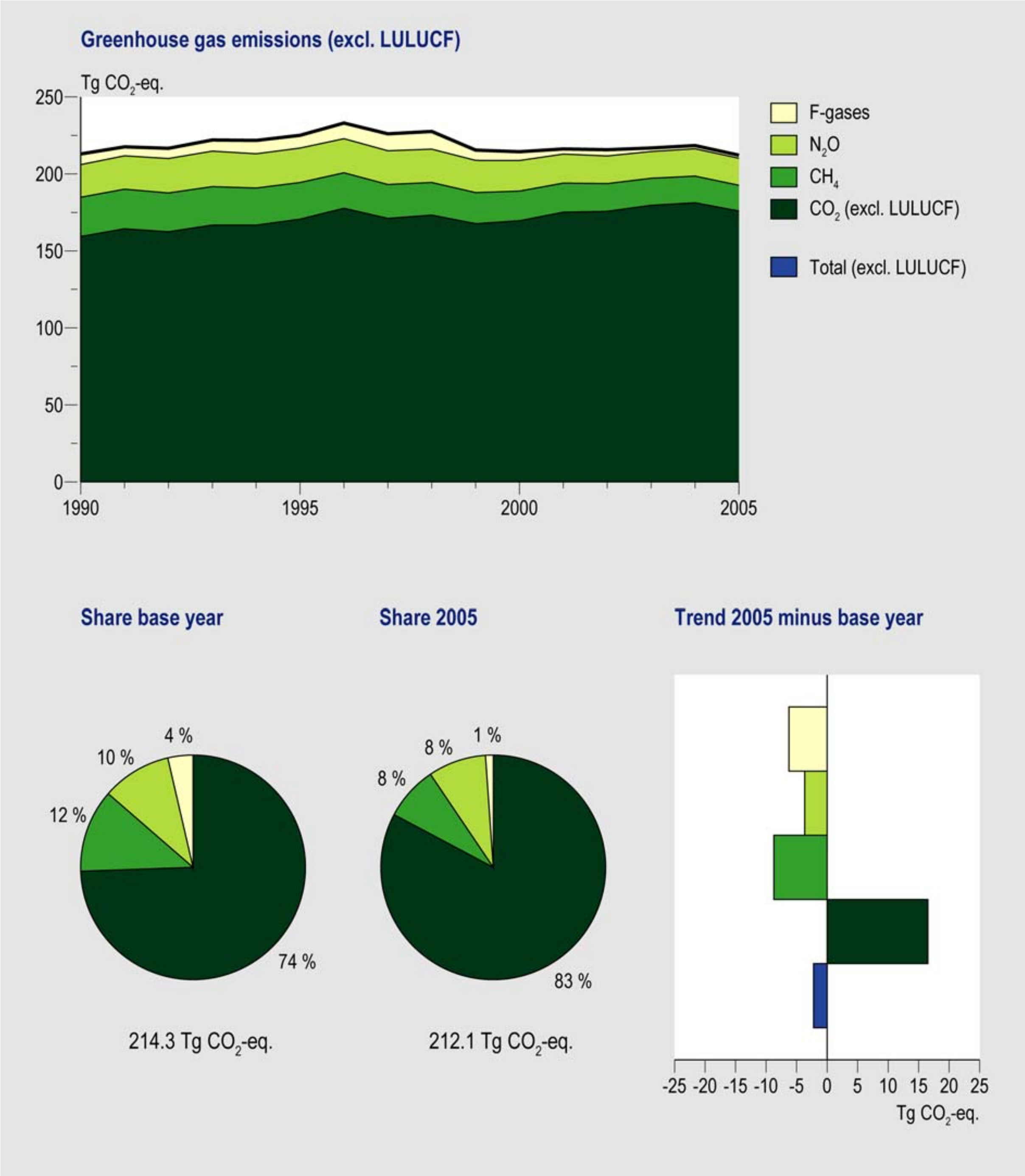


Figure 2.1 Greenhouse gases: trends, emission levels and share of gases, 1990–2005.

In 2005 total direct greenhouse gas emissions (excluding emissions from LULUCF) in the Netherlands are estimated at 212.1 Tg CO_2-eq., which is one percent lower as the 214.3 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.

The contribution of non-CO_2 greenhouse gases (CH_4, N_2O and F-gases) to the aggregated total emissions decreased between 1990 and 2005 (26% in the base year compared to 17% in 2005). Consequently, the trend shown by aggregated greenhouse gas emissions in the Netherlands is that of an increasing dominance by CO_2 emissions.

In the period 1990–2005 emissions of CO_2 increased by 10% (excluding LULUCF), while emissions of non-CO_2 greenhouse gases decreased by 34% compared with the base year emissions. Of the non-CO_2 greenhouse gases, CH_4, N_2O and the F-gases individually decreased 34%, 17% and 77%, respectively. Emissions of LULUCF decreased 1.5%, from 2.39 Tg in 1990 to 2.34 Tg CO_2-eq. in 2005.

Between 2004 and 2005, total greenhouse gas emissions (excl. LULUCF) dropped by about 3% (-6.3 Tg CO_2-eq.). This decrease was largely due to a reduction of CO_2 emissions (-5.4 Tg CO_2) and a further decrease of CH_4 emissions (-0.6 Tg CO_2-eq.).

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 IPCC, to the trend in total national CO_2 emissions (excluding LULUCF). In the period 1990–2005 the total inventory of national CO_2 emissions increased by 10% (from 159.4 to 175.9 Tg). The IPCC sector Energy is by far the largest contributor to CO_2 emissions in the Netherlands (96%), with the categories 1A1 ‘Energy industries’ (+28%) and 1A3 ‘Transport’ (+33%) contributing the most to the increased CO_2 emissions. Fuel combustion emissions in category 1A2 ‘Manufacturing industries and construction’ decreased by 18%. This decrease is explained by a re-allocation of CO_2 emissions to category 1A1a ‘Public electricity and heat production’ as a result of changes in the ownership (joint-ventures) of the co-generation plants during this period. The increased emissions included in category 1A1 ‘Energy industries’ are partly explained by this (see section 3.3.1).

The relatively high level of CO_2 emissions in 1996 is mainly explained by a very cold winter, which caused 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% – resumed.

In 2005, total CO_2 emissions dropped by 3% (-5.4 Tg) compared to 2004. The CO_2 emissions decreased due to the increased use of biomass fuel for electricity generation, less energy use by households and the commercial/institutional sector for heating during a relatively warm winter, and by increased import of electricity.

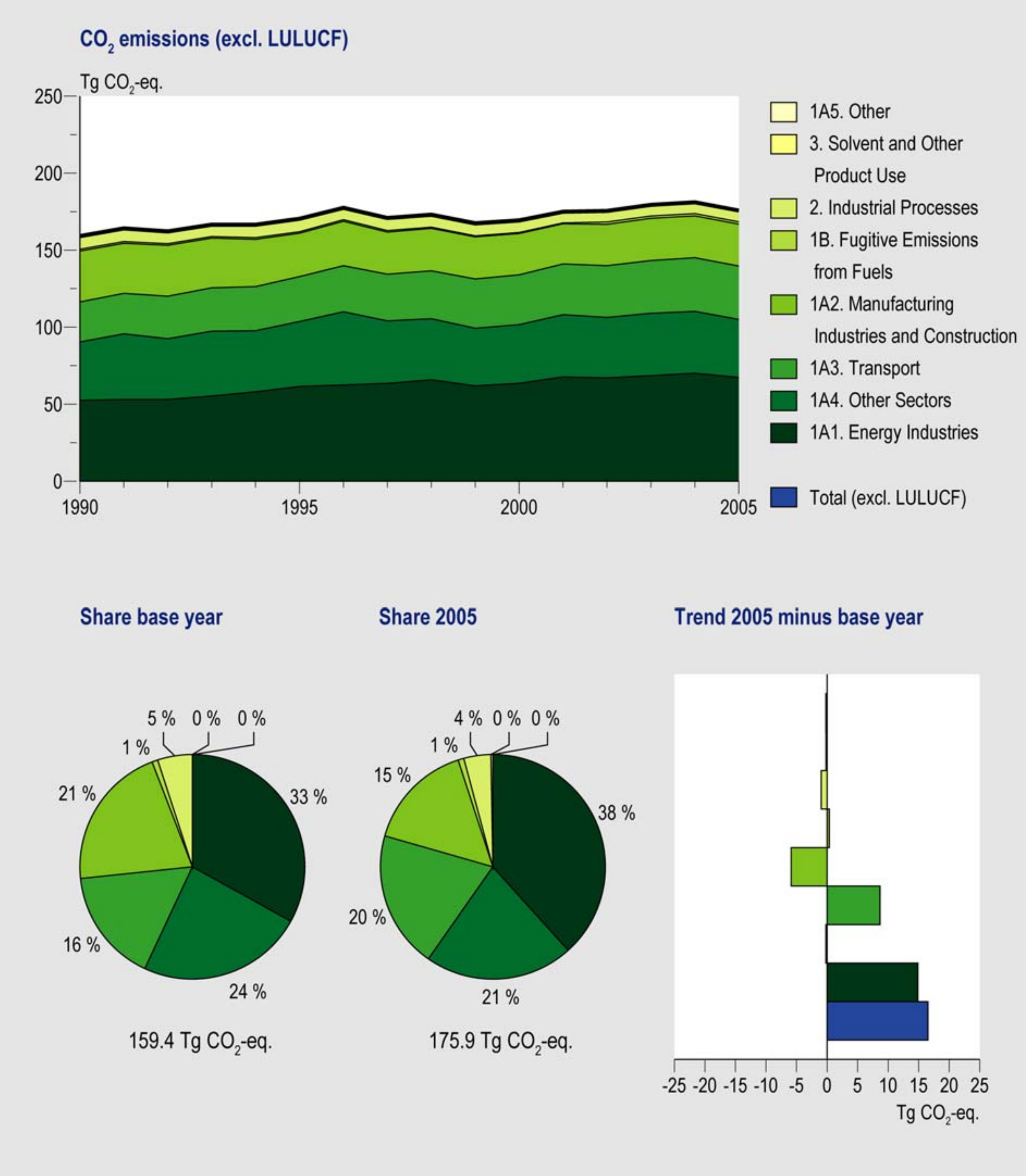


Figure 2.2 CO_2: trend, emission levels and share of sectors, 1990–2005.

2.2.2 Methane

Figure 2.3 presents the contribution of the most important IPCC sectors to the trend in national total CH_4 emissions. The total inventory of national CH_4 emissions decreased 34%, from 1211 Gg in 1990 to 796 Gg in 2005 (25.4 to 16.7 Tg CO_2-eq.). Sectors contributing the most to the reported decrease are Waste (–50%), Agriculture (–16%) and the fugitive emissions from Energy (–53%).

Compared to 2004, total CH_4 emissions dropped by 3% in 2005 (-0.6 Tg CO_2-eq.), due to the further decrease of CH_4 emissions in category 6A: solid waste disposal on land.

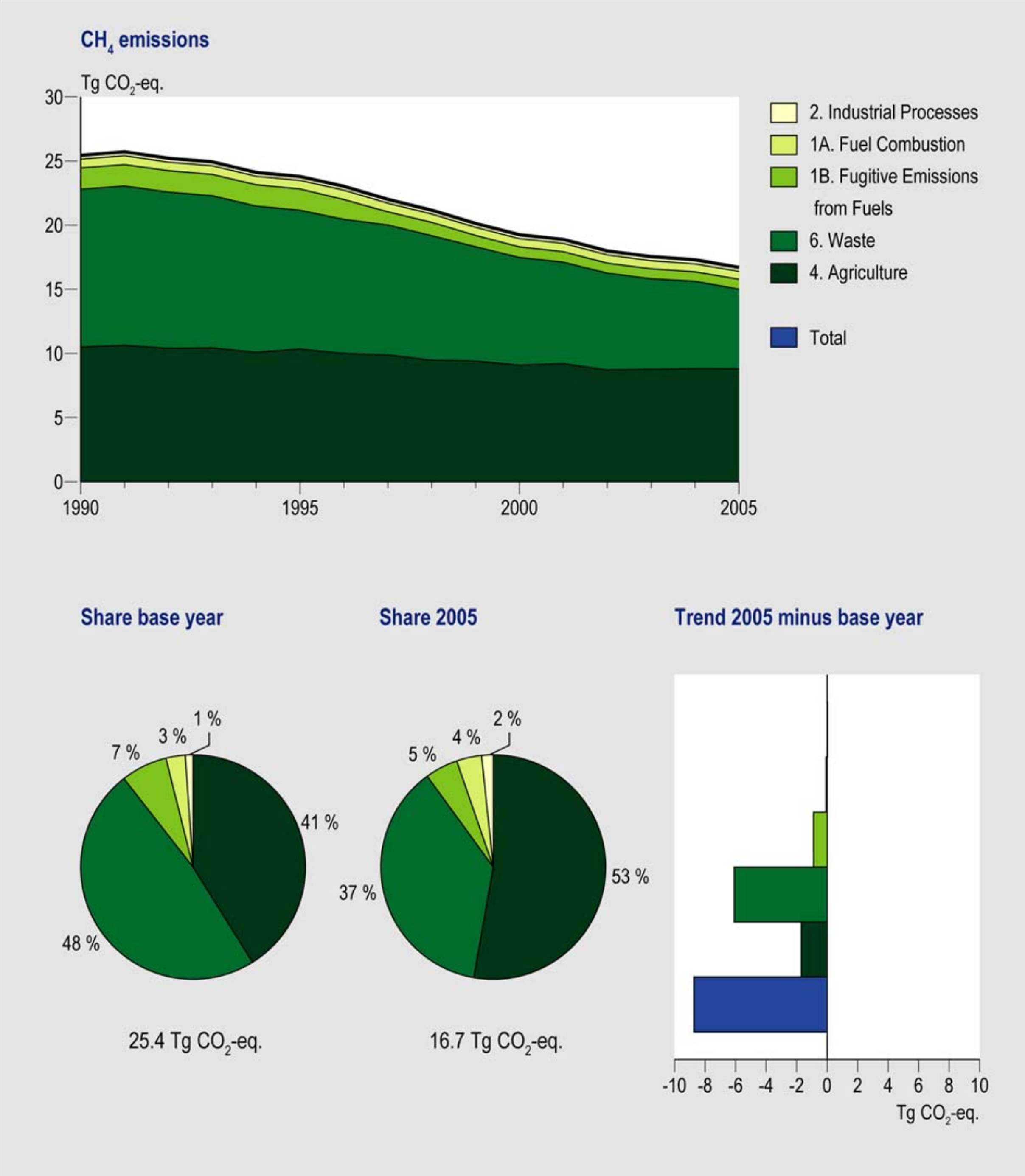


Figure 2.3 CH_4: trend, emission levels and share of sectors, 1990-2005.

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 17%, from 68 Gg in 1990 to 57 Gg in 2005 (from 21.2 to 17.6 Tg CO_2-eq.). Sectors contributing the most to this decrease in N_2O emissions are sectors 2 ‘Industrial Processes’ (–18%) and 4 ‘Agriculture’ (–18%). During the same period N_2O emissions from fossil fuel combustion increased. This latter trend can be largely clarified by increased emissions from Transport, which are partly compensated for by decreased emission levels from the Sectors Industrial Processes and Agriculture.

In 2005, total N_2O emissions remained almost at the same level as in 2004.

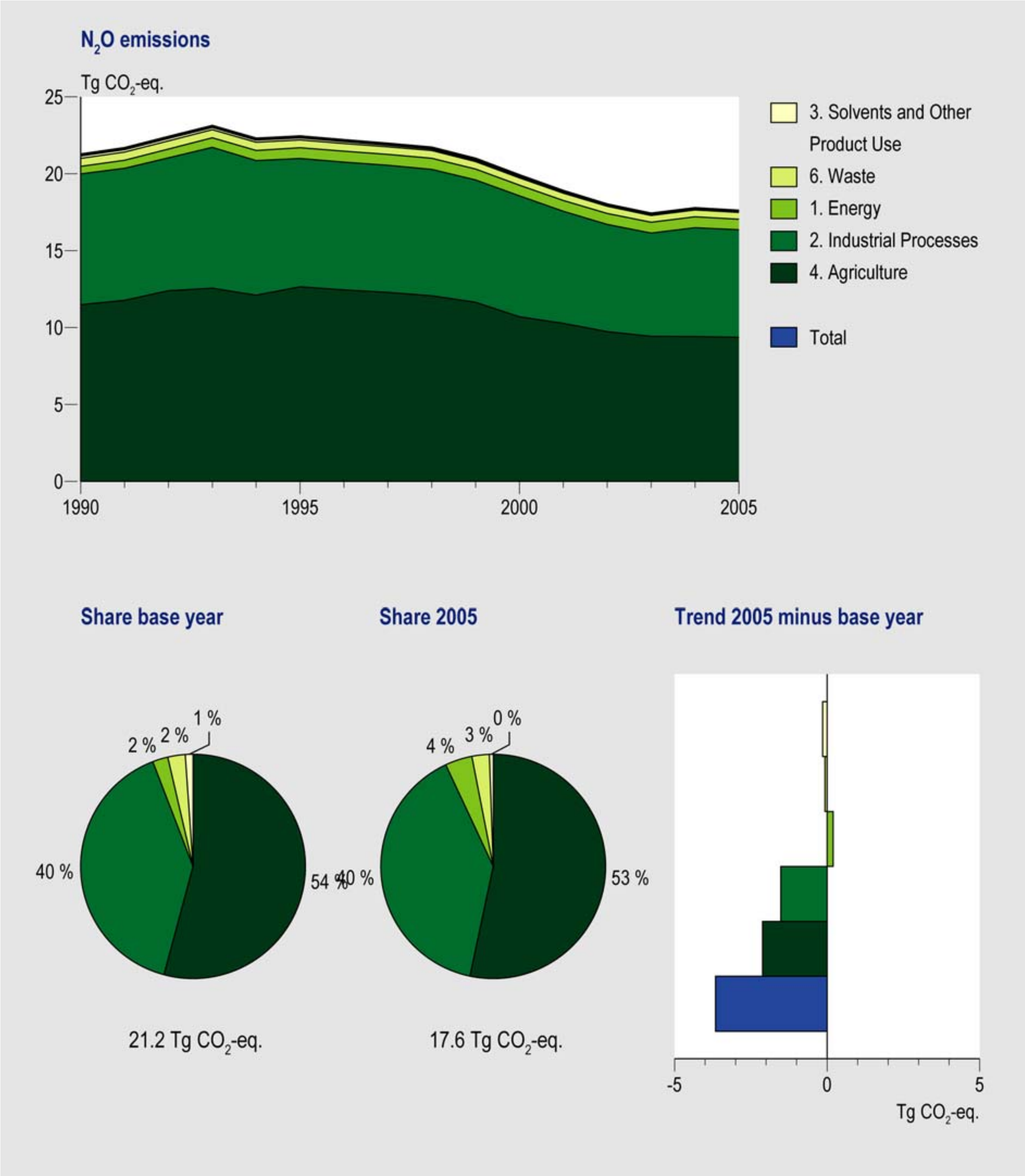


Figure 2.4 N_2O: trend, emission levels and share of sectors, 1990–2005.

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 76% between 1995 and 2005, from 8.3 Tg CO_2-eq. in 1995 (base year for F-gases) to 2.0 Tg CO_2-eq. in 2005. Emissions of HFCs and PFCs decreased by approximately 78% and 86%, respectively, during this same period, while SF_6 emissions increased by 12%.

The aggregated emissions of F-gases decreased by 8% from 2004 to 2005: SF_6 emissions showed a minor increase, while HFC and PFC emissions showed a continued decrease.

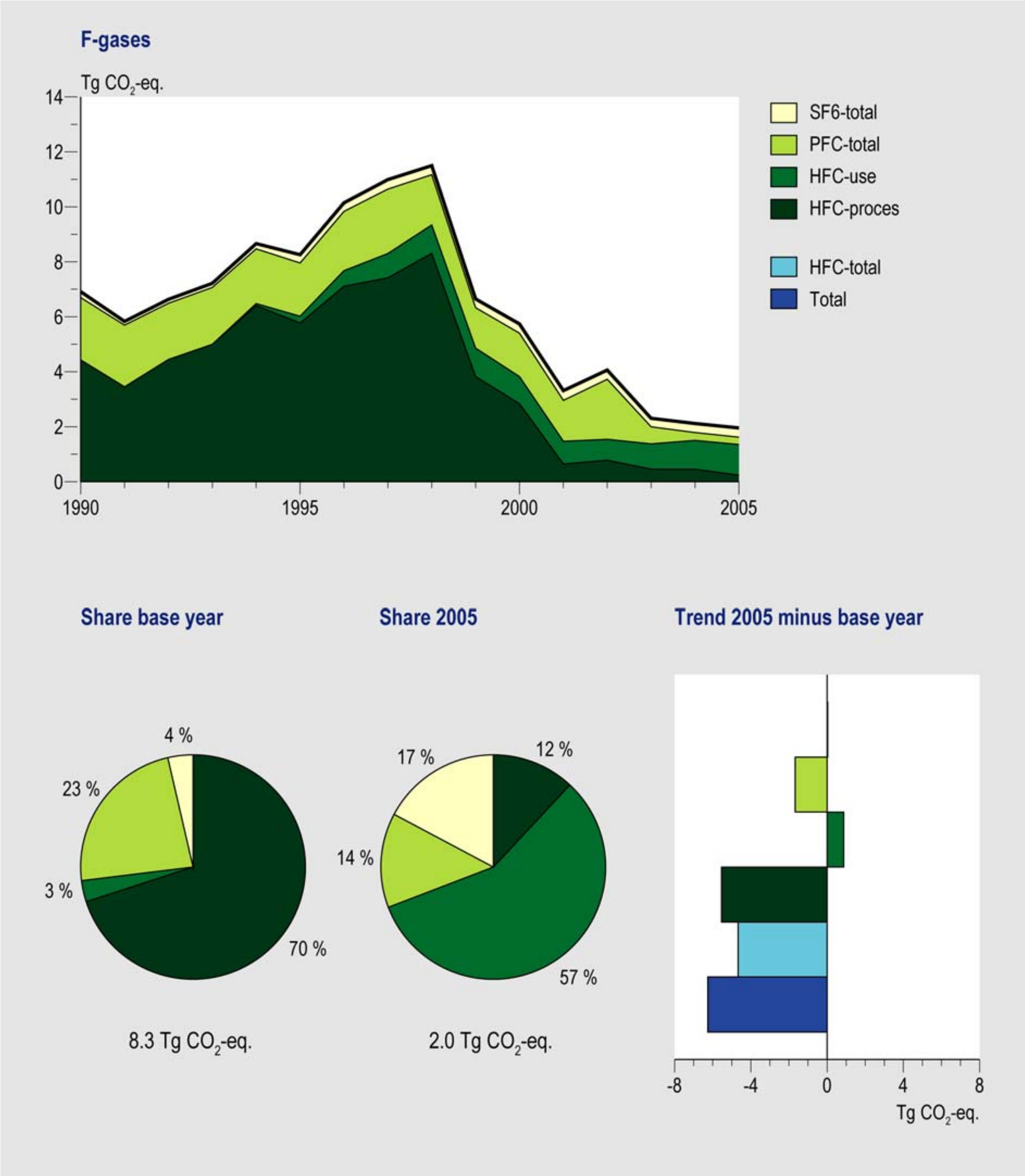


Figure 2.5 Fluorinated gases: trend, emission levels and share of individual F-gases, 1990–2005.

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 taken together is estimated to be approximately ±3%-points in the 1% decrease, 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 ±2.5%-, ±10%-, ±15%- and ±7%-points, respectively.
For all greenhouse gases taken together the uncertainty estimate in ***annual*** emissions is ±5% and for CO_2 ±3%. 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 sector 1 Energy is by far the largest contributor to the total greenhouse gas emissions in the national inventory (contributing 72% in the base year and 81% in 2005). In contrast, the emissions from the other sectors decreased. The emission level of the sector Energy increased approximately 11% in the period 1990–2005, and total greenhouse gas emissions from the sectors Waste, Industrial processes and Agriculture decreased 48%, 35%, and 17%, respectively, in 2005 compared to the base year.

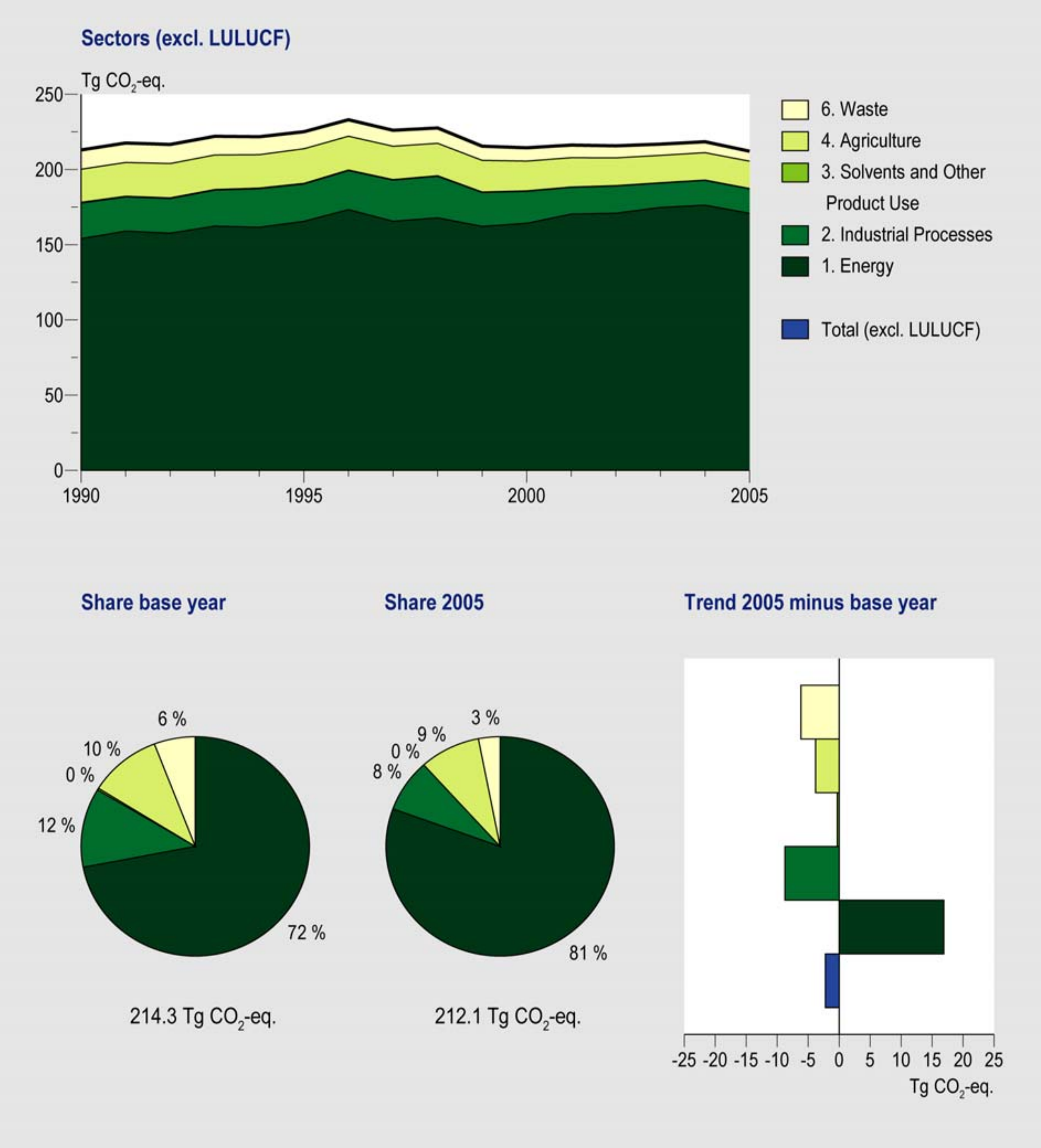


Figure 2.6 Aggregated greenhouse gases: trend, emission levels and share of sectors, 1990-2005.

In 2005, greenhouse gas emissions in the energy sector decreased by about 5.4 Tg (mainly CO_2) due to a marked decrease in the category 1A1a 'Public electricity and heat production'. The emission of CO_2 from the combustion of fossil fuels in this category was reduced by approximately 2.7 Tg. The use of natural gas and coal, for example, was cut down by 3% and 7 % respectively. In spite of the

reduction, the amount of electrical energy available remained at the same level due to promotion of renewable energy sources and extra imports of electricity. The use of renewable energy sources increased by approximately 40% in 2005, compared to the previous year, and net imports increased by 13%. Furthermore, CO_2 emissions in category 1A4 'Other Sectors' decreased by about 2.4 Tg, especially in the categories 1A4a 'Commercial/Institutional' and 1A4b 'Residential', due to a decrease in energy use for heating during a relatively warm winter and an increasing number of high efficiency boilers.
Trends in emissions by category and subcategory are described in more detail in the 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%, ±20%, ±30%, ±40% 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 11% increase, for sector 2 Industry at ±7%-points in the 35% decrease, for sector 4 Agriculture at ±14%-points in the 17% decrease and for sector 6 Waste at ±10%-points in the 48% the decrease.

2.4 Emission trends for indirect greenhouse gases and SO_2

Figure 2.7 shows the trends in total emissions of CO, NO_x, NMVOC and SO_2. Compared to 1990, the CO and NMVOC emissions were reduced in 2005 by 52% and 64%, respectively. For SO_2 this is even 66%, and for NO_x, the 2005 emissions are 41% 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 show discontinuities for 1991–1994.In contrast with the direct greenhouse gases, the 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 3.5.4.).
Uncertainty in the emission factors for NO_x, 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).

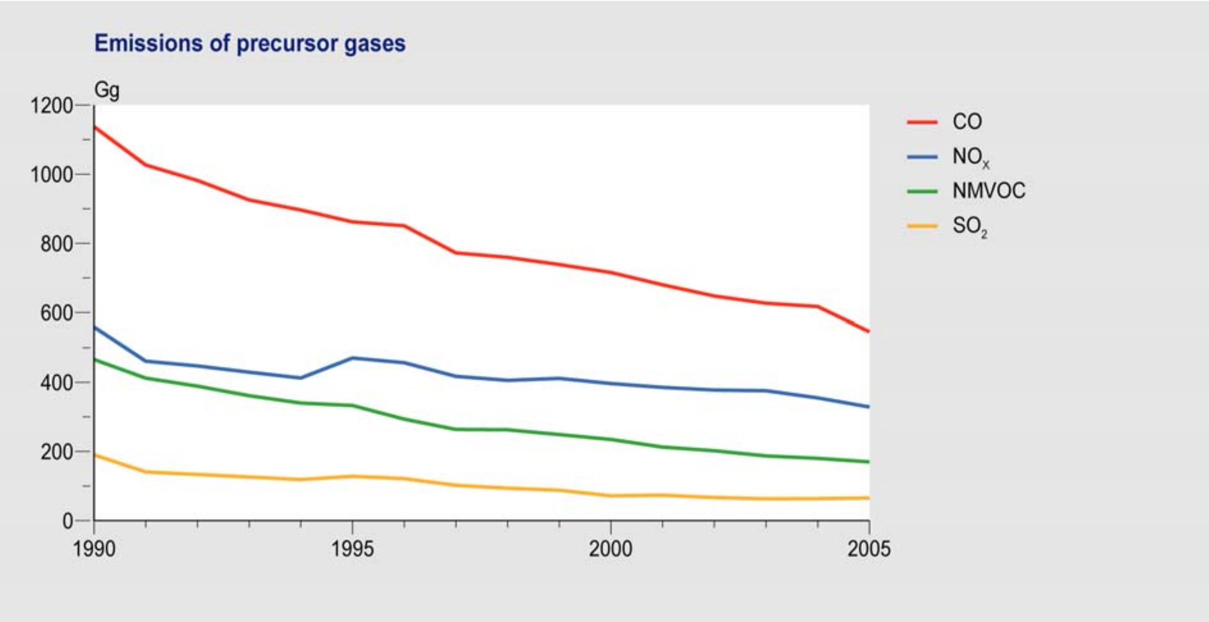


Figure 2.7 Emission trends of NO_x, CO, NMVOC and SO_2. (Units: Gg).

3. ENERGY [CRF sector 1]

Major changes in the *Energy* sector compared to the *National Inventory Report 2006*

Emissions: Compared to the previous submission, CO_2 emissions from the sector *Energy* (subcategory refineries, 1A1b) decreased for the years 2002 to 2004 by 0.8, 1.1 and 0.4 Tg, respectively. The most important changes are for refineries due to the use of more detailed data on fuel used for combustion processes and CO_2 emission factors for some highly specific fuels. Moreover, based on information in annual environmental reports by refineries, an improved split could be made for refineries between CO_2 emissions from fuel combustion and from other processes for 2002 onwards. These process emissions are now reported under 1B2a-iv Refining/Storage.
Key sources: Compared to the previous submission, the following source categories are no longer identified as key soures as a result of changing emission levels in 2005 compared to 2004: N_2O emissions from road transportation (1A3b); CO_2 emissions from navigation (1A3d) and CO_2 emissions from solid fuel transformation-coke production (1B1b).
Methodologies: The CO_2 emission factor for specific refinery fuels (refinery gas) was changed based on detailed data from individual refineries. Process emissions of CO_2 from a hydrogen plant of a refinery (about 0.9 Tg CO_2 per year) have been re-allocated from 1A1b to 1B2a-iv for 2002 onwards.

3.1 Overview of sector

Emissions from this sector include all emissions from energy use in the Netherlands. Categories of the Energy sector are divided into two main categories:

1A Fuel-related emissions from combustion activities:
- 1A1 'Energy Industries' (power generation, refineries, oil and gas production, coke ovens);
- 1A2 'Manufacturing Industry and Construction';
- 1A3 'Transport' (domestic);
- 1A4 'Other Sectors' (residential, services, agriculture/fisheries);
- 1A5 'Other' (military ships and military aircraft).

1B 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, oil refining, transport, distribution).

The Energy sector includes emissions from waste incineration for electricity and heat production (included in 1A1a instead of being reported under 6C 'Waste Incineration'), combustion of by-products from blast furnaces in the iron and steel industry (blast furnace gas and oxygen furnace gas') (included in 1A1a and 1A2a) and energy-related emissions from the chemical industry (chemical residual gases, which are comparable with refinery gas) (included in 1A1a and 1A2c). According to the IPCC Guidelines CO_2 emissions included in the total national inventory are only fossil-fuel related emissions, thereby excluding CO_2 from organic carbon sources, i.e. from the combustion of biomass. On the basis of sectoral allocation in national statistics, data reported by joint-ventures with utilities is reported under subcategory 1A1a 'Public Electricity and Heat Production'.

Trends in fossil fuel use and fuel mix
In 2005 natural gas was the most important of the fossil fuels, contributing 56% to total fossil fuel use. Liquid fuels contributed 32%, and solid fuels, mainly coal used for public power generation, contributed another 11%. Although the combustion of fossil waste (reported under Other Fuels) has tripled since 1990, its share in total fossil fuel use is still only 1% at the present time. In the period 1990–2005 total fossil fuel combustion increased by 10%, of which two-thirds was due to a 14% increase in gas consumption, while liquid fuel use increased by 8%. At the same time the combustion of solid fuels decreased by 11%.

Total fossil fuel consumption for combustion decreased by about 4% between 2004 and 2005, mainly due to a 4% decrease in gas consumption, but also less liquid fuels (-1%) and solid fuels (-6%) are used. The decreased use of solids and gas for combustion is mainly to be seen in power-generating activities (-6% for solids and -6% for gaseous fuel use in category 1A1a), due to higher electricity imports and higher renewable energy production. Electricity import increased by 13% between 2004 and 2005; renewable energy increased by 40%. As the winter temperatures of 2005 were higher than in 2004, total gas consumption in the other sectors (1A4: residential, services, agriculture) was also lower (–6%) in 2005.

Structure of energy production and consumption sectors

The Netherlands produces large amounts of natural gas, both onshore (Groningen gas) and offshore. About 50% of the gas produced is exported. 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. Natural gas production and distribution generates related emissions such as fugitive methane emissions. The Netherlands closed its last active underground coal mines in the late 1960s, and no post-mining emissions occur at the present time.

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 co-generation plants, with many of the latter being operated as joint-ventures with industries. Related 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 wind and biomass.

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. Rotterdam is the world’s largest supplier of marine bunker oils. Freight transport by trucks makes up a large share of road transport due to the many goods that are transferred from ships to trucks for further transport into Europe. In addition, Schiphol Airport is Western Europe’s largest supplier of aviation bunker fuels (jet-fuel) (see section 3.8). The Netherlands also has one integrated steel plant, one cement manufacturer and two primary aluminium smelters. The food processing industry is relatively large due to the proximity of an intensive livestock breeding industry.

The protocols listed below can be accessed at www.greenhousegases.nl for a description of the methodologies applied for estimating emissions of the *Energy* sector in the Netherlands (see also *Annex 6*):

- Protocol 7101: CO_2 , CH_4 and N_2O from ‘Stationary Combustion: Fossil Fuels’ (included in 1A);
- Protocol 7141: Emissions from biomass combustion: Memo item on CO_2; CH_4 and N_2O emissions (including emissions from combustion of fossil waste (1A1a, 6B, Memo item CO_2);
- Protocol 7103: CO_2 , CH_4 and N_2O from ‘Mobile Equipment’ (1A2f, 1A4c);
- Protocol 7105: CO_2 from ‘Road Transport’ (1A3b);
- Protocol 7107: CH_4 from ‘Road Transport’ (1A3b);
- Protocol 7106: N_2O from ‘Road Transport’ (1A3b);
- Protocol 7104: CO_2 , CH_4 and N_2O from ‘Inland Aviation’ (1A3a);
- Protocol 7110: CO_2 , CH_4 and N_2O from ‘Fisheries’ (1A4c);
- Protocol 7108: CO_2 , CH_4 and N_2O from ‘Rail Transport’ (1A3c);
- Protocol 7109: CO_2 , CH_4 and N_2O from ‘Inland Navigation’ (1A3d);
- Protocol 7111: CO_2 , CH_4 and N_2O from ‘Military ships and aircraft’ (1A5);
- Protocol 7112: CO_2 , CH_4 and N_2O from ‘Oil and Gas Production’ (1B2);
- Protocol 7113: CO_2 , CH_4 and N_2O from ‘Oil and Gas Distribution/Transport’ (1B2);
- Protocol 7102: CO_2 , CH_4 and N_2O from ‘Process Emissions: Fossil Fuels’ (1B).

Completeness

Fossil fuel combustion emissions from the Energy sector are completely consistent with the national energy statistics per sector, with the exception of a few subcategories which are partly based on other data or which have been re-allocated to comply with IPCC Reporting Guidelines:

- ‘Stationary’: own use (1A1c) and ‘Flaring/Venting’ (1B2) in the oil and gas production industries;
- ‘Mobile Sources’: ‘Domestic Aviation’ (1A3a), ‘Inland Navigation’ (1A3d), ‘Fisheries’ (1A4c-ii), ‘Military Ships and Aircraft’ (1A5).
- ‘Charcoal Production’ (1B2) and Charcoal Combustion’ (1A4) is not accounted for. According to FAO statistics annual production is less than about 10 kton and apparent consumption varies between about 15 and 40 kton per year (see http://faostat.fao.org/). Related CH_4 and N_2O emissions are therefore almost negliglable (considerable less than 1 Gg per year).

Transparency
All key emission factors for the Energy sector are listed in the methodology descriptions in either the source category sections, in the Annexes or in the methodology descriptions available online at the national greenhouse gas website. Characteristics in emission trends are explained in the source category sections on the basis of changes in either the activity data, the fuel mix determining implied emission factors, re-allocations over time due to changes in ownership of combustion facilities (joint-ventures) or the different degrees of capturing residual gases that affect the proportion of emissions allocated to fuel combustion and to industrial processes.

Overview of shares and trends in emissions
Table 3.1 and Figure 3.1 show the contribution of the source categories in the sector Energy to the total national greenhouse gas inventory. In 2005 the Energy sector accounted for 81% of the total national emissions (excluding LULUCF), the predominant share of these being CO_2 emissions. About 47% of the CO_2 emissions from fuel combustion stems from the combustion of natural gas, 18% from solid fuels (coal) and 33% from liquid fuels. CH_4 and N_2O emissions from fuel combustion contribute less than 1% to the total emissions from this sector.

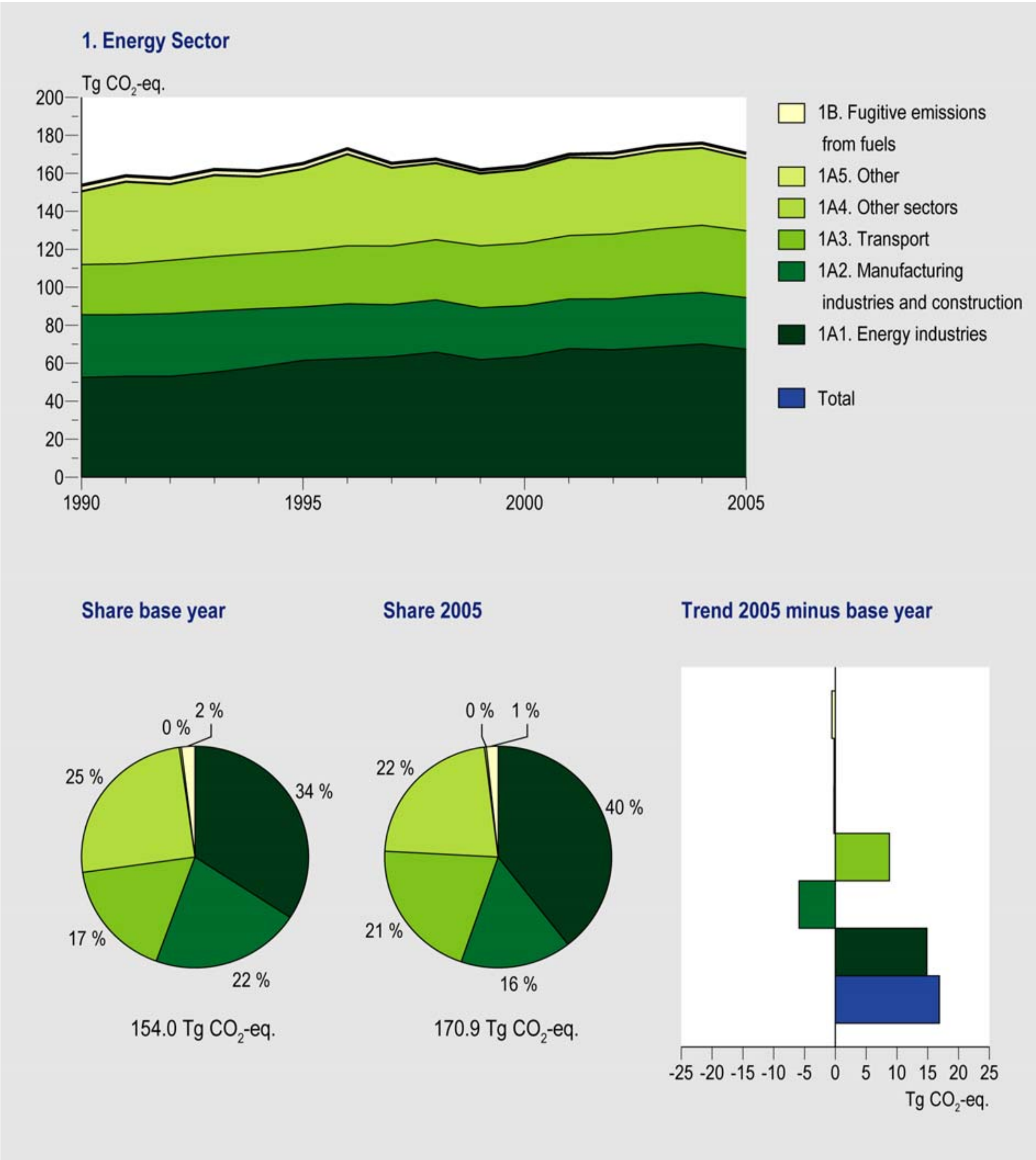


Figure 3.1 Sector 1 'Energy': trend, emission levels and share of source categories in sector 1, 1990-2005

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

Sector/category Key source	**Gas**	**Key[1)]**	**Emissions in base year**		**Emissions in 2005**		**Change 2005-2004**	**Contribution to total in 2005 (%)**		
		Level, Trend, No Key	Gg	Tg CO_2-eq.	Gg	Tg CO_2-eq.	Tg CO_2-eq.	By sector	Of total gas	Of total CO2-eq.
1 Energy	CO_2			151.2		168.8	-5.4	99	96	80
	CH_4		111.8	2.3	66.2	1.4	0.0	1	8	0.6
	N_2O		1.6	0.5	2.2	0.7	0.0	0.0	4	0.3
	All			**154.0**		**170.9**	**-5.4**	**100**		**81**
1A Fuel combustion	CO_2	*		150.0		167.3	-5.4	98	95	79
	CH_4		32.4	0.7	29.2	0.6	0.0	0.4	4	0.3
	N_2O		1.6	0.5	2.2	0.7	0.0	0.4	4	0.3
	All			**150.7**		**167.3**	**-5.4**	**98**		**79**
1A CH_4 stationary combustion (excl. 1A3)	CH_4	L2	24.9	0.5	26.8	0.6	0.0	0.4	3	0.3
1A1 Energy industries	CO_2	*		**52.5**		**67.4**	**-2.7**	**39**	**38**	**32**
1A1a. Public electricity and heat production	CO_2	*		39.9		54.0	-2.8	32	31	25
1A1a liquids	CO_2	L1,T		0.2		2.2	0.0	1	1	1
1A1a solids	CO_2	L		25.8		25.7	-1.2	15	15	12
1A1a gases	CO_2	L,T		13.3		24.0	-1.6	14	14	11
1A1a other fuels: waste incineration	CO_2	L1,T		0.6		2.1	0.0	1	1	1
1A1b. Petroleum refining	CO_2	*		11.0		11.3	0.0	7	6	5
1A1b liquids	CO_2	L		10.0		8.9	-0.2	5	5	4
1A1b gases	CO_2	L1,T1		1.0		2.5	0.2	1	1	1
1A1c. Manufacture of solid fuels and other energy industries	CO_2	*		1.5		2.1	0.1	1	1	1
1A1c gases	CO_2	L,T		1.5		2.1	0.1	1	1	1
1A2 Manufacturing industries and construction	**CO_2**	*		**33.0**		**27.2**	**0.0**	**16**	**15**	**13**
1A2 liquids	CO_2	L,T1		9.0		7.4	0.1	4	4	3
1A2 solids	CO_2	L,T1		5.0		4.3	-0.2	3	2	2
1A2 gases	CO_2	L,T1		19.0		15.5	0.1	9	9	7
1A2a. Iron and steel	CO_2	*		4.0		4.5	-0.2	3	3	2
1A2b. Non-ferrous metals	CO_2	*		0.2		0.2	0.0	0.0	0.1	0.1
1A2c. Chemicals	CO_2	*		17.2		11.7	0.0	7	7	6
1A2d. Pulp, paper and print	CO_2	*		1.7		1.7	0.2	1.0	1.0	0.8
1A2e. Food industry	CO_2	*		4.1		3.9	-0.1	2	2	2
1A2f. Other	CO_2	*		5.8		5.1	0.1	3	3	2
1A3 Transport	CO_2			26.0		34.7	-0.1	20	20	16
	N_2O		0.9	0.3	1.5	0.5	0.0	0.1	3	0.2
	All			**26.4**		**35.2**	**-0.2**	**21**		**17**
1A3a. Civil aviation	CO_2			0.04		0.04	0.0	0.0	0.0	0.0
1A3b. Road vehicles	CO_2	*		25.5		33.9	0.1	20	19	16
1A3b gasoline	CO_2	L,T1		10.9		13.0	-0.2	8	7	6
1A3b diesel oil	CO_2	L,T		11.8		19.9	0.3	12	11	9
1A3b LPG	CO_2	L1,T		2.7		1.1	-0.1	1	0.6	0.5
1A3b. Road vehicles	N_2O	NK	0.9	0.3	1.5	0.5	0.0	0.3	3	0.2
1A3c. Railways	CO_2	NK		0.1		0.1	0.0	0.0	0.1	0.1
1A3d. Navigation	CO_2	NK		0.4		0.6	-0.2	0.4	0.3	0.4
1A4 Other sectors	CO_2	*		37.9		37.7	-2.5	22	21	18
	CH_4	*	18.7	0.4	17.6	0.4	0.0	0.2	2	0.1
	All			**38.3**		**38.1**	**-2.5**	**22**		**18**
1A4 liquids (excl. from 1A4c)	CO_2	T		1.5		0.6	-0.1	0.3	0.3	0.3
1A4a. Commercial/institutional	CO_2	*		7.5		9.9	-1.6	6	6	5
1A4a gases	CO_2	L,T		6.6		9.6	-1.4	6	5	5
1A4b. Residential	CO_2	*		19.5		18.2	-0.9	11	10	9
	CH_4		16.9	0.4	15.7	0.3	0.0	0.2	2	0.2
1A4b gases	CO_2	L,T1		18.7		17.9	-0.9	11	10	8
1A4c. Agriculture/Forestry/Fisheries	CO_2	*		10.9		9.6	0.0	6	5	5
1A4c liquids	CO_2	L		2.5		2.6	0.0	2	1	1
1A4c gases	CO_2	L,T		8.3		7.0	0.0	4	4	3
1A5 Other	**CO_2**	NK		**0.6**		**0.4**	**0.0**	**0.2**	**0.2**	**0.2**
1B Fugitive emissions from fuels	CO_2	*		1.2		1.5	0.0	0.9	0.9	0.7
	CH_4	*	79.5	1.7	37.0	0.8	0.1	0.4	5	0.4
	All			**2.8**		**2.3**	**0.1**	**1.4**	**1.3**	**1.0**
1B1 Solid fuel transformation: coke production	CO_2	NK		0.4		0.5	-0.1	0.3	0.3	0.2
1B2 venting/flaring	CO_2	T		0.8		0.1	0.0	0.1	0.1	0.1
1B2 venting/flaring	CH_4	T	59.6	1.3	16.3	0.3	0.0	0.2	2	0.1
Total National emissions	CO_2			159.4		175.9	-5.4		100	
	CH_4		1211.5	25.4	795.7	16.7	-0.6		100	
	N_2O		68.4	21.2	56.7	17.6	-0.2		100	
National total GHG emissions (excl LULUCF)	All			214.3		212.1	-6.3			100

[1)]Key sources in the 1A1, 1A2, and 1A4 categories (indicated by an asterisk) are based on aggregated emissions of CO_2 by fuel type.The results of the key source analysis are based on the NIR/CRF 2006 and will be updated in the submission in April 2007

Category 1A1 ‘Energy industries’ is the main source category contributing to the Energy sector, accounting for 39% of the greenhouse gas emissions from this sector in 2005. Categories 1A2 ‘Manufacturing and construction industries’, 1A3 ‘Transport’ and 1A4 ‘Other sectors’ (residential, services and agriculture/fisheries) contributed 16%, 21% and 22% of the total emissions, respectively (see Figure 3.1).

Since 1990, emissions from the Energy sector have increased approximately 11% (154.0 to 170.9 Tg CO_2-eq.), mainly due to increased CO_2 emissions in categories 1A1a ‘Public electricity and heat production’ (35%) and 1A3 ‘Transport’ (33%). Overall, emissions from 1A4 ‘Other sectors’ have remained stable. Total Fugitive emissions from oil and natural gas’ [1B] decreased by 18% in the period 1990–2005 (from 2.8 to 2.3 Tg CO_2-eq.), of which CH_4 emissions decreased by 53% and CO_2 increased by 15%. Between 2004 and 2005, total emissions in the Energy sector decreased by 3% or 5.4 Tg CO_2-equivalents, mainly as a result of decreased emissions from gas and solid fuel combustion from category 1A1a ‘Public electricity and heating’ (-2.8 Tg CO_2) and from from category 1A4 ‘Other sectors (-2.5 Tg CO_2).

Key sources

Table 3.1 also presents the key sources in the Energy sector specified by both level and trend (see also Annex 1). The key sources 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 to note that – with the exception of inland aviation, navigation and railways – almost all CO_2 sources are identified as key sources. The total CH_4 emissions from all combustion sources together are also identified as a key source.

The following changes are found compared to the key source analysis for the NIR 2006:

- N_2O emissions from 1A3 Mobile combustion: road vehicles: now non-key;
- CO_2 emissions from 1A3 Mobile combustion: water-borne navigation: now non-key;
- CO_2 emissions from 1B1b Coke production: now non-key.

3.2 Fuel combustion activities [1A]

3.2.1 Source category description

This source category includes all fuel-related emissions from combustion activities:

- 1A1 ‘Energy Industries’ (power generation, refineries, oil and gas production, coke ovens);
- 1A2 ‘Manufacturing Industry and Construction’;
- 1A3 ‘Transport’ (domestic);
- 1A4 ‘Other Sectors’ (residential, services, agriculture/fisheries);
- 1A5 ‘Other’ (military ships and military aircraft).

The following sections discuss the greenhouse gas emission inventory of the Energy sector per source category. Stationary and mobile sources of combustion-related emissions are discussed per fuel type.

Activity data and (implied) emission factors

Almost all activity data in this sector are derived from the national energy statistics. When more detailed information is used, the data sources and the allocation to IPCC source categories are described either in the NIR or in the methodology descriptions available online at the website www.greenhousegases.nl. All key emission factors for greenhouse gases are listed in the methodology descriptions, background documents or Annex 2 of the NIR 2007. In some instances, activity data for the year are based on preliminary data. More detailed information on activity data and (implied) emission factors is provided in the following sections.

3.2.2 Methodological issues

Different methods are used to estimate emissions from fuel combustion in related source categories. For more details on this subject, the reader is referred to the following sections and the website www.greenhousegases.nl.

The emissions from fuel combustion in the sector Energy emissions are consistent with the national energy statistics per sector. Possible areas of double counting or omissions of CO_2, such as conversion losses in refineries, coke ovens, blast furnaces in the steel industry and fuels used as feedstock in the chemical industry, are partly or wholly covered by the residual gases accounted for in the statistics. A carbon balance calculation is made for most of these processes (except for emissions from feedstock use in the chemical industry) to account for conversion losses in those cases where the residual fuels are not fully captured in the statistics. An energy balance calculation is made for the oil and gas production industry in which total net fuel use is allocated to either for own use (included in 1A1c) or to vented/flared (included in 1B2).

3.2.3 Uncertainty and time-series consistency

Uncertainty

Most uncertainty estimates for activity data are the judgements of CBS and MNP experts and are based on the assumed accuracy of the underlying statistics, annual variability and the monitoring method of the fuel uses involved. For the emission factors, the uncertainty estimate is based on the background of the determination and selection of the emission factor, the degree of heterogeneity within the sources and within fuel types – this is particularly true for derived gases – and over time (see Olivier and Brandes, 2007).

Time-series consistency

The emissions from fuel combustion are consistent with the national energy statistics. However, the time series of the energy statistics is not fully consistent at the detailed sector and detailed fuel-type levels for the years 1991–1994. This inconsistency is caused by revisions in the economic classification scheme that were 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, Statistics Netherlands (CBS) has re-assessed the original statistics and made them compatible with the ‘new’ 1993 classification system. 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). In some cases this re-allocation has resulted in apparent discontinuities in fuel use for liquid and solid fuels due to the simplified estimation of the residual gases or derived gases, or in discontinuities in implied emission factors due to the simplified fuel mix (liquids in 1A2b, -d, -f, and in 1A4a, -b; solids in 12a, -f and in 1A4a, -b).

3.2.4 Source-specific QA/QC and verification

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

3.2.5 Source-specific re-calculations

A source-specific recalculation was made for CO_2 from refineries (1A1b) for 2002-2004. For details see section 3.3.5.

3.2.6 Source-specific planned improvements

There are no source-specific improvements planned.

3.3 Energy industries [1A1]

3.3.1 Source category description

This source category consists of 1A1a ‘Public Electricity and Heat Production’ (including emissions from waste incineration), 1A1b ‘Petroleum Refining’ and 1A1c ‘Manufacture of Solid Fuels and Other Energy Industries’. Within these categories, natural gas and coal combustion by public electricity production and oil combustion by refineries are the dominating key sources. However, liquid fuels and other fuels (i.e. waste) in power generation and natural gas combustion in refineries and in manufacturing of solid fuels and other energy industries are also key sources. 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 minor key source, since this source is only identified as a level key source when uncertainty information is added (Tier 2 key source analysis; see Annex 1). N_2O emissions from 'Energy Industries' are not identified as a key source (see Table 3.1).

1A1a 'Public Electricity and Heat Production' includes all emissions from large-scale waste incineration (see Figure 3.2; note that CO2 from organic waste (waste organic part) does not contribute to net CO2 emissions.), since (almost) all incineration facilities also produce heat and/or electricity. 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. This subcategory also includes the co-generation (Combined Heat and Power, CHP) facilities (and sometimes also steam boilers) that are operated as joint-venture concerns. Since CHP has a substantial and increasing share in fuel consumption and the ownership of several privately owned facilities has changed over time in joint-ventures with public electricity production industries, there has been a significant impact on emissions trends in the public electricity and heat production sector on one hand and the manufacturing industry and the other sectors on the other hand (see Figure 3.4).

1A1c 'Manufacturing of Solid Fuels and Other Energy Industries' includes emissions from the combustion of one independent coke production facility (Sluiskil), the operation of which discontinued in 1999. However, in accordance with IPCC classification guidelines, but contrary to the national SBI/NACE allocation scheme, emissions from fuel combustion for on-site coke production by the iron and steel company (Corus) are included in 1A2 'Manufacturing Industries' since this is an integrated coke, iron and steel plant (see section 3.4.1.). Source category 1A1c also 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 the amounts of associated gas which is either flared or vented or otherwise lost by leakage, et cetera);
- 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.

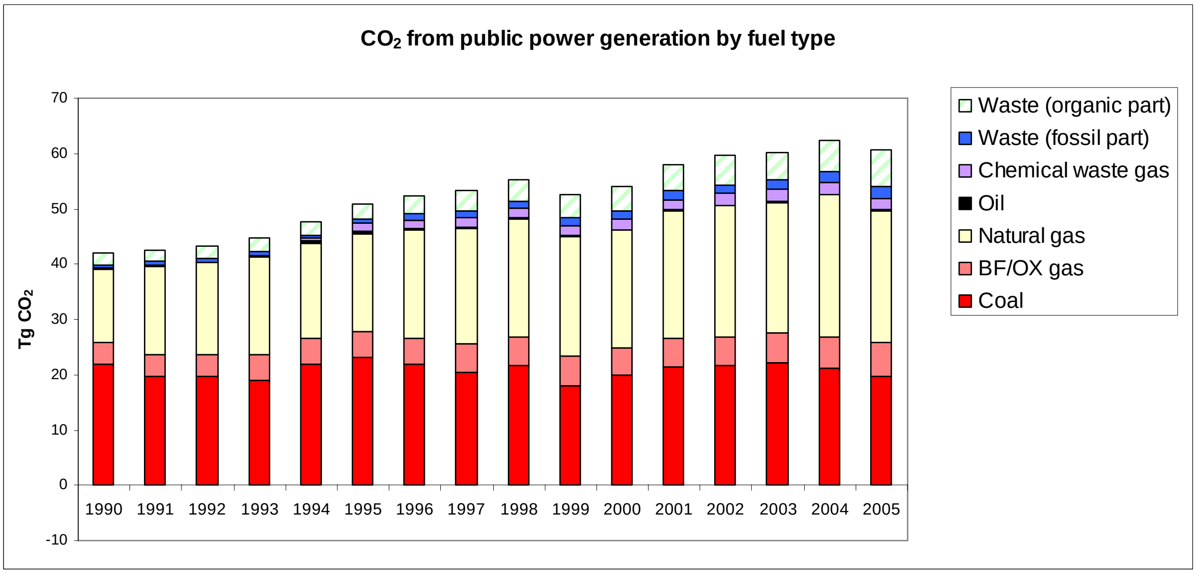


Figure 3.2 Trend in sources of CO_2 from fuel use in power plants (a small amount from coke oven gas, about 0.1 Tg, is included in coal).

Overview of shares and trends in emissions

In 2005 CO_2 emissions from category 1A1 'Energy industries' contributed 32% to the total national greenhouse gas emission inventory (excluding LULUCF) compared to 25% in 1990, while CH_4 and N_2O emissions from this same category contribute relatively little to the total national greenhouse gas emissions. The share contributed by 1A1 'Energy industries' to the total greenhouse gas emissions from Energy sector increased from 34% in 1990 to 39% in 2005 (see Figure 3.3), partly due to a change in ownership of CHP plants (joint-ventures, which are allocated to this source category).

Between 1990 and 2005, total CO_2 emissions from 1A1 'Energy industries' increased 28%, from 52.5 to 67.4 Tg (see Figure 3.3). Due to an increasing demand for electricity, 1A1a 'Public electricity and heat production' (+14.1 Tg CO_2), is the most important source category responsible for the increased emissions in the category 1A1 'Energy industries'. In 2005, CO_2 emissions from 1A1 'Energy industries' decreased by about 4%, especially in category 1A1a 'Public electricity and heat production.

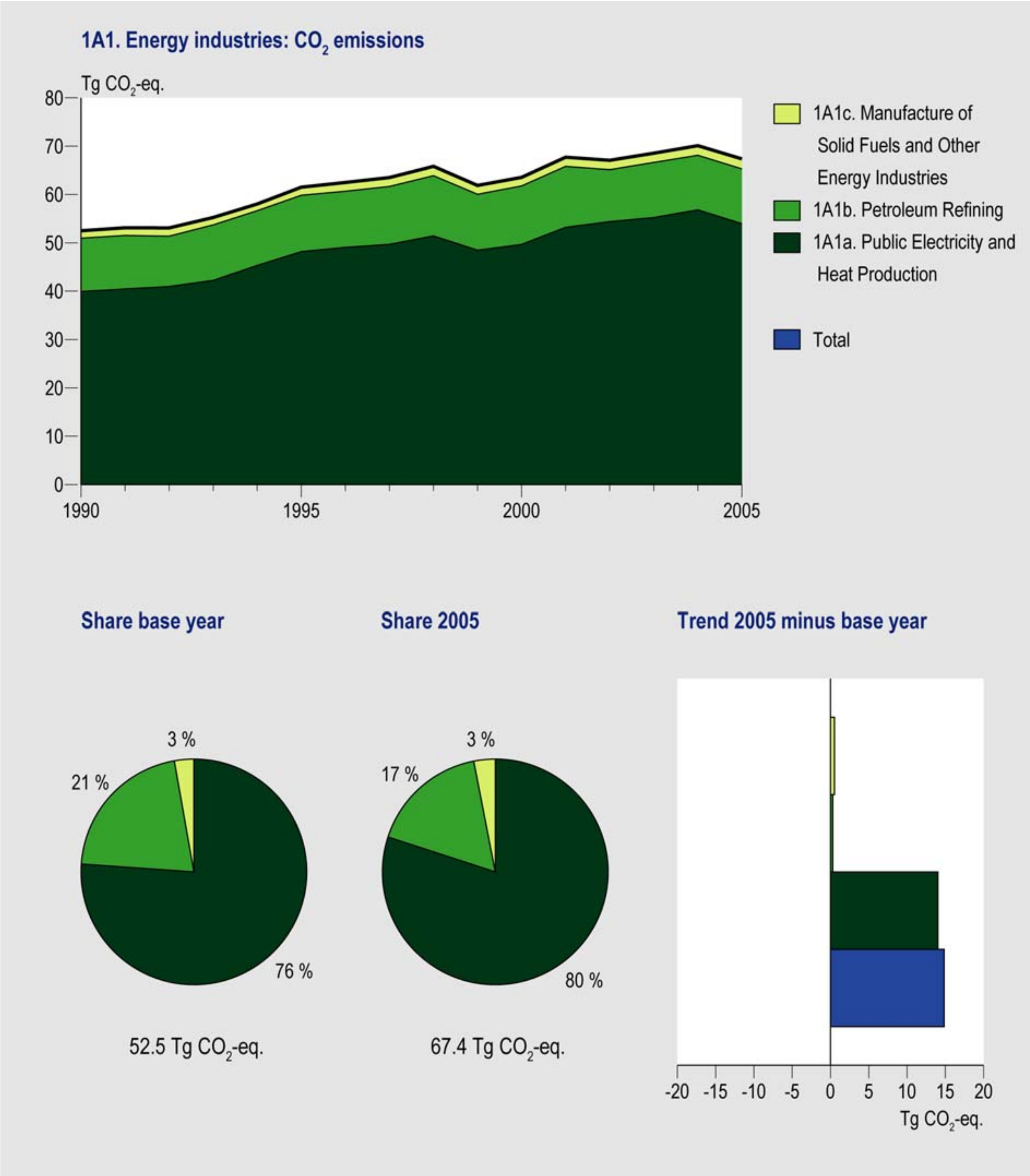


Figure 3.3 1A1 'Energy industries': trend, emission levels and share of source categories in 1A1, 1990-2005.

Public Electricity and Heat Production [1A1a]

In 2005, 1A1a 'Public electricity and heat production' was the largest source category within the 1A1 Energy industries, accounting for 80% of the total greenhouse gas emissions from this category (see Figure 3.3). CO_2 emissions from waste incineration of fossil carbon represent only one procent of the total greenhouse gas emissions in 1A1a Public electricity and heat production.

Between 1990 and 2005, total CO_2 emissions from 'Public electricity and heat production' increased by 35%, from 39.9 to 54.0 Tg. This increase in CO_2 emissions are mainly explained by an increase in fossil fuel combustion for the generation of electric power. The CO_2 emission level from waste incineration of fossil carbon increased from 0.6 to 2.1 Tg CO_2 due to the increasing amounts of municipal waste that are combusted instead of being deposited in landfills. The increasing level of CO_2 emissions in this period is partly compensated by a shift from the use of coal to natural gas and the increased efficiency of power plants.

Between 1990 and 1998, changed ownership relations of plants (joint-ventures) caused a shift of co-generation plants from Manufacturing industries [1A2] to Public electricity and heat production. About 50% of the increased emission levels included in this source category (almost 30% in the period 1990–1998) can be explained by a re-allocation caused by this phenomenon.

In 2005, the emissions of CO_2 from the combustion of fossil fuels in this source category dropped by 2.8 Tg. Biomass combustion in power generation increased 35% in 2005, mainly due to increased co-combustion of biomass in coal-fired power stations, which is the result of the MEP subsidising scheme to encourage the use of biomass in electricity production. Further explanation of the trends after 1998 are discussed below under the section on Activity data and (implied) emission factors.

Petroleum Refining [1A1b]
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 17% in 2005. However, the combustion emissions from this subcategory should be viewed in relation to the fugitive emissions reported under 1B2. Between 1990 and 2005 total CO_2 emissions from the refineries (including fugitive CO_2 emissions from hydrogen production reported in 1B2a-iv Refining) fluctuated between 11 and 12 Tg (11.0 Tg in 1990 and 12.3 Tg in 2005).

Manufacture of Solid Fuels and Other Energy Industries [1A1c]
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 2005. This category comprises mostly CO_2 emissions from the combustion of natural gas. The dominating source is the use for energy purposes of oil and gas production and the transmission industry. CO_2 emissions from this source category increased from 1.5 Tg in 1990 to 2.1 Tg CO_2 in 2005 due to the exploitation of less favourable production sites compared with those exploited in the past.

Activity data and (implied) emission factors

Public electricity and heat production [1A1a]
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 (Figure 3.3). One-half of the almost 30% increase in natural gas combustion that occurred between 1990 and 1998 – for example, 19% in 1991 and 11% in 1996 – is largely explained by co-generation plants and a few large residual-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 (see Figure 3.5).

Figure 3.3 also shows a remarkable drop 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 period 1990–1998 and 2000 and thereafter. In actual fact, electricity consumption in the Netherlands was in 1999 2% higher 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 residual chemical 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 3% as a direct result of the start-up in 2004 of a large new gas-fired 790 MW_e co-generation plant, and a 2% decrease in coal combustion.

In 2005, CO_2 emissions in this category decreased by 2.9 Tg. The use of natural gas and coal was cut down by 6 and 4%, respectively. In spite of this reduction, the amount of electrical energy available remained at the same level due to higher production by renewable energy sources and extra import of electricity: the use of renewable energy sources increased by approximately 40% in 2005 and net electricity imports increased by 13%.

Solid fuel combustion decreased by 14% in 1999 and increased by 7% in 2001. This trend is partly caused by the large increase in 1999 in imported electricity (see Figure 3.4) as the higher electricity import corresponds to approximately 4 Tg CO_2 emissions. In addition, significant amounts of blast furnace (BF) and oxygen furnace gas (OX) purchased from the steel plant are used – included in solid fuels – thereby explaining the inter-annual variation in the implied emission factors (IEFs) for CO_2.

The strong increase in liquid fuel use in 1994 and 1995, with a sharp increase in 1995, is due to residual chemical gas being used, as shown in Figure 3.4, predominantly in joint-venture electricity and heat production facilities. This also explains the somewhat lower IEF for CO_2 from liquids since 1995.

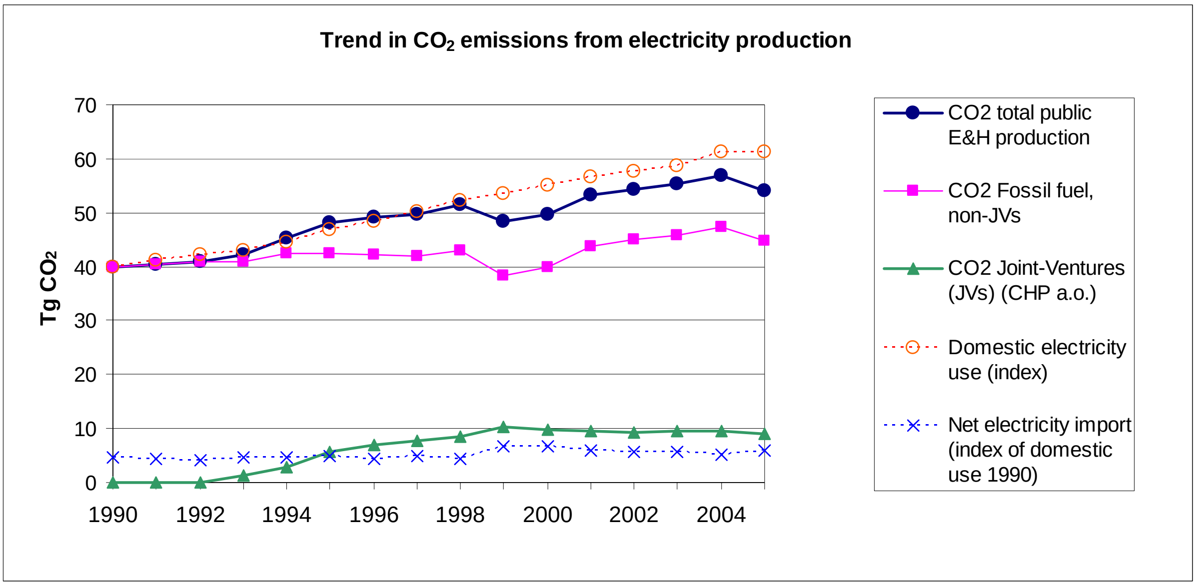


Figure 3.4 Trends in CO_2 emissions from public electric power generation (including public heat production).

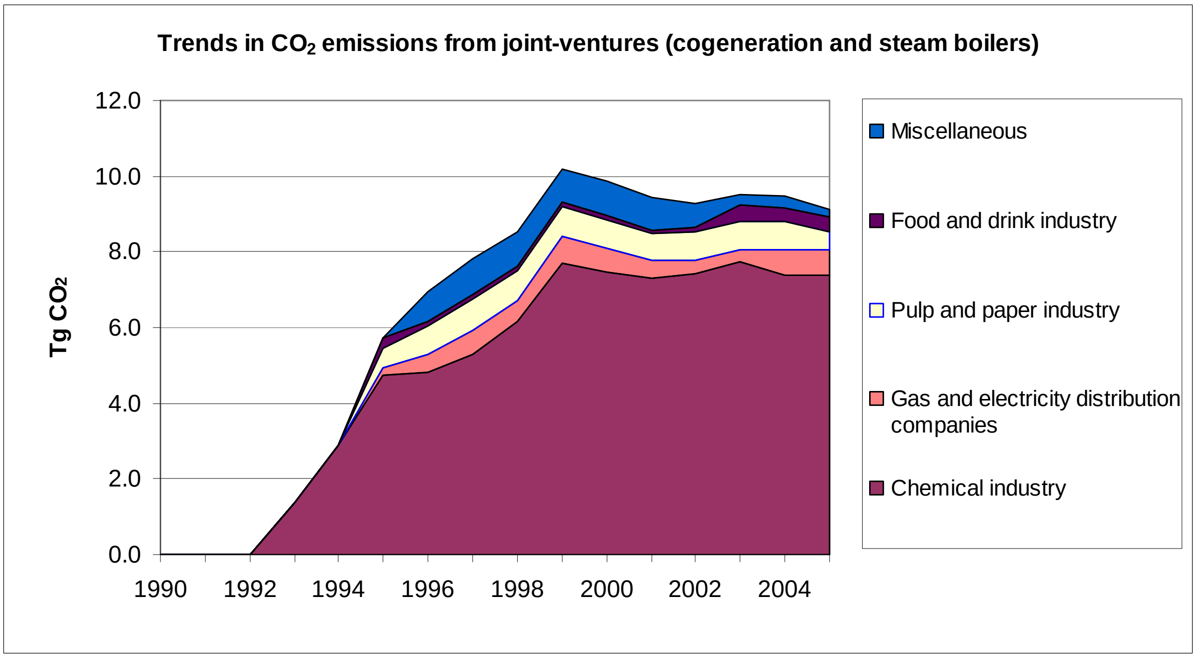


Figure 3.5 Trends in CO_2 emissions from joint-ventures of cogeneration plants and steam boilers.

The increase in combustion of other fuels is explained by the strong increase in waste incineration with heat and electricity recovery, which is the result of environmental policy to reduce waste disposal in landfills (see chapter 8). The increase in the CO_2 emission factor since 2004 is due to the increase in the the share of plastics (witch have a high carbon fraction) in the combustible waste (see Table 8.6 on composition of incinerated waste). The decrease in 2005 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.

Although CO_2 emissions from the waste incineration of fossil carbon increased, their share in the total 1A1a category is only 4 percent. This also explains a large part of the increase found in both biomass fuels, but the co-combustion of biomass in coal-fired power stations (showing a marked increase in 2002 and about 25% in 2005) and the combustion of biogas in CHP from landfill sites (15% share) is also part of this category and has increased significantly (see section 3.8).

Refineries [1A1b]

As of this year, besides combustion emissions from this subcategory also fugitive CO_2 emissions from hydrogen production (including gasification) are reported under 1B2. For 2002 onwards, the latter are no longer included as ‘unaccounted for’ in liquid fuel combustion of this subcategory. This affects both activity data for liquid fuel and the related emissions. Resulting CO_2 combustion emissions from ‘Refineries’ decreased by 7% in 1999 and by 15% in 2002. This corresponds with similar reductions in the activity data in terms of liquid fuel combustion and in terms of crude throughput (somewhat larger, but partly compensated by increases in gas combustion). These liquid fuel combustion emissions constitute about 5% of the national total CO_2 emissions (see Table 3.2).

The inter-annual variation in the IEFs for CO_2, CH_4 and N_2O from liquid fuels is explained both by the high but 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 (see section 3.3.2), and by the variable addition of ‘unaccounted for liquids’, which 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 (see section 3.3.5 on recalculations). In fact, is assumed that after the re-allocation of this fugitive CO_2 source and the use of the more detailed CO_2 emissions reported by the individual referies no unaccounted for liquid fuel remains for these years. As the ‘unaccounted for’ amounts decreases over time, this causes the IEFs of CH_4 and N_2O to increase over time because the ‘unaccounted for fuel use’ was determined solely to calculate CO_2 emissions due to net carbon losses only, not for other emissions. All remaining differences with the CO_2 calculation based on the national energy statistics and default emission factors are, therefore, show up in the calculated carbon content of the combusted refinery gas and thus in the implied emission factor of CO_2 for liquid fuel.

Table 3.2 Trends in CO_2 emissions from refineries by fuel type (Units:Tg).

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Liquid: total	10.0	9.9	9.3	10.2	10.0	10.4	10.1	10.0	10.6	9.7	10.2	10.8	8.6	9.3	9.0	8.9
o.w. oil products, excl. refinery gas	*1.6*	*1.7*	*1.5*	*4.5*	*4.5*	*4.5*	*4.8*	*4.2*	*4.0*	*3.4*	*3.1*	*3.1*	*2.7*	*2.8*	*2.6*	*2.6*
o.w. refinery gas in refineries	*3.8*	*3.9*	*4.0*	*4.2*	*4.4*	*4.2*	*3.9*	*5.0*	*4.9*	*4.7*	*5.2*	*5.1*	*5.9*	*6.5*	*6.4*	*6.3*
o.w. unaccounted for liquid fuel	*4.6*	*4.3*	*3.8*	*1.4*	*1.1*	*1.7*	*1.4*	*0.7*	*1.7*	*1.5*	*1.9*	*2.6*	*0.0*	*0.0*	*0.0*	*0.0*
Gaseous fuels: total	1.0	1.2	1.1	1.3	1.3	1.2	1.5	2.0	1.8	1.9	1.9	1.8	2.1	2.1	2.3	2.5
Process vent in SGHP plant	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.9	0.9
Total CO_2 from refineries	**11.0**	**11.1**	**10.4**	**11.5**	**11.3**	**11.7**	**11.6**	**12.0**	**12.4**	**11.6**	**12.1**	**12.6**	**11.7**	**12.3**	**12.2**	**12.3**
Refinery act data: throughput (PJ)	2.2	2.5	2.6	2.8	2.8	2.7	2.7	2.7	2.8	2.4	2.5	2.5	2.2	2.3	2.3	2.3
CO_2/PJ throughput	*5.0*	*4.4*	*4.0*	*4.1*	*4.1*	*4.4*	*4.3*	*4.4*	*4.5*	*4.7*	*4.9*	*5.1*	*5.3*	*5.3*	*5.3*	*5.3*

Manufacture of solid fuels (coke) and other energy industries (fuels production) [1A1c]

This category comprises mainly CO_2 emissions from natural gas. The dominating source is ‘own use’ for energy purposes by the oil and gas production and transmission industry. The emissions from this source category increased from 1.5 Tg in 1990 to 2.1 Tg CO_2 in 2005 due to the exploitation of less favourable production sites than in the preceding years. 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 included herein. The trend in solid fuel use is explained by the activities of the one stand-alone coke production plant in Sluiskil, the operation of which was discontinued in 1999. The small amounts of solid fuel combustion by this coke production facility in the period 1990-1994 are not separately recorded in the energy statistics but are included in the iron and steel industry (category 1A2a). The fuel consumption for the on-site coke production by the integrated steel works is also reported under 1A2a.

3.3.2 Methodological issues

It should be re-emphasized that all four fossil fuels are key sources for this category: all of the fossil fuels in 1A1a (in particular solids and gases); liquids and gases in 1A1b and gases in 1A1c. A country-specific top-down (Tier 2) method is used for calculating the emissions for fuel combustion in the 1A1 'Energy Industries'. The 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 residual chemical 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, residual chemical gas and blast furnace gas (see Table A2.2). More details on methodologies, the data sources used and country-specific source allocation issues are provided in the monitoring protocols (see www.greenhousegases.nl and section 3.1).

Category 1A1a 'Public Electricity and Heat Generation' includes co-generation (and some steam boilers) operated as joint-ventures of a utility and private industries. In the national energy statistics, fuel consumption of these sources are also included in 'Public Electricity and Heat Generation', following international NACE guidelines for allocating economic activities and, consequently, so are their emissions. The type of ownership may change with time – which has indeed happened – thereby affecting the allocation of the emissions to the IPCC source categories. The effect can be seen in the energy consumption trends and, subsequently in the emission trends on the sector level. The trends in both this sector and the manufacturing industries categories can be well explained (see Figures 3.4 and 3.5) if the activity data and the related emissions in 1A1a relating to these re-allocations are explicitly displayed. 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.

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 operates the SGHP-unit, supplying all the hydrogen for a large scale hydrocracker. When producing hydrogen also CO_2 is 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. The fuel used to provide the carbon for this non-combustion process is subtracted from the fuel consumption used to calculation the combustion emissions reported in this subcategory. However, 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 (i.e. the 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). However, 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'. Table 3.2 shows that this represents approximately 10% (5 –20%) of the total fuel consumption accounted for in the statistics. For 1998-2001 also the unspecified CO_2 process emissions from the hydrogen plant are included.

In 1A1c 'Other Energy Industries', the combustion emissions from oil and gas production refers to the so-called 'own' use of the gas and oil production industry. Production and sales data are based on the national energy statistics, while the amounts flared and vented are based on MJVs from the sector. Also included in this category is energy consumption for gas transmission (for gas compressor stations), which is not separately recorded in the national energy statistics but is included in the MJVs of the gas transport industry. Fuel consumption for coke production is included elsewhere (in 1A2a), with the exception of the data for the years 1995–1999 for which the fuel consumption of one stand-alone coke production plant has been separately included in the national energy statistics.

In the Netherlands one large production site for charcoal production serves most of the Netherlands and also serves a large share of the market of our neighbouring countries. Greenhouse gas emissions from fossil fuel use are not included in 1A1, but included in 1A2.

3.3.3 Uncertainty and time-series consistency

Uncertainties
The uncertainty in CO_2 emissions of this category is estimated to be 3% (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 two exceptions are solids in the 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 and Brandes, 2007). 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 recent fuel quality analysis reported by Heslinga and Van Harmelen (2006) and further discussed in Olivier and Brandes (2007); however this value is not yet 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 Corus). 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 residual chemical 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% 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 (Olivier and Brandes, 2007).

Time-series consistency
see section 3.2.3.

3.3.4 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). First, 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 7101: CO_2, CH_4 and N_2O from 'Stationary Combustion: Fossil Fuels'.

3.3.5 Source-specific re-calculations

A source-specific recalculation was made for refineries (1A1b) for 2002-2004. A pure CO_2 stream generated and released by refineries, which is was previously reported as 'unaccounted for liquid fuel use' as part of 1A1b, is now separately reported and included in the CRF as process emissions under subcategory 1B2a-iv. The energy balance is the basis for the emission calculations. CO_2 emissions calculated with these aggregated fuel data agree well with the aggregated emission data in the individual refinery registration (MJVs). Since 2002 refinery fuel data are integrated in the energy balance with much more detail. Also the CO_2 emissions are calculated with these detailed individual data. Although the same method is still used, the quality of the data used to calculate and report CO_2 emissions has been improved for recent years by incorporating these more accurately determined CO_2 emissions reported by the individual refineries for 2002 onwards.
As part of this improvement, besides combustion emissions from this subcategory now also fugitive CO_2 emissions from hydrogen production (including gasification) are reported under 1B2. For 2002 onwards, the latter are no longer included as 'unaccounted for' in liquid fuel combustion of this subcategory.
This affects also activity data for liquid fuel and the related emissions in 1A1b: the fuel used to provide the carbon for this non-combustion process is subtracted from the fuel consumption used to calculation the combustion emissions reported in this subcategory. 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 – does not influence the value of the implied emission factor for CO_2 for total liquid fuel compared to the years prior to 2002.
The high implied values of this IEF for 2002 onwards are due to the assumption that no 'unaccounted for' liquid fuel use remains and that all differences between emissions reported by the refineries and the calculation using default CO_2 emission factors due to plant-specific factors for refinery gas. The high IEF values suggest that also some other CO_2 emissions occur that are not accounted for by the fuel consumption data only. The years 1998-2001 were not recalculated because the reported emissions were not available at the appropriate aggregation level.

Table 3.3. Re-calculated of total CO_2 emissions of 'Refineries' in categories 1A1b and 1B2a-iv due to revised activity data and detailed emission factors for 2002-2004 (Units: Tg CO_2).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
NIR 2007	11.0	11.1	10.4	11.5	11.3	11.7	11.6	12.0	12.3	11.6	12.1	12.6	11.7	12.3	12.2
NIR 2006	11.0	11.1	10.4	11.5	11.3	11.7	11.6	12.0	12.3	11.6	12.1	12.6	10.9	11.2	11.8
Difference	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**1.1**	**0.4**
Reallocated to 1B2-iv	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.9

3.3.6 Source-specific planned improvements

In electricity and heat production, preliminary new data on waste composition (component fractions and carbon fractions) suggest that the split of incinerated waste into the organic and fossil fractions may need to be updated for recent years (for example since 2000). This will be considered for the NIR 2008.
For refineries, the high IEF values for CO_2 from liquid fuel for 2002 onwards suggest that also some other CO_2 emissions occur that are not accounted for by the fuel consumption data only. Therefore, the present allocation method for reporting CO_2 emissions from refineries will be evaluated and reconsidered, when another methods appears to provide the data more transparently. If in the future part of the CO_2 produced by the gasification- and hydrogen plant is sold to external users (for example for industrial applications or for crop fertilization in greenhouse horticulture), this may be monitored separately and allocated accordingly.

3.4 Manufacturing industries and construction [1A2]

3.4.1 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' 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.

1A2a 'Iron and Steel' 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.

Subcategory 1A2b 'Non-ferrous Metals' consists mainly of two aluminium smelters. CO_2 emissions from anode consumption in the aluminium industry are included in 2C. Dutch industry comprises a relatively large share of petrochemical plants, which is mirrored in the combustion CO_2 emissions in 1A2c 'Chemicals' in association with the manufacture of chemical products and non-energy use of natural gas. 1A2f 'Other' includes all other industry branches, among which are mineral products (cement, bricks, other building materials, glass), textiles, wood and wood products. Also included are the emissions from the building construction industry and the emissions of 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.

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 which 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).

Overview of shares and trends in emissions

In 2005 the share of CO_2 emissions from 1A2 'Manufacturing and construction industries' in the total national greenhouse gas emission inventory was estimated to be 12% compared to 13% in 1990. In contrast, the share of the other greenhouse gas emissions in this category is relatively small.

Category 1A2c 'Chemical industry' is the largest contributor to CO_2 emissions, accounting for approximately 52% in 1990 and 43% in 2005 of the total emissions from the manufacturing industry.

In the period 1990–2005, CO_2 emissions from combustion in 1A2 'Manufacturing and construction industries' decreased 18% (from 33.0 to 27.2 Tg; see Figure 3.6). The chemical industry contributes the most to this decrease in emissions in this source category, with its contribution to CO_2 emissions decreasing by 32%, or 5.5 Tg. When the re-allocations of CO_2 emissions to the Energy industry due to the above-mentioned formation of joint-ventures are taken into account (see sections 2.3.1 and 3.3.1 for more details), the CO_2 emissions from fuel combustion in most of the industrial source categories remained almost stable, while the production significantly increased (see section 3.4.1).

Total CO_2 emissions from 1A2 'Manufacturing and construction industries' in 2005 remained stable compared to 2004, also in the underlying industrial subcategories.

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 so-called 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, when 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 and not as an industrial process in sector 2.

Iron and Steel [1A2a]

The contribution of 1A2a 'Iron and steel' to the CO_2 emissions from 1A2 'Manufacturing and construction industries' was about 12% in 1990 and 17% in 2005. Interannual 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 (see section 3.4.1). In 2005 CO_2 emissions from solid fuel combustion of the iron and steel industry decreased slightly (-0.2 Tg).

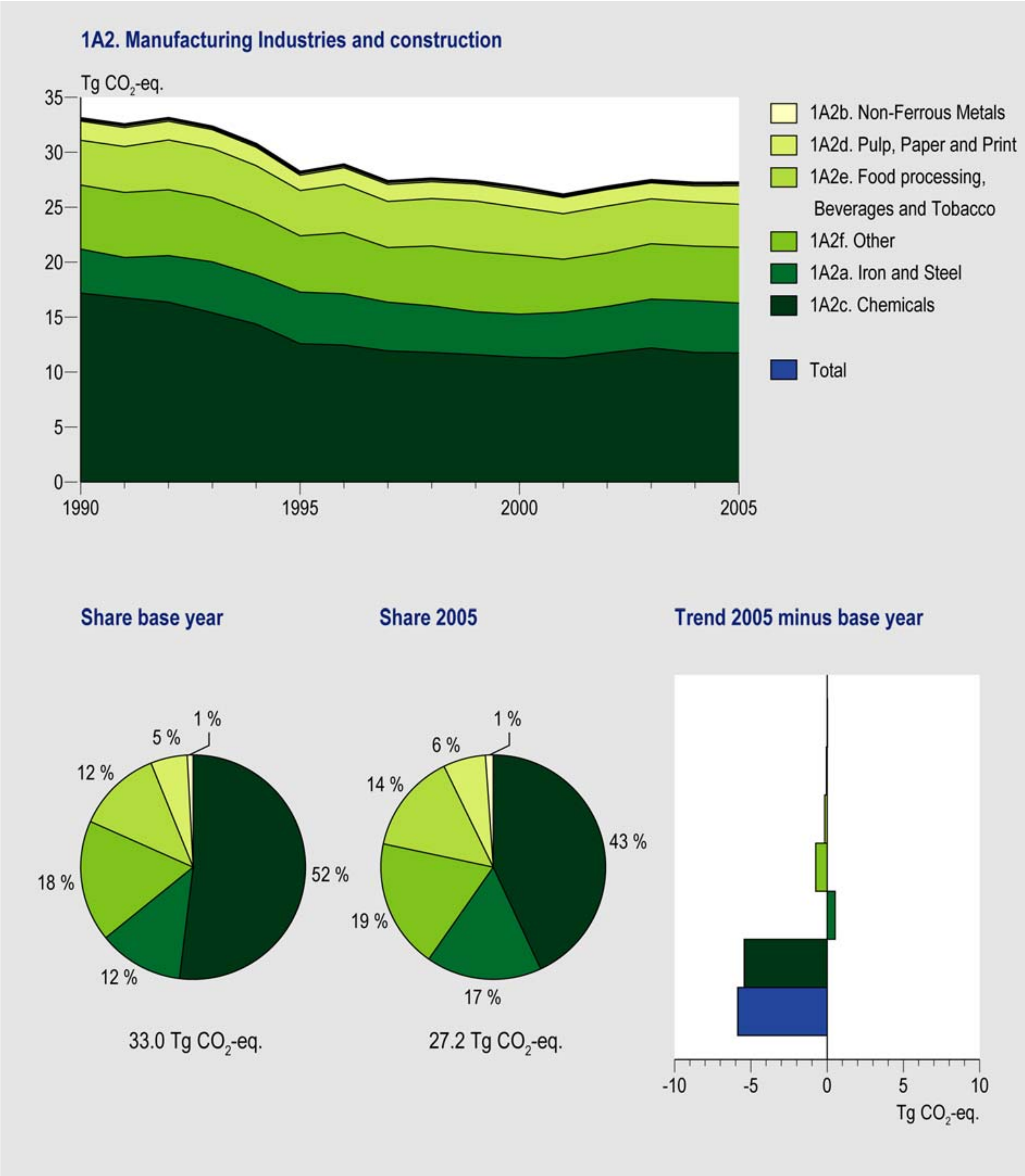


Figure 3.6 1A2 'Manufacturing and construction industries': trend, emission levels and share of source categories in 1A2, 1990-2005.

Non-ferrous metals [1A2b]

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.

Chemicals [1A2c]

The contribution of 1A2c 'Chemical industry' to CO_2 emissions from 1A2 'Manufacturing and construction industries' decreased from 52% in 1990 to 43% in 2005. The combustion of natural gas and liquid fuels, both account for approximately 50% 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 40% decrease in the consumption of natural gas during the same period.

In 2005 CO_2 emissions from liquid fuel combustion in the chemical industry decreased by about 10%, or 0.1 Tg CO_2 whereas emissions from gas combustion increased 0.1 Tg between 2004 and 2005.

The steady decline in the amount of natural gas used for combustion by the chemical industry can be explained largely by re-allocation of the emissions to the Energy sector due to the above-mentioned formation of joint-ventures (see sections 2.3.1 and 3.4.1).

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 is rather constant in the period 1990–2005. Given that since 1990 the production has increased significantly (see section 3.4.1), the constant emission level indicates substantial improvements in the efficiency of energy use and/or structural changes within the chemical industry.

Pulp, paper and print [1A2d]
The contribution of 1A2d ‘Pulp, paper and print’ to CO_2 emissions from 1A2 ‘Manufacturing and construction industries’ is estimated to be approximately 5% in 1990 and 6% in 2005. In line with the decreased consumption of natural gas, CO_2 emissions have decreased approximately 3% since 1990, of which a large fraction (approximately 65%) 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. In 2005, CO_2 emissions from gaseous fuel combustion increased by about 16%, or 0.2 Tg CO_2.

Food processing, beverages and tobacco [1A2e]
The contribution of 1A2e ‘Food processing, beverages and tobacco industries’ to CO_2 emissions from 1A2 ‘Manufacturing and construction industries’ was 12% in 1990 and 14% in 2005. The CO_2 emissions, which originate largely from the combustion of natural gas, remained almost constant in the period 1990–2005: the 9% increase in gas consumption since 1990 is compensated by the decrease use of other fuels for combustion. In 2005 CO_2 emissions from gaseous fuel combustion in this source category decreased about 3%.

Other [1A2f]
The share of category 1A2f ‘Other’ (including construction and other off-road machinery) in the CO_2 emissions from 1A2 ‘Manufacturing and construction industries’ was approximately 18% in 1990 and 2005. Most of the 5 Tg CO_2 emissions from this source category stem from gas combustion (3.4 Tg), while almost all of the remaining CO_2 emissions are associated with the combustion of liquid fuels (1-2 Tg CO_2), of which off-road machinery accounts for 0.7–1.4 Tg CO_2. CO_2 emissions from this source category have decreased 13% since 1990. In 2005 total CO_2 emissions from the other manufacturing industries increased 2%.

Activity data and (implied) emission factors
Although total industrial production has increased about by 22% (in fixed monetary units) since 1990, the combustion emissions of CO_2 have decreased by 19% – or by about 6.4 Tg – to which the shift of ownership through CHP joint-ventures has contributed more than 7 Tg and that of steam boilers in joint-ventures about 2 Tg CO_2. The largest change is in the chemical industry, the CO_2 emissions of which decreased by 34%, or 5.9 Tg (with about the same amount of CHP re-allocated to the Energy sector and another 2 Tg CO_2 from steam boilers now operated in joint-ventures). Nevertheless, it can be concluded that, apart from the CHP re-allocation, by and large the CO_2 emissions from combustion have remained almost constant in most industry source categories, while their production has significantly increased. The trend in CO_2 combustion emissions from the 1A2 categories and the trends in the underlying production data are presented in Figures 3.7a and 3.7b. This figure shows that per category the inter-annual variation is closely linked and that CO_2 emission trends are generally lower than the activity trends. Apart from the re-allocation of joint-ventures, the remaining differences can be explained mainly by energy conservation. Between 1989 and 1999, the Dutch industrial sectors improved energy efficiency by 20%, which is equivalent with an energy conservation of 142 PJ (EZ, 2000), or approximately 8.5 Tg CO_2 emissions or more (depending on the fuel mix assumed).

Iron and steel [1A2a]
The iron and steel industry shows inter-annual variations in combustion CO_2 emissions that are mainly due to the varying amounts of solid fuels that are used in the sector. 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 (Table 3.4). Total CO_2 emissions have remained rather constant in the period 1990–2005 even though production has increased by more than 25%. This indicates a

substantial energy efficiency improvement in the sector. This conclusion is supported by the decreasing trend in CO_2 losses from the coke and coal inputs in the blast furnaces, which have fallen from about 25% in 1990 to 12% at the present time and the corresponding increase (about 40%) in the capture and energetic use blast furnace gas (and oxygen furnace gas).

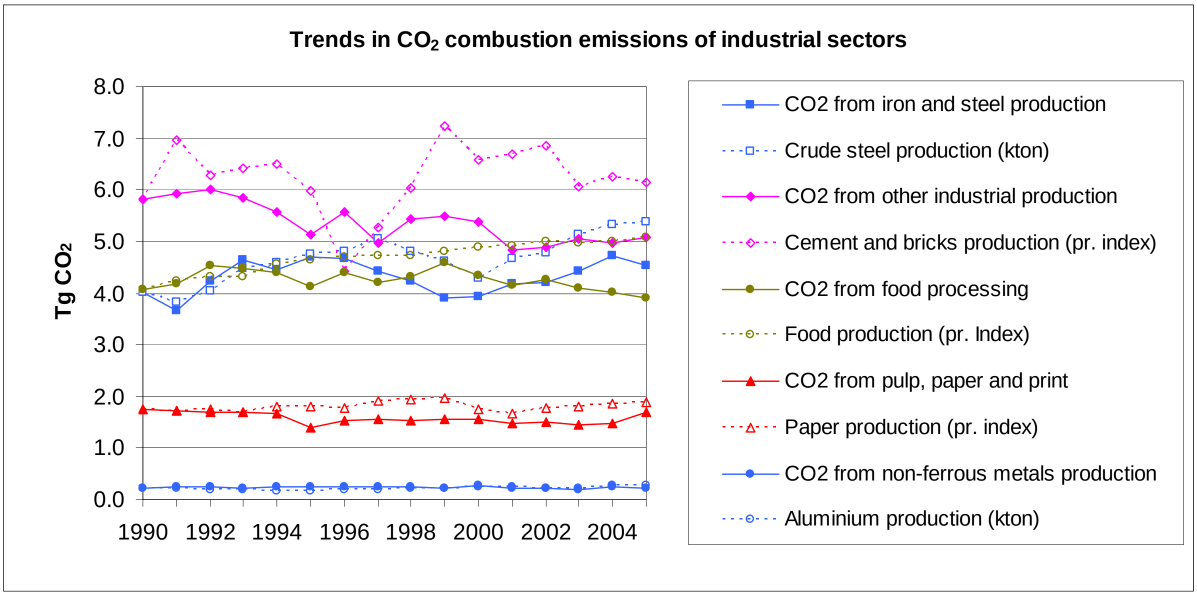


Figure 3.7.a. Trends in CO_2 emissions from combustion in industrial sectors.

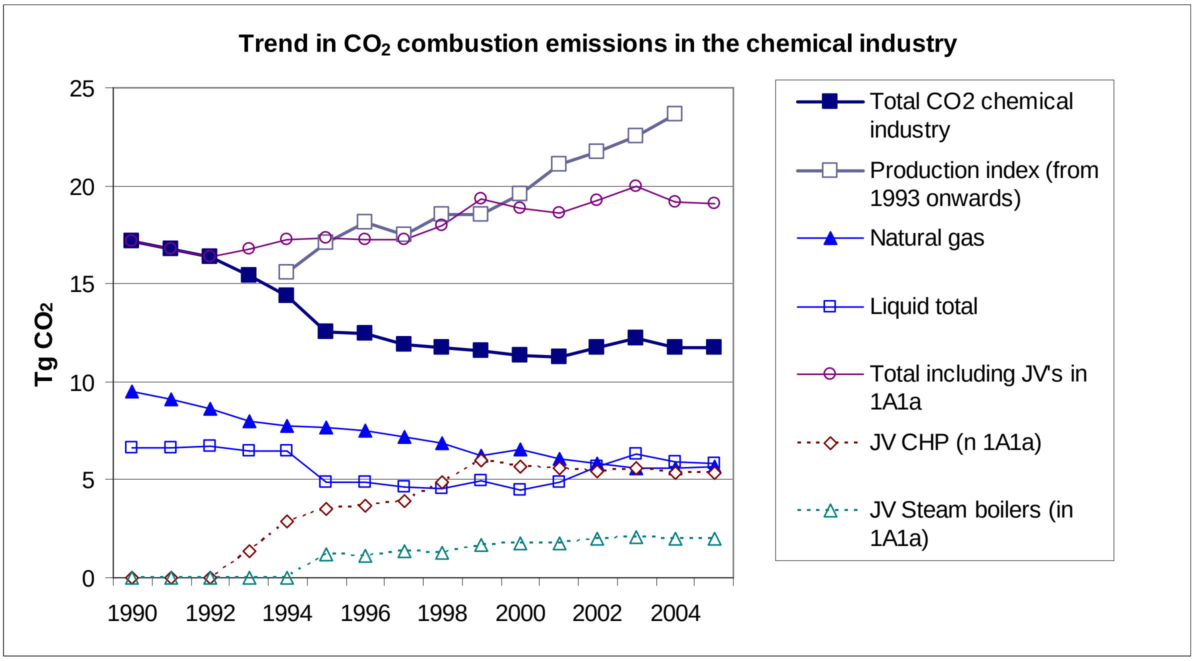


Figure 3.7.b. Trends in CO_2 emissions from combustion in the chemical industry.

In 2005 solid fuel combustion decreased by 5% (-0.2 Tg CO_2) compared to 2004, which is not solely explained by the +4% trend in activity data but rather reflects a smaller fraction of derived gases (blast furnace gas, oxygen furnace gas) used in 2005 combustion of the iron and steel industry. In addition to this development, a 2% higher fraction of blast furnace gas and oxygen gas was captured in 2005, which reduced conversion losses in blast furnaces in the industrial processes sector (-0.2 Tg CO_2 in 2C1).

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 (see Table 3.4). The relative 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.

Table 3.4 CO_2 emissions from the iron and steel industry by fuel type (excluding CO_2 losses in coke ovens) (Units:Tg).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Solid: total	3.3	2.9	3.5	3.9	3.7	3.9	3.9	3.7	3.5	3.1	3.1	3.4	3.4	3.7	4.0	3.8
o.w. BF/OX gas in steel	2.4	2.1	2.7	3.1	2.8	3.1	3.0	2.8	2.7	2.5	2.5	2.7	2.8	3.0	3.4	3.1
N.B. BF/OX gas 1A1A.	3.8	3.9	4.0	4.6	4.8	4.8	4.7	5.1	5.4	5.4	4.9	5.3	5.3	5.5	5.9	6.1
Total BF/OX gas	6.2	6.0	6.7	7.7	7.6	7.9	7.7	7.9	8.0	7.8	7.4	8.1	8.1	8.6	9.3	9.2
o.w. CO gas in steel	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.6	0.6	0.6	0.6	0.6	0.7	0.6
o.w. other than BF/OX or CO gas	0.1	0.0	0.0	0.1	0.1	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0
Gaseous fuels	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.7
Liquid: total	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Net CO_2 from C inputs in BF (2C1)	2.5	2.1	1.6	1.5	1.8	1.8	1.8	2.1	1.7	1.5	1.3	1.3	1.3	1.5	1.3	1.2
o.w. carbon from iron ore	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.1	0.1
o.w. coke inputs in blast furnaces 2)	2.2	1.9	1.3	1.2	1.5	1.5	1.5	1.8	1.4	1.3	1.0	1.0	1.1	1.2	0.7	0.8
o.w. limestone use	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3	0.3
Total CO_2 from steel production	6.5	5.8	5.8	6.1	6.3	6.5	6.4	6.5	5.9	5.4	5.2	5.4	5.6	5.9	6.0	5.7
Activity data: crude steel prod. [Gg]	5.2	4.9	5.2	5.8	5.9	6.1	6.2	6.5	6.2	6.0	5.5	6.0	6.2	6.6	6.9	6.9
CO_2/ton crude steel	1.3	1.2	1.1	1.1	1.1	1.1	1.0	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.8

Non-ferrous metals [1A2b]

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. Energy use in the primary aluminium industry consists mostly of electricity use, of which the related combustion emissions from the production are accounted for in category 1A1a ‘Public Electricity and Heat Production’. It should be noted that CO_2 from anode consumption, which was about 0.5 Tg in 2005, is reported under 2C.

Chemicals [1A2c]

The steady decreasing CO_2 emissions from the combustion of natural gas can be largely explained by the decreasing use or ownership of co-generation facilities by the industry. CO_2 emissions from liquid fuel combustion stem predominantly from the combustion of chemical residual gas. The marked decrease in liquid fuel consumption since 1995 (see Table 3.5) is not due to a decrease in chemical production or data errors, but mainly to a large shift of ownership of a large co-generation plant – one using residual chemical 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-venture and thus moved to the ‘Energy Industry’ sector. When all CO_2 emissions from the chemical industry are combined – including the net process emissions reported under category 2B – and the shift to joint-ventures are taken into account, it is apparent that total CO_2 emissions have remained rather constant during the 1990–2005 period (see Table 3.5). Since 1990 the production has increased significantly (e.g. in terms of fuels used as chemical feedstock), indicating a substantial improvement in energy efficiency and or structural changes within the chemical industry.

Table 3.5 CO_2 emissions from the chemical industry specified by fuel type (Units: Tg).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Natural gas	9.5	9.1	8.6	8.0	7.8	7.7	7.5	7.2	6.9	6.2	6.6	6.1	5.8	5.6	5.6	5.7
Liquid: total used in chem. ind.	6.6	6.6	6.7	6.4	6.5	4.9	4.9	4.7	4.6	5.0	4.5	4.9	5.7	6.3	5.9	5.8
o.w. chem.residual gas	*5.4*	*5.0*	*5.0*	*5.0*	*4.9*	*3.8*	*4.0*	*3.8*	*3.8*	*4.1*	*3.8*	*4.2*	*5.1*	*5.8*	*5.7*	*5.6*
N.B. chem. residual gas in power gen.	*0.0*	*0.0*	*0.0*	*0.0*	*0.3*	*1.5*	*1.4*	*1.7*	*1.7*	*1.8*	*1.8*	*1.9*	*2.1*	*2.2*	*2.1*	*2.1*
Total chem. residual gas	*5.4*	*5.0*	*5.0*	*5.0*	*5.2*	*5.3*	*5.5*	*5.5*	*5.4*	*5.9*	*5.7*	*6.1*	*7.2*	*8.0*	*7.8*	*7.7*
o.w. other fuels	*1.2*	*1.6*	*1.7*	*1.4*	*1.6*	*1.1*	*0.9*	*0.8*	*0.8*	*0.9*	*0.6*	*0.6*	*0.6*	*0.5*	*0.3*	*0.2*
Natural gas	9.5	9.1	8.6	8.0	7.8	7.7	7.5	7.2	6.9	6.2	6.6	6.1	5.8	5.6	5.6	5.7
Solid fuels	1.1	1.0	1.0	1.0	0.1	0.0	0.1	0.1	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0
Ammonia production (a.o.) (2B)	3.1	3.5	3.5	3.4	3.6	3.6	3.4	3.6	3.6	3.6	3.6	3.0	2.9	2.9	3.1	3.1
Total CO_2 chemical industry	17.2	16.8	16.4	15.4	14.4	12.6	12.5	11.9	11.8	11.6	11.3	11.3	11.7	12.2	11.8	11.7
Joint-Ventures (JV)	0.0	0.0	0.0	1.4	2.9	4.8	4.8	5.3	6.2	7.8	7.5	7.4	7.5	7.8	7.4	7.4
Total including JVs	17.2	16.8	16.4	16.8	17.3	17.3	17.3	17.2	18.0	19.4	18.9	18.6	19.2	20.0	19.2	19.1

Pulp, paper and print [1A2d]

The CO_2 emission level in 1995 is relatively low, due to the shift of joint-venture co-generation to the energy sector (approximately 1 Tg CO_2) (see Figure 3.5). 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. The emission factors for biomass combustion have not yet been re-calculated. The large changes in the (very small) amounts of biomass combustion are due to the incomplete monitoring of individual industries (see completeness paragraph in section 3.1). A very large fraction, almost 1 Tg from a total of about 1.5 Tg CO_2, results from co-generation (Figure 3.7.a).

Food processing, beverages and tobacco [1A2e]

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. The emissions of biomass combustion have been re-calculated, although not yet validated. The large changes in the (very small) amounts of biomass combustion are due to incomplete monitoring of individual industries (see completeness paragraph in section 3.1). About 1.5 Tg of a total of about 4 Tg CO_2 is currently emitted by co-generation plants owned by the food industry.

Other [1A2f] (including construction and other off-road)

Most of the present 5 Tg CO_2 emissions from this source category stem from gas combustion (about 3.5 Tg). Almost all of the remaining CO_2 emissions relate to the combustion of liquid fuels (1-2 Tg CO_2), of which off-road machinery accounts for 0.7–1.2 Tg CO_2. A very small portion of the CO_2 emissions (0.2 Tg) originates from co-generation plants.

The varying amounts from liquid fuel are mainly due to the relatively large inaccuracy of the fuel consumption data in the energy statistics for off-road machinery. The much higher levels of biofuel combustion during the period 1991–1994 include the amounts not reported under the previous categories 1A2b to 1A2e and, by accident, the amount originally allocated to category 1A1a. The small amounts and varying shares of derived gases explain the large inter-annual variation that can be observed in the IEFs for solid and liquid fuels. For 1991–1994, in particular, the detailed fuel mix assumed was often different from that of the adjoining years 1990 and 1995 due to the revision of the energy statistics at a high aggregation level (for more details on this, see Klein Goldewijk et al., 2005).

3.4.2 Methodological issues

It should be re-emphasized that in this category, liquid, solid and gaseous fossil fuels are key sources (in particular, gases and liquids). Major emission sources are solids in 1A2a, liquids and gases in 1A2c, gases in 1A2d and 1A2e, and gases and liquids in 1A2f (using a threshold of 0.6 Tg CO_2, derived from the 95% cumulative share in total national greenhouse gas emissions).

A country-specific top-down (Tier 2) method is used for calculating the emissions for fuel combustion from 'Manufacturing Industries and Construction' (1A2). The 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 residual chemical 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 residual chemical 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) and section 3.1.

In the '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 3.4.1).

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' industry. 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 subcategory 1A2f are the least accurate.

3.4.3 Uncertainty and time-series consistency

Uncertainties

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 and Brandes, 2007). This includes the uncertainty in the subtraction of the amounts of gas and solids for non-energy/feedstock uses on the one hand, including the uncertainty in the conversion from physical units to Joules, and the completeness of capturing blast furnace gas in total solid consumption and residual chemical 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 and Brandes (2007), 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 residual chemical 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 the 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.

Time-series consistency

see section 3.2.3.

3.4.4 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 (residual chemical gas combustion and process emissions from ammonia production etc.). 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 is found in the monitoring protocol 7101: CO_2, CH_4 and N_2O from 'Stationary Combustion: Fossil Fuels'.

3.4.5 Source-specific re-calculations
There have been no source-specific re-calculations.

3.4.6 Source-specific planned improvements
The Netherlands intends to use more plant-specific CO_2 emission factors in the future such as those reported in the MJVs of large companies. This might improve the accuracy of the emissions, while maintaining consistency and transparency. This will particularly affect the emissions from the combustion of residual chemical gas, blast furnace gas and coke oven gas for this source category.

3.5 Transport [1A3]

3.5.1 Source category description
The source category 1A3 ‘Transport’ comprises the following sources: ‘Civil Aviation’, ‘Road Transportation’, ‘Railways’, ‘Navigation’ and ‘Other Transportation’. 1A3a ‘Civil Aviation’ only consists of the emissions from domestic (inland) transport. Domestic aviation consists of the domestic civil aviation traffic between Dutch airports, while ‘Civil Aviation’ is the aviation traffic from and to the same airport. Emissions from international transport (aviation bunkers) are reported separately; see section 3.8. 1A3d ‘Navigation’ includes emissions from domestic navigation (inland shipping). Emissions from fuel used in international navigation are not included in 1A but in the inventory in ‘Marine Bunkers’; see also section 3.7. Emissions from national fisheries are included in 1A4c ‘Agriculture, Forestry and Fisheries’; see section 3.6. Greenhouse gas emissions from mobile combustion by military aircraft and shipping activities (Hulskotte, 2004a, b) are included in 1A5 (see section 3.7), while emissions from off-road machinery, such as tractors in agriculture, are included in 1A4c ‘Agriculture’. Emissions from road and building construction equipment and other areas are reported under category 1A2f ‘Other’. Energy consumption for pipeline transport is not recorded separately in the national energy statistics, but included in 1A1c for gas compressor stations and in 1A4a for pipelines for oil and other products.

Overview of shares and trends in emissions
Between 1990 and 2005, total greenhouse gas emissions from 1A3 ‘Transport’ increased 33%, from 26.4 Tg CO_2-equivalents in 1990 to 35.2 Tg CO_2-equivalents in 2005. The greenhouse gas emissions from the transport sector are summarised in Table 3.1 and Figures 3.8 and 3.9. CO_2 emissions from 1A3b ‘Road transport’ prevail in this category (more than 95% during the whole period), N_2O emissions in the Energy sector are also caused by this source category. In the period 1990–2005, total CO_2 emissions from 1A3 ‘Transport’ increased 33%, mainly due to the 32% increase in fuel consumption by road transport.

In 2005, CO_2 emissions are at the same level as 2004, due to 0,2 Tg lower CO_2 emissions from petrol combustion and a similar increase of emissions due to increased diesel combustion in category 1A3b ‘Road transport’.

Civil aviation [1A3a]
The contribution of 1A3a ‘Civil aviation’ to the national inventory of CO_2 emissions was less than 1% in both 1990 and 2005. Domestic aviation in the Netherlands emitted 0.04 Tg CO_2 in both 1990 and 2005.

Road transport [1A3b]
The contribution of 1A3b ‘Road transport’ to the national inventory of CO_2 emissions was 16% in 1990 and 19% in 2005. By far the largest contributors to this source category are passenger cars, which account for 64% in 1990 and 57% in 2005. See Figure 3.8 for trends in passenger transport. The share of CO_2 emissions contributed by freight transport (including buses) to the total CO_2 emissions from road transport increased from 36% in 1990 to 42% in 2005. See Figure 3.9 for trends in freight transport.

CO_2 emissions from road transport increased by 8.4 Tg (33%) to 33.9 Tg in 2005. This increase is mainly caused by the increased use of passenger cars (+17%, or 2.8 Tg) and vans (+152%, or 3.6 Tg).

CH_4 emissions from road transport fell by about 69% between 1990 and 2005: this translates to a decrease in CH_4 emissions from 7.5 to 2.3 Gg. In 2005 passenger cars accounted for 81% of the total CH_4 emissions from road transport.

N_2O emissions from road transport increased from 0.9 Tg in 1990 to 1.5 Tg N_2O in 1999 and remained more or less constant between 1999 and 2005.

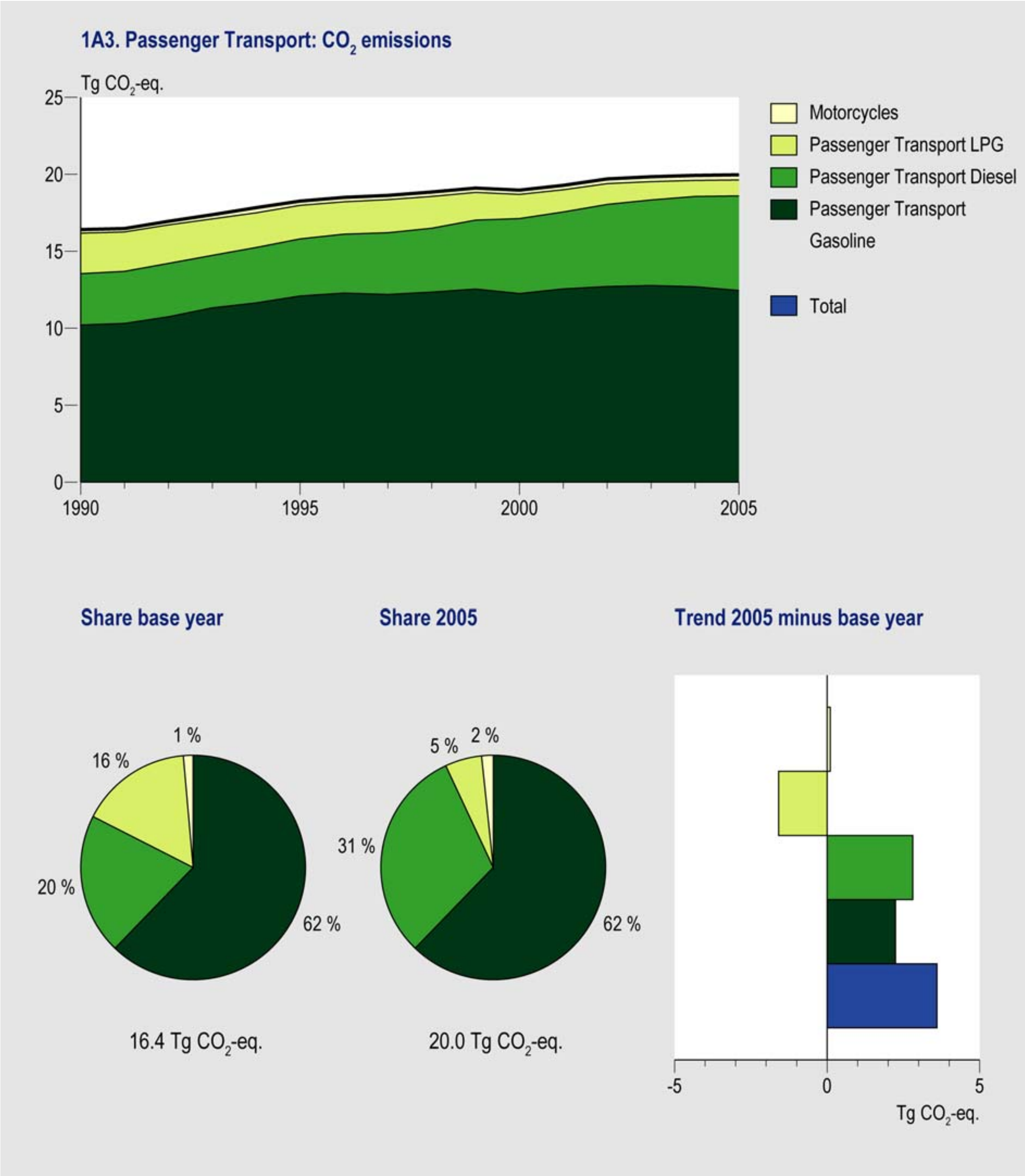


Figure 3.8 Category 1A3 'road transport': passengers: trend, emission levels and share of source categories in 1A3b 'Road transport-passengers', 1990-2005.

Civil Aviation [1A3a]

The share of 1A3a 'Civil Aviation' in national total CO_2 emissions was less than 1% in both 1990 and 2004. Domestic aviation in the Netherlands released 0.04 Tg CO_2 in 1990 and in 2004, based on a rough estimate of fuel consumption in 2000 by domestic aviation, which is applied to the whole time series (see section 3.5.2).

Navigation [1A3d]

The share of domestic waterborne navigation (1A3d) in national CO_2 emissions was small (about 0.3%) in both 1990 and 2005. Emissions were about 0.4 Tg in 1990 and 0.6 Tg in 2005.

Rail transport [1A3c]

The share of 1A3c Rail transport in national total CO_2 emissions was only 0.1% in 1990 and 2005 (0.1 Tg).

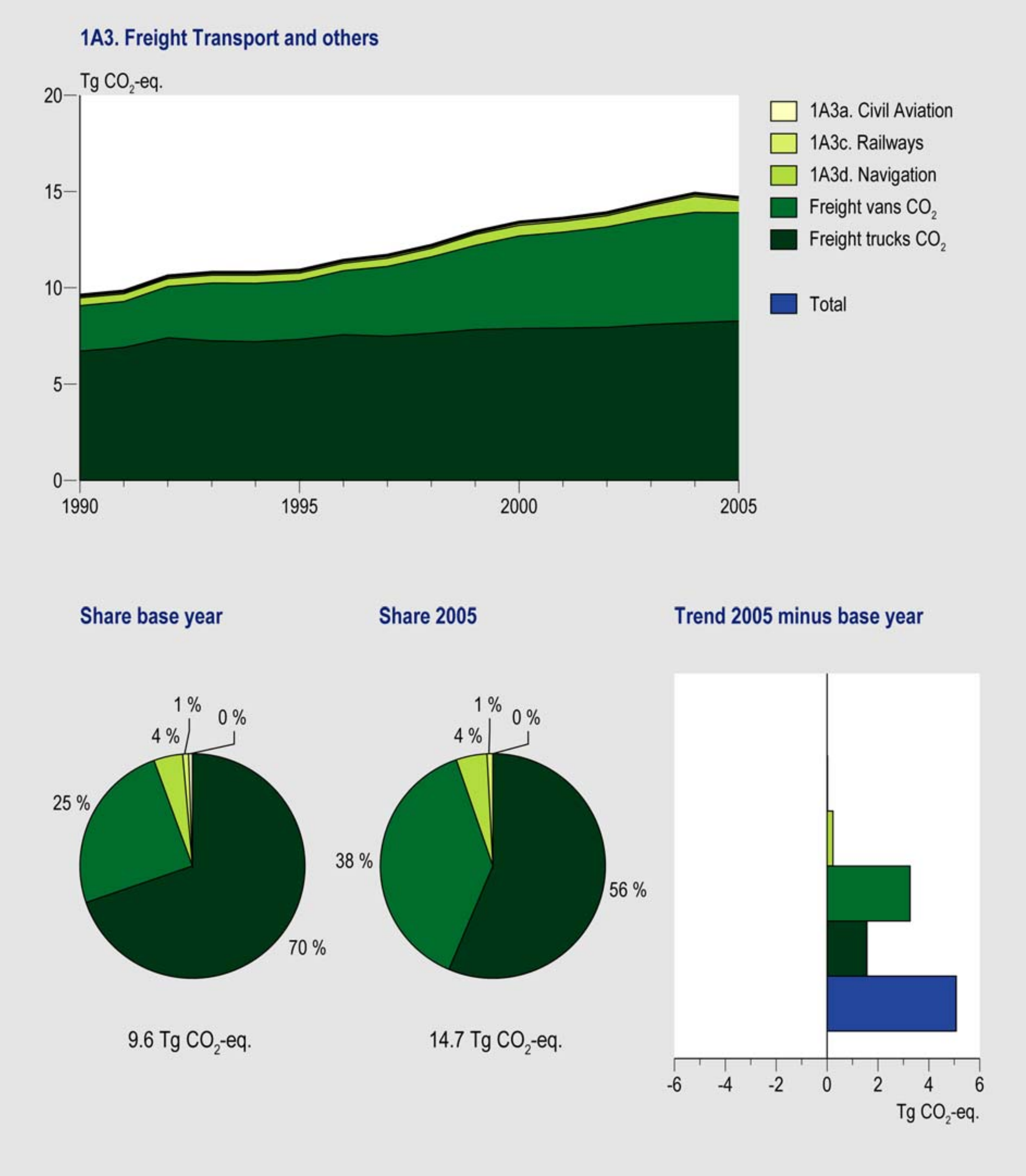


Figure 3.9 Category 1A3b' freight transport': trends, emission level and share in the emissions of source categories in 1A3b' freight transport', 1990-2005.

Key sources

CO_2 emissions from 1A3b 'Road Transport', all fuel types, are identified as key sources (Table 3.1).

Activity data and (implied) emission factors

Road transport [1A3b]

While the share of petrol in fuel sales to road vehicles has remained rather constant over the period 1990-1999, there has been a shift from LPG to diesel fuel. This shift has increased the share of diesel in road transport fuel sales from 46% in 1990 to 58% in 2005 (see Figure 3.10). Furthermore, since 2003 petrol consumption decreased by 2%.

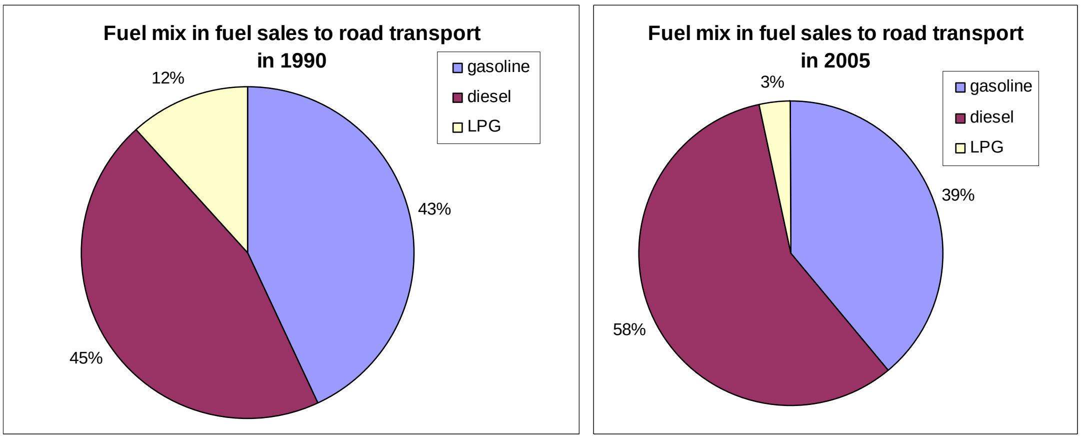


Figure 3.10 Shares of petrol (gasoline), diesel and LPG in fuel sales to 'Road Transport' 1990 and 2005.

In addition, the energy efficiency of passenger cars and of vans did not improve significantly between 1990 and 1999. The European, Korean and Japanese car manufacturers are committed to selling new cars in the European Union in 2008 that release, on average, 25% less CO_2 per kilometre than in 1995. While this has probably led to a slight decrease in average fuel use per kilometre driven (in the 'real world' situation) during the last years, this supposition cannot be proven because data on car use has become more and more uncertain since 1999. In 1999 Statistics Netherlands cancelled the annual passenger car use survey that supplied data on car use and fuel efficiency per fuel type.

The 60% reduction of CH_4 emissions from road transport is correlated to a reduction in total VOC emissions that has resulted from the implementation of European Union emission legislation for new road vehicles: total combustion and fugitive VOC emissions by road transport decreased by approximately 50% during the period 1990–2005, primarily due to the effect of the increasing number of catalyst-equipped passenger cars on the road.

The increasing trend in N_2O emissions up to 1999 can be explained by the increased vehicle kilometres and the increasing share of petrol cars equipped with a catalytic converter, as the latter have a higher emission factor than cars without this emission control technology. The fact that N_2O emissions from transport are constant between 1999 and 2005, despite the increase in vehicle-kilometres, is explained by a mix of developments (see Figures 3.11 and 3.12):

- Subsequent generations of catalytic converters (the second was introduced in 1996) appear to have lower N_2O emission factors (Gense and Vermeulen, 2002).
- The share of diesel cars in road passenger transport, which are assumed to have a lower emission factor than catalyst-equipped petrol cars, has increased during the last few years.

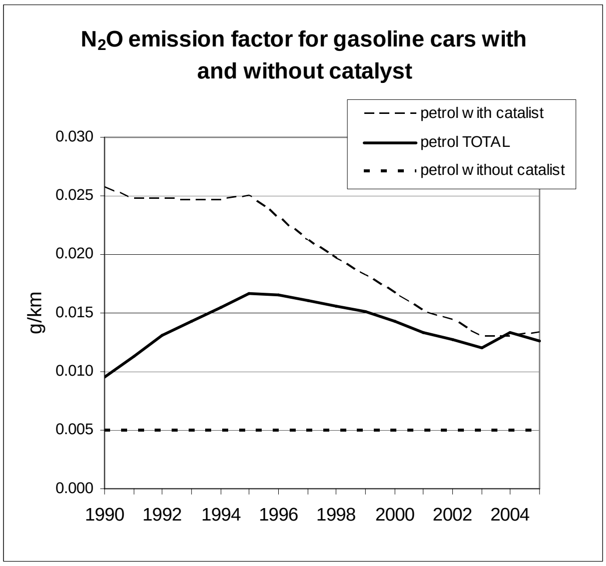


Figure 3.11 Trends in emission factors for N_2O from petrol passenger cars in the Netherlands due to the increase in the numbers of cars equipped with a catalytic converter.

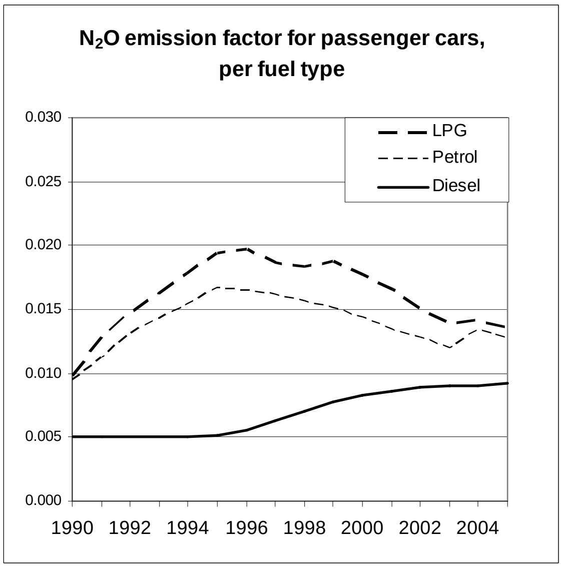


Figure 3.12 Trends in emission factors for N_2O from passenger cars in the Netherlands specified by fuel type

3.5.2 Methodological issues

A detailed description of the methodology and data sources used to calculate transport emissions are provided 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'. It is not possible to use fuel sales figures because there are no reliable data available on the distribution of these sales between national, international and military aviation. Therefore, the figures included in the national energy statistics (NEH) are not used. 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), these figures are used for the whole time series. CO_2 emissions are calculated based on fuel consumption by aircraft for domestic flights in the Netherlands (Pulles, 2000). Default IPCC emission factors for kerosene and aviation petrol are used to calculate greenhouse gas emissions. Deliveries of bunkers to international aviation are not included in this source category.

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

Road Transport [1A3b]

For national policy purposes, air pollution from 'Road Transport' is, in general, calculated bottom-up from statistics collected on vehicle-kilometres. However, the fuel consumption figure that is based on vehicle-kilometres is lower than the fuel consumption included in the statistics on energy sales in the Netherlands. The Revised IPCC Guidelines (IPCC, 1997) asks countries to report greenhouse gas emissions from combustion on the basis of fuel consumption within the national territory. Thus, 'Road Transport' emissions of the direct greenhouse gases CO_2, CH_4 and N_2O are calculated based using IPCC methodologies.

An IPCC Tier 2 methodology is used for CO_2 emissions from 'Road Transport' using the Netherlands' data on fuel sales to 'Road Transport' from Statistics Netherlands (CBS) and country-specific emission factors, as reported in Klein et. al. (2004), see Annex 2.

An IPCC Tier 3 methodology is used for CH_4 emissions from 'Road Transport'. CH_4 emissions from 'Road Transport' were calculated based on data on the mass fractions of different compounds in total VOC (Veldt and Van der Most, 1993). In turn, VOC emissions from 'Road Transport' are calculated using data on vehicle-kilometres from Statistics Netherlands (CBS), and VOC emission factors are obtained from the Netherlands Organization for Applied Scientific Research (TNO). The mass fraction is dependent on the fuel type and whether a petrol-fuelled vehicle is equipped with a catalyst or not. 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, while diesel-fuelled vehicles emit less CH_4 per unit of total VOC than petrol-fuelled vehicles without a catalyst. For each diesel-fuelled vehicle category, the calculation methodology distinguishes between several vehicle characteristics, such as age, fuel type and weight. In addition, the methodology also distinguishes between three road types and takes into account cold starts.

An IPCC Tier 3 (country-specific) methodology is used for N_2O emissions from 'Road Transport'. N_2O emissions are calculated by combining fuel deliveries with energy-specific emission factors. Data on fuel deliveries are obtained from Statistics Netherlands. The emission factors for passenger cars and light 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 based on Riemersma et al. (2003). From 2005 onwards, new heavy-duty diesel engines will require exhaust after-treatment systems such as SCR-deNO_x (selective catalytic converters) or EGR (exhaust gas re-circulation) combined with a CRT (continuous regeneration trap) to be able to meet the Euro4 emission limits. Euro4 and Euro5 heavy-duty diesel vehicles will probably emit about 50 mg N_2O per kilometre (Riemersma et al., 2003).

Since the CO_2 emissions from 'Road Transport' are considered to be key sources (see Table 3.1), the present Tier 2 and Tier 3 methodologies comply with the IPCC Good Practice Guidance (IPCC, 2001). CH_4 and N_2O 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 therefore calculated bottom-up using vehicle-kilometre data (i.e. with fuel consumption figures that are somewhat different from the energy supply statistics; see section 3.5.4 for more details).

Rail Transport [1A3c]

Information on fuel use by diesel trains is obtained from the Dutch Railways (NS). For CO_2 emissions, country-specific emission factors are used (Olivier, 2004), see Annex 2. For CH_4 and N_2O emissions, IPCC default emission factors have been used.

Navigation [1A3d]

An IPCC Tier 2 methodology is used for CO_2 emissions from domestic shipping. CO_2 emissions are calculated based on fuel deliveries to waterborne 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 (for example sold without levies and VAT). Although the national energy statistics (NEH) makes a distinction between trips on the Rhine river and inland shipping in the fuel consumption data for shipping, the sum of bunker fuel sales and domestic fuel sales to waterborne navigation in the NEH includes fuel used for international navigation that should not be reported as part of domestic shipping according to IPCC Good Practice. Using the Emission Monitor Shipping (EMS) method, 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 does comply with the IPCC Good Practice Guidance (IPCC, 2001). Emissions from fisheries are allocated under the domestic source category 1A4c 'Commercial/ Institutional/Fisheries' as required by the IPCC Reporting Guidelines (see section 3.2.5).

3.5.3 Uncertainty and time-series consistency

Uncertainties

The uncertainty in CO_2 emissions from 'Road Transport' is estimated to be about 4% in annual emissions (see section 1.7 for more detailed information). For petrol and diesel fuel, the uncertainty in the emission factor for CO_2 is based on 50 samples of petrol and diesel fuel from petrol stations in the Netherlands in 2004 (Olivier, 2004). The uncertainty in the CO_2 emission factor for petrol and diesel is calculated to be 0.4% and 0.2%, respectively, while the uncertainty in the CO_2 emission factor for LPG is estimated to be 0.2%. For jet kerosene and diesel used in non-road categories, the uncertainty is estimated to be 0.5% and 0.2%, respectively. These uncertainties (expressed as the standard error of the mean) are much lower than the uncertainties presented in the NIRs of other West European countries (Ramírez-Ramírez et al., 2006). The uncertainty in fuel use by road vehicles is 2% for petrol, 5% for diesel oil and 10% for LPG.

The uncertainty in CH_4 emissions from 'Road Transport' is estimated to be approximately 60% in annual emissions. The share of CH_4 in VOC emissions is based on the report of Veldt and Van der Most (1993), and the composition of VOC emissions from 'Road Transport' has not been validated since. It is very possible that the mass fraction of CH_4 has changed due, for example, to recent changes in the aromatic content of road transport fuels or to improved exhaust after-treatment technology. The uncertainty in N_2O emissions from 'Road Transport' is estimated to be 50% in annual emissions. Although current emissions from heavy-duty diesel vehicles are probably overestimated, when the whole time series (since 1990) is taken into consideration, the overestimation only slightly affects the emission trend.

The uncertainty in fuel used by 'Civil Aviation' is presently estimated to be about 50%, while that in 'Navigation' is estimated to be 20%. The uncertainty in CH_4 and N_2O emissions from other non-road transport sources is estimated to be about 100% in annual emissions (50% uncertainty in activity data and 100% in emission factors). As for 'Road Transport', data on the share of CH_4 in total VOC from these sources are based on Veldt and Van der Most (1993) and has not been validated since.

Time-series consistency

The methodologies used to estimate emissions from transport are consistent throughout the time series.

3.5.4 Source-specific QA/QC and verification

Vehicle-kilometre approach versus IPCC approach

The Netherlands applies two methodologies to calculate the CO_2 emissions from fuel consumption by 'Road Transport': (1) the IPCC approach (based on fuel deliveries); (2) the national approach, which is based on transport statistics in terms of vehicle-kilometres travelled.
The difference in fuel consumption inferred from transport statistics compared with that inferred from supply statistics on deliveries to fuelling stations is in the range of about 4–9%. This difference is not so much caused by petrol, which shows only differences up to +7%, with an average of around 2%, but rather by diesel and LPG figures, which differ annually by up to –23%, with an average of about –12% and –14%, respectively (see NIR 2006, Figure 3.8). These differences can be explained to some extent, but not completely; for example, by fuel bought on both sides of the Dutch borders but consumed on the other side (Van Amstel et al., 2000a). Another explanation is the bad representation of company cars – which drive the most kilometres per year (usually using diesel or LPG) – in the passenger car questionnaire, which results in an underestimation of kilometres travelled by passenger cars. The discrepancy between total road fuel consumption and fuel deliveries has tended to decrease during the last 5 years. It can be concluded that roughly both methods show similar trends in fuel consumption by fuel type over the last 10 years.

3.5.5 Source-specific re-calculations

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

3.5.6 Source-specific planned improvements

For calculating non-greenhousegas emissions in the sector 'Road Transport', this year an improved model (VERSIT+) is applied. This results in a re-calculation of NMVOC emissions; but also the CH_4 emissions will be recalculated. The (very minor) effects will be implemented in the CRF/NIR next year. The effects are very minor (in the order of 6 Gg CO2-equivalents). The base year will not be changed.

3.6 Other sectors [1A4]

3.6.1 Source category description

Source category 1A4 ‘Other Sectors’ comprises the following categories:

- 1A4a ‘Commercial and Institutional Services’;
- 1A4b ‘Residential’;
- 1A4c ‘Agriculture (mainly greenhouse horticulture), Forestry and Fisheries’.

1A4a ‘Commercial/Institutional Services’ 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’ 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’ 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). 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 90% 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.

Overview of shares and trends in emissions

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 2005, respectively. The share of CH_4 emissions from this source category in the national total greenhouse gas emissions is very small (0.4 Tg CO_2-eq., or about 0.2%); the share of N_2O emissions is almost negligible.1A4b ‘Residential’ is the main contributor, contributing approximately 10% to the total national CO_2-equivalent emissions.

About 50% 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). Over 70% of these CH_4 emissions stem from gas combustion, in particular from cooking losses; the remainder is from biofuel combustion.

CO_2 emissions of 1A4 ‘Other sectors’ decreased 0.2 Tg or 0.5% in the period 1990–2005. The main contributor this increase is 1A4a ‘Commercial/Institutional’ (Figure 3.13 and Table 3.1), for which emissions increased approximately 30% (from 7.5 Tg to 9.9 Tg CO_2). This increase is partially compensated by the 15% (1.3 Tg) decrease in emissions from 1A4c ‘Agricultural’ and the 7% (1.3 Tg) decrease in emissions from 1A4b ‘Residential’. The (overall) increased emissions from ‘Commercial/Institutional’ can be explained by the strong growth of this category during this period. 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 9.7 Tg CO_2). CO_2 emissions from 1A4b ‘Residential’ remained more or less at the same level during this period, largely due to the improved insulation of dwellings and increased efficiency of heating apparatuses (increased use of high-efficient boilers for central heating) (see section 3.6.1).

In 2005, CO_2 emissions from 1A4 ‘Other sectors’ decreased by 6% or 2.5 Tg compared to the 2004 level mainly due to decreased gas combustion (-2.3 Tg CO_2), which is related to the relative warm winter compared to 2004 and affects the gas consumption in all three subcategories. The 13% decrease in CO_2 from gas consumption in the ‘Commercial/institutional’ subcategory and the constant gas consumption in ‘Agriculture’ in 2005 must therefore be an artefact of being determined as the difference between national total net domestic gas consumption and the amounts estimated to be used by other sectors.

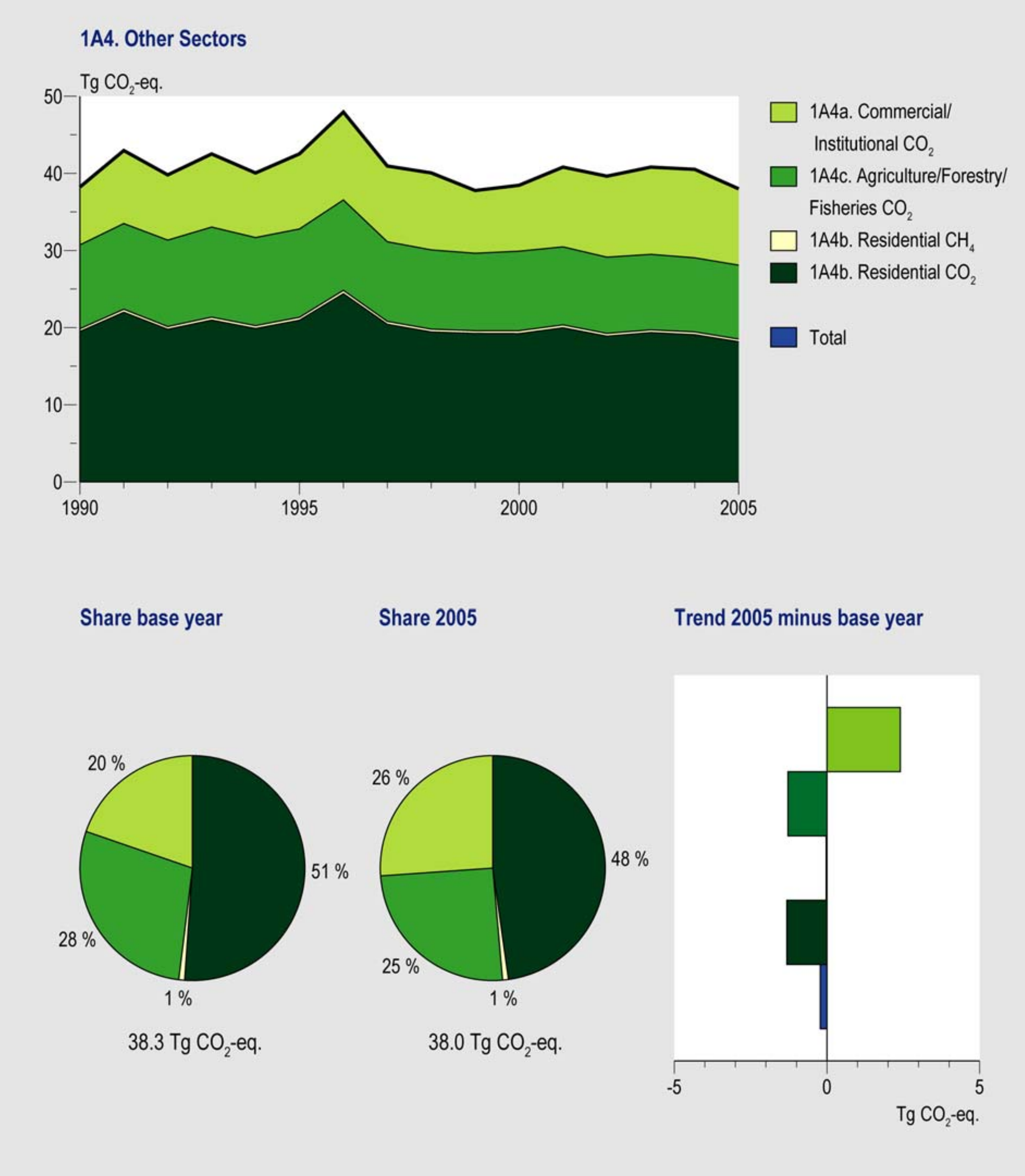


Figure 3.13 Category 1A4: trend, emission levels and share of source categories in emissions of 1A4 'Other sectors', 1990-2005.

Key sources

Within this source category, the combustion of gases and liquids form a key source for CO_2 emissions, this is particularly true for gases. Within the categories, gases in 1A4a and 1A4b, and gases and liquids in 1A4c are key sources.

Activity data and (implied) emission factors

Commercial and institutional services [1A4a]

In the 'Commercial/Institutional Services' sector, CO_2 emissions have increased 32% since 1990. However, when a temperature correction is taken into account, the structural, anthropogenic trend shows a somewhat lower increase of 23% in this period (see Peek, 2007, in preparation). The 'Commercial/Institutional Services' sector has grown strongly during this period: the amount of manpower (in man-years) increased 32% in the period 1990–2000, while energy consumption increased 28%. This increase is roughly compatible with the approximately 45% structural increase in the emissions. It should be noted that of the 7.5 Tg CO_2 emissions from the service sectors, about

0.4 Tg in 1990, increasing to about 0.8 Tg in 2005, are emissions from co-generation facilities, which may also provide electricity to the public grid.

However, 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 subcategory, which is for natural gas magnified in 2005 by the assumption of almost constant gas consumption in the agricultural subcategory.

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 the re-calculation paragraph in section 3.1). 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, e.g. landfill gas used as fuel (see section 3.9). According to the renewable energy statistics, the latter increased substantially in 2005.

Residential sector [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 4% (Figure 3.14). The variations are much larger for liquid and solid fuels because of the much smaller figures. The biomass consumption is almost all wood (fuelwood, other wood: also less than 1% waste). The cause of the irregularity in biomass fuel use in 1999 is unknown but may be due to a small error in the survey procedures (for details see the monitoring protocol 7141 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; however, when the temperature correction is accounted for, the structural anthropogenic trend including temperature correction shows a decrease of 13% in this period (see Peek 2007, in preparation).Although the number of households and residential dwellings increased about 15%since 1990, the average fuel consumption per household decreased by about 23%mainly due to the improved insulation of dwellings and the increased efficiency of heating apparatus (increased use of high-efficient boilers for central heating).

Agriculture and forestry [1A4c] (stationary combustion)
Total CO_2 emissions in the ‘Agriculture and Fisheries’ category have decreased by about 12% since 1990, mainly due to a 15% decrease in gas consumption for stationary combustion; however, when the temperature correction is taken into account, the structural, anthropogenic trends of the total category show a decrease of 17% in this period (see Peek, 2007, in preparation). This is mainly due to energy conservation measures in greenhouse horticulture, which accounts for approximately 85% of the primary energy use of the agricultural sector. Space heating and artificial lighting are the dominant uses of energy here. The sector has significantly improved its energy efficiency in the past decade (Van Harmelen and Koch, 2002). The total area of heated greenhouses increased about 8% in the 1990’s and now occupies over 95% of the total area of greenhouses. In particular, the cultivation of flowers and plants showed a large aerial increase of about 15%. Thus, is concluded that heated greenhouses have reduced their energy consumption, although their surface area has increased by about 8% and physical production only decreased by 5% over this period (LEI/CBS, 2002). It should be noted that about 0.6–0.8 Tg of the CO_2 emissions from the agricultural sector are emissions from

co-generation 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 plant fertilisation purposes. Total annual amounts, however, will be limited to a few tenths of Tg CO_2.

Agricultural machinery and fisheries [1A4c] (mobile combustion)
In Table 3.6 the CO_2 emissions from off-road machinery in agriculture and from fisheries are presented. Both sources emit a little over 1 Tg of CO_2.

Table 3.6 Trend in CO_2 emissions from 'Agricultural Machinery and Fisheries'.

Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Agricultural machinery	1.2	1.4	1.4	1.4	1.5	1.6	1.5	1.5	1.5	1.5	1.5	1.6	1.4	1.5	1.5	1.4
Fisheries	1.2	1.3	1.2	1.3	1.4	1.4	1.3	1.3	1.2	1.3	1.3	1.2	1.1	1.1	1.1	1.1
Total mobile in 1A4c	2.4	2.6	2.6	2.7	2.8	3.0	2.8	2.8	2.7	2.8	2.7	2.8	2.5	2.6	2.5	2.5

3.6.2 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 90% 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.greenhousegases.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 called '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. This is also suggested by *Figure 3.9*, where the uncorrected trend is smoother than the temperature-corrected trends. 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.

Emissions from 'Off-road Machinery and Fisheries' in this category (1A4c-ii) are calculated based on IPCC Tier 2 methodologies. The fuel use data from LEI 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 NEH. However, since the NEH does not separately account for fisheries, it is not possible to use fuel sales figures in the NEH. 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 subcategory 1A4c and subtracted from the amount of bunker fuel consumption in the NEH. The modified bunker figures are reported as a Memo item. Table 3.23 shows the emission factors from this source. For more details, see the monitoring protocol 7109 for in-land navigation.

3.6.3 Uncertainty and time-series consistency

Uncertainties
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 subcategories 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, 9% 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. 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 (the so-called BAK and BEK data sets of annual surveys 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 and Brandes (2007), but this has not yet been used in the uncertainty assessment in section 1.7 and Annex 1. 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.

Time-series consistency
For general information on time-series consistencies, see section 3.2.3. 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 ('HDD: running normal' in Table 3.7), as explained in Visser (2005). Table 3.7 presents the calculated temperature correction factors for space heating; for more details, see Peek, 2007, in preparation).

Table 3.7 Heating degree-days and temperature correction factors used for trend analysis

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Heating: degree-days (H)	2677	3163	2829	3076	2835	2917	3504	2929	2821	2676	2659	2880	2720	2913	2877	2765
HDD: :running normal (N)	3030	3017	3003	2989	2976	2962	2948	2934	2919	2905	3000	2876	2862	2848	2834	2834
T-correction factor (= N/H)	**1.13**	**0.95**	**1.06**	**0.97**	**1.05**	**1.02**	**0.84**	**1.00**	**1.03**	**1.09**	**1.13**	**1.00**	**1.05**	**0.98**	**0.98**	**1.02**

Figure 3.14 compares the actual emission trend data for CO_2 of the three subcategories with temperature-corrected data and the basic activity indicator trends of the 'Residential', 'Service' and 'Agricultural' sectors. This comparison clearly shows that in 1990 and 1996 much less and much more gas was consumed as a result of a relatively warm and cold winter, respectively, than under normal weather conditions. The corrected trends for the 'Residential' and 'Agricultural' sectors are quite smooth (all or most large inter-annual variations are removed), with the exception of that for the 'Commercial/Institutional' sector (see section 3.6.1). Figure 3.14 shows that the temperature correction method used is indeed a reasonable proxy for correcting for the weather influence since it removes the largest inter-annual variations; however, the resulting time series is still not a completely smooth line. This is of particular interest in the 'Residential' sector, since the quality of the data on annual gas consumption is assumed to be quite good.

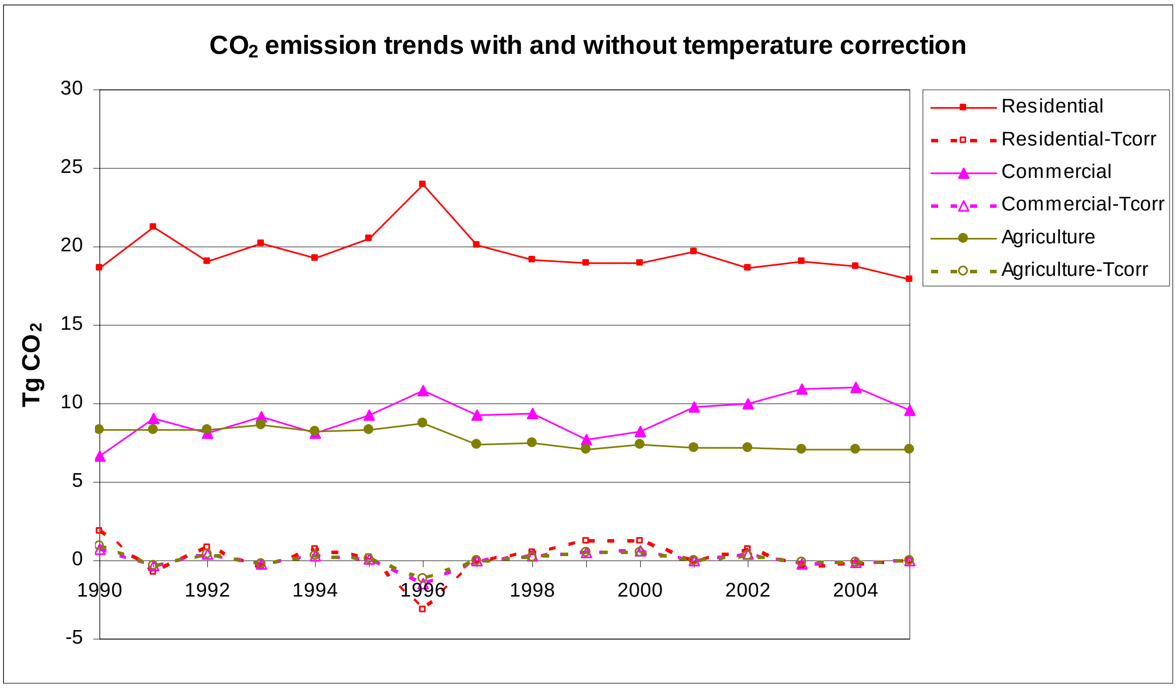


Figure 3.14 CO_2 emissions of 1A4 'Other Sectors': actual versus temperature-corrected trends, based on a 'normal' determined by the long-term trend.

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.

3.6.4 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 (for example 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 7101: CO_2, CH_4 and N_2O from 'Stationary Combustion: Fossil Fuels'.

3.6.5 Source-specific re-calculations

There have been no source-specific re-calculations.

3.6.6 Source-specific planned improvements

An improvement considered is a revision of aggregated emission factors for the years 1991–1994 to bring them in line with the fuel mixes in 1990 and 1995.

3.7 Others [1A5]

3.7.1 Source category description

Category 1A5 'Others' includes the emissions from military ships and aircraft (in 1A5b). This category is not a key source.

Overview of shares and trends in emissions

The CO_2 emissions from this source category are approximately 0.5 Tg, with some inter-annual variation caused by different levels of operations, including fuel use for multilateral operations, which are included here (Table 3.8). The emissions of CH_4 and N_2O are negligible.

Table 3.8 Trend in CO_2 emissions from military ships and aviation.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Military ships	0.25	0.23	0.24	0.23	0.21	0.23	0.20	0.21	0.22	0.23	0.21	0.18	0.22	0.17	0.17	0.15
Military aviation	0.32	0.31	0.32	0.31	0.28	0.28	0.30	0.27	0.30	0.42	0.37	0.29	0.28	0.27	0.27	0.22
Total	**0.57**	**0.54**	**0.55**	**0.54**	**0.49**	**0.51**	**0.51**	**0.49**	**0.52**	**0.65**	**0.58**	**0.47**	**0.50**	**0.44**	**0.44**	**0.38**

Activity data and (implied) emission factors

The emission factors used are presented in Table 3.9.

Table 3.9 Emission factors[1)] used for military marine and aviation activities.

Category		**CO_2**	**CH_4**	**N_2O**
Military ships	Emission factor	75.25 kg/GJ	2.34 g/GJ	1.87 g/GJ
Military aviation	Emission factor	72.9 kg/GJ	5.8 g/GJ	10 g/GJ
Total	Emissions in 2003 (Gg)	0.44	0.03	0.04

[1)] Source: Hulskotte (2004b).

3.7.2 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 (see Table 3.9). The methodology and data sources for the calculation of these emissions can be found on the website www.greenhousegases.nl and in section 3.1.

3.7.3 Uncertainty and time-series consistency

Uncertainties

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.

Time-series consistency

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.

3.7.4 Source-specific QA/QC and verification

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

3.7.5 Source-specific re-calculations

There have been no source-specific re-calculations.

3.7.6 Source-specific planned improvements

There are no source-specific planned improvements.

3.8 International bunker fuels

3.8.1 Source category description

Category 1C1 'International Bunker Fuels' include fuels used for international civil aviation or by seagoing ships engaged in international transport. In accordance with the Revised 1996 IPCC Guidelines, emissions from fuel sold to ships or aircraft engaged in international transport are not included in national emission totals but are instead reported separately.

Overview of shares and trends in emissions

Emissions in category 1C1 'international bunkers' are not included in the total dutch greenhouse gas emissions. Total greenhouse gas emissions in this category increased by 67%, from 39 Tg CO_2-eq. in 1990 to 65 Tg CO_2-eq. in 2005. CO_2 emissions from 1C1b 'Marine bunkers' showing a 58% increase during this period (up to about 54 Tg in 2005). CO_2 emissions from 1C1a 'Aviation bunkers' increased by 138% in the same period to reach 10.8 Gg in 2005.

Between 2004 and 2005, CO_2 emissions from marine bunkers increased by 16% (+7.3 Tg). CO_2 emissions from aviation bunkers increased 3% or 0.3 Tg.

Activity data and (implied) emission factors

The energy consumption of 1C1b Marine bunkers and 1C1a Aviation bunkers has grown substantially in the period 1990–2005 (see Table 3.10). Between 2004 and 2005, marine bunker fuel consumption increased by about 16%.

Table 3.10 Energy consumption[1)] (Units:PJ) in the period 1990–2005.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Marine bunkers[2)]	**445**	**460**	**464**	**480**	**455**	**461**	**471**	**499**	**505**	**522**	**555**	**611**	**604**	**564**	**608**	**702**
Heavy fuel oil	368	378	382	410	384	375	391	427	427	446	473	522	521	491	541	628
Gas/diesel oil	73	78	78	66	66	82	75	68	73	71	76	82	77	68	63	69
Lubricants	4	4	4	4	5	4	5	5	5	5	6	7	5	5	4	5
Aviation bunkers[3)]	**64**	**68**	**79**	**87**	**91**	**106**	**113**	**122**	**134**	**138**	**136**	**133**	**140**	**137**	**147**	**152**
- jet fuel (kerosene)	64	68	79	87	91	106	113	122	134	138	136	133	140	137	147	152
Total bunkers	**509**	**528**	**543**	**567**	**546**	**567**	**584**	**622**	**639**	**660**	**692**	**745**	**743**	**702**	**755**	**854**

[1)] Source: CBS (NEH/Energy Monitor, Table 1.1; revised data), with a few corrections for differences in the definitions.
[2)]Lubricants used as bunker fuel are 100% oxidised (instead of 50% in the National Approach). [3)]Aviation petrol is included under jet fuel.

3.8.2 Methodological issues

Emissions from international bunkers are calculated based on energy statistics provided by Statistics Netherlands (CBS) and default IPCC emission factors for CH_4 and N_2O and for CO_2 from residual fuel oil (heavy fuel oil), lubricants and jet kerosene. The emission factor for CO_2 from gas/diesel oil is based on the measured carbon contents of 50 samples of diesel fuel (Olivier, 2004).

Although the results of a recent study on CH_4 and N_2O emission factors show that the IPCC defaults (IPCC, 1997) may be outdated (Denier van der Gon et al., 2002), these factors have still been used for the calculation of N_2O and CH_4 emission estimates since no better data are currently available.

The following adjustments to the international marine and aviation bunker data included in the national energy statistics were made for the calculation of greenhouse gas emissions:

- Bunker data for international fisheries are estimated and reported separately (under 1A4c) and thus subtracted from the bunker totals.
- Bunker data from military aviation and shipping, including those for multilateral operations which are not estimated separately, are estimated and reported separately (under 1A5, see section 3.4.7) and thus subtracted from the bunker totals.
- Bunker data from domestic navigation total fuel consumption are estimated and reported separately (under 1A3d, see section 3.4.7) as these are included in the national energy statistics as a part of domestic shipping (i.e. this also includes some international shipping) and as a part of Marine bunkers. Therefore, both an addition to and a subtraction from the Marine bunker totals was carried out to correct for the total consumption for domestic shipping reported here as part of the national totals (under 1A3d).
- For bunker data for domestic aviation, the minor total fuel consumption (the Netherlands is a very small country) is not based on national energy statistics but estimated and reported separately (under 1A3d, see section 3.4.7), since it appears that the national energy statistics for domestic aviation are compounded with military fuel use. Thus, the original domestic aviation fuel consumption is added to the original Aviation bunker fuel consumption, and the new amount estimated as consumption for domestic aviation is subtracted from it.

The method for calculating emissions from national fisheries and military activities (reported under 1A4c and 1A5) and the distinction between fuel use by domestic navigation and international navigation are documented in Hulskotte (2004a,b).

3.8.3 Uncertainty and time-series consistency

Uncertainty

The uncertainty of CO_2 emissions from international bunkers is estimated to be about 2% in annual emissions (Boonekamp et al., 2001).

Time-series consistency

The methodology used to estimate emissions from international bunkers is consistent throughout the time series.

3.8.4 Source-specific QA/QC and verification

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

3.8.5 Source-specific re-calculations

There have been no significant source-specific re-calculations. A small error correction was made for lubricant consumption in 1991–1994.

3.8.6 Source-specific planned improvements

There are no source-specific planned improvements.

3.9 CO_2 emissions from biomass

In accordance with the Revised 1996 IPCC Guidelines, CO_2 emissions from biomass are not included in national emission totals but are reported separately as a Memo item ‘CO_2 emissions from biomass’.

3.9.1 Source category description

In the Netherlands biomass fuels are used in various categories:

- 1A1a ‘Electric Power and Heat Generation’ – organic part of municipal waste combusted in waste incinerators that are recovering heat and electricity for energy purposes, wood and other biogenic material co-combusted in coal-fired power plants, biogas (methane) recovered by landfills operators and mostly combusted in CHP facilities owned by utilities;
- 1A2 ‘Manufacturing Industries’ – mainly in the pulp and paper industry (e.g. paper sludge) and the wood construction industry (e.g. wood waste); biomass combustion in the cement industry is not reported;
- 1A4a ‘Commercial/Institutional’ – biogas (methane) recovered from waste water treatment plants and used for energy purposes, and some individual companies classified in 1A4a that report biomass combustion in their annual environmental reports;
- 1A4b ‘Residential’ sector –fuel-wood only;
- 1A4c ‘Agriculture/Forestry/Fisheries’ – biogas from composting of manure, and composting of kitchen and garden waste.

Table 3.11 Biomass fuel consumption specified per source category and fuel type (Units: in PJ).

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total 1A1	15.2	15.9	16.7	19.2	19.1	21.6	25.9	28.7	30.4	33.1	36.0	39.1	44.4	41.3	44.9	60.4
Total 1A2	2.6	2.4	2.5	2.6	2.8	3.2	3.3	3.4	3.3	3.2	3.2	3.1	3.3	3.7	4.5	4.7
Total 1A4	13.9	13.9	14.0	14.0	13.7	13.4	13.5	13.5	13.3	12.9	13.9	14.2	14.1	13.4	13.3	13.7
National total	31.8	32.3	33.3	35.9	35.7	38.2	42.8	45.6	47.0	49.2	53.1	56.4	61.8	58.4	62.8	78.8

Activity data and implied emission factors

Table 3.11 and Table 3.12 presents an overview of all bio-fuel combustion data included in the greenhouse gas inventory. There has been a strong increase in total bio-fuel use since 1990 – from about 30 PJ to about 80 PJ. This increase is the result of increased waste incineration with energy recovery since the early 1990s and the strong increase in the co-combustion of biomass in coal-fired power plants since 2000; both of these developments were stimulated by environmental policy on waste and climate, respectively. On the other hand, fuel-wood use in the ‘Residential’ sector has somewhat decreased since 1990. In addition, the use of biogas produced from landfills and WWTPs has increased significantly and now has about a 6% share in total bio-fuel combustion (reported in category 1A2). Through these developments, the share of residential bio-fuels decreased from 33% in

1990 to 12% in 2005. Please note that no sludge combustion outside 1A1a has been reported and that no greenhouse gas emissions from charcoal combustion in barbeques are reported in source category 1A4.

Table 3.12 Organic CO_2 emissions (Units: Gg) reported as CO_2 from biomass combustion (included in 1A).

Cat.	Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1A	Fuel combustion, o.w.:	3.9	3.8	3.9	4.1	4.0	4.3	4.9	5.3	5.5	5.7	6.2	6.5	7.1	6.8	7.4	8.7
1A1	Energy industries	2.1	2.1	2.2	2.4	2.3	2.6	3.1	3.6	3.8	4.1	4.4	4.7	5.3	5.0	5.5	6.8
1A2	Manufacturing industries	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.4	0.5	0.5
1A3	Transport	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A4	Other sectors, o.w.:	1.5	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.4	1.5	1.5	1.4	1.4	1.4
1A4a	- Commercial/Institutional	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.3	0.3	0.4
1A4b	- Residential	1.3	1.2	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.0	1.1	1.1	1.1	1.0	1.0	1.0
1A4c	- Agriculture/Forestry/Fisheries	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total memo CO_2 from biomass		3.9	3.8	3.9	4.1	4.0	4.3	4.9	5.3	5.5	5.7	6.2	6.5	7.1	6.8	7.4	8.7

[1)]NO, Not occurring; o.w. = of which

3.9.2 Methodological issues

All activity data is from a special annual project with the aim of monitoring the use of renewable energy sources in the Netherlands (CBS, 2005; Segers, 2005), which contains a consistent time series back to 1990. For residential bio-fuel use, the present PER monitoring data include fuelwood and organic waste combustion in residential multi-burners even though this is not included in the data collection method of the DE project.

Charcoal consumption is included in CBS (2005), while the PER emissions from charcoal (for non-greenhouse gases) are derived from proxy data (a fraction of meat consumption is assumed to be prepared on barbeques fired with charcoal). As these two very small sources have a high degree of uncertainty, these sources are not (yet) included in the PER data set for greenhouse gas emissions. However, according to FAO statistics annual apparent consumption varies between about 15 and 40 kton per year (see http://faostat.fao.org/) and related CH_4 and N_2O emissions are therefore almost negligible (e.g. considerably less than 1 Gg per year).

3.9.3 Uncertainty and time-series consistency

Uncertainty

The uncertainty in the activity data is much higher for bio-fuels than for fossil fuels since the monitoring of biomass use is much less detailed and less extensive. Based on expert judgements, the uncertainty in fuel-wood and bio-gas consumption is estimated to be approximately 25% and 10%, respectively (Olivier and Brandes, 2007).

For the organic fraction of waste incineration in 1A1a as well as for wood and other organic material co-combusted in coal-fired power plants, the uncertainty is also estimated at 10% for all years (perhaps higher for recent years). For the manufacturing industries and individual companies reported under 1A4a, current fuel data from the individual companies and other sources are used in the compilation of the Netherlands greenhouse gas inventory and the associated CRF files, the total uncertainty of which is much higher due to incomplete monitoring – for example, +50 to -100%. The uncertainty in the emission factors is rather high (for example 10% for CO_2) due to the uncertainty in the carbon and energy content of the biomass; this is caused by the inclusion of variable fractions of water in the weight and variable composition of the biomass. The uncertainty in CH_4 and N_2O emission factors is estimated to be much higher (for example about 50% and 100%, respectively).

Time-series consistency

The methodology used to estimate emissions from biomass is consistent throughout the time series.

3.9.4 Source-specific QA/QC and verification

More details on the validation of the biomass fuel data can be found in the monitoring protocol 7141 on the Memo item: 'CO_2 from Biomass'.

3.9.5 Source-specific re-calculations

There have been no source-specific re-calculations.

3.9.6 Source-specific planned improvements

There are no source-specific planned improvements.

3.10 Comparison of the sectoral approach with the reference approach for CO_2

The IPCC Reference Approach (RA) for CO_2 from energy use utilizes apparent consumption data specified per fuel type in order 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). More details on the calculation and the re-calculation differences can be found in Annex 4.
There are three main causal factors for differences in the two approaches, some are country-specific and others are inherent to the comparison method itself (see Annex 4):

- the non-inclusion of CO_2 from incineration of waste that contains fossil carbon in the Reference Approach (RA);
- the fossil fuel-related emissions reported as process emissions (sector 2) and fugitive emissions (sector 1B), which are not included in the Sectoral Approach (SA) total of sector 1A, the most significant of which being gas used as feedstock in ammonia production (2B1) and losses from coke/coal inputs in blast furnaces (2C1);
- the country-specific storage factors used in the RA are multi-annual averages; therefore, 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.

In addition, the liquids and other fuel components in the RA are different from those in the SA in that the LPG in 'Transport' is in the National Approach (NA) reported under 'Other Fuel' versus in 'Liquid Fuel' in the RA.

In Table 3.13 the results of the IPCC Reference Approach calculation are presented for 1990–2005 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 0.6% for 2004 and -4.5% for 1991 and 1992 and is (2.7±0.6) % on average. The largest differences are seen for the 1990s. The 1990-2005 trends are 10.6% in the RA and 11.5% in the NA, respectively.

However, if corrected for the fossil waste included in the NA and selected sector 1B and sector 2 emissions that should be added to the 1A total before the comparison is made, then the remaining differences in totals are much smaller and generally below 1% (see Table 3.14): between -1.3% in 2004 and ±0.9% in 2005. Also, the largest differences do not concentrate in a particular time span of the period in question. The corrected 1990–2005 trends still differ only about 1.5%: 10.0% for the NA (= sum of sectoral emissions in source category 1A plus selected 1B and 2) and 11.5% for the RA (including fossil waste). The corrected comparison with the RA based on national energy balance data (including fossil waste from 1A for 'other fuels') shows differences in emissions from liquid fuels of up to -3% for a single year (except for 2004, when it was -4%) compared to -3% for several of the years when uncorrected comparisons were made; for solid fuels differences of up to 3% compared to 11% and for gaseous fuels -1% compared to +5% are calculated if corrections are made for 2G ('Non-energy Uses') in NA-liquids, 1B1 ('Coke Production'), 2A ('Soda Ash'), 2B5, 2C1 ('Blast Furnaces) and 2D in NA-solids, and 1B2 ('Gas Flaring') and 2B1 (Ammonia') in NA-gases.

Table 3.13. Comparison of CO_2 emissions: Reference Approach (RA) versus National Approach (in percentage).

Fuel type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Liquid fuels*	-0.2%	1.5%	2.1%	-0.6%	0.2%	-1.7%	-0.7%	-1.1%	-2.8%	-2.5%	-1.0%	-1.7%	-2.6%	-3.1%	-3.6%	2.6%
Solid fuels	9.8%	11.0%	9.3%	8.1%	8.8%	7.2%	8.0%	8.7%	6.6%	7.0%	6.1%	4.5%	5.8%	7.1%	5.9%	6.9%
Gaseous fuels	4.8%	4.9%	5.1%	4.8%	5.3%	5.2%	4.6%	5.2%	5.3%	5.2%	5.5%	4.6%	4.4%	4.3%	4.0%	4.3%
Other	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
Total (RA-NA)/NA	**3.8%**	**4.5%**	**4.5%**	**3.2%**	**3.9%**	**2.8%**	**2.9%**	**3.0%**	**2.0%**	**1.9%**	**2.4%**	**1.6%**	**1.3%**	**1.3%**	**0.6%**	**2.9%**

* Excluding international bunkers.

Table 3.14 Comparison of CO_2 emissions: differences between corrected Reference Approach (RA) versus corrected National Approach [(RA-NA*)/NA*)] (in percentage).*

Fuel type *	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Liquids	-0.5%	1.0%	1.5%	-1.0%	-0.2%	-2.0%	-1.1%	-1.4%	-3.2%	-2.8%	-1.3%	-2.0%	-3.0%	-3.4%	-3.9%	2.2%
Solids	0.8%	2.2%	2.6%	1.8%	1.5%	0.5%	0.7%	0.7%	0.2%	0.3%	0.5%	-0.4%	0.6%	1.4%	0.9%	2.1%
Gaseous	-0.8%	-0.1%	-0.2%	-0.2%	-0.1%	-0.1%	0.2%	0.0%	0.2%	0.1%	0.3%	0.4%	0.3%	0.2%	-0.2%	-0.2%
Total corrected	**-0.5%**	**0.5%**	**0.8%**	**-0.1%**	**0.1%**	**-0.7%**	**-0.2%**	**-0.4%**	**-1.0%**	**-0.9%**	**-0.3%**	**-0.6%**	**-0.8%**	**-0.8%**	**-1.3%**	**0.9%**

Note: Shown in red and blue are the largest annual differences, respectively.
* Liquids incl. 2G; Solids incl. 1B1,2A,2B5,2C1,2D; Gaseous incl. 1B2, 2B1; Total incl. fossil waste.

3.11 Feedstocks and other non-energy use of fossil fuels

3.11.1 Source category description

In energy statistics the non-energy use of fossil fuels generally refers to the total consumption of fuels as chemical feedstock, the consumption of the non-energy refinery products, such as naphtha, bitumen and lubricants, and the use of other refinery products for non-combustion purposes. Chemical feedstock use refers to hydrocarbons that are used for the production of synthetic organic materials, such as plastics and solvents, and as a raw material for non-carbon-containing products, such as ammonia and hydrogen. A part of the carbon in feedstocks is embodied in petrochemical products (storage of carbon), and a part can be attributed to by-product CO_2 emissions (e.g. ammonia production from natural gas) or leakages and another part is used as a fuel for energy purposes (e.g. chemical residual gas used partially within and partially outside the chemical sector and refinery gas). Subsequently, CO_2 emissions may occur during domestic use of these petrochemical products, often in the form of NMVOC emissions. In the context of greenhouse gas inventories, the fossil carbon inputs in blast furnaces are also considered to be a feedstock, but this is not reflected in the IPCC Reference Approach for CO_2. Finally, in the waste phase, fossil CO_2 emissions will occur if the waste products are incinerated; because this is part of the life cycle of fossil carbon, this aspect is also discussed here, but it is formally not considered to be a feedstock/non-energy use. At the present time the following emissions are accounted for as feedstocks and other non-energy use:

- CO_2 emissions from the use of feedstock and other non-energy uses of fuels: feedstocks from natural gas and oil products in the chemical industry (IPCC categories 2B1 and 2B5) and coke and coal inputs in blast furnaces in the iron and steel industry (part of 2C1);
- CO_2 emissions from other non-energy uses of fuels for their physical properties in other industrial sectors: coke for soda ash production (part of 2A4), coke (2D2), lubricants and waxes (2G4);
- Indirect CO_2 emissions from solvents and other product use (3);
- CO_2 emissions from 'Waste Incineration' (6C, in the Netherlands reported under 1A1a);
- CO_2 emissions from the combustion of by-products produced in the Industry sector (e.g. blast furnace gas, residual chemical gas and refinery gas), reported as combustion emissions in the Energy sector under 1A1a 'Electricity and Heat Production' and 1A1c 'Manufacturing Industry and Construction'.

Key sources

The major CO_2 sources reported under 'Industrial Processes' are identified as key sources: 'Ammonia Production' (2B1), 'Other Chemical Product Manufacture' (2B5) and 'Carbon Inputs in Blast Furnaces' (2C1). However, it should be noted that the Netherlands accounts for most of the use of chemical residual gas and of blast furnace gas separately as combustion in the source categories 1A1a, 1A2a and 1A2c. As the former may be included in feedstock emissions by other countries, with significant levels of CO_2 emissions, they would then become key sources when assessed separately.

Overview of shares and trends in emissions

The share of total feedstock-related emissions, including the combustion of residual chemical gas and waste combustion, in national total CO_2 emissions (excluding LULUCF) is about 12%. The largest part of these emissions, 64% in 1990 and about 80% in 2005, is reported under 'Fuel Combustion' (1A). About 50% of these emissions are from blast furnace gas, which is largely used for power generation, and the other 50% stems from residual chemical gas, which is predominantly used in the chemical industry. The share of combustion of the by-product gases and waste incineration reported under sector 1A has increased from 8% to 10% since 1990, while the share of industrial process emissions in sector 2 has remained about 3%. The share of emissions from 'Waste Incineration' (sector 6, but allocated under 1A1a) was 3% in 1990 and about 10% in 2005. The share of emissions from industrial processes (sector 2) decreased from 33% in 1990 to about 20% in 2005 (Table 3.15). Most of the feedstock emissions reported in sector 2 are found in the iron and steel industry in blast furnaces (2C1) and ammonia production in the chemical industry (2B1). Indirect CO_2 emissions from product use (domestic solvent evaporation in sector 3) account for a small share of about 1%.

Activity data and implied emission factors

The reduction of industrial process emissions is largely due to the increasing fraction of blast furnace gas captured and used as fuel; this is particularly true for the 1990s (see section 4.4.1). This also explains one half of the increase in the combustion emissions in the 1A sector. The environmental policy that encourages waste being incinerated rather than being used as landfill resulted in a 1 Tg increase in fossil waste emissions. As a result of the policy of reducing NMVOC emissions, the evaporative emissions from paints and other solvents has been substantially reduced. Since the indirect CO_2 emissions, however, are quite small, the associated reduction in CO_2 emissions is also very minor.

Table 3.15 CO_2 emissions from non-energy and feedstock uses of fossil fuels (production and product use) in sectors 1, 2 and 3 (Units: Tg).

IPCC no. /category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1A1a Public power & heat																
BF/OF gas	3.8	3.9	4.0	4.6	4.8	4.8	4.7	5.1	5.4	5.4	4.9	5.3	5.3	5.5	5.9	6.1
Chemical residual gas	0.0	0.0	0.0	0.0	0.3	1.5	1.4	1.7	1.7	1.8	1.8	1.9	2.1	2.2	2.1	2.1
Waste (fossil part)	0.6	0.6	0.6	0.7	0.7	0.8	1.1	1.3	1.4	1.5	1.5	1.5	1.6	1.7	2.1	2.1
1A2a Iron and steel																
BF/OF gas	2.4	2.1	2.7	3.1	2.8	3.1	3.0	2.8	2.7	2.5	2.5	2.7	2.8	3.0	3.4	3.1
1A2c Chemicals																
Chemical residual gas	5.4	5.0	5.0	5.0	4.9	3.8	4.0	3.8	3.8	4.1	3.8	4.2	5.1	5.8	5.7	5.6
TOTAL ENERGY1[1)]	**12.2**	**11.6**	**12.3**	**13.5**	**13.5**	**14.0**	**14.3**	**14.8**	**14.9**	**15.2**	**14.5**	**15.7**	**16.9**	**18.3**	**19.2**	**19.0**
2A Mineral products																
Soda Ash Production	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2B Chemical industry																
2B1 Ammonia production	3.1	3.5	3.5	3.4	3.6	3.6	3.4	3.6	3.6	3.6	3.6	3.0	2.9	2.9	3.1	3.1
2B5 Production of other chemicals	0.4	0.0	0.0	0.0	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.4
2B5 Carbon electrodes	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2B5 Production of activated carbon[2)]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2C Metal production																
2C1 Coke inputs blast furnace	2.2	1.9	1.3	1.2	1.5	1.5	1.5	1.8	1.4	1.3	1.0	1.0	1.1	1.2	0.9	0.8
2D Other production																
Food and drink	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
2G Other																
2G4 Other economic sectors	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
TOTAL INDIVIDUAL PROCESSES[1)]	**6.1**	**5.8**	**5.4**	**5.1**	**5.6**	**5.7**	**5.4**	**5.9**	**5.6**	**5.5**	**5.3**	**4.6**	**4.6**	**4.7**	**4.7**	**4.7**
Solvents/product use[3)]																
TOTAL PRODUCT USE[3)]	**0.2**	**0.1**	**0.1**	**0.1**	**0.1**	**0.2**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
Total Feedstock/NEU CO_2	**18.6**	**17.6**	**17.8**	**18.7**	**19.3**	**19.8**	**19.8**	**20.8**	**20.6**	**20.8**	**19.9**	**20.4**	**21.5**	**23.2**	**24.0**	**23.8**

[1)]0.0 means a non-zero emission, less than 0.05.
[2)]Peat consumption is not included in the Netherlands Energy Statistics (NEH) but is taken from other sources.

Table 3.16 shows that the increase of oil feedstocks of about 80% since 1990 originates from a variety of inputs: naphtha use decreased by one quarter, whereas the feedstock use of natural gas liquids (NGL) increased by about two third. On average, it has been calculated for the CO_2 RA that about 22% of the carbon in the oil feedstocks and about 61% of the natural gas is emitted as CO_2 (e.g. about 2-3 Tg each from naphtha, NGL and natural gas) (see Table 3.17). Additional information on feedstock/non-energy uses of fuels is provided in Annex 4.

Table 3.16 Chemical industry: feedstock uses of fuels (Units: PJ).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Oil products[1)]	303	327	336	303	319	321	299	318	317	350	387	411	427	472	496	547
o.w. naphtha	136	*141*	*145*	*150*	*154*	159	176	171	117	111	74	77	94	181	159	104
o.w. natural gas liquids	143	*151*	*159*	*167*	*174*	182	168	169	164	181	201	210	253	217	227	237
o.w. LPG	63	*62*	*60*	*58*	*56*	55	20	38	39	28	39	35	3	4	20	36
o.w. gas/diesel oil	34	*29*	*24*	*20*	*15*	10	12	18	15	19	6	4	6	4	3	0
Natural gas	101	109	107	102	109	110	105	113	107	107	113	100	97	97	97	101

Note: Values represent net consumption (i.e. after subtraction of the amounts produced; this application may sometimes result in negative values).
[1)]Excluding lubricants, bitumen, coals, coal-derived fuels, which are mainly or fully used elsewhere.
[2)]Figures in italics are interpolated data.

3.11.2 Methodological issues

Clearly, not all CO_2 emissions from the use of feedstock and other non-energy uses of fuels are allocated under sector 2. This is mainly because the Netherlands allocates a large part of the residual chemical gas produced in the industry sector into the energy sector. In addition, significant parts of residual chemical gas and blast furnace gas are combusted in a sector (i.e. public power generation) other than the one in which they were produced, making it logical to allocate these combustion emissions to sector 1 Energy rather than to sector 2 Industrial Processes. This allocation applies to the residual chemical gases from the production of silicon carbide, carbon black, ethylene and methanol. In addition, the Netherlands reports waste combustion emissions under fuel combustion by the Energy sector (1A1a) since most of these facilities also produce commercial energy (heat and/or electricity).

Country-specific methodologies are used for the emissions from feedstock use and feedstock-product use with country-specific or default IPCC emission factors (see Annex 2). Only indirect CO_2 emissions from domestic uses of petrochemical products are reported here. A full description of the methodology is provided in the monitoring protocols 7101 and 7102, which describe CO_2 , CH_4 and N_2O emissions, respectively, from the stationary combustion of fossil fuels and process emissions from fossil fuel use. In the Sectoral Approach, the Netherlands uses the following data sources to estimate these emissions:

- Sectoral energy consumption statistics, including chemical residual gas produced from feedstock uses of fuels;
- Plant-specific fuel consumption data to identify a particular industrial process – for example, soda ash production;
- Production data for estimating the net oxidation fractions – for example, urea production;
- NMVOC emissions from solvents and other products;
- Emissions from waste: the amount (and composition in order to calculate the fraction and amount of fossil carbon) of waste incinerated.

3.11.3 Uncertainty and time-series consistency

Uncertainty

The uncertainty in the feedstock/non-energy use emissions of CO_2 in sector 2 is estimated to be about 5% and 2% for the production of soda ash (2A) and ammonia (2B1), respectively. For most other sector 2 sources the uncertainty estimate is about 10%. Emissions from residual chemical gas combustion reported in sector 1A are also less accurate – for example, about 10% – due to the variability of its carbon content; CO_2 emissions from waste incineration may have a similar uncertainty due to the limited accuracy of both the total activity data and the underlying composition and fossil carbon fraction of the various waste types. More details and assumptions on uncertainties in energy data and emission factors will be documented in Olivier and Brandes (2007).

Time-series consistency

The methodology used to estimate feedstock/non-energy use emissions is consistent throughout the time series.

3.11.4 Source-specific QA/QC and verification

The main question is whether the accounting of residual chemical gas, blast furnace gas and refinery gas production in energy statistics is complete. For blast furnace gas this question is not relevant, since the not-captured gas is by definition included in the net carbon loss calculation used for the process emissions in 2C1. The unaccounted use of refinery gas by refineries is included in a similar way (in unaccounted for liquids in 1A1b). For residual chemical gas, however, the question if the accounting is complete may be an issue to be elaborated further. The area of concern is that of oxidation losses in the production of ethylene, methanol and carbon black; it does not apply to ammonia production, for which a carbon storage factor is applied to calculate CO_2 emissions from the non-energy use of natural gas for this process, since there is no reporting of residual gases here.

3.11.5 Comparison with the CO_2 Reference Approach

All 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 oxidized during the use of these fuels during product manufacture or other uses is subtracted from the total carbon contained in total apparent fuel consumption by fuel type. The fractions stored/oxidized have been calculated as three average values, one each for gas, liquid and solid fossil fuels (see Annex 4 for more details). In Table 3.19 the total CO_2 calculated as being emitted from the oxidation of these non-energy uses are presented per fuel type.

According to the Reference Approach data set, the CO_2 emissions of this group of sources increased by about 30% (or 2.8 Tg CO_2), mostly due to changes in emissions from liquid fuels (Table 3.17). This should be compared to sector 2 emissions and selected by-product emissions in sector 1A, but with the exclusion of waste incineration and blast furnace gas in 1A1a and product use in sector 3. For the comparison, the most relevant sources from Table 3.17 are summarized in Table 3.18; no attempt has been made to be completely accurate and complete. However, similar trends are seen for the three fuel types. This is particularly true for natural gas, which is essentially the sum of emissions from ammonia production and other chemicals: totals and trends are almost equal. Other differences are due to the use of one average oxidation factor for all years, whereas in the derivation of the annual oxidation figures differences up to a few percentage points can be observed.

Table 3.17 Trends in CO_2 emitted by feedstock use of energy carriers (production and direct uses) according to the correction term in the IPCC Reference Approach for CO_2 from fossil fuel use (Units: Tg).

Fuel type	Oxidation Factors[3)]	1990	…	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004[)]	2005	Trend
Liquids[1)]	22.3%	5.0		5.2	4.9	5.1	5.0	5.6	6.1	6.6	6.8	7.8	7.9	7.9	2.9
Solids[2)]	42.5%	0.4		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0
Gaseous	61.2%	3.5		3.8	3.7	3.9	3.7	3.7	3.9	3.5	3.4	3.2	3.4	3.4	-0.1
Total		**8.9**		**9.4**	**9.0**	**9.5**	**9.2**	**9.8**	**10.4**	**10.5**	**10.6**	**11.4**	**11.7**	**11.7**	**2.8**

1) Excluding refinery gas.
2 Coal oils and tars (from coking coal), coke and other bituminous coal, and coal derived gases (e.g. coke oven gas).
3) Using country-specific carbon fuel type-averaged Oxidation Factors, calculated from all processes for which emissions are calculated in the sectoral approach, assuming an oxidised fraction – for example, ammonia – or by accounting for by-product gases.

Table 3.18 Trends in CO_2 emitted by feedstock use of energy carriers by fuel type (Units: Tg).

Fuel type	Sources	1990	…	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Trend
Liquids	Chemical residual gas in 1A + 2G4 lubr./wax	5.6		5.5	5.6	5.7	5.6	6.1	5.8	6.3	7.4	8.2	8.0	7.9	2.3
Solids[1)]	2A4 soda ash + 2D2 food	0.2		0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.0
Gaseous	2B1 ammonia + 2B5 other chemicals[2)]	3.5		3.7	3.5	3.8	3.8	3.8	3.8	3.2	3.1	3.1	3.4	3.5	0.0
Total		**9.3**		**9.4**	**9.3**	**9.7**	**9.6**	**10.0**	**9.8**	**9.7**	**10.7**	**11.5**	**11.5**	**11.6**	2.3

1) Excluding coke used a reducing agent in blast furnaces. Also excluding coal and coke-derived gases such as coke oven gas, blast furnace gas and oxygen furnace gas. Included is 2B5 electrode production (refers to a mixture of liquid [pet coke] and solids [coke] used as input).
2) Including some emissions from coke use (or combustion of phosphorus oven gas).

3.12 Fugitive emissions from fuels [1B]

3.12.1 Source category description

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, oil refining, transport, distribution).

The following sections discuss the inventory of fugitive emissions from fuels.

Overview of shares and trends in emissions

The contribution of emissions from category 1B to the total national greenhouse gas emissions inventory was 1.3% in 1990 and 0.6% in 2005. CO_2 and CH_4 emissions in this category contribute 47% and 53%, respectively, to source category 1B.

Between 1990 and 2005 total greenhouse gas emissions in this category decreased from 2.8 Tg to 1.9 Tg.

Activity data and implied emission factors

The decrease in CO_2 and CH_4 emissions from oil and gas production resulted from the implementation of environmental measures aimed at reducing venting and flaring, while the reduction in CH_4 emissions from gas distribution is due to the gradual replacement and expansion of the pipeline network. More detailed information on activity data and (implied) emission factors is provided in sections 3.13 and 3.14.

3.12.2 Methodological issues

Different methods are used to estimate 'Fugitive Emissions from Fuels'. An energy balance calculation is made for fuel use in the 'Oil and Gas Production' industry in order to prevent double counting or omissions. For more details see sections 3.1, 3.13 and 3.14 and www.greenhousegases.nl.

3.12.3 Uncertainty and time-series consistency

Uncertainty

Most uncertainty estimates for activity data are based on the judgements of CBS and MNP experts, who in turn base them on the assumed accuracy of the underlying statistics, annual variability and the monitoring method involved. The uncertainty estimates for the emission factors are also based on expert judgements.

Time-series consistency

The methodologies used to estimate 'Fugitive Emissions from Fuels' are consistent throughout the time series.

3.12.4 Source-specific QA/QC and verification

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

3.12.5 Source-specific re-calculations

For source-specific re-calculations see section 3.3.5.

3.12.6 Source-specific planned improvements

Fugitive emissions from 'Charcoal Production', notably CH_4, may be included when a new data set for estimating biomass burning emissions (CBS, 2004) is used for the next inventory (see section 3.9.6).

3.13 Solid fuels [CRF category 1B1]

3.13.1 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 Corus. 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. We note that fugitive emissions from all coke production sites are included (in contrast with fuel combustion emissions from on-site coke production by the iron and steel industry, which are included in 1A2a instead of 1A1c, since these are reported in an integrated and aggregated manner).

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.

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. Table 3.19 shows the trend in CO_2 emissions from coke production during the period 1990–2005.

Table 3.19 Trend in CO_2 emissions from coke production (transformation losses reported in 1B1b.

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
CO_2 emissions (Gg)	403	430	431	446	559	517	651	505	492	446	422	412	430	464	509	457
Coke production (PJ)	78.0	83.6	83.2	82.0	82.3	82.3	83.1	82.5	80.6	66.1	60.3	62.8	60.3	61.1	62.8	63.8
CO_2 losses/coke prod. (kg/GJ)	5.2	5.1	5.2	5.4	6.8	6.3	7.8	6.1	6.1	6.7	7.0	6.6	7.1	7.6	8.1	7,2

3.13.2 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. Fugitive emissions from 'Charcoal Production' – the Netherlands has one large production location that serves most of the Netherlands and also a large share of the market of our neighbouring countries – are presently not accounted for.

3.13.3 Uncertainty and time-series consistency

Uncertainty

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 and Brandes, 2006).

Time-series consistency

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

3.13.4 Source-specific QA/QC and verification

No source-specific QA/QC and verification.

3.13.5 Source-specific re-calculations

No source-specific re-calculations.

3.13.6 Source-specific planned improvements

No source-specific improvements planned.

3.14 Oil and natural gas [CRF category 1B2]

3.14.1 Category description

The fugitive emissions – mostly CH_4 – from category 1B2 comprise non-fuel combustion emissions from flaring and venting emissions from oil and gas production, emissions from gas transport (compressor stations) and gas distribution networks (pipelines for local transport) and oil refining.

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 this 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 and re-allocated from 1A1b to 1B2a-iv for 2002 onwards.

With respect to fugitive emissions from 'Charcoal Production', the Netherlands has one large 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.

CO_2 from gas flaring (including the venting of gas with a high carbon dioxide content) and methane from gas venting/flaring are identified as key sources (see Table 3.1).

Activity data and emission factors

Gas production, of which about 50% is exported, and gas transmission varies according to demand –i.e. in cold winters more gas is produced – which explains the peak in 1996 (details are discussed in Peek 2007, in preparation). 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). 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 utilization of energy purposes of produced gas that was formerly wasted.

The Process emissions of CO_2 from a hydrogen plant of a refinery are obtained from the environmental report.

For gas distribution, the IEF 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 6%; in 1990 this was still 11%.

Table 3.20 Trend in CH_4 emissions from gas distribution and emission factors per type of pipeline material (Unit:Gg)

Material	CH_4 (mm^3)/ Mm/year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Grey cast iron	610	4.6	4.2	4.0	3.9	3.8	3.7	3.6	3.5	3.4	3.3	3.3	3.2	3.1	3.1	3.2	3.3
Other material	120	7.5	7.9	8.0	8.1	8.2	8.3	8.4	8.6	8.8	9.0	9.1	9.3	9.5	9.7	9.8	9.8
Total CH_4		12.1	12.1	12.1	12.0	12.0	12.0	12.0	12.0	12.1	12.2	12.3	12.4	12.5	12.8	13.0	13.1

3.14.2 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' (1B2) is based on two country-specific emission factors of 610 m^3 (437 Gg) methane for grey cast iron and 120 m^3 (86 Gg) for other materials per 1000 km of pipeline due to leakages; 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 will annually record the number of leaks found per material, and any future possible trends in the emission factors will be 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 listed in section 3.1.

3.14.3 Uncertainty and time-series consistency

Uncertainty

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 50% 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.

Time-series consistency

A consistent methodology is used to calculate emissions throughout the whole time series.

3.14.4 Source-specific QA/QC and verification

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

3.14.5 Source-specific re-calculations

During the compilation of the CRF based on the PER inventory for 2005 a minor error was detected in the emissions reported in category 1B2, distribution of oil and gas. The whole time series (except 1990) was corrected (shifted one year).

A source-specific recalculation was made for refineries for 2002-2004. A pure CO_2 stream generated and released by refineries, which was previously reported as 'unaccounted for liquid fuel use' as part of 1A1b, is now separately reported and included in the CRF as process emissions under subcategory 1B2a-iv.

Table 3.213. Re-allocation of CO_2 process emissions of 'Refineries' from 1A1b to 1B2 (Units: Tg CO_2).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
NIR 2007	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.9
NIR 2006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	00
Difference	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.9**	**0.9**	**0.9**

3.14.6 Source-specific planned improvements

Fugitive emissions from 'Charcoal Production', notably CH_4, may be included when a new data set for estimating biomass burning emissions (CBS, 2004) is used for the next inventory (see section 3.9.6).

4. INDUSTRIAL PROCESSES [CRF sector 2]

Major changes in sector 4 Industrial Processes compared to the National Inventory Report 2006

Emissions: The total greenhouse gas emissions in this sector remained almost constant between 2004 and 2005.
Key sources: There are no changes in the key source allocation in this sector.
Methodologies: There have been no methodological changes. Some minor errors in the use of HFCs (activity data) were corrected for a number of years.

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 (i.e. including their use in other sectors). Greenhouse gas emissions from fuel combustion in industrial activities are included in the Energy sector. Fugitive emissions of greenhouse gases in the Energy sector (i.e. 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 paragraphs.

Following protocols on www.greenhousegases.nl describe the methodologies applied for estimating emissions of CO_2, CH_4, N_2O and F-gases of the Industrial processes sector in the Netherlands:

- Protocol 7102: CO_2, CH_4 and N_2O from Process emissions: fossil fuels;
- Protocol 7114: CO_2, CH_4 and N_2O from Process emissions and product use;
- Protocol 7115: N_2O from Nitric acid production (2B2);
- Protocol 7116: N_2O from Caprolactam production (2B5);
- Protocol 7117: PFCs from Aluminium production (2C3);
- Protocol 7118: HFC23 from HCFC22 production (2E1);
- Protocol 7119: HFCs from Handling (2E3);
- Protocol 7120: HFCs from Stationary refrigeration (2F1);
- Protocol 7121: HFCs from Mobile airconditioning (2F1);
- Protocol 7122: HFCs from Foams (2F2);
- Protocol 7123: HFCs from Aerosols (2F4);
- Protocol 7126: SF_6 from Electrical equipment (2F8);
- Protocol 7125: SF_6 and PFCs from Semiconductor manufacturing (2F7);
- Protocol 7124: SF_6 from Sound-proof windows (2F9).

Key sources
The key sources in this sector are presented in Table 4.1. Annex 1 presents all sources identified in the Industrial processes sector in the Netherlands.

N_2O emission from Nitric acid production and Caprolactam production are major key sources, both in terms of level and trend. Other key sources are CO_2 emissions from Ammonia production, CO_2 emissions from Iron and steel production and HFC emissions from Substitutes for ozone-depleting substances.

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

In 2005 Industrial processes contributed 8% to the total national greenhouse gas emissions (without LULUCF) in comparison to 12% in the base year. The sector is a major source of N_2O emissions in the Netherlands, accounting for 40% of the national total N_2O emissions.

Category 2B Chemical industry contributes most to emissions from this sector.

Compared to the base year, total CO_2-equivalent greenhouse gas emissions of the sector declined by 8.5 Tg to 16.5 Tg CO_2-eq. in 2005 (–34%). CO_2 emissions from Industrial processes decreased 9% during the period 1990–2005. N_2O emissions decreased 18% in the same period. Total emissions of fluorinated gases (F-gasses) have been strongly reduced.

Table 4.1 Contribution of the main categories and key sources in CRF sector 2 Industry.

Sector/category Key source	Gas	Key[1]	Emissions base year (1990/1995[1])		Emissions 2005		Change 2005 - 2004	Contribution to total in 2005 (%):		
		Level, Trend	Gg	Tg CO_2-eq.	Gg	Tg CO_2-equivalents		By sector	Of total gas	To total CO_2-equivalents
2 Industry	CO_2			7.9		7.2	0.3	44	4	3
	CH_4		14.1	0.3	14.9	0.3	0.0	2	1.8	0.1
	N_2O		27.4	8.5	22.8	7.0	-0.1	42	39	3
	HFC			6.0		1.4	-0.1	8	100	0.7
	PFC			1.9		0.3	0.0	2	100	0.1
	SF_6			0.3		0.3	0.0	2	100	0.2
	All			**25.0**		**16.5**	**0.1**	**100**		**8**
2A. Mineral products	**CO_2**			**1.0**		**1.1**	**0.0**	**7**	**0.6**	**0.5**
2B. Chemical industry	CO_2			3.7		3..9	0.2	24	2	2
	N_2O		24.4	7.6	20.6	6.4	0.0	39	36	3
	All			**11.3**		**10.3**	**0.2**	**64**		**5**
2B1 Emissions from ammonia production	CO_2	L1		3.1		3.1	0.0	19	2	1
2B2 Nitric acid production	N_2O	L,T	20.4	6.3	18.1	5.7	0.0	34	32	2.6
2B5 Caprolactam production	N_2O	L,T	4.0	1.2	2.4	0.7	-0.1	4	4	0.3
2B5 Other chemical product manufacture	CO_2	L2		0.6		0.8	0.2	5	0.4	0.4
2C. Metal production	CO_2			2.9		1.8	0.0	11	1.0	0.8
	PFC			1.9		0.1	0.0	1	33	0.0
	All			**4.8**		**1.9**	**0.0**	**11**		**0.9**
2C1 Iron/steel production (carbon inputs)	CO_2	L1,T1		2.5		1.3	0.0	8	0.7	0.6
2C3 PFC from aluminium production	PFC	T		1.9		0.1	0.0	0.5	33	0.0
2D. Other production	**CO_2**			**0.1**		**0.0**	**0.0**	**0.2**	**0.0**	**0.0**
2E. Production of halocarbons and SF6	**HFC**			**5.8**		**0.2**	**-0.2**	**1**	**17**	**0.1**
2E1 HFC-23 from HCFC-22 manufacture	HFC	T		5.8		0.2	-0.2	1	17	0.1
2F. Consumption of halocarbons and SF_6	HFC			0.2		1.2	0.1	7	83	0.5
	PFC			0.0		0.2	0.0	1	67	0.1
	SF_6			0.3		0.3	0.0	2	100	0.2
	All			**0.6**		**1.7**	**0.1**	**10**		**0.8**
2F (1-4). Emissions from substitutes for ozone-depleting substances	HFC	L,T		0.2		1.0	0.0			
2G. Other	CO_2			0.2		0.3	0.0	2	0.2	0.2
	N_2O		3.0	0.9	2.3	0.6	-0.1	4	4	0.3
	All			**1.2**		**1.0**	**0.0**	**6**		**0.2**
2G. Indirect N_2O from NO_2 from combustion and industrial processes	N2O	L2,T	2.85	0.9	2.1	0.6	0.0	2	0.2	0.2
Total national emissions	CO_2			159.4		175.9	-5.4		100	
	CH_4		1,211.5	25.4	823.5	16.7	-0.6		100	
	N_2O		68.4	21.2	57.2	17.6	-0.2		100	
	HFCs			6.0		1.4	-0.2		100	
	PFCs			1.9		0.3	0.0		100	
	SF_6			0.3		0.3	0.0		100	
National total greenhouse gas emissions (excluding CO_2 from LULUCF)	All			214.3		212.1	-6.3			100

[1]Base year for F-gases (HFCs, PFCs and SF_6) is 1995.

In 2005, total greenhouse gas emissions in the sector remained almost at the same level as in 2004. CO_2 emissions increased by 4% or 0.3 Tg CO_2. SF_6 emissions showed a minor increase, while HFC and PFC emissions decreased further.The N_2O emissions remained almost at the same level as in 2004.

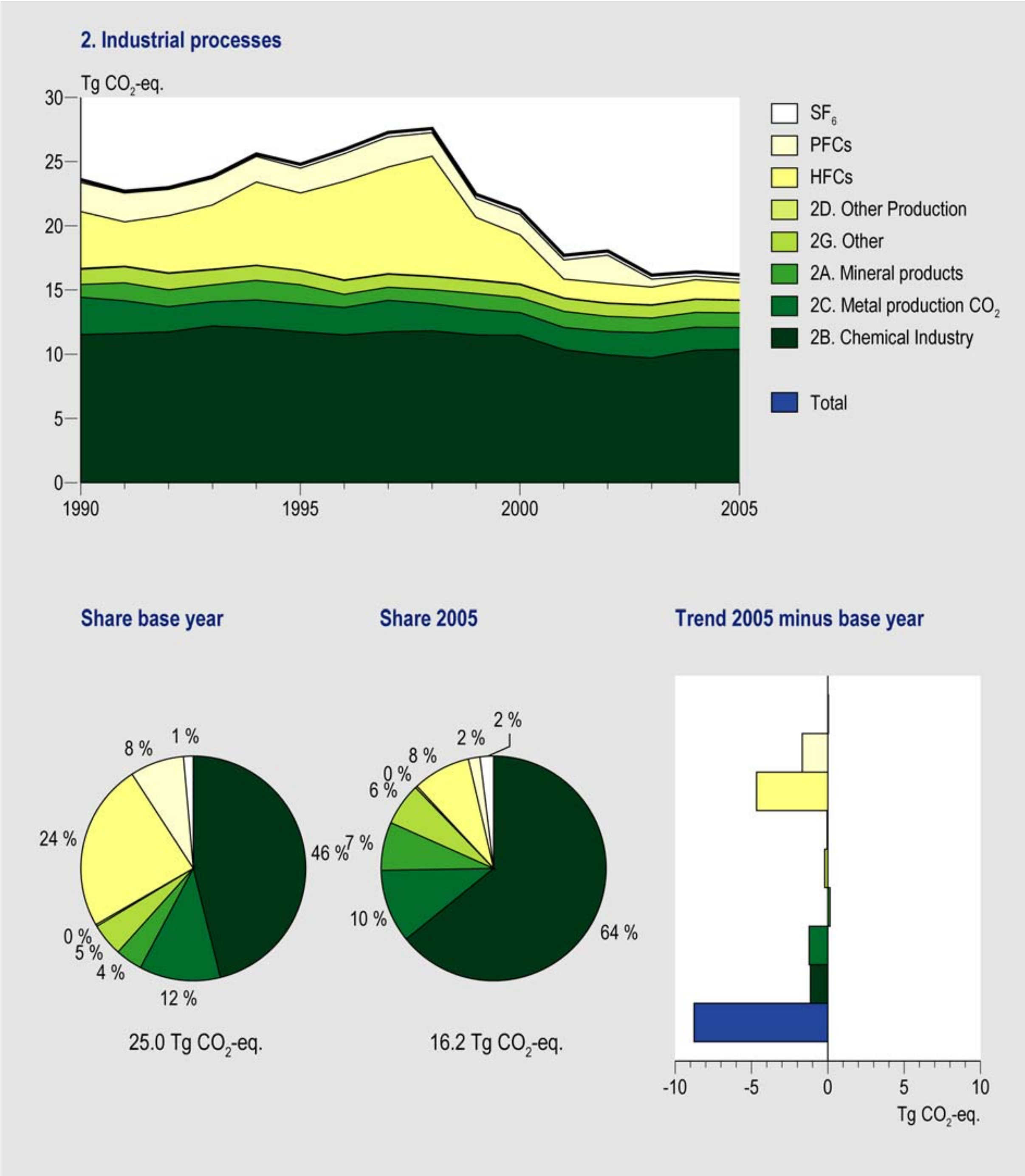


Figure 4.1 Sector 2 'Industrial processes: trend', emission levels and share of source categories in emissions from industrial processes, 1990-2005.

4.2 Mineral products [2A]

4.2.1 Source category description

General description of the source categories

CO_2 emissions are generated in industrial applications involving the heating of limestone – mostly in the form of calcium carbonate ($CaCO_3$) or dolomite – at high temperatures. There are no key sources identified for CO_2 emissions from these source categories (see also Annex 1). 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 2A2 Lime production are not estimated since production was negligible in the early 1990s and has stopped later, and those from 2A5 Asphalt roofing and 2A6 Road paving with asphalt are not estimated since no methodology is available. However, compared with national emission levels, emissions from these source categories are negligible.

Overview of shares and trends in emissions
Total CO_2 emissions (1.0 Tg in 1990 and 1.1 Tg in 2005) in category 2A have remained stable since 1990 (see Table 4.1), since the activities of the industries in this category have not changed structurally.

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: emission data obtained from the environmental report related to clinker production figures give an implied emission factor of 0.55 t/t clinker (IPCC Default = 0.51 t/t clinker);
- 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: EF= 0.16 t/t (country specific), which is defined as total non-fossil CO_2 per unit of gross glass production from the use of limestone, dolomite and soda ash. The emission factor is derived from the average of the 1990 and 1995–1998 emissions reported by glass-producing facilities.

4.2.2 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 7102 and 7114 on www.greenhousegases.nl, as indicated in section 4.1.
- 2A1 Cement clinker production: the CO_2 emissions from this source category are based on (measured) data reported by the single company in the Netherlands that produces clinkers. CO_2 emissions from cement production included in this source category are correlated to clinker production, not cement production. About 35% of the cement clinker used for cement production is imported into the Netherlands; consequently, comparison with emission factors based on cement production data would provide the wrong impression.
- 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 factor of 0.16 t/t glass.

4.2.3 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 judgement 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, since these sources are not identified key sources, these minor sources for CO_2 are 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.

4.2.4 Source-specific QA/QC and verification

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

4.2.5 Source-specific re-calculations

There have been no source-specific re-calculations in comparison to the previous submission.

4.2.6 Source-specific planned improvements

Possible future improvements would be if the glass industry would report disaggregated data on the use of limestone, dolomite and soda ash; then CO_2 estimates could be more accurate and double counting could be avoided.

4.3 Chemical industry [2B]

4.3.1 Source category description

General description of the source categories

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 the 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.
- 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).

Key sources

Emissions from Ammonia production and Other chemical product manufacture are identified as key-sources for CO_2 emissions. Nitric acid production and Caprolactam production are key-sources for N_2O emissions for both level and trend (see Table 4.1).

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 1990–2005. Table 4.1 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 2005. Nitric acid production is the most important source of N_2O emissions from industrial processes in the Netherlands. The contribution of N_2O emissions from 2B 'Chemical industry' was 3% of the total national greenhouse gas emission inventory.

From 1990 to 2005, total greenhouse gas emissions in 2B 'Chemical industry' decreased by 9%, mainly due to reduction of N_2O emissions from the production of nitric acid and caprolactam. For an detailed explaination of the N_2O emission trend, see paragraph 'Activity data and (implied) emission factors' below.

Between 2004 and 2005 total greenhouse gas emissions in 2B 'Chemical industry' increased by 0.2 Tg due to higher CO_2 emissions from 2B5 'Other Chemical industry'. In 2005 the N_2O emissions remained almost at the same level as in 2004.

Table 4.2 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. Technical measures 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 the N_2O emissions remained almost at the same level as in 2004.

Table 4.2 Trend in N_2O emissions from Chemical industry processes (2B) (Units: Gg CO_2).

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2B2. Nitric acid production	6.3	6.4	6.5	7.0	6.7	6.3	6.3	6.3	6.2	6.0	5.9	5.3	5.0	5.1	5.6	5.7
2B5. Other	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.0	0.8	0.7
Total	7.6	7.7	8.3	7.9	7.5	7.5	7.5	7.5	7.5	7.2	7.1	6.6	6.3	6.0	6.4	6.4

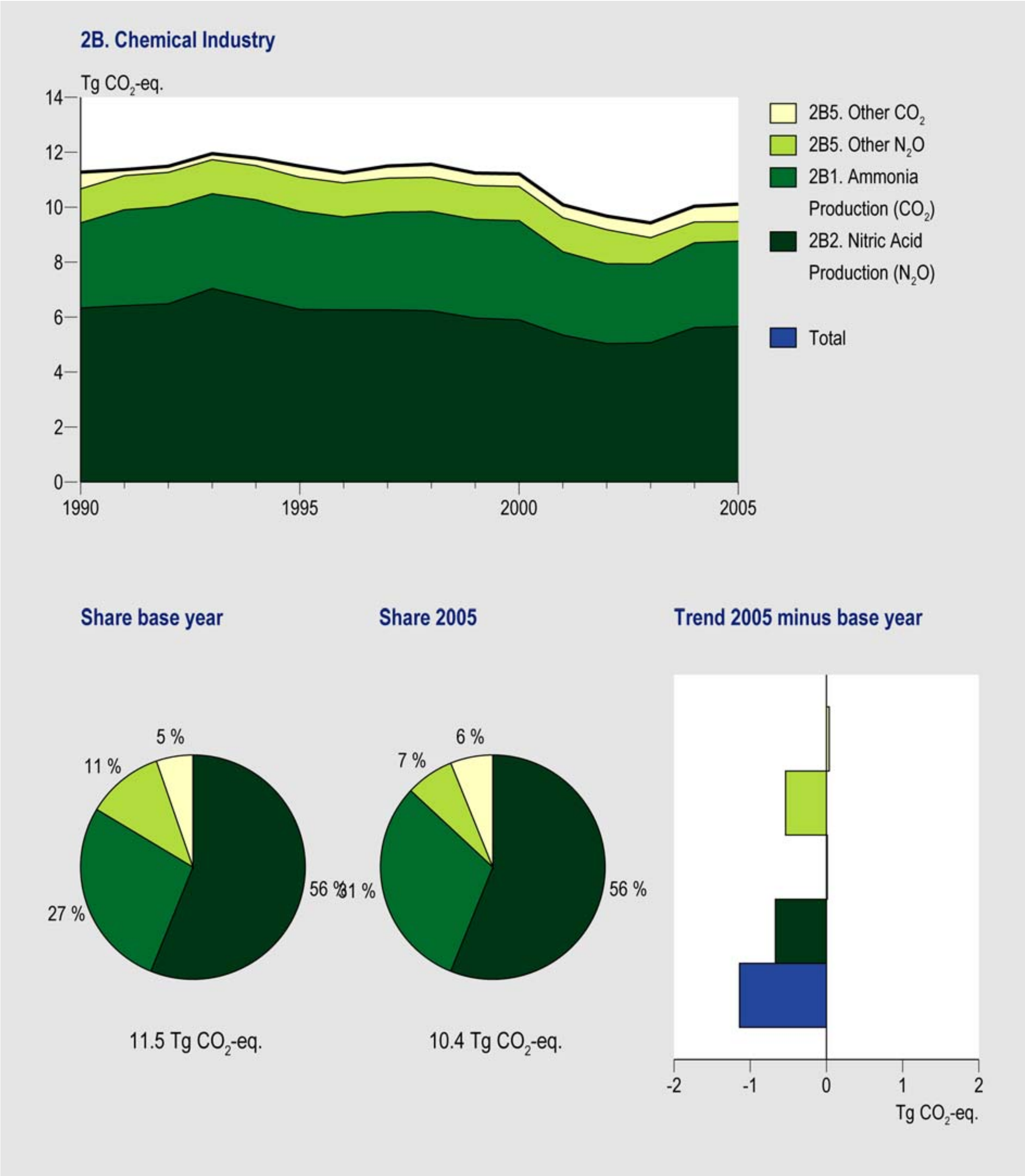


Figure 4.2 Category 2B 'Chemical industry: trend', emission levels and share of source categories in emissions from 2B 'Chemical industry', 1990-2005.

After 2002 more accurate measurements were performed to estimate N_2O emissions from Caprolactam production (2B5), and these resulted in lower reported emission levels than in the years before. The pre-2003 emissions are based on measurement results of the mid-1990s, and the corresponding data are considered to be more representative for the period before 2003 than the newly measured results. In 2005 the N_2O emissions remained almost at the same level as in 2004.

Activity data and (implied) emission factors

Detailed information on activity data and emission factors can be found in monitoring protocols 7102, 7114, 7115 and 7116 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).
- 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. 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.

4.3.2 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 (7102, 7114, 7115 and 7116) 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 national Pollutant Emission Register (PER).
- 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.
  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 utilization 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.

4.3.3 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 (i.e. Ammonia, Nitric acid, Caprolactam production). 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 Nitric acid production and Caprolactam production is estimated to be approximately 50% and 70%, respectively.

Time-series consistency

Consistent methodologies are used throughout the time series for the sources in this category. The time series involve some extrapolation of the emissions of Caprolactam production in the period 1999–2002, thereby slightly increasing uncertainties in the emissions of this source in this period.

4.3.4 Source-specific QA/QC and verification

The source categories are covered by the general QA/QC procedures which are discussed in chapter 1. Although ammonia and urea production data are considered confidential, international statistics such as UN, IFA and USGS do report production data for the Netherlands.

4.3.5 Source-specific re-calculations

There have been no source-specific re-calculations in comparison to the previous submission.

4.3.6 Source-specific planned improvements

There are no source-specific improvements planned.

4.4 Metal production [2C]

4.4.1 Source category description

General description of the source category

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 named Hoogovens). Integrated steelworks convert iron ores into steel by means of sintering, producing pig iron in blast furnaces and converting pig iron to steel in basic oxygen furnaces. For the purpose of the inventory, emissions from integrated steelworks are estimated for these three processes as well as for some other minor processes.
  Emissions from sintering are included in 1A. 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 CO_2. In addition, CO_2 is produced as by-product from the use of limestone during the conversion from pig iron to steel. A portion of the coke oven gas and blast/oxygen furnace gas produced during these processes is sold to a nearby power plant to be used as fuel. These CO_2 emissions are included in category 1B. The carbon content of the blast and oxygen furnace gases lost is included in source category 2C1.
- 2C3 Aluminium production: CO_2 and PFC emissions: in the Netherlands aluminium is produced at two primary aluminium smelters (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.

2C2 Ferroalloys production and 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.

Key sources
Iron and steel production is identified as a key source for CO_2 emissions and Aluminium production is identified as a key source for PFC emissions (see Table 4.1).

Overview of shares and trends in emissions
Table 4.1 gives an overview of shares in emissions of the main categories.

Total CO_2 emissions from 2C1 ‘Iron and steel production’ decreased by 1.2 Tg during the period 1990–2005. In 2005 the CO_2 emissions remained at the same level as in 2004

PFC emissions from primary ‘Aluminium industry’ (2C3) decreased by 1.8 Tg CO_2-eq. between 1995 and 2005. In 2005 the PFC emissions remained at the same level as in 2004.

Table 4.3 shows the trend in implied CF_4 and C_2F_6 emission factors (IEF) for aluminium production during the period 1990–2005. The largest company produces approximately two thirds of the national total production. The IEFs decreased by 97% between 1995 and 2005. 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.

Table 4.3 Implied emission factors for CF_4 and C_2F_6 from Aluminium production (Units: kg/Tg) (2C3).

Gas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
CF_4	1.02	1.04	1.06	1.10	1.11	1.10	1.16	1.21	0.78	0.53	0.53	0.52	0.83	0.19	0.04	0.03
C_2F_6	0.18	0.18	0.18	0.18	0.19	0.18	0.19	0.19	0.15	0.12	0.12	0.12	0.20	0.04	0.01	0.01

Activity data and (implied) emission factors
Detailed information on activity data and emission factors can be found in the monitoring protocols 7102, 7114 and 7117 on the website www.greenhousegases.nl

Activity data are based on the following sources:
- Iron and steel production: data on coke production, 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 of the different sources 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.

4.4.2 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 7102, 7114 and 7117 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):

$$CO_2 \text{ from coke/coal inputs} = \text{amount of coke} * EF_{coke} + \text{amount of coal} * EF_{coal} - (\text{blast furnace gas} + \text{oxygen oven gas produced}) * EF_{BFgas} \quad (1a)$$

$$CO_2 \text{ from limestone use} = \text{limestone use} * ZF(\text{limestone}) * EF_{limestone} \quad (1b)$$

$$CO_2 \text{ from ore/steel} = (\text{C-mass in ore, scrap and raw iron purchased} - \text{C-mass in raw steel}) * 44/12 \quad (1c)$$

The same emission factors for blast furnace gas and oxygen furnace gas are used (see Annex 2).

Only the net 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 iron ore/steel in the period 1990–2000. The amount of limestone stone was calculated from the average consumption 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.

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 $Al_2O_3 + 3/2C \rightarrow 2Al + 3/2\ CO_2$. 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 1990–2005. Emission factors are plant-specific and are based on measured data.

4.4.3 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 5% for Iron and steel production and Aluminium production respectively, whereas the uncertainty in PFC emissions from Aluminium production is estimated to be 25%. 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.

4.4.4 Source-specific QA/QC and verification

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

4.4.5 Source-specific re-calculations

There have been no source-specific re-calculations in comparison to the previous submission.

4.4.6 Source-specific planned improvements

There are no source-specific improvements planned.

4.5 Food and drink production [2D]

4.5.1 Source category description

General description of the source category

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; i.e. cokes used for the whitening of sugar. Carbon is oxidised during these processes, resulting in CO_2 emissions.

Key sources

This minor source is no key source for CO_2 (see also Annex 1).

Overview of shares and trends in emissions

Emissions vary at around 0.05 Gg, and are rounded off to either 0.1 or 0.0 Gg (see Table 4.1).

Activity data and (implied) emission factors

Detailed information on the activity data and emission factors can be found in monitoring protocol 7102 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 2000-2003).

4.5.2 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 7102 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.

4.5.3 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.

Time-series consistency

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

4.5.4 Source-specific QA/QC and verification

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

4.5.5 Source-specific re-calculations

There have been no source-specific re-calculations in comparison to the previous submission.

4.5.6 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

General description of the source categories

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.
  HFC22 is produced at one plant in the Netherlands. Tri-fluormethane (HFC23) is generated as a by-product during the production of chlorodifluormethane (HCFC22) and emitted through the plant condenser vent.
- 2E3 Handling activities: emissions of HFCs. In the Netherlands HFCs are released during the handling activities of HFCs at two companies.

Key sources

The source category Production of HCFC-22 is a key source; see Table 4.1.

Overview of shares and trends in emissions

Table 4.1 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 2005, with HFC-23 emissions from HCFC-22 production being the major source of HFC emissions. Other HFC emissions from handling contributed 16 % to the total HFC emissions from this category in 2005. For a detailed explaination of the HFC emission trend, see paragraph 'Activity data and (implied) emission factors' below.

Table 4.4 shows the trend in HFC emissions from the categories HCFC-22 production and HFCs from handling activities for the period 1990–2005. 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 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 the 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.

The large interannual variation in handling emissions can be explained by variations in handling activities over time.

Table 4.4 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.).

Compound	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
2E1. HFC-23	4432	3452	4423	4947	6278	5759	6887	6709	7791	3440	2421	450	685	415	354	196
2E3. HFCs	NO	NO	25	51	129	12	224	707	519	384	418	192	98	40	99	39
HFC total	**4432**	**3452**	**4447**	**4998**	**6407**	**5771**	**7110**	**7416**	**8310**	**3825**	**2838**	**641**	**783**	**455**	**454**	**235**

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 the 1999 measurement data provided by one company. The other company uses both

measurement data and a mass balance relating to the kind of handling activity used to estimate the emissions.

More detailed information on the activity data and emission factors can be found in the monitoring protocols 7118 and 7119 on the website www.greenhousegases.nl.

4.6.2 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 7118 and 7119 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 HFC23 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.

4.6.3 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 50%. The uncertainty in the activity data for these sources is estimated at 10%. The uncertainties in the emission factors for HFC23 from HCFC-22 production and for HFC from Handling activities are estimated at 10% and 50%, 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.

4.6.4 Source-specific QA/QC and verification

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

4.6.5 Source specific recalculations

There have been no source-specific re-calculations in comparison to the previous submission.

4.6.6 Source-specific planned improvements

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

4.7 Consumption of halocarbons and SF6 [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 categories:

2F(1-4): Emissions from substitutes for Ozone- depleting substances.
The inventory comprises the following sources in this source category:

- 2F1-i Stationary refrigeration: HFC emissions;
- 2F1-ii Mobile air conditioning: HFC emissions;
- 2F2-i Foams: HFC emissions; (included in 2F9);
- 2F4-i Aerosols: HFC emissions; (included in 2F9);

- 2F9-i Other: HFC emissions.

2F6: PFC emissions from PFC use.
The inventory comprises the following source in this source category:
- 2F7 Semiconductor manufacture (including SF_6 emissions).

2F9: SF6 emissions from SF6 use.
The inventory comprises the following sources in this source category:
- 2F8 Electrical equipment (included in 2F9);
- Sound-proof windows (included in 2F9);
- Electron microscopes (included in 2F9);
- 2F9 Other: SF_6 emissions.

Due to reasons pertaining to confidentiality, only the sum of the HFC emissions of 2F2 and 2F4 (included in 2F9) and of the SF_6 emissions of all source categories and 2F7 Semiconductor manufacturing is reported (included in 2F9).

Key sources
Emissions from Substitutes for ozone-depleting substances [2F(1-4)] are identified as a key source (see Table 4.1).

Overview of shares and trends in emissions
The contribution of HFC emissions from category 2F to the total national inventory of F-gas emissions was 7 % in the base year 1995 and 85 % in 2005. This corresponds to 1.7 Tg CO_2-eq. and accounts for 0.8% in the national total greenhouse gas emissions in 2005.

The level of HFC emissions increased by a factor of 3 in 2005 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 1995–2005. See Table 4.5, in which the trends in actual emissions from 1990 onwards are presented.

Table 4.5 Actual emission trends specified per compound from the use of HFCs, PFCs and SF_6 (2F) (Units: Gg CO_2-eq.).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
HFC-134a	NO	NO	NO	NO	17	48	81	116	137	130	162	210	259	309	362	416
HFC-143a	NO	NO	NO	NO	NO	6	26	48	68	73	106	143	179	217	256	291
HFC-125	NO	NO	NO	NO	NO	7	25	43	57	60	87	119	149	180	212	241
HFC-152a	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-32	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other HFC's	NO	NO	NO	NO	57	187	433	674	766	768	625	350	164	207	209	160
HFC Total	NO	NO	NO	NO	74	249	567	885	1,032	1,035	985	828	759	922	1,049	1118
PFC use	18	21	24	28	32	37	51	101	114	147	193	163	120	180	179	178
SF_6 use	217	134	143	150	191	301	312	345	329	317	335	356	332	309	328	337
Total HFC/PFC/SF_6	**236**	**155**	**167**	**178**	**297**	**587**	**931**	**1,331**	**1,474**	**1,499**	**1,514**	**1,347**	**1,211**	**1,411**	**1,556**	**1,634**

Activity data and (implied) emission factors
Detailed information on the activity data and emission factors can be found in the monitoring protocols 7120–7126 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 airconditioning, Aerosols and Foams) are obtained from annual reports from PriceWaterhouseCoopers.
- Activity data on the use of SF_6 and PFCs in Semiconductor manufacturing, Electrical equipment, 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 the literature.
- Semiconductor manufacturing: emission factors which are confidential information of the company.
- Electrical equipment: emission factors are confidential information of the companies.
- 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 company.

4.7.2 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 airconditioning, Aerosols, Foams and Semiconductor manufacturing.
The country-specific methods for the sources Electrical equipment, Sound-proof windows and Electron microscopes are equivalent to IPCC Tier 2 methods.
More detailed descriptions of the methods used and emission factors can be found in the protocols 7120-7126 on the website www.greenhousegases.nl as indicated in section 4.1.

4.7.3 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 judgements of experts.

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

4.7.4 Source-specific QA/QC and verification

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

4.7.5 Source-specific recalculations

Errors were detected in the use of HFC134a (activity data) in the source category Stationary refrigeration and in Other HFC emissions. These were corrected for a number of years.

Table 4.6. Effects of correction of errors of HFCs from HFC use (2F) 1990-2004 (in Gg CO_2 -eq)).

		1990	1991	1992	1993	1994	1995 *	1996	1997	1998	1999	2000	2001	2002	2003	2004
HFCs	NIR2006	236	155	167	178	297	587	931	1,331	1,474	1,499	1,514	1,347	1,211	1,353	1,530
	NIR2007	236	155	167	178	297	587	931	1,331	1,474	1,499	1,514	1,347	1,211	1,411	1,556
	Difference	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**58**	**26**

* Base year for F-gases in the Kyoto Protocol.

4.7.6 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;
- Deposition of NO_x and NH_3 emitted by domestic non-agricultural sources: (indirect) 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 main non-agricultural source of NO_x emissions in the Netherlands is the Transport sector, which provides a two thirds share of the non-agricultural sources in the national inventory. Because of changes in methodologies for calculating emissions of the transport sector, the NO_x emissions of this sector will change. This may affect (indirect) N_2O emissions. However, this change in methodologies was not finalized in time for this NIR. The results will be included in the NIR of 2008. Minor sources include fuel combustion for power generation and for the manufacturing industry. At the present time the Residential sector (mainly humans and their pets) is the main source of non-agricultural NH_3; in 1990 the emission level of the Chemical industry was similar to that of the Residential sector.

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).

Key sources
Indirect N_2O from the deposition of NO_x is identified as a key source (see Table 4.1).

Overview of shares and trends in emissions
The small CO_2 and CH_4 emissions remained rather constant between 1990 and 2005, whereas the indirect N_2O emissions from the deposition of NO_x decreased by about 25% during this same period. This decrease is mainly caused by the decrease in NO_x emissions from Combustion in road transport Power generation and the Manufacturing industry.

Activity data and (implied) emission factors
Detailed information on the activity data and emission factors can be found in the monitoring protocols 7102 and 7114 on the website www.greenhousegases.nl

The activity data used are based on the following sources:
- Fireworks: data on annual sales from branche organization;
- Candles: average use of 3.3 kg per person (www.bolsius.com);
- Non-agricultural NO_x and NH_3 emissions: Netherlands Emission Register (ER);
- Production of drinking water: Volume Statistics Netherlands (CBS);
- Fuel use: energy statistics obtained from Statistics Netherlands (CBS).

Emission factors:
- Fireworks: CO_2: 43 t/t; CH_4: 0.78 t /t; N_2O: 1.96 t/t (Brouwer et al., 1995);
- Candles: 2.3 t/t (EPA, 2001);
- NO_x and NH_3 emissions: Netherlands Emission Register (ER);
- Production of drinking water: 2.47 tons CH_4 /10^6 m^3;
- Use of fuels for production of lubricants: ODU factor of 50% (the IPCC default);
- Production of waxes: ODU factor of 100% (the IPCC default).

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

4.8.2 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 7102 and 7114 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.
- Deposition of NH_3 and NO_x from non-agricultural sources: a Tier 1b method is used for estimating indirect N_2O emissions from the deposition of nitrogen from domestic anthropogenic sources of N_2O, NO_x and NH_3, including emissions from other source sectors than agriculture. Non-agricultural sources of N_2O were neglected because of their negligible size.
- 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.

4.8.3 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 indirect N_2O emissions from non-agricultural sources of NO_2 and NH_3 are based on the default IPCC methodology for indirect N_2O emissions from atmospheric deposition. The methodology applied to estimate the emissions – using default IPCC emission factors – results in highly uncertain annual emissions that are estimated to be of a factor of 2 at the very least. The uncertainty in the activity data – i.e. emissions of NO_x and NH_3 – are estimated to be 25%, based on an uncertainty assessment made in 2004 (TNO, 2004).

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 – i.e. 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.

4.8.4 Source specific QA/QC and verification

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

4.8.5 Source specific recalculations

There have been no source-specific re-calculations compared to the previous submission.

4.8.6 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 2006

Emissions: No changes.
Key sources: There are no changes in the key source allocation in this sector.
Methodologies: There have been no methodological changes in this sector.

5.1 Overview of sector

Emissions of the greenhouse gases of this sector include indirect emissions of CO_2 related to the release of non-methane volatile organic compounds (NMVOCs) with the use of solvents and a wide range of other fossil carbon-containing products (e.g. paints, cosmetics, cleaning agents etc). 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, in 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 all non-combustion emissions from sectors other than those of the manufacturing and energy industries, with the exception of :

- Indirect CO_2 emissions from 3C Chemical products, manufacture and processing. For this source category NMVOC emissions are included in categories 3A, 3B and 3D.
- 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, etc.). 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 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 7114: CO_2, N_2O en CH_4 from Other process emissions and product use.

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 2005. Indirect emissions of CO_2 and N_2O for dispersive uses accounted for 65% and 35%, respectively, of the CO_2-equivalent emissions from the sector.

Total emissions of the sector declined by 60% between 1990 and 2003, and remained stable between 2003 and 2005. CO_2 emissions from the sector decreased by 67% between 1990 and 2005, mainly due to decreasing indirect emissions from paints that resulted from the implementation of the emission reduction programme for NMVOC. N_2O emissions fell by 65% from 1990 to 2002 due to the better dosing of anaesthesia in hospitals and other medical institutions. Since 2002, emissions remained stable.

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

Sector/category Key source	Gas	Key	Emissions base year (1990)		Emissions 2005		Change 2005 - 2004	Contribution to total in 2005 (in %)		
		Level, Trend	Gg	Tg CO_2-equivalents	Gg	Tg CO_2-eq.	Tg CO_2-eq.	By sector	Of total gas	Of total CO_2-equivalents
3 Solvents and other product use	CO_2			0.3		0.1	0.0	65	0.1	0.1
	N_2O		0.73	0.2	0.25	0.1	0.0	35	0.4	0.0
	All			**0.5**		**0.2**	**0.0**	**100**		**0.1**
3A Paint application	**CO_2**			**0.2**		**0.1**	**0.0**	**36**	**0.0**	**0.0**
3B Degreasing and dry cleaning	**CO_2**			**0.0**		**0.0**	**0.0**	**1**	**0.0**	**0.0**
3D Other	CO_2			0.1		0.1	0.0	28	0.0	0.0
	N_2O		0.73	0.2	0.25	0.1	0.0	35	0.4	0.0
	All			**0.3**		**0.1**				**0.1**
3D1 Anaesthesia	N_2O		0.65	0.2	0.13	0.0	0.0	18	0.2	0.0
3D3 Aerosol cans	N_2O		0.08	0.0	0.12	0.0	0.0	17	0.2	0.0
Total National Emissions	CO_2			159.4		175.9	-5.4		100	
	N_2O		68.5	21.2	56.7	17.5	-0.2		100	
National total GHG emissions (excluding CO_2 from LULUCF)	**All**			**214.3**		**212.1**	**-6.3**			**100**

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 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.

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 7114 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). More details can be found in Spakman et al. (2003).

The consumption of almost all solvent-containing products has increased since 1990. However, the general NMVOC content of products (especially paints) has decreased over the past 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 during recent years. The NMVOC contents of these products have remained more or less stable.

Emission factors: it is assumed that all of NMVOC in the product is emitted (with the exception of some cleaning products and methylated spirit, which partly are broken down in sewerage treatment plants or used as fuel in BBQ's). The carbon contents of NMVOC emissions are documented in the monitoring protocol on the website www.greenhousegases.nl.

5.2.2 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.

The 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 NMVOCs are calculated from the average carbon contents of the NMVOC emissions reported in categories 3A, 3B and 3D. The carbon contents are based on the composition of compounds responsible for 85–95% of the total NMVOC emission within the category. The fractions are calculated on the basis of the 1990 and 2000 emissions. This simplification is justified due to the small contribution of these emissions to the total inventory of national NMVOC emissions. The following fixed carbon fractions are used for the total time series:

3A	3B	3D
0.72	0.16	0.69

The emissions are then calculated as follows:

$$CO_2 \text{ (in Gg)} = \Sigma\{\text{NMVOC emission in subcategory i (in Gg)} * \text{C-fraction subcategory i}\} * 44/12$$

The fraction of organic carbon (i.e. of natural origin) in the NMVOC emissions is assumed to be negligible.

5.2.3 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 judgments of experts, 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 25%.

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. The emission estimates for the source categories are expected to be quite good.

5.2.4 Source-specific QA/QC and verification

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

5.2.5 Source-specific re-calculations

There have been no source-specific re-calculations in comparison to the previous submission.

5.2.6 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.

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 7114 on the website www.greenhousegases.nl.

Activity data: The major hospital supplier of N_2O for anaesthetic use reports the consumption data of anaesthetic 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 these data. More details can be found in Spakman et al. (2003).

Domestic sales of cream in aerosol cans have shown a small increase since 2000. In 2005 sales increased 7%, which is reflected in the increased emission in that year.

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, and – based on data provided by the producer – it is assumed to be constant over time.

5.3.2 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 7114 on the website www.greenhousegases.nl.

5.3.3 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.

5.3.4 Source-specific QA/QC and verification

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

5.3.5 Source-specific re-calculations

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

5.3.6 Source-specific planned improvements

There are no source-specific improvements planned.

6. AGRICULTURE [CRF sector 4]

Major changes in the Agriculture sector with respect to the National Inventory Report 2006

Emissions: Compared to the previous NIR submission, N_2O and CH_4 emissions slightly decreased as a result of a small decrease of CH_4 and N_2O emissions.

Key sources: The key source classification in this NIR has not been changed compared to the previous NIR.

Methodologies: There were no methodological changes.

6.1 Overview of the sector

Emissions of greenhouse gases from this sector include all anthropogenic emissions from Agriculture, with the exception of emissions from fuel combustion and sewage. These emissions are included in 1A Energy and 6B Waste. In the Netherlands three source categories occur in this CRF sector:

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

The other 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, prohibited by law, is negligible in practice.

Manure management (4B) includes all emissions from confined animal waste management systems (AWMS). Two different approaches, both in accordance with the IPCC guidelines (IPCC, 2001), are used for reporting CH_4 and N_2O emissions from animal waste produced in the meadow during grazing. CH_4 emissions from animal waste 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.

Methane emissions from agricultural soils are regarded as natural (non-anthropogenic) emissions and therefore are not estimated. CO_2 emissions from agricultural fuel combustion are included in category 1A4c Agriculture/forestry/fisheries. CO_2 emissions from agricultural soils are included in Sector 5 LULUCF (5D, see section 7.5).

The following protocols on www.greenhousegases.nl describe the methodologies applied in estimating N_2O and CH_4 emissions in the agricultural sector in the Netherlands:

- Protocol 7127: CH_4 from Enteric fermentation: cattle (4A1);
- Protocol 7128: CH_4 from Enteric fermentation: other animal categories (4A2-13);
- Protocol 7130: CH_4 from Manure management: cattle (4B1);
- Protocol 7131: CH_4 from Manure management: swine (4B8);
- Protocol 7132: CH_4 from Manure management: other animal categories (4B2-7, 9-13);
- Protocol 7129: N_2O from Manure management (4B);
- Protocol 7133: N_2O from Agricultural soils: indirect emissions (4D);
- Protocol 7134: N_2O from Agricultural soils: direct emissions and emissions from animal production (4D).

Overview of shares and trends in emissions

Figure 6.1 and Table 6.1 show 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 2005 CO_2-equivalent emissions from sector 4 'Agriculture' contributed 8.6% to the total inventory of national emissions (without LULUCF) compared to 10% in 1990. In 2005, emissions of CH_4 and N_2O from agricultural sources each accounted for roughly 50% 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 17% between 1990 and 2005, from 22.0 Tg CO_2-eq. in 1990 to 18.2 Tg CO_2-eq. in 2005. This decrease was largely the result of decreasing numbers of livestock, a decreased application of animal waste and a decreased use of synthetic fertilizers.

From 2004 to 2005, both N_2O and CH_4 emissions in the sector slightly decreased. The small decrease in CH_4 emissions by cattle was compensated by an increase of CH_4 emissions by other livestock. The small increase in N_2O emissions by manure management was compensated by a decrease in both direct and indirect N_2O emissions.

Table 6.1 Contribution of main categories and key sources in Agriculture

Sector/category *Key source*	Gas	Key*	Emissions base year		Emissions 2005		Change 2005 - 2004	Contribution to total in 2005 (%)		
		Level, Trend, Non-Key	Gg	Tg CO_2-equivalents	Gg	Tg CO_2-eq.	Tg CO_2-eq.	By sector	Of total gas	Of total CO_2-eq.
4 Agriculture	CH_4		499.7	10.5	419.2	8.8	-0.0	48	53	4.2
	N_2O		37.1	11.5	30.2	9.4	-0.0	52	53	4.4
	All			22.0		18.2	-0.1	100		8.6
4A Enteric fermentation	CH_4		358.4	7.5	302.1	6.3	-0.0	35	38	3.0
4A1 Cattle	CH_4	L,T	322.3	6.8	270.3	5.7	-0.0	31	34	2.7
4A8 Swine	CH_4	NK	20.9	0.4	17.0	0.4	0.0	2	2	0.2
4A2-13 Other animals	CH_4	NK	15..2	0.3	14.8	0.3	0.0	2	2	0.1
4B Manure management	CH_4		141.4	3.0	117.1	2.5	-0.0	14	15	1.2
	N_2O	L	2.2	0.7	2.4	0.8	0.0	4	4	0.4
	All			3.7		3.2	0.0	18		1.5
4B2 Cattle	CH_4	L	74.9	1.6	69.0	1.4	-0.0	8	9	0.7
4B8 Swine	CH_4	L,T2	54.3	1.1	44.4	0.9	0.0	5	6	0.4
4B9 Poultry	CH_4	T2	11.6	0.2	3.0	0.1	0.0	0	0	0.0
4B2-7, 10-13 Other animals	CH_4	NK	0.6	0.0	0.8	0.0	0.0	0	0	0.0
4D Agricultural soils	N_2O		34.8	10.8	27.8	8.6	-0.0	47	49	4.1
4D1 Direct soil emissions	N_2O	L,T2	14.8	4.6	15.5	4.8	-0.0	26	27	2.3
4D2 Animal production on agricultural soils	N_2O	L2,T	4.2	1.3	2.1	0.7	0.0	4	4	0.3
4D3 Indirect emissions	N_2O	L,T	15.7	4.9	10.2	3.2	-0.0	17	18	1.5
Total National Emissions	CH_4		1,211.5	25.4	795.7	16.7	-0.0		100	
	N_2O		68.4	21.2	56.7	17.6	-0.0		100	
National Total GHG emissions (excl. CO_2 from LULUCF)	All			214.3		212.1	-0.0			100

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

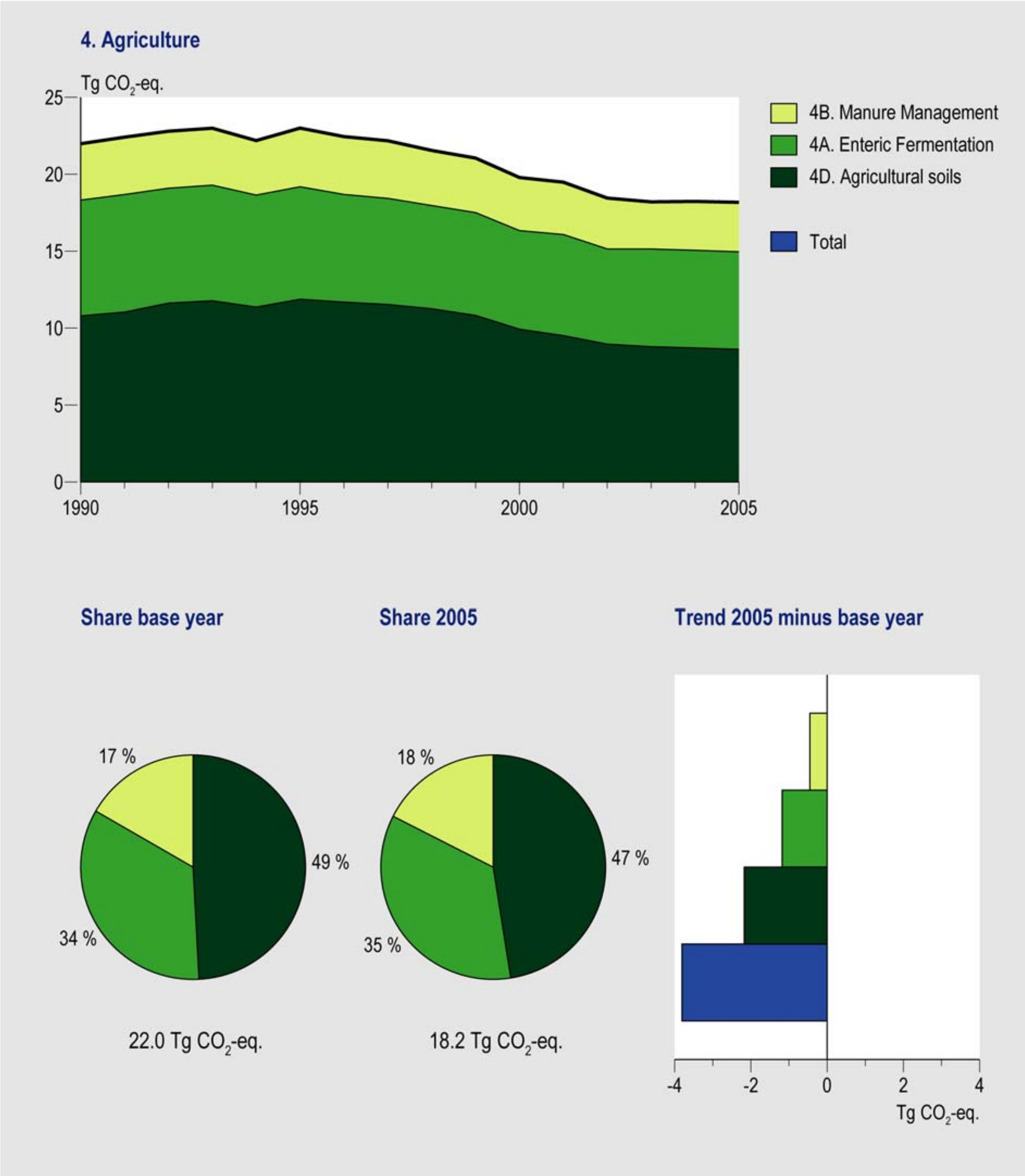


Figure 6.1 Category 4 'Agriculture: trend', emission levels and share of source categories in emissions of 4 'Agriculture', 1990-2005.

Overview of trends in activity data

Livestock numbers

Activity data for the animal population are based on the annual agricultural survey performed by Statistics Netherlands (CBS). Data can be found on the website www.cbs.nl and in background documents (e.g. Smink et al., 2005; Van der Hoek and Van Schijndel, 2006a).

For cattle three categories are distinguished:

- Dairy cattle: adult female cows (for milk production);
- Non-dairy cattle: adult cows (for meat production);
- Young cattle showing a mix of different age categories (for breeding and meat production).

Table 6.2 Numbers of animals in 1990–2005 (1000 heads) (CBS, 2006).

Animal type	**1990**	**1995**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Cattle	4,926	4,654	4,070	4,034	3,858	3,759	3,767	3,799
- dairy cattle	*1,878*	*1,708*	*1,504*	*1,546*	*1,486*	*1,478*	*1,471*	*1,433*
- non-dairy cattle	*120*	*146*	*163*	*161*	*151*	*144*	*145*	*152*
- young cattle	*2,929*	*2,800*	*2,403*	*2,328*	*2,222*	*2,137*	*2,151*	*2,214*
Sheep	1,702	1,674	1,308	1,289	1,186	1,185	1,236	1,363
Goats	61	76	179	219	255	274	282	292
Horses	70	100	118	120	121	126	129	133
Swine × 1000	13.9	14.4	13.1	13.0	11.6	11.2	11.2	11.3
Poultry × 1000	95.6	92.2	107.2	103.4	104.0	74.9	88.5	94.4

Between 1990 and 2005 cattle and swine animal numbers decreased by 23 and 19% respectively, while poultry numbers hardly changed. Sheep numbers decreased by 20%. Goat numbers increased by 479% and horse numbers increased by 91%.

For cattle the decrease in numbers is mainly explained by an increase in milk production per dairy cow combined with an unchanged total milk production. Milk production per cow increased between 1990 and 2005, a development which has resulted from both genetic changes in cattle (due to breeding programmes) and the change in amount and composition of feed intake. Total milk production in the Netherlands is determined mainly by EU policy on milk quota. Milk quota remained unchanged in the same period. In order to comply with the unchanged milk quota, animal numbers of (dairy) cattle had to decrease to counteract the effect of increased milk production per cow. Between 1990 and 2005 the numbers of young (dairy) cattle follow the same trends as those of adult female cattle – namely, a decrease (Van der Hoek and Van Schijndel, 2006a).

In addition, by regulating the amount of manure production and manure application, the Netherlands policy on manure management directly influences livestock numbers in the Netherlands, especially of young (dairy and non-dairy) cattle.

The decrease in total cattle numbers between 1990 and 2003 changes into a small increase in 2004 as well as in 2005. The increase in total cattle numbers does not occur for dairy cattle numbers. The decreasing dairy cattle numbers is continued in 2005 and is explained above by the increasing milk production per cow in combination with unchanged national milk quota.

For young cattle the decreasing trend of the past has flattened the last couple of years. In 2004 a slight increase in animal numbes is noted here. More specifically, young non-dairy cattle show an increase in animal numbers while young dairy cattle numbers follow the same decreasing trend as adult dairy cattle (Smink et al., 2005; Smink, 2005; Van der Hoek and Van Schijndel, 2006a). Apparently, for non-dairy (young and adult) cattle the Netherlands policy on manure management no longer effectuates an ongoing decrease in livestock numbers in the Netherlands.

The decreasing numbers of swine are a result of the manure management policy of the Netherlands. The same phenomenom as with non-dairy cattle is noticed with swine. The decreasing trend of the past has flattened the last couple of years and has changed into a slight increase in animal numbers in 2005.

The increased number of swine in 1997 was a direct result of the outbreak of classical swine fever in that year. 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 stay on the pig farms. This explains why the annual census of 1997 shows a relatively high number of pigs.

Table 6.2 shows an increase in the number of poultry animals between 1990 and 2002. In 2003, however, poultry animal numbers decreased by almost 30% as a direct result of the avian flu outbreak. In 2004 and 2005, the poultry population has recovered to a large extent: in 2005 it has reached a level of 10% below the 2002 level.

Nitrogen flows

Table 6.3 presents *activity data* for the nitrogen flows from synthetic fertilisers and from animal waste management systems in the Netherlands. About 80–85% of the manure collected in the stable and in storage is applied to soils. A small portion of the manure (approximately 2–4%) is exported; the remainder is emitted as ammonia during storage. Ultimately, between 1990 and 2005 the part of the N in manure and synthetic fertiliser emitted as NH_3 (during storage, grazing and application to the field) decreased from approximately 18% to 13%. Of the total nitrogen flow to the soil only 30% (default IPCC fracleach) is subject to leaching and run-off.

Table 6.3 Nitrogen flows related to N_2O emissions from soils.

	1990	1995	2000	2004	2005	Change 2005 - 1990
Nitrogen fertilizer consumption	412.0	406.0	339.0	300.5	279.2	-32%
of which ammonium fertilizer	3.6	11.2	6.5	38.8	30.7	753%
NH_3-N emission during application	11.1	10.6	9.2	10.5	9.8	-12%
Net fertilizer to soil	400.9	395.4	329.8	290.0	269.5	-33%
Nitrogen excretion by animals	663.9	657.0	528.0	461.0	467.1	-30%
Nitrogen excretion in animals houses	493.1	500.5	414.9	373.2	379.1	-23%
of which in solid form	61.9	71.2	76.9	68.1	73.6	19%
of which in liquid form	431.2	429.3	338.0	305.1	305.5	-29%
NH_3-N emission in animal houses	73.4	73.8	60.6	48.7	50.2	-32%
Net available manure for application	419.7	426.7	354.3	324.5	328.9	-22%
Nitrogen in manure exported abroad	6.4	22.1	14.7	15.5	14.9	133%
NH_3-N emission during application	98.2	51.4	36.8	33.0	32.2	-67%
Net animal manure to soil	315.1	353.2	302.8	276.0	281.8	-11%
Nitrogen excretion in meadow	170.8	156.5	113.1	87.9	88.0	-48%
NH_3-N emission in meadow	13.0	11.9	8.5	7.1	7.1	-45%
Net animal manure to soil	157.8	144.6	104.6	80.8	80.9	-49%
Total nitrogen supply to soil (manure + fertilizer - export)	1069.5	1040.9	852.3	746.0	731.5	-32%
Nitrogen fixation in arable crops	7.8	4.9	4.7	4.8	4.5	-42%
Nitrogen in crop residues left in field	36.4	34.9	34.1	32.8	32.1	-12%
Nitrogen in sewage sludge on agric. land	5.0	1.5	1.5	1.1	1.2	-76%
Atmospheric deposition agr. NH3-N em	195.8	147.7	115.2	99.3	99.3	-49%
Nitrogen lost through leaching and run off	322,3	306,6	255,7	223,8	219,4	32%

The amount of nitrogen in manure (applied to soil and produced in the meadow) and fertiliser applied to agricultural soils decreased by approximately 32% between 1990 and 2005. This is explained by the Netherlands policy on manure management, aimed at reducing N leaching and run-off. This manure policy regulates the amount of manure production and its application.

In the next sections more details on animal number changes and other activitiy data are given to provide an explanation of the changes in emissions of CH_4 and N_2O.

6.2 Enteric fermentation [4A]

6.2.1 Source category description

Methane emissions are produced as a by-product of the digestive process in which carbohydrates are broken down by micro-organisms into simple molecules under anaerobic conditions. Both ruminant (e.g. cattle and sheep) and non-ruminant animals (e.g. pigs and horses) produce CH_4, although ruminants produce more CH_4 per unit of feed intake than non-ruminants.

Buffalo and camels do not occur in the Netherlands. The emissions from llamas, mules and donkeys are negligible and, therefore, are not taken up in the estimation. Enteric fermentation emission from poultry is not estimated due to the lack of data on CH_4 emission factors 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.

Overview of shares and trends in emissions

In 2005 Enteric fermentation accounted for 35% of the total greenhouse gas emissions from the agricultural sector (see Table 6.1). In the Netherlands CH_4 emissions from Enteric fermentation are related particularly to the production of cattle; this source contributed substantially to the greenhouse gas emissions from agriculture in 2005 (31%). The second largest CH_4 emission source in category 4A is pig production. 4A Other (sources of enteric fermentation) consists of sheep, goats and horses.

CH_4 emissions from Enteric fermentation decreased from 7.5 Tg CO_2-eq. to 6.3 Tg (–16%) between 1990 and 2005, with CH_4 emissions from enteric fermentation by cattle and swine decreasing by 16% and 19%, respectively. From 2004 to 2005 a slight decrease of 0,2% indicates a stabilization of the CH4 emission (Figure 6.2). Here a small CH4 emission increase of all animal categories (except dairy cattle) is compensated by a small but greater CH4 emission decrease from cattle. This can be explained by the increase in animal numbers of all animal categories except dairy cattle compensated by an ongoing decrease of dairy cattle numbers (Table 6.2).

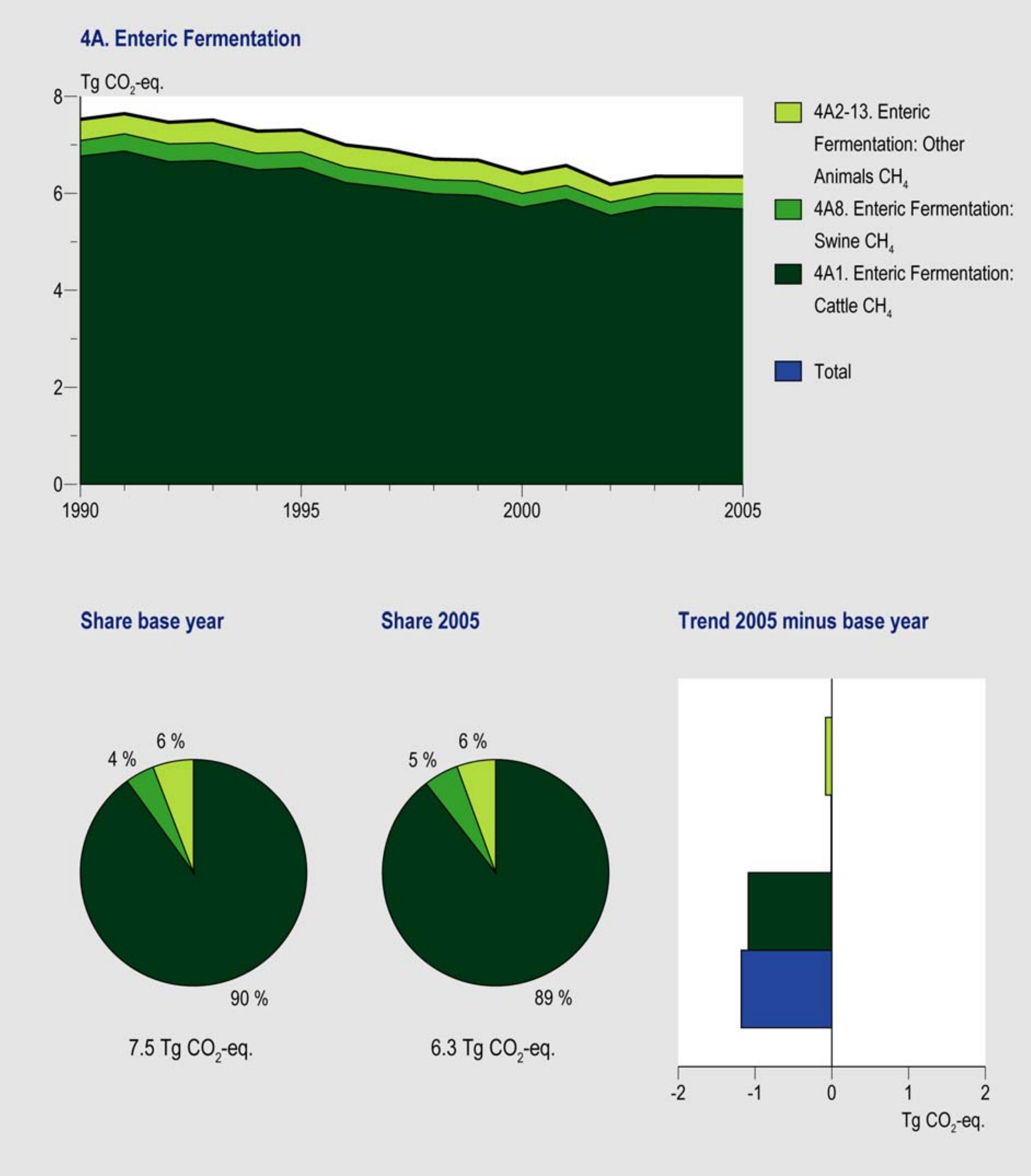


Figure 6.2 Category 4A 'Enteric fermentation: trend', emission levels and share of source categories in emissions of 4 'Agriculture', 1990-2005.

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 7127: CH_4 from Enteric fermentation: cattle (4A1);
- Protocol 7128: CH_4 from Enteric fermentation: other animal categories (4A2-13);

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

Activity data for the animal population (see also Table 6.2) are based on the annual agricultural survey performed by Statistics Netherlands (CBS). Data can be found on the website www.cbs.nl and in background documents (Smink et al., 2005; Smink, 2005; Van der Hoek and Van Schijndel, 2006a).

The increase in the number of goats might be explained as an effect of the milk quota for catlle. As result of the milk quota for cattle and the market development for goats milk products, farmers tent tot change there management towards goats.

The decreased CH_4 emission from swine between 1990 and 2005 largely results from the decrease in their animal numbers. For cattle to a great extent this is also the case, but the decrease in animal numbers is not entirely followed by the same decrease in CH_4 emissions from enteric fermentation. Especially for dairy cattle the emission factor has increased as result of the increased feed intake in order to increase milk production. On the level of cattle subtypes animal numbers cannot explain the emission trend entirely. For an explanation more detailed information is needed on emission factors of cattle sub types.

For swine, sheep, goat and horses default IPCC emission factors are used (1.5, 8, 5 and 18 kg/animal, respectively). So changes in emissions for these animal categories are explained entirely by changes in animal numbers.

The emission factors for three cattle types are calculated annually (e.g. adult dairy, adult non-dairy and young cattle, respectively. Table 6.4 shows the (implied) emission factors (IEF) of the different cattle categories reported.

Table 6.4 Implied emission factors for methane emissions from enteric fermentation specified according to CRF animal category (Units: kg/animal).

	1990	1995	2000	2001	2002	2003	2004	2005
Adult dairy cattle	108	113	118	120	119	125	126	128
Adult non-dairy cattle	67	67	68	68	68	73	74	72
Young cattle	38	39	35	35	35	36	35	34

For both adult dairy and adult non-dairy cattle during the period 1990–2005 IEF increased as a result of an increase in total feed intake and of changes in the share of feed components. For dairy cattle also a change in the feeds nutrient composition influenced the IEF (see section 6.2.2). For young cattle the IEF decrease between 1990-2005 can be explained by a change in the total feed intake and in the share of feed components in the same period. This change was caused by a change towards a relatively high share of meat calves in the young cattle population (Smink, 2005 and Van der Hoek en Van Schijndel, 2006).

Table 6.5 shows that the adult dairy cattle IEF follows the increasing trend in milk production. The slightly lower IEF compared to the default IPCC IEF for adult dairy cattle at a comparable milk production rate (e.g. 7400 kg per cow per year in 2000) can be explained by the higher feed digestibility in the Netherlands.

Table 6.5 Milk production (kg milk/cow/year) and IEF (kg/animal) for adult dairy cows.

	1990	1995	2000	2001	2002	2003	2004	2005
Milk production	6050	6580	7416	7336	7187	7494	7415	7568
CH_4 IEF	108	113	118	120	119	125	126	128

Table 6.5 shows that, in 2000, a milk production of about 7400 kg per year per cow leads to an emission factor of 118 kg per animal per year, about 7-8% lower compared to the default of 126 kg per animal per year. This is in compliance with the higher digestibility of the feed in the Netherlands (70–75%) compared to the feed digestibility underlying the IPCC default value (65%).

With increasing milk production a decrease in amount of CH_4 emission per liter milk (from 0.018 to 0.017 kg CH_4 per liter milk) can be noticed

For adult non-dairy cows the higher IEF (compared to the IPCC default value of 48 per animal) for the Netherlands 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.

From 2004 to 2005 dairy cows IEF increased by 1.5% as a consequence of a higher feed intake to reach a 2% higher milk production. For non-dairy cows and young cattle IEFs decreased by 3% as a consequence of a decreased feed intake.

Figure 6.3 summarizes the relation between the trends in the number of cattle (dairy, non-dairy and young) and the methane emission due to enteric fermentation from these categories.

The figure clearly shows that for adult dairy cattle in the period 1990–2005 the pace at which methane emissions have declined does not match the trend for declining numbers of dairy cattle animals. The difference can be explained by an increased methane emission factor per cow.

Non-dairy cattle emissions increased between 1990 and 2005. This increase is not fully reflected in the smaller increase in animal numbers. The difference can be explained by an increased implied emission factor

For young cattle also the decrease in methane emissions cannot be completely explained by the higher decrease in animal numbers. The difference is explained by the decrease in the methane emission factor.

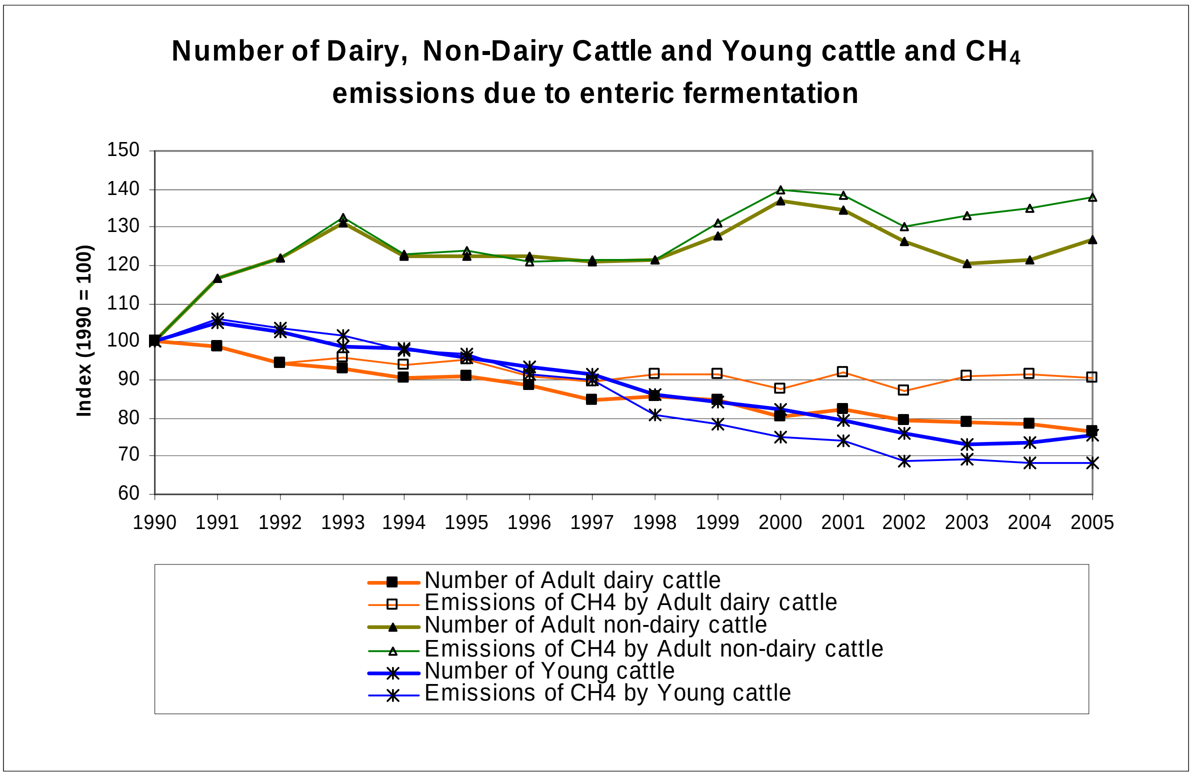


Figure 6.3 Number of cattle and CH_4 emissions due to enteric fermentation from cattle.

6.2.2 Methodological issues

A detailed description of the method, data sources and emission factors are found in the protocols on the website www.greenhousegases.nl, as indicated in section 6.1. A specified description with more details on data and data sources on cattle can be found in Smink et al. (2005) and Smink (2005). Emissions from enteric fermentation are calculated from animal population data and the appropriate emission factors.

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

Cattle

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

The dry matter intake of cattle, which is estimated from the energy requirement calculation used in the Netherlands, is the most important parameter in the calculation of methane production. For dairy cows the energy requirement (VEM or feed unit of lactation) is calculated on the basis of total milk production and feed composition. The intake of grass silage, maize silage, wet by-products and concentrates is estimated from national statistics found at www.cbs.nl (Van Bruggen, 2006). On the basis of the energy requirement, the other part of the ration is assumed to be meadow grass, which means that the calculated feed intake is suitable to cover the need for VEM. More information on the the Netherlands VEM system is presented in Smink et al. (2005).

Adult dairy cows

The production of methane from enteric fermentation by dairy cows is calculated using dynamic modelling (Smink et al., 2005), employing the model of Mills et al. (2001), including updates (Bannink et al., 2005a,b). This model is based on the rumen model of Dijkstra et al. (1992). It has been developed for dairy cows and is therefore not suitable for all cattle categories. The model calculates the gross energy intake and methane production per cow per year on the basis of data on the share of feed components (grass silage, maize silage, wet by-products and concentrates) and their chemical nutrient composition (sugars, NDF, et cetera). Data on the share of feed components are found at www.cbs.nl (Van Bruggen, 2007). Data on the chemical nutrient composition are provided by Blgg. Data used between 1990 and 2004 are presented in Smink et al. (2005), while data for 2005 are published by Bannink (2007) (via www.emissieregistratie.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 gross energy (GE) uptake by a methane conversion factor (Smink, 2005). Changes in gross energy uptake are based on changes in the total feed intake and on the share of feed components. Total feed intake is calculated on basis of various factors, including weight gain.

The equation for calculating the EF (in kg per animal per year) is:

$$EF = (Y_m * GE * 365 \text{ day/yr}) / 55.65 \text{ MJ/kg } CH_4$$

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

Where:
- GE intake = DM intake × 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 adult non-dairy cattle (IPCC, 2001)

Figures on dry matter intake are annually provided by CBS.

Other livestock

Emission factors for the source categories swine, sheep, horses and sheep are based on default IPCC Tier 1 emission factors presented in an OECD publication in 1991 and documented in Van Amstel et al. (1993).

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 was already mentioned in section 6.2.1, enteric fermentation emission from poultry is not estimated due to lack of data on CH_4 emission factors for this animal category. The IPCC Guidelines do not provide a default emission factor for this animal category. Other countries also do not estimate emissions from poultry.

6.2.3 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 20% in annual emissions, using a 5% uncertainty for animal numbers and 20% for the emission factor. The uncertainty in the emission factor for swine and other animals is estimated to be 50% and 30%, respectively.

Time-series consistency

A consistent methodology is used throughout the time-series. Emissions are calculated from animal population data and the appropriate emission factors. The animal population data are collected in an annual census and published by Statistics Netherlands. The compilers of the activity data for this long-time publication strive to use consistent methods to produce the activity data. The time-series consistency of these activity data is very good due to the continuity in the data provided.

6.2.4 Source-specific QA/QC and verification

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

6.2.5 Source-specific re-calculations

There were no source-specific recalculations for this subcategory

6.2.6 Source-specific planned improvements

There are no source-specific improvements planned.

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. These emissions are related to the quantity and the composition of the manure, and to the manure management system types and conditions. In general: In comparison to anaerobic conditions, aerobic conditions in the manure management system will increase N_2O emissions and decrease CH_4 emissions.

The category 4B Other animals (sources of Manure management) reflects the emissions of sheep, goats and horses. Buffalo and camels do not occur in the Netherlands, and llamas, mules and donkeys are negligible and therefore not estimated. Three animal waste management systems (AWMS) are distinguished for emission estimations 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).

Overview of shares and trends in emissions

In 2005, Manure management accounted for 18% of the total greenhouse gas emissions from the agricultural sector (Table 6.1 and Figure 6.4). In the Netherlands CH_4 emissions from Manure management are particularly related to the production of cattle and swine, which, in 2005, contributed 8% and 5%, respectively, to the total greenhouse gas emissions in the agricultural sector. Poultry is a minor key source for methane emissions by manure management (Tier 2 trend key source). Furthermore, N_2O emissions from Manure management contribute 4% of the total greenhouse gas emissions from the agricultural sector.

Between 1990 and 2005, the emission of CH_4 from Manure management decreased by 17%. Emissions from cattle, swine and poultry decreased by 8%, 18% and 74%, respectively, during this same period.

From 2004 to 2005, the emission of CH_4 from Manure management stabilizes.

The decreased CH_4 emission from swine manure management largely results from the decrease in their animal numbers. For cattle to a small extent this is also the case, but here a change in implied emission factor explains the emision trend. Especially for dairy cattle the emission factor has increased because of the increased feed intake in order to increase milk production. For poultry the emission trend is largely explained by the replacement of the the liquid manure system by the solid manure system (with a 15-fold lower CH_4 emission factor), causing a decrease of the implied emission factor.

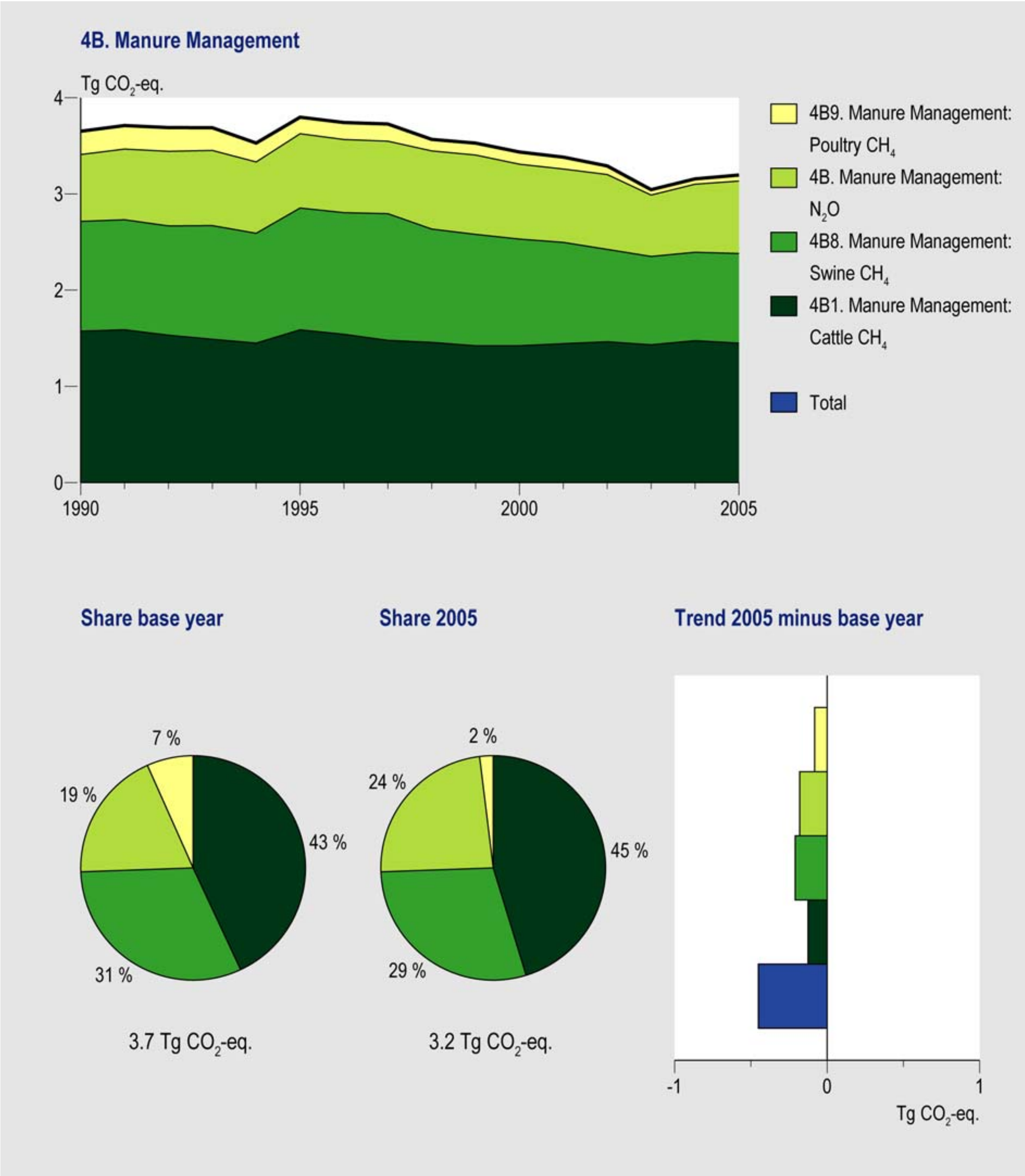


Figure 6.4 Category 4B Manure management: trend, emission levels and share of source categories in emissions of 4 'Agriculture', 1990-2005.

The emissions of N_2O from *Manure management* increased 10% between 1990 and 2005, from 2.24 to 2.43 Gg N_2O in 2005 (*Table 6.1*). This increase cannot be explained by decrease in total manure N excretion as a result of the decrease in total animal numbers. Therefore more information is needed on the different types of manure management systems.

The relatively large decrease in N_2O emissions of solid manure in 2003 is a direct result of the decrease in poultry animal manure. This decrease was due to the reduction in the number of poultry animals that followed the avian flu epidemic. In 2004, N_2O emissions increased once again following the recovery of poultry animal numbers.

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 7130: CH4 from Manure management: cattle (4B1);
- Protocol 7131: CH4 from Manure management: swine (4B8);
- Protocol 7132: CH4 from Manure management: other animal categories (4B2-7, 9-13);
- Protocol 7129: N2O 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 population can be found on the website www.cbs.nl and in a background document (Van der Hoek and Van Schijndel, 2006). Activity data on manure production (volume) and manure N excretion are estimated for different management systems on the basis of animal numbers per animal category (see Table 6.2) and manure production or manure N excretion per animal. More specified data on Manure management are based on statistical information on management systems; these data are documented in Van der Hoek and Van Schijndel (2006a,b).

For most cattle types, manure production per animal has not changed in the 1990-2005 period. The only exception is adult dairy cows. Here a 13% increase in total manure production in stable and meadow per adult dairy cow has occurred between 1990 and 2005. Most swine and poultry types have remained the same or decreased their manure volumes per animal.

The decreased CH_4 emission from swine, adult non-dairy cows and young cattle largely result from the decrease in their animal numbers. For adult dairy cattle the small decrease in CH_4 emission is much lower than the decrease in animal numbers. Also the increase in manure production per cow cannot fully explain this. For poultry the large decrease in CH_4 emissions cannot be explained by the rather small decrease in animal numbers, neither by the small decreases in manure production. So for adult dairy cattle and poultry trends in activity data (e.g. animal numbers and manure production) cannot explain emission trends. For an explanation more detailed information is needed on implied emission factors of cattle and poultry manure management systems.

Between 2004 and 2005 a small CH_4 emission increase for all animal categories except adult dairy cattle is counteracted by a slightly higher CH_4 emission decrease from cattle. This can be explained by the stabilization or small increase in animal numbers of all animal categories (except dairy cattle) counteracted by an ongoing decrease of dairy cattle numbers (Table 6.2).

CH_4 emission factors for Manure management

Table 6.6 shows the implied emission factors for Manure management specified by the animal categories that contribute the most to CH_4 emissions.

Table 6.6 CH_4 implied emission factor (kg/head) for Manure management as specified by animal category, 1990–2004.

Animal type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Cattle																
- dairy cattle	27.74	27.74	27.74	27.74	27.74	30.54	30.53	30.53	30.53	30.53	33.17	33.03	35.70	35.70	37.50	37.51
- non-dairy cattle	3.26	3.23	3.29	3.26	3.28	3.35	3.35	3.32	3.37	3.28	3.43	3.48	3.44	3.47	3.51	3..43
- young cattle	7.67	7.74	7.74	7.59	7.47	8.20	8.05	7.98	7.80	7.59	7.19	7.35	7.26	6.99	6.77	6..64
Swine*	3.91	4.12	3.82	3.76	3.73	4.19	4.18	4.13	4.17	4.06	4.02	3.84	3.92	3.91	3.92	3.92
Swine exclpiglets	6.2	6.2	6.1	6.1	6.1	6.8	6.9	6.8	6.7	6.6	6.6	6.6	6.6	6.6	6.6	6.6
- fattening pigs	5.0	5.0	4.8	4.8	4.8	5.7	5.7	5.7	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5
- breeding swine	11.4	11.3	11.4	11.5	11.5	11.6	11.5	11.4	11.2	11.5	11.2	11.3	11.4	11.2	11.3	11.3
Poultry	0.12	0.12	0.11	0.11	0.10	0.09	0.09	0.09	0.06	0.05	0.06	0.06	0.04	0.04	0.03	0.03

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

Comparison with IPCC defaults

The CS 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 animal waste management systems underlying the IPCC defaults. No IPCC defaults per animaltype have been presented. Also the values of two of the underlying parameters per manure management system (VS and B0) per animal type are not directly comparable. The Netherlands approach differs from the IPCC method in that the Netherlands uses the organic matter (OM) content of the manure instead of volatile soilids (VS) content of the feed in the IPCC calculation equations. As a consequence, B0 is also based on OM per kg manure in the Netherlands method, while it is based on VS per kg feed in the IPCC methodolgy.

Compared to the IPCC default MCF values, the Netherlands MCF values for liquid manure systems of swine, poultry 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; for manure production in the meadow, it uses the IPCC default MCF value.

Trends in IEF

The IEF for management of dairy cow manure increased between 1990 and 2005 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 stable manure increased between 1990 and 2005, while simultaneously the amount of manure produced in the meadow during grazing was reduced. This is a consequence of the increase of the time period dairy cattle are kept indoors. Firstly this is done to increase cost-effectiveness of milk production and secondly to increase the efficiency of manure application as an effect of the Netherlands manure policy. 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 (Van der Hoek and Van Schijndel, 2006a,b).

In short, between 1990 and 2005 the increases 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. These changes combined with the decrease in the number of adult dairy cow since 1990 fully explain the slight increase in the total CH_4 emission of milk-producing cows.

For *poultry,* the substantial decrease in CH_4 manure management IEF between 1990 and 2005 fully 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 solid manure production increased to great extent: 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. Overall, this leads to a substantially decreased IEF, which in combination with the very slight decrease in animal numbers fully explains the decrease in CH4 emissions (Van der Hoek and Van Schijndel, 2006a,b).

Compared to 1990, the IEF of swine manure management (based on total swine numbers, including piglets), hardly changes in 2005. However, there are some interannual changes. These changes can be explained by looking at emissions factors of underlying swine categories. The calculation method for CH4 emissions from swine manure management is based on the 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 interannual changes.

For fattening pigs the 4% decrease in IEF between 1992 and 1993 is explained by a 4% decrease in manure production per animal. The 19% increase between 1994 and 1995 is effectuated by an increase in the emission factor for the manure management system. Another 4% decrease in IEF between 1997 and 1998 is explained by another 4% decrease in manure production per animal. These changes are the 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. As a consequence not only manure volume decreased, but also an increase in the organic matter concentration of manure occurred. An higher organic matter content results in a higher emission factor.

The interannual changes between the IEF for *breeding pigs'* manure are explained by interannual 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, 2006a,b).

N_2O emission factor for Manure management

Emission factors for N_2O from *Manure management* represent the IPCC default values for liquid and solid systems.

Table 6.7 N_2O implied emission factor for Manure management and total N-excretion per animal waste management system (Units: mln kg/year and kg N_2O/kg manure).

	1990	1995	2000	2001	2002	2003	2004	2005
Total N-excretion	493.0	500.5	414.9	411.8	394.9	375.6	373.2	379.1
-liquid system	431.2	429.3	338.0	338.8	318.7	316.1	305.1	305.5
-solid storage	61.9	71.2	76.9	73.0	76.2	59.6	68.1	73.6
N_2O emission manure management	2.24	2.49	2.51	2.46	2.51	2.06	2.28	2.43
N_2O IEF manure management	0.0045	0.0050	0.0060	0.0060	0.0064	0.0055	0.0061	0.0064

Table 6.7 shows that the N_2O emissions from Manure management increased between 1990 and 2005. This increase cannot be explained by the decrease in total N excretion. Between 1990 and 2005 the proportion of the total solid manure N excretion increased. Compared to the liquid manure system, the N_2O emission factor for the solid system is about 20-fold higher, which explains the increased overall IEF. This increased IEF was not fully counteracted by the decrease in de total N excretion and therefore has lead to a small increase in N_2O emissions.

The N_2O emissions of solid manure decreased in 2003 as a direct result of the decrease in poultry animal manure. This decrease was due to the reduction in the number of poultry animals that followed the avian flu epidemic. In 2004, N_2O emissions increased once again following the recovery of poultry animal numbers.

6.3.2 Methodological issues

Methane emissions from animal manure

The methodologies used to calculate CH_4 from manure management systems are in accordance with the IPCC guidelines. However, the approach of the method applied by the Netherlands for CH_4 calculations differs slightly from the IPCC method. The Netherlands uses a country-specific emission factor for a specific animal category, which is expressed as amount of methane 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.

The amount of manure produced is calculated by multiplying manure production factors (in kiloggrammes per head per year) by animal numbers. Detailed descriptions of the methods can be found on the website www.greenhousegases.nl.

A Tier 2 approach is followed for CH_4 emissions. The amounts of manure (in kilogrammes) 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 methane-producing potential (B0);
- manure management system conditions (storage temperature and period) for liquid manure systems, which determine the methane conversion factor (MCF).

For the other manure systems (solid manure and manure produced in the meadow), IPCC default values for the methane conversion factor (MCF) 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 possibly higher (see Van der Hoek and Van Schijndel, 2006a,b). 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 methane emission calculations.

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

The calculations of N_2O emissions are based on the same activity data as those for the calculations of CH_4 emissions. For the manure management systems and animal categories distinguished, the total N content of the manure produced – also called N excretion – (in kilogramme N) is calculated by multiplying N excretion factors (kg N per head × year) by animal numbers. Activity data are collected in compliance with a Tier 2 level method. However, 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), because the N_2O emission from manure management is a 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 section 6.1 and 6.4).

6.3.3 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 CH_4 and N_2O emissions from manure management from cattle and swine is estimated to be approximately 100% in annual emissions. 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%.

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.

6.3.4 Source-specific QA/QC

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

6.3.5 Source-specific re-calculations

Compared to the previous submission, there have been no re-calculations.

6.3.6 Source-specific planned improvements

A possible policy measure to prevent methane emissions due to Manure management is manure treatment in an anaerobic digester. The Netherlands will examine future needs and possibilities in this area to include anaerobic treatment in the methodology and to extend calculations, thereby taking the impact of this measure on emissions into account.

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 fertilisers, animal wastes and sewage sludge to soils, and from N-fixing crops, crop residues and the cultivation of histosols (4D1);
- Animal production – i.e. animal waste produced in the meadow during grazing (4D2);
- Indirect emissions from nitrogen leaching and run-off, and from deposition (4D3).

Overview of shares and trends in emissions
The share of N_2O emission from Agricultural soils in the national total N_2O emissions was approximately 50% in both 1990 and 2005. The most important sources of N_2O emissions from Agricultural soil are direct emissions due to the application of synthetic fertilisers and animal manure to soil and indirect emissions caused by nitrogen leaching and run-off. The share of direct N_2O emissions in the national total N_2O emissions was about 22% in 1990 and about 27% in 2005. The share of indirect N_2O emissions in the national total was about 23% in 1990 and about 18% in 2005 (see also Table 6.1).

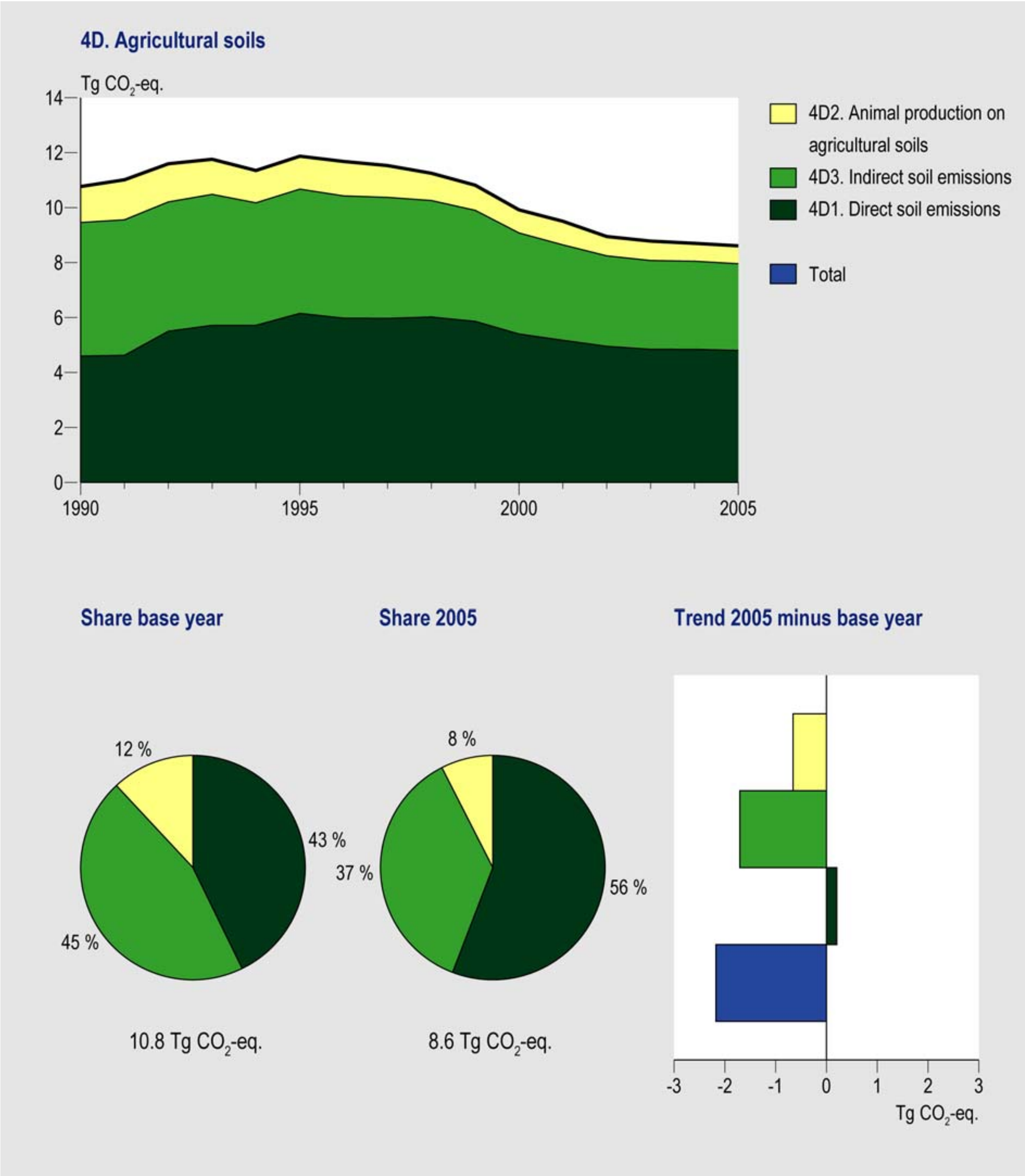


Figure 6.5 N_2O emissions from 4D Agricultural soils, 1990-2005.

In the Netherlands CH_4 emissions from *Manure management* are particularly related to the production of direct and indirect N_2O emissions, and to the emissions from animal production in the meadow. In 2005, these sources contributed 26%, 17% and 4%, respectively, to the total greenhouse gas emissions in the agricultural sector.

Total N_2O emissions from Agricultural soils decreased by 20% between 1990 and 2005 (see Figure 6.5). This decrease is caused by a relatively high decrease in N-input to soil (from manure and chemical fertiliser application and animal production in the meadow) partly counteracted by the increased implied emission factor in this period that resulted from a shift from the surface spreading of manure to the incorporation of manure into soil.

Key sources
Both direct and indirect N_2O soil emissions are major-level and/or trend key sources (see Table 6.1).

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 7134: N_2O from Agricultural soils: direct emissions and emissions from animal production (4D);
- Protocol 7133: N_2O from Agricultural soils: indirect emissions (4D).

More details and specific data (activity data and emission factors), including data sources (emission factors), are documented in background documents (mentioned below). 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 an overview see NIR 2006, the protocols (www.broeikasgassen.nl) or the background documents (Van der Hoek et al., 2006;Van der Hoek en Van Schijndel, 2006b).

The total N-input to soil in the Netherlands decreased by 32% from 1990 to 2005, mainly as a result of the Netherlands manure policy aimed at reducing N leaching and run-off. This decrease is not fully reflected in the 20% decrease in agricultural soil N_2O emissions during the same period (Table 6.1). The 32% decrease in **indirect** N_2O emissions is fully reflected by the decrease in N-input by atmospheric deposition and nitrogen leaching and run-off. The decrease in N-input by atmospheric deposition of almost 50%, as a result of ammonia legislation, was relatively high.
The 50% decrease in N_2O emissions by **Animal production** is completely reflected in the decrease in N-input by this source.
However, the 5% increase in **direct** N_2O emissions cannot be explained by the 32% decrease in the direct N-input to soil by manure and chemical fertiliser application. For an explanation more detailed information is needed on implied emission factors of direct emissions sub sources

IPCC default emission factors are used to calculate indirect N_2O emissions from atmospheric deposition and nitrogen leaching and run-off.

Country-specific emission factors are used for direct N_2O emissions and emissions from animal production. The country-specific emission factors for mineral soils are lower
(e.g. 0.01 kgN/kgN-input) and higher for organic soils (0.02 kg N/kg N-input) compared to the IPCC default of 0.0125 kg N/kg N-input. A higher emission factor of 0.02 kg N/kg N-input is also used for manure incorporation into soil.

Table 6.8 shows the implied emissions factors (IEF) for N_2O emissions from Agricultural soils for several sources. For direct soil emissions by manure application to soil a doubling of the IEF occurs in the period 1990–2004 which is caused by a shift from the surface spreading of manure to the incorporation of manure into the soil.

Table 6.8 Direct and animal production N_2O implied emission factors for Agricultural soils by CRF category (Units: kg N/kg N-input).

	1990	1995	2000	2001	2002	2003	2004	2005
Nitrogen input from applic. of synthetic fertilizers	0.011	0.011	0,011	0.010	0.010	0.010	0.010	0.010
Nitrogen input from manure applied to soils	0.011	0.02	0,02	0.02	0.02	0.02	0.02	0.02
Nitrogen input from animal production	0.016	0.016	0,015	0.015	0.015	0.015	0.015	0.015

Between 1990 and 1999, N_2O emissions from manure application (4.D.1.2) increased a factor 2. This increase can not be explained by the (relatively small) decrease in N-input to the soil in that period. During this period there was a change in the method of animal manure application to agricultural soils. Before 1991 manure was applied by spreading on the surface of grasslands and agricultural soils. Initiated by the Netherlands' policy to reduce ammonia emissions, this practice changed in 1991 into manure incorporation into the soil (e.g. sod injection and ploughing in). The N_2O emission factor for incorporation into mineral soils is twice as high as the N_2O emissions factor for surface spreading. In combination with the small decease in N-input, this explains the two times higher increase in N_2O emissions by manure application.

Between 1999 and 2005 direct soil N_2O emissions from manure application decreased by 15%. This decrease is fully reflected in the decrease in N-input during the same period.

6.4.2 Methodological issues

Direct and indirect soil N_2O emissions, as well as N_2O emissions by animal production are estimated using country-specific activity data on N-input to soil and NH_3 volatilisation during grazing, manure management (storage) and manure application. Most of these data are estimated on a Tier 2 level (or higher). 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. (2006), with more details in Kroeze (1994).

Direct N2O emissions and animal production
The IPCC Tier 1b/2 methodology is used to estimate direct N_2O emissions from animal production. Emissions from the application of synthetic fertiliser and manure have been estimated according to different subsources: organic and inorganic soils, ammonium phosphate/sulphate and other synthetic fertilisers and different manure application methods.

For Animal production a distinction is made between nitrogen in urine and in faeces. Direct N_2O emissions from histosols, crop residues and nitrogen fixation are also estimated using country-specific Tier 2 methods.

Country-specific emission factors are used for direct N_2O emissions and emissions from animal production. The country-specific emission factors for mineral soils are lower than IPCC defaults and higher for organic soils.

A higher emission factor than the IPCC default is also used for incorporation into soil. In theory, these new incorporation methods will increase the local concentration of nitrogen in the upper layer of the soil, resulting in a different microbial environment and therefore influencing microbial processes. Ultimately, N_2O emissions per amount of manure applied will increase, as has been shown in past research projects (mostly on laboratory scale) (Kroeze, 1994).

A recent survey on N_2O emission factors for the field-scale application of animal manure (Kuikman et al., 2006) showed that on the basis of available data it was not possible to make an update of the N_2O emission factors applied in the past (Kroeze, 1994). Very few comparative trials between surface spreading and incorporation have been carried out in the Netherlands to date, resulting in very low emission rates for both techniques. Field-scale comparative experiments carried out in other countries show that, in most cases, N_2O emissions increased and seldom were lower in comparison with surface application. However, it was not possible to deduce long-term average N_2O emission factor from these findings and to translate these to the Netherlands circumstances. Therefore, it was not possible to underpin an update of the N_2O emission factor for the application of animal manure. More research is needed in order to be able to take the specific circumstances of the Netherlands into account.

Indirect N_2O emissions
The IPCC Tier 1 method is used to estimate *indirect* N_2O emissions. Indirect N_2O emissions resulting from atmospheric deposition are estimated using country-specific data on ammonia emissions (estimated at a Tier 3 level). IPCC default values are used for N_2O emission factors because of the lack of country-specific data.

Indirect N_2O emissions resulting from leaching and run-off N emissions are estimated using country-specific data on total N-input into soil. IPCC default values are used for the fraction of N-input to soil that leaches from the soil and ends up partly as N_2O emissions from groundwater and surface water (fraction leached) and for N_2O emission factors. The reason for this is the lack of country-specific data that can be used consistently together with data employed in the estimation of direct soil emissions.

6.4.3 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 nitrogen used in agriculture is estimated to be more than a factor of 2.

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.

6.4.4 Source-specific QA/QC

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

6.4.5 Source-specific re-calculations

Compared to the previous submission, there have been no re-calculations.

6.4.6 Source-specific planned improvements

IPCC default values are used to estimate the fracleach (fraction of N-input to soil leaching from the soil and being released partly as N_2O from groundwater and surface water) for the indirect N_2O emissions from agricultural soils and the N_2O emission factors. The main reason for this approach is the lack of country-specific data that is consistent with the data used to estimate direct soil emissions. The present methodology fully complies with the IPCC Good Practice Guidance (IPCC, 2001). The specific characteristics of the Netherlands agricultural soils (with relatively high water tables) justify the calculation of the fracleach and the emission factors on the basis of country-specific data. Therefore, the Netherlands will examine the needs and possibilities of extending calculations in the future in order to take specific circumstances into account.

A higher emission factor than the IPCC default is used for the incorporation of manure into soil. In the past, research (mostly on laboratory scale) has shown an increase in N_2O emissions (Kroeze, 1994). However, the findings of a recent survey on N_2O emission factors for the field-scale application of animal manure did not provide the necessary underpining for an update of long-term average N_2O emission factors for the application of manure under the specific circumstances in the Netherlands. Consequently, more research is needed to take the specific circumstances into account.

7. LAND USE, LAND USE CHANGE and FORESTRY [CRF sector 5]

Major changes in the LULUCF sector compared to the National Inventory Report 2005

Emissions: The emission figures from LULUCF in 2005 show a very small decrease in net emission compared to the figures of 2004. The decrease in emission reflects the impact of a slight increase in sequestration in forests − leading to a decrease in emission − from *Land converted to Forestry* (increase is comparable to earlier years, which is a direct consequence of the used methodology) and a small decrease in emissions from *Other* due to changes in the use of limestone and dolomite.
Key sources: no changes.
Methodologies: Changes in methodology have not been made.

7.1 Overview of sector

The sector Land Use, Land Use Change and Forestry (LULUCF) covers the emissions and removals of CO_2 and the emissions of non- CO_2 greenhouse gases. For the Netherlands only emissions and removals of CO_2 are reported (N_2O from land use is included in the Agriculture sector in category 4D, Agricultural soils). 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.
The methodology of the Netherlands 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 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.

Approximately 57% of the territorial area of the Netherlands is agricultural (grassland and cropland), 13% is used for settlements and 10% is forested (including trees outside forests) and 2% comprises dunes, nature reserves, wildlife areas and heather. The remaining area in the Netherlands is open water (19%).
The changes in land use have been calculated by comparing topographical maps that best represent 1990 and 2000. Changes after 2000 have been obtained by linear extrapolation. The land use changes, as they occurred during the period 1990–2000, show that the area used for settlements increased at a rate similar to the decrease in the area under grassland (about 100,000 ha in 10 years; approximately 2% of the total territorial area). Changes in the area under cropland and forest during this period were relatively small. The net increase in forested area, including a category of forest that does not meet the forest definition (‘trees outside forest’), was about 3000 ha and the decrease in cropland was about 3000 ha.

The contribution of the sector LULUCF was reported for the first time in 2003, when it covered only 5A Forest Land. It was in the NIR 2005 that all LULUCF categories were included for the first time in the inventory. As a result of this inclusion, the contribution of the LULUCF sector to the total national greenhouse gas emission inventory changed from a net sink in the NIR’s of 2003 and 2004 – which included only forestry – to a net source of CO_2 (including all LULUCF categories) in the NIR 2005.
The national inventory of the Netherlands comprises seven source/removal categories in the LULUCF:

- 5A: Forest Land;
- 5B: Cropland;
- 5C: Grassland;
- 5D: Wetlands;
- 5E: Settlements;
- 5F: Other Land;
- 5G: Other.

All categories are relevant in the Netherlands. The net emissions of land use categories remaining unchanged (e.g. cropland remaining cropland) are assumed to be zero, except for the stocks in Forest Land (5A1) due to stock growth, felling and thinning and in Grasslands (5C1) due to (water) the management of organic soils.

The availability in the Netherlands of detailed information on the use of the entire land area allows the establishment of a land use matrix according to IPCC guidance. As a result, the information on carbon contents can be expressed with a relatively high degree of accuracy. The Netherlands has an intensive agricultural system with high inputs of nutrients and organic matter, and much agricultural land is in a rotation (within arable land and between grassland and cropland (especially maize). On this basis it is assumed that the impact of land use in the Netherlands in terms of loss of soil carbon is likely to be relatively small. We have assumed no changes in the carbon stocks due to land and soil management and cultivation practices over the period 1990–2005.

Emissions from liming are also presented in CRF Table 5(iv). The available data on the use of limestone and dolomite are not considered separately for grassland and cropland.

The data and methods used for this sector were validated for the NIR 2007, and the data used were refined. This has changed the reported net emission of CO_2 compared with the previous submission. The changes imply a more accurate calculation of the carbon stock in soils (average stock is now calculated using 70 soil strata instead of seven soil classes), a correction of the carbon stock in peat soils with a specific ground water level (gtII) and an improvement of the land use and land use change maps for 1990 and 2000, which affects area data, carbon stock in soils and deforestation and afforestation data.

In adjusting the methodologies, the IPCC Good Practice Guidance on Land Use, Land Use Change and Forestry (IPCC, 2003) was taken into account. The methodologies applied for estimating CO_2 emissions and removals of the land use change and forestry in the Netherlands are described in the following two protocols (see also the website at www.greenhousegases.nl):

- Protocol 7135: CO_2 from forest (5A);
- Protocol 7136: CO_2 from total land use categories (5B-5G).

Sector 5 ‘Land use, land use change and forestry’ (LULUCF) accounted for 1.1% of the total national CO_2 emission in 1990 and 2005. For 1990 and 2005, the total net emissions are estimated to be approximately 2.4 Tg CO_2 respectively 2.3 Tg CO_2, with the major source being CO_2 emissions from the decrease in 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: –2.3 Tg CO_2, included in 5A1 ‘Forest Land remaining forest land’.

Table 7.1 shows the sources and sinks in the LULUCF sector in 1990 and 2005. For 1990 and 2005 the total net emissions were estimated to be approximately 2.4 Tg CO_2 respectively 2.3-Tg-CO_2-equivalents (1.1% in 1990 and 1.1% in 2005 of the total CO2 emissions). The key sources are 5A1 (Forest Land remaining Forest Land), 5C1 (Grassland remaining Grassland) and 5F2 (Land converted to Other Land). The major source is CO_2 emissions from the decrease in carbon stored in organic soils and peat lands (4.2 Tg CO_2-equivalents included in 5C1 Grassland remaining Grassland) resulting from agricultural and water management. The major sink is the storage of carbon in forests (-2.5 Tg CO_2-equivalents included in 5A1 Forest Land remaining Forest Land).

The net emission from Forest Land converted to Other Land category is 369 Gg CO_2. Of this net emission 75.8% is from forests (according the definition) and 24,2% is from trees outside forests and from heather. The net emissions from forests is an information item in CRF Table 5 for LULUCF; relevant for the assessment of the Assigned Amount (75.8% of 369 Gg CO_2 = 280 Gg CO_2). The contribution of LULUCF to the reported **Assigned Amount** of the Netherlands is less than 0.13%.

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

Sector/category *Key sources*	**Gas**	**Key**	**Emissions base year (1990)**		**Emissions 2005**		**Contribution to total in 2005 (%)**		
		Level, Trend, Non-Key	Gg	Tg CO_2-eq.	Gg	Tg CO_2-eq.	By sector	Of total gas	Of total CO_2-eq.
5. Total land use categories	CO_2		**2,392**	**2.4**	**2,341**	**2.3**	**100**[1)]	**1.3**	**1.1**
5A. Forest land	CO_2		**-2,516**	**-2.5**	**-2,459**	**-2.5**	**-32**		
5A1. Forest Land remaining Forest Land	CO_2	L,T2	-2,505	-2.5	-2,289	-2.3	-30		
5A2. Land converted to Forest Land	CO_2		-11	0.0	-170	-0.2	-2		
5B. Cropland	CO_2		**-36**	**0.0**	**-36**	**0.0**	**-0.5**		
5B1. Cropland remaining Cropland	CO_2		NA, NE		NA, NE				
5B2. Land converted to Cropland	CO_2		-36	0.0	-36	0.0	-0.5		
5C. Grassland	CO_2		**4,195**	**4.2**	**4,195**	**4.2**	**54**		
5C1 Grassland remaining Grassland	CO_2	L	4,246	4.2	4,246	4.2	55		
5C2. Land converted to Grassland	CO_2		-51	-0.1	-51	-0.1	-0.7		
5D. Wetlands	CO_2		**NE**		**NE**				
5D1. Wetlands remaining Wetlands	CO_2		NE		NE				
5D2. Land converted to Wetlands	CO_2		NE		NE				
5E. Settlements	CO_2		**-152**	**-0.2**	**-152**	**-0.2**	**-2**		
5E1. Settlements remaining Settlements	CO_2		NE		NE				
5E2. Land converted to Settlements	CO_2		-152	-0.2	-152	-0.2	-2		
5F. Other Land	CO_2		**717**	**0.7**	**717**	**0.7**	**9**		
5F1 .Other Land remaining Other Land	CO_2		0	0.0	0	0.0	0		
5F2. Land converted to Other Land	CO_2	L	717	0.7	717	0.7	9		
5G. Other	CO_2		**183**	**0.2**	**75**	**0.1**	**1**		
Total National Emissions (incl. CO_2 LULUCF)	**CO_2**		**161,771**	**161.8**	**178,241**	**178.2**		**100**	
National Total GHG emissions (incl. CO_2 LULUCF)	All			216.7		214.4			100

[1)]Absolute value 2005 (sinks and sources total: 7735 Gg)

7.2 Forest Land [5A]

7.2.1 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. Over the last decades the share of mixed and broad-leaved forests has been growing (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.

Forest land is defined as land with woody vegetation and with tree crown cover of more than 20% over an area in excess of 0.5 ha. The trees should be able to reach a minimum height of 5 m at maturity in situ. Forest land may consist either of closed forest formations, where trees of various heights 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 (that have yet to reach a crown density of 20% or a tree height of 5 m) are included in the term ‘forest’, as are 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 land.

Forest land also includes:
- Forest nurseries and seed orchards that constitute an integral part of the forest;
- Forest roads, cleared tracts, firebreaks and other small open areas 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, that cover an area of over 0.5 ha and have a width crown cover of more than 30 m;
- Windbreaks and shelterbelts of trees covering an area of over 0.5 ha and have a width of crown projection of more than 30 m.

It also includes systems with vegetation that currently falls below, but is expected to exceed, the threshold of the forest land category. In the Netherlands case, 'heather' is included in the forest definition. Tree stands in agricultural production systems – for example, in fruit plantations and agro-forestry systems – are not included.

Activity data and (implied) emission factors
Activity data are based on forest inventories carried out in 1988–1992 (HOSP data) and in 2001–2002 (MFV data). HOSP data, which include 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, were used for the 1990 situation. Forward calculation with these data was applied to the year 1999. Additional data on felling, final cut, thinning and outgrown coppice were used to complete the data set. MFV plot level data (in total 1440 plots, with same items as HOSP) were applied to the years 2000, 2001 and 2002. In addition, in order to assess the changes in activity data, databases with tree biomass information, with allometric equations to calculate above- and below ground biomass and with forest litter, respectively, as well as wood harvest statistics, soil carbon estimations and high-resolution topographical maps of 1990 and 2000 were used. See the website at www.greenhousegases.nl for more details on activity data.

Land use changes have an impact on carbon stored in forest and forest soil. As the sampling density of the national inventory was not dense enough to assess the carbon stock of the actual deforested lot, a static approach is followed to quantify the carbon implications of land use changes. This approach includes the assumption that at the time of deforestation, the living biomass is lost in the same year; the loss in biomass is estimated using the Dutch average forest biomass carbon stock (on average, 71 Mg C ha^{-1}). For afforestations, it is assumed that one half of the carbon uptake factor applies, as this has been found to be the average for the existing forest. This was the only reasonable assumption as specific data on each afforested lot were not available. In the future, more specific data of each afforested lot will be registered within the framework of the 'Groenfonds'.

N_2O emissions might occur as a result of using fertilizer 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.

7.2.2 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 to carbon. Detailed descriptions of the methods used and emission factors can be found in the protocol 7135 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 aboveground biomass, belowground biomass, litter, dead wood, and soil organic carbon. Changes in the carbon stock are calculated for aboveground biomass, belowground biomass and dead wood in forests. For litter and soil organic carbon and for biomass in other nature terrains, it is assumed that the stock did not change during the period 1990–2000. Calculations for the living biomass carbon balance are carried out at the 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- and belowground 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 2 years, the basic wood density and the carbon content of the dry mass. This last step is represented in the following equation:

$$\Delta C(trees)_{plot} = \frac{\left(M_{tree}(t) - M_{tree}(t+1)\right)}{\Delta t} \times N_{trees} \times F_{carbon}$$

with:

$\Delta C(trees)_{plot}$	Net C flux in living biomass per plot (kg C $ha^{-1}y^{-1}$)
$M_{tree}(t)$	Total tree biomass at time t (kg DW)
N_{trees}	Number of trees (ha^{-1})
F_{carbon}	Carbon content (kg C kg^{-1} DW)
Δt	Time between t and t+1 (year)

Thinning
Thinning was carried out in all plots that met the criteria for thinning (age >110 years or growing stock more than 300 m^3 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.

Deadwood
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. A net build up may exist, since Dutch forestry just began to pay attention to dead wood a decade ago.

The following equations are used to calculate the net carbon flux to dead wood:

$$\Delta C(deadwood)_{plot} = OutC(deadwood)_{plot} - InC(deadwood)_{plot}$$

$$InC(deadwood)_{plot} = M_{tree}(t) \times N_{tree} \times F_{carbon} \times F_{mortality}$$

$$OutC(deadwood)_{plot} = \left(\frac{V_{dead\_S}}{TBP_S} + \frac{V_{dead\_L}}{TBP_L}\right) \times WD_{dead} \times F_{carbon}$$

with

$\Delta C(deadwood)_{plot}$	Net C flux in dead wood mass per plot (kg C $ha^{-1}y^{-1}$)
$OutC(deadwood)_{plot}$	C input into dead wood from dying trees (kg C $ha^{-1}y^{-1}$)
$InC(deadwood)_{plot}$	C loss per plot due to decomposition of dead wood (kg C $ha^{-1}y^{-1}$)
$M_{tree}(t)$	Total living tree biomass at time t (kg DW)
N_{tree}	Number of living trees (ha^{-1})
F_{carbon}	Carbon content of dry mass (kg C kg^{-1} DW)
$F_{mortality}$	Mortality ($year^{-1}$)
V_{dead_SL}	Volume of standing/lying dead wood
TBP_{SL}	period for total decay of dead wood, standing and lying
WD_{dead}	Density of dead wood

7.2.3 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 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 and Brandes (2007) for details. Uncertainty in the implied emission factor of 5A1 Forest Land remaining Forest Land

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 living biomass is calculated at 13% (rounded at 15% in the calculation spreadsheet). The uncertainty in the implied emission factor of decrease living biomass is calculated at 30%. The uncertainty in the net carbon flux from dead wood is calculated at 30% (rounded at 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, thus, 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 are the same (Groot et al., 2005). Thus, the uncertainty is the uncertainty of the change in carbon content in mineral soil, which is calculated at 38% (rounded at 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 are area changes calculated by comparing two topographic maps. The uncertainty of one topographic map is estimated at 5% (expert judgement). Thus, 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 time series for category 5A shows a slight decrease in sink strength from 1990 to 2002 (see Table 7.2). The figures in category 5A1 for the period after 2000 are copied from 2000. Without taking into consideration afforestation, the decrease in sink strength is even more profound over the same period, mainly due to a slight increase in harvest and a slight decrease in incremental carbon biomass. Although different databases have been used, the time series shows a stable trend. The figures in category 5A2 are based on up-to-date afforestation data. The very limited changes over time are a direct result of averaging the results over the period 1990–2000 and extrapolation after 2000 (see dead wood and trees outside forest). In addition, harvest figures show a rather stable pattern.

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	2001	2002	2003	2004	2005
5A Forest Land	-2516	-2621	-2406	-2416	-2427	-2437	-2448	-2459
5A1 Forest Land remaining Forest Land	-2.505	-2.558	-2.289	-2.289	-2.289	-2.289	-2.289	-2.289
of which								
Live trees	*-4.073*	*-3.912*	*-3.959*	*-3.959*	*-3.959*	*-3.959*	*-3.959*	*-3.959*
Harvest	*2.110*	*1.901*	*2.214*	*2.214*	*2.214*	*2.214*	*2.214*	*2.214*
Trees outside Forest	*-209*	*-209*	*-209*	*-209*	*-209*	*-209*	*-209*	*-209*
Dead wood	*-334*	*-338*	*-336*	*-336*	*-336*	*-336*	*-336*	*-336*
5A2 Land converted to Forest Land (Afforestion)	-11	-64	-117	-127	-138	-148	-159	-170

7.2.4 Source-specific QA/QC and verification

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

7.2.5 Source-specific planned improvements

Planned improvements address the verification of the topographical maps that are used to obtain land use information. A comparison will be made between the maps used and satellite observations. It is expected that this comparison will provide – at the very least – information on the categories forest land, grassland and cropland.

7.3 Cropland [5B]

7.3.1 Source category description

The source category 5B Cropland includes only the emissions of CO_2 from 5B2 Land converted into Cropland. Cropland is defined here as all land used as building land or where crops are grown. The emissions from 5B1 Cropland remaining Cropland is put at zero, since management-related changes in soil carbon are considered to be small in the Dutch intensive agricultural land use system. Therefore, the emissions due to soil management and cultivation practices of this category are not considered in the inventory.

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 (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.

7.3.2 Methodological issues

A country-specific Tier 2 method is used to estimate CO_2 emissions from soils resulting from changes in land use. The methodology can be summarized in two steps. In the first step, the type of land use is determined using digitized topographical maps (scale: 1:10,000), which allows the land use matrix to be completed conform to the recommendations in the Good Practice Guidance on Land Use, Land Use Change and Forestry (IPCC, 2003). Areas are thus obtained for the six main categories of land use as well as for the gross land use changes in (and between) these categories. The second step is the calculation of the carbon stock. Using the soil map combined with soil profile details based on LSK (see above) it is possible to produce a map and achieve a spatially explicit picture of the carbon stocks in the topsoil by applying the following formula:

$$SOC_{(1990\text{-}2000),S1} = \sum_{1}^{n} \left(\text{Os} \times \text{bulk density} \times \text{average C-content} \times \text{topsoil} \right) / n$$

Where:

$SOC_{(1990\text{-}2000),s1}$	Soil organic matter in the period 1990–2000 for soil unit S1 in ton C ha^{-1}
Os	Organic substance level in dry ground (%)
Bulk density	kg m^{-3} dry ground
Average C-content	kg C kg^{-1} os (default is 0.5)
Topsoil	Thickness of the topsoil in metres (default is 0.3 m)
N	Number of soil samples in soil unit S1

The change in carbon content of mineral soils in the Netherlands is calculated by:

$$\Delta C_{(c,\ mineral)} = \sum_{S} [(SOC_{(1990\text{-}2000)} \ \text{x} \ A \ ]$$

Where:

$\Delta C_{(c,\ mineral)}$	Annual change in carbon content in mineral soil (ton C $year^{-1}$)
$SOC_{(1990\text{-}2000)}$	Stock of soil organic substances in the relevant year (ton C ha^{-1})
$SOC_{(0\text{-}T)}$	Soil organic matter stocks in T years for the relevant inventory (ton C ha^{-1})
T	Inventory period in years
A	Land area of a specific land use (ha)
S	Varying and differentiated soil types

The relevant data and calculations can lead to changes in the areas of specific land use and to changes in the carbon levels, and they follow the IPCC requirements concerning methodologies and concepts. The years 1990 and 2000 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 2000 are obtained by means of extrapolation. More detailed descriptions of the methods used and emission factors can be found in the protocols 7135 and 7136 on the website www.greenhousegases.nl.

7.3.3 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 used a Tier 1 analysis for the uncertainty assessment of the sector LULUCF. The uncertainties of 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 and Brandes (2007) 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 at 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 are area changes calculated by comparing two topographic maps. The uncertainty of one topographic map is estimated to be 5% (expert judgement). Thus, 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 time series does not show any differentiation. This is due to the averaging of the emissions from the converted lands into cropland over the entire period concerned on the basis of two measurements. The yearly sink of CO_2 due to the conversion of Other Land uses to cropland is 36 Gg CO_2.

7.3.4 Source-specific QA/QC and verification

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

7.3.5 Source-specific planned improvements

See section 7.2.6 for information on the planned verification of the land use and land use change maps.

7.4 Grassland [5C]

7.4.1 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. Grasslands are defined as all managed grasslands, natural grassland and grassland for recreation. 5C1 Grassland remaining Grassland includes the emissions from drained organic soils (peat soils). Additional CO_2 emissions are created when peat soils settle due to water level management. Since most of the organic soils are under permanent grassland, they are reported in their entirety in this category. The source category 5C1 is by far the most important source of CO_2 within the sector LULUCF. 5C2 Land converted to Grassland includes all deforestations.

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 (see section 7.3.1). The activity data for organic soils are based on soil maps (1:50,000 for the 1960-1990), recent inventories on organic soils (2001–2003), profile information from LSK and data on field levels in 1990 and 2000.

7.4.2 Methodological issues

A country-specific Tier 2 method is used to estimate CO_2 emissions from soils that result from changes in land use (Land converted to Grassland) and from the drainage of organic soils (Grassland remaining Grassland). A detailed description of category 5C2 Land converted to Grassland, the methods used and the emission factors on emissions from soils as a result of changes in land use is given in section 7.3.2.

For grassland, CO_2 emissions resulting from soil settlement of peat land due to drainage are added. The calculation of the CO_2 emission of 5C1 Grassland remaining Grassland is based on a drop in ground level for various types of peat and available information on the extent of drainage (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 over 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 stable since 1990 (223,000 ha). The 2003 stated area of organic soils with the relevant water management conditions assumes an emission factor of 19.04 ton CO_2/ha (Kuikman, 2005). More detailed descriptions of the methods used and emission factors can be found in protocols 7135 and 7136 on the website www.greenhousegases.nl.

7.4.3 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 and Brandes (2007) 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 are area changes calculated by comparing two topographic maps. The uncertainty of one topographic map is estimated to be 5% (expert judgement). Thus, 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

This time series does not distinguish between the CO_2 emissions from drained organic soils and those from Land converted into Grassland (deforestation). This results from the averaging of the emission from both subcategories of grasslands over the entire period concerned on the basis of two measurements. The yearly source of CO_2 that results from the drainage of organic soils is 4.246 Gg CO_2. The yearly sink of CO_2 due to the conversion of forest land and ‘other land’ to grassland (an emission due to deforestation and to a much larger sink due to conversion from ‘other land’ to grassland) is 51 Gg CO_2.

7.4.4 Source-specific QA/QC and verification

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

7.4.5 Source-specific planned improvements

In the near future more attention is required for the change and the amount of carbon stored in peat soils. Attention should also be paid to the classification of grasslands. Some grassland areas follow a pattern that comes closer to arable land than to grassland, while others are managed like nature reserves and are not used for production purposes. These uses all affect the amount of soil carbon that is stored and affects the year-by-year emission or sink. See also section 7.2.6 for information on the planned verification of the land use and land use change maps.

7.5 Wetland [5D]

7.5.1 Source category description

The source category 5D Wetland includes only CO_2 emissions from 5D1 Wetland remaining Wetland and 5D2 Land converted to Wetland. Wetlands are defined as all land that is covered, or saturated, with water for part or all of the year and which does not fall under the categories forest, cropland, grassland or settlements.

Activity data and (implied) emission factors

The activity data are 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 put at zero in the land use change matrix.

7.5.2 Methodological issues

A country-specific Tier 2 method is used to estimate CO_2 emissions from soils that result from changes in land use and for the unchanged use of land. For a detailed description of the methods used and the emission factors of emissions from soils as a result of changes in land use, see section 7.3.2. The CO_2 emissions have not been estimated for either of these categories – 5D1 Wetland remaining Wetland and 5D2 Land converted to Wetlands. 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 7135 and 7136 on the www.greenhousegases.nl.

7.5.3 Uncertainty and time-series consistency

Uncertainties

For information on the uncertainty estimates, the reader is referred to section 7.3.3, which discusses the uncertainty of soil carbon and changes in land use.

Time-series consistency

The emission is zero over the entire period.

7.5.4 Source-specific QA/QC and verification

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

7.5.5 Source-specific planned improvements

See section 7.2.6 for information on the planned verification of the land use and land use change maps.

7.6 Settlement [5E]

7.6.1 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. Settlements are defined as all land that has been developed and consists of infrastructure and land suitable for construction. Small sections of grassland, cropland and forests that are located within a primarily built environment area are not viewed as settlements but as belonging to one of the aforementioned main categories.

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.

7.6.2 Methodological issues

The reporting is considered as to be a Tier 2 level (see protocol 7136). Because there has been no change in soil carbon and, in any case, no loss of soil carbon was expected for the period 1990–2000, 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. In the case of conversion from Other Land, with no carbon stock, to settlements, there is a sink of carbon, which results from the wall-to-wall approach and the assumption that Other Land has no carbon stock. More detailed descriptions of the methods used and the emission factors can be found in the protocols 7135 and 7136 on the website www.greenhousegases.nl, as indicated in section 7.1.

7.6.3 Uncertainty and time-series consistency

Uncertainties
For information on the uncertainty estimates, the reader is referred to section 7.3.3, which discusses the uncertainty of soil carbon and changes in land use.

Time-series consistency
The yearly sink of CO_2 due to the conversion of Other Land uses to settlements is 152 Gg CO_2. This value is the same for all years due to the averaging of two emission measurements over the entire period concerned.

7.6.4 Source-specific QA/QC and verification

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

7.6.5 Source-specific planned improvements

See section 7.2.6 for information on the verification of the land use and land use change maps.

7.7 Other Land [5F]

7.7.1 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. Other Land is defined as land such as rocks, uncultivated land and all non-managed land that does not belong to one of the other categories. In the Netherlands this refers to the coastal areas (beaches, dunes, sandy roads, uncultivated land alongside rivers, streams and sea waters).

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. The category Other Land consists of two main subcategories: Other Land (dunes) and Other Land (water).

7.7.2 Methodological issues

A country-specific Tier 2 method is used to estimate CO_2 emissions from soils resulting from changes in land use (Land converted to Other Land) and for the unchanged use of land (Other Land remaining Other Land). For a detailed description of the methods used and the emission factors of emissions from soils as a result from changes in land use see section 7.3.2. Because there has been no change in soil carbon and, in any case, no loss of soil carbon was expected for the period 1990–2000, the emission from the 5F1 Other Land remaining Other Land conforms to the recommendations of Good Practice Guidance set at zero.

More detailed descriptions of the methods used and the emission factors can be found in protocols 7135 and 7136 on the website www.greenhousegases.nl, as indicated in section 7.1.

7.7.3 Uncertainty and time-series consistency

Uncertainties
For information on the uncertainty estimation, the reader is referred to section 7.3.3, which discusses the uncertainty of soil carbon and changes in land use.

Time-series consistency
The methodology used to calculate the figures for the period 1990–2000 is consistent over time and uses topographic maps to determine land use and the most recent soil data for soil carbon stocks. The category 5F2 Land converted to Other Land addresses the change from mainly grassland and cropland into other types of land (dunes as well as water). Although the land included in this category is small in area, the net emission from Grasslands converted to Other Land (water) is significant. The net CO_2 emission per annum is 717 Gg CO_2. This is the same for all years due to the averaging of the emissions over the entire period concerned based on two measurements.

7.7.4 Source-specific QA/QC and verification

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

7.7.5 Source specific recalculations

Recalculations have been described under section 7.2.5 (improvement in land use change) and under section 7.3.5 (elaborated soil carbon content calculations and some corrections in the calculations).

7.7.6 Source-specific planned improvements

See section 7.2.6 for information on the verification of the land use and land use change maps.

7.8 Other [5G]

7.8.1 Source category description

This 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.

Activity data and (implied) emission factors
The activity data are derived from agricultural statistics for total lime fertilizers (period: 1990–2005). Data available on the application of limestone and dolomite do not address their use on grassland and cropland separately.

7.8.2 Methodological issues

The reporting is considered to be at the Tier 2 level (see protocol 7136). 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 (0.477 tons CO_2 per ton pure dolomite). More detailed descriptions of the methods used and the emission factors can be found in protocols 7135 and 7136 on the website www.greenhousegases.nl, as indicated in section 7.1.

7.8.3 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 CO_2 emissions from limestone and dolomite vary per annum, since the amounts used also vary from year to year (see Table 7.3). The methodology used to calculate the figures for the period 1990-2005 is consistent over time.

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
5G Other (liming of agricultural soils)	183	98	98	80	85	86	79	75

7.8.4 Source-specific QA/QC and verification

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

7.8.5 Source-specific recalculations

There have been no source-specific recalculations. Only the figure for 1993 has been updated (one of the fertilizers was lacking in the previous submission).

7.8.6 Source-specific planned improvements

There are no source-specific improvements planned.

8. WASTE [CRF sector 6]

Major changes in *Waste* sector compared to the National Inventory Report 2006

Emissions: In 2005,the total greenhouse gas emissions in this sector decreased further. Emissions in the period 1990-2004 did not change compared to the previous NIR.
Key sources: There are no changes in the key source allocation in this sector.
Methodologies: There have been no methodological changes in this sector

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 emissions (included in [1A1a]);
- 6D Other waste: CH_4 emissions.

Carbon dioxide emissions from the anaerobic decay of landfilled waste 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). However, methodological issues of 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 7101: CO_2 from Waste incineration (included in 1A1a);
- Protocol 7137: CH_4 from Waste disposal (6A1);
- Protocol 7138: CH_4, N_2O from Wastewater treatment (6B);
- Protocol 7139: CH_4, N_2O from Industrial composting (6D).

The Waste sector accounted for 3% of total national emissions (without LULUCF) in 2005 compared with 6% in 1990, with the emissions of CH_4 and N_2O accounting for 94% and 6% of CO_2-equivalent emissions from the sector, respectively. Emissions of CH_4 from waste – almost all (96%) from Landfills (6A) – accounted for 35% of the national total CH_4 emissions in 2005. The N_2O emissions from the Waste sector stem from domestic and commercial wastewater. The fossil-fuel related emissions from waste incineration, mainly CO_2, are included in the fuel combustion emissions from the Energy sector (1A1) since most large-scale incinerators also produce electricity or heat for energetic purposes.

Emissions from the Waste sector decreased by 48% between 1990 and 2005 (see Figure 8.1), mainly due to a 51% reduction in CH_4 from Landfills (6A1 'Managed waste disposal on land). Between 2004 and 2005 the CH_4 emissions from landfills decreased by about 5%. The decreased methane emission from 'Landfills' since 1990 is the result of: (1) the consideable reduction in municipal solid waste (MSW) disposal at landfills through the increased recovery and recycling of waste for composting and/or incineration; (2) the decrease in the organic waste fraction of the waste disposed; (3) the increase in methane recovery from the landfills (from 5% in 1990 to 16% in 2005).

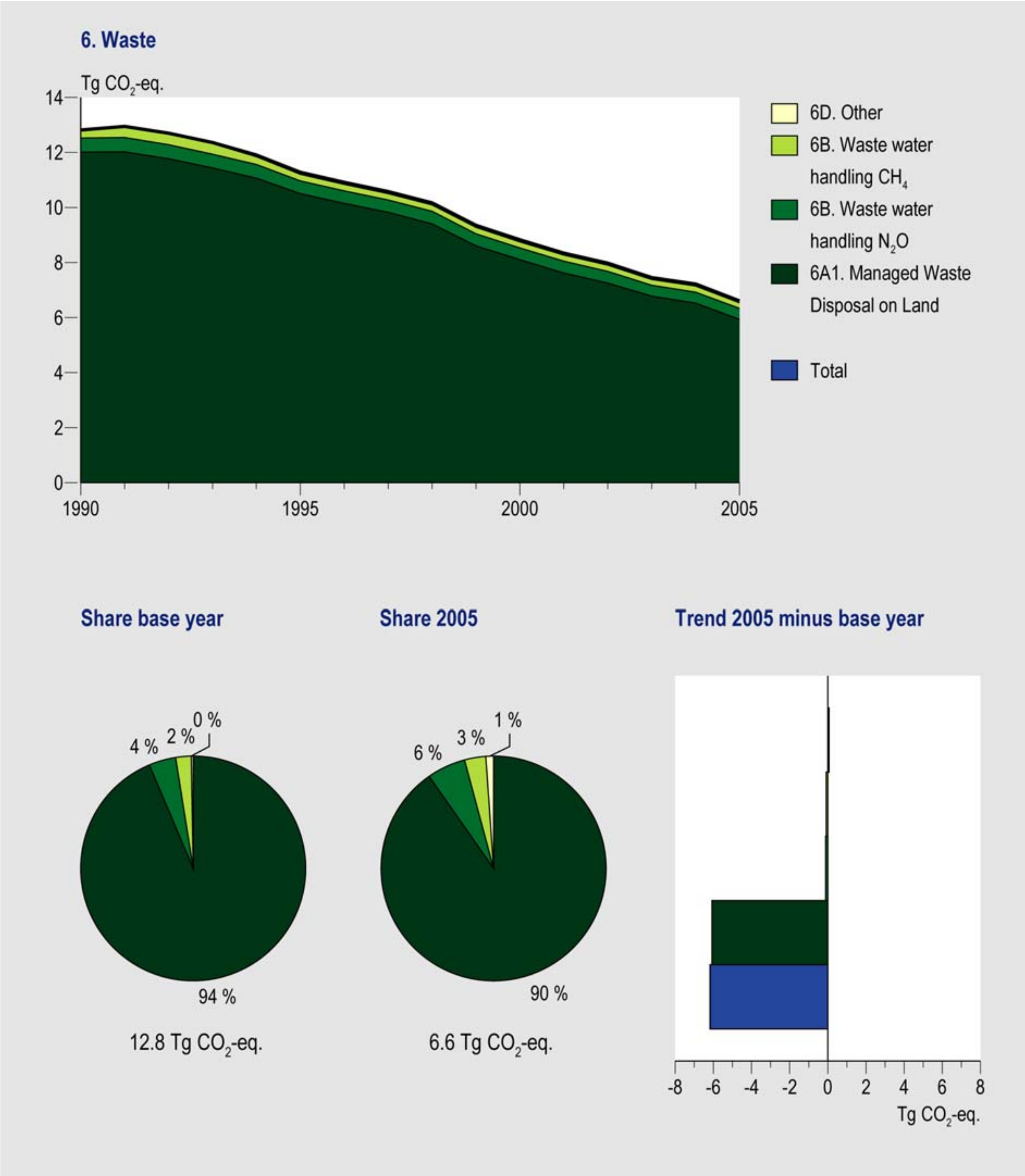


Figure 8.1 Sector 6 'Waste': trend, emission levels and share of source categories in emissions of 6 'Waste', 1990-2005.

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 6.6 Tg CO_2-eq. in 2005. This decrease is mainly due to:

- 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 (see Annex 1).

Table 8.1 Contribution of main categories and key sources in sector 6 Waste.

Sector/category Key source	**Gas**	**Key**	**Emissions base year (1990)**		**Emissions 2005**		**Change 2005 - 2004**	**Contribution to total in 2005 (%)**		
		Level, Trend	Gg	Tg CO_2-eq.	Gg	Tg CO_2-eq.	Tg CO_2-eq.	by sector	of total gas	Of total CO_2-eq.
6 Waste	CH_4		585.8	12.3	295.4	6.2	-0.6	94	37	3
	N_2O		1.7	0.5	1.4	0.4	0.0	6	2	0.2
	All			**12.8**		**6.6**	**-0.6**	**100**		**3**
6A. Solid waste disposal on land	**CH_4**		**571.9**	**12.0**	**282.4**	**5.9**	**-0.6**	**89**	**35**	**3**
6A1. CH_4 emissions from solid waste disposal sites (SWDS)	CH_4	L,T	571.9	12.0	282.4	5.9	-0.6	89	35	3
6B. Wastewater handling	N_2O		1.7	0.5	1.3	0.4	0.0	6	2	0.2
	CH_4		13.8	0.3	9.8	0.2	0.0	3	1	0.1
	All			**0.8**		**0.6**	**0.0**	**9**		**0.3**
6D. Other	CH_4		0.06	0.0	3.2	0.1	0.0	2	0.5	0.0
Total National Emissions	CH_4		1,211.5	25.4	795.8	16.7	-0.6		100	
	N_2O		68.4	21.2	56.6	17.5	-0.2		100	
National Total GHG emissions (excluding CO_2 LULUCF)	All			214.3		212.1	-6.3			100

8.2 Solid waste disposal on land [6A]

8.2.1 Source category description

In 2005 there were 27 operating landfill sites as well as a few thousand older sites that are still reactive. CH_4 recovery takes place at 50 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 will not be released into the atmosphere. The CH_4 may be degraded (oxidized) to some extent by bacteria when it passes through the landfill cover; this results in a lower CH_4 concentration.

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, 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).

In 2005 the share of CH_4 emissions from Landfills in the total national inventory of greenhouse gas emissions was 6% in 1990 and 3% in 2005. Between 1990 and 2005 CH_4 emissions have decreased by 49% to 282 Gg. This decrease is due to the increase in recovered CH_4 – from about 5% in 1990 to 16% in 2005 – but also to the decrease in methane produced in solid waste disposal sites.

In 2005 solid waste disposal on land accounted for 89% of the total emissions in the Waste sector and 3% of the total 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 landfill. This policy requires enhanced prevention of waste production and recycling 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 as landfill has decreased, thereby reducing emissions from this source category from more than 14 million tonnes in 1990 to 3.5 million tonnes in 2005.

Activity data and (implied) emission factors

Detailed information on activity data and emission factors can be found in the monitoring protocol 7137 on the website www.greenhousegases.nl.

Activity data on the amount of waste disposed on 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. These data can be found on the website www.uitvoeringafvalbeheer.nl and are documented in SenterNovem (2005). This document also contains the amount of CH_4 recovered from landfill sites yearly.

The (implied) emission factors correspond with the IPCC default values.

8.2.2 Methodological issues

A more detailed description of the method used and emission factors can be found in the protocol 7137 on the website www.greenhousegases.nl as indicated in section 8.1.

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 landfilled 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 (Until 2001 the fraction of methane in landfill gas was set at 60%. From 2002 and onwards the average fraction of CH_4 is determined yearly based on the composition of landfill gas at all sites with CH_4 recovery.):

- Total amount of land-filled waste;
- Fraction of degradable organic carbon (DOC) (see Table 8.2 for a detailed time-series);
- CH_4 generation (i.e. 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 years, respectively (see Table 8.2 for a detailed time-series);
- CH_4 oxidation factor: 10%;
- Fraction of DOC actually dissimilated (DOC_F): 0.58;
- CH_4 conversion factor (IPCC parameter): 1.0.

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 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 1990s. The integration time for the emission calculation is defined as the period from 1945 to the year for which the calculation is made.

Table 8.2 Parameters used in the IPCC Tier 2 method that change over time (additional information on solid waste handling part[1]).

Parameter	1990	1995	2000	2001	2002	2003	2004	2005
Waste generation rate[1] (kg/cap/day)	1.52	1.50	1.69	1.68	1.70	1.67	1.70	1.70
Fraction MSW disposed to SWDS	0.38	0.29	0.09	0.08	0.08	0.03	0.01	0.01
Fraction DOC in MSW	0.13	0.13	0.11	0.10	0.10	0.09	0.08	0.08
Fraction of waste incinerated	0.08	0.09	0.11	0.12	0.13	0.13	0.13	0.12
Fraction of waste recycled	0.63	0.75	0.80	0.80	0.80	0.81	0.83	0.84
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	47	51	50	50	50
Waste incineration[2] (Tg)	3.9	4.7	7.1	7.5	8.2	8.2	7.9	7.1

[1]Waste generation rate refers to MSW (muncipal solid waste), excluding inorganic industrial waste such as construction or demolition waste.

[2] Waste incineration refers to the total amount of waste incinerated: municipal solid waste, industrial waste, commercial waste, sewage sludge e.a.

8.2.3 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 and Brandes, 2007.

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 2001 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.

8.2.4 Source-specific QA/QC and verification

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

8.2.5 Source-specific recalculations

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

8.2.6 Source specific planned improvements

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

8.3 Wastewater handling [6B]

8.3.1 Source category description

General description of the source category

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) as well as nitrogen compounds can lead to 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 2% to total N_2O emissions in 2005 (as well as in 1990) and 0.2% in total CO_2-equivalents. N_2O emissions from waste water handling decreased by 22% during the period 1990–2005. This decrease is mainly caused by improved nitrogen removal at Urban WWTPs, thereby resulting 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 in the national total of CH_4 emissions in 2005 was 1%. Since 1993, CH_4 emissions from wastewater treatment plants have decreased due to the introduction in 1990 of a new sludge stabilisation system in one of the largest wastewater treatment plants. As the operation of the plant took a few years to optimise, venting emissions were higher in the introductory period (1991–1993) than under normal operating conditions.

The amount of wastewater and sludge being treated does not change much over time. Therefore, the interannual changes in methane emissions can be explained by varying fractions of methane being flared instead of vented or used for energy purposes.

N_2O emissions from wastewater treatment (see Table 8.1) contributed about 2% to the total N_2O emissions in 2004 (as well as in 1990) and 0.2% in total CO_2-equivalents. The contribution of wastewater handling in the national total of CH_4 emissions in 2004 was 1%. Since 1993, CH_4 emissions from WWTPs have decreased due to the introduction in 1990 of a new sludge stabilization system in one of the largest WWTPs in the Netherlands. However, the operation of this plant took a few years to optimize, which caused increased venting emissions in the introductory period (1990-1993) compared to normal operating conditions.

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**	**2001**	**2002**	**2003**	**2004**	**2005**
CH_4 industrial wastewater	0.25	0.33	0.34	0.35	0.36	0.34	0.34	0.35
CH_4 domestic & commercial wastewater	9.07	7.90	7.96	8.15	8.55	7.99	8.50	8.19
CH_4 septic tanks	4.47	3.25	2.20	1.98	1.81	1.73	1.46	1.22
Net CH_4 emissions	13.79	11.48	10.50	10.47	10.72	10.06	10.30	9.76
CH_4 recovered and/or flared	33.0	39.2	40.4	39.6	43.3	43.2	44.0	41.9
Recovery/flared (% gross emission)	71	77	79	79	80	81	81	80
N_2O domestic & commercial wastewater	0.81	0.84	0.85	0.86	0.86	0.84	0.84	0.85
N_2O from human sewage	0.85	0.65	0.53	0.54	0.51	0.44	0.44	0.44
Total N_2O emissions	1.66	1.49	1.38	1.39	1.37	1.28	1.29	1.29

Activity data and (implied) emission factors

Detailed information on activity data and emission factors can be found in the monitoring protocol 7138 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 the dry weather conditions in 2003 the volumes of treated wastewater and of the total load of DOC were significantly lower than those in surrounding years.

Table 8.3 shows that total N_2O emissions from wastewater handling decreased 22% from 1990 to 2005. This decrease is mainly caused by improved nitrogen removal at urban WWTPs, which has resulted in lower effluent loads (see Table 8.4) and a subsequent decrease in the (indirect) N_2O emissions from human sewage.

From Table 8.4 it can be concluded that the DOC of treated wastewater and sludge does not change to any extent over time. Therefore, the interannual 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 thus no longer using septic tanks.

Table 8.4 Activity data of domestic and commercial wastewater handling (Gg/year) and total volume of treated urban waste water (Units: Mm^3/year).

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Wastewater DOC[1)]	933	940	948	960	970	921	921	916	930	915	921	937	939	923	949	943
Sludge DOC	254	263	248	246	251	269	283	270	279	282	281	299	290	290	296	298
Nitrogen in effluent	53.8	54.0	51.1	48.3	47.3	41.5	40.3	37.9	39.6	36.0	33.8	34.2	32.4	28.3	28.3	28.3
Treated volume	1711	1683	1836	1897	2062	1908	1681	1717	2194	2034	2034	2169	2083	1791	1915	1841

[1)]DOC, Degradable organic component.

8.3.2 Methodological issues

A full description of the methodology is provided in the monitoring protocol 7138 (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 WWTP, the CH_4 emission factor is expressed as 0.056 t/t DOC design capacity, assuming a utilization rate of 80% and a methane recovery (MR) of 99%.

For Urban wastewater treatment and anaerobic sludge handling, the combined emission factor is defined as 0.085 tons CH_4 per ton $DOC_{influent}$. The emission factor takes into account that 37% of the influent DOC remains in the sludge and that CH_4 recovery from anaerobic sludge treatment is 94%. Incidental venting of biogas at urban WWTPs is recorded by the plant operators and subsequently reported to Statistics Netherlands.

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. Because of their insignificance compared to N_2O from domestic wastewater treatment, no N_2O emissions were estimated for industrial wastewater treatment and from septic tanks.

N_2O emissions

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, respectively. Since N_2O emissions from wastewater handling was identified in the previous NIR as a key source, the present Tier 2 methodology complies with the IPCC Good Practice Guidance (IPCC, 2001). In the improved key source analysis this category is no longer a key source.

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 judgements 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 that are discussed in chapter 1.

8.3.5 Source-specific re-calculations

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

8.3.6 Source-specific planned improvements

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

8.4 Waste incineration [6C]

8.4.1 Source category description

General description of the source category

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 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).

Activity data and emission factors

Detailed information on activity data and emission factors can be found in the monitoring protocol 7101on the website www.greenhousegases.nl.

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 (SenterNovem, 2005a).

8.4.2 Methodological issues

A more detailed description of the method used and the emission factors can be found in the protocol 7101 on the website www.greenhousegases.nl, as indicated in section 8.1.

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 emissions from Waste incineration (e.g. plastics) are calculated from the total amount of waste incinerated. The composition of the waste (the six types listed in Table 8.5) is determined per waste stream (residential and several others). An assumption is made for each of these six types of waste with respect to the specific carbon and fossil carbon fractions, which will subsequently yield the CO_2 emissions. Table 8.6 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 (Joosen and De Jager, 2003) and in the monitoring protocol. CH_4 emissions from these sources are not estimated (= neglected). Based on measurement data (Spoelstra, 1993), an emission factor of 20 g/ton waste is applied for N_2O.

Table 8.5 Composition of incinerated waste: carbon fraction and fossil fraction (%).

Waste type	Carbon fraction	Fossil fraction
WIP[1)]: paper/cardboard (%)	30	0
WIP: wood (%)	45	0
WIP: other organic (%)	20	0
WIP: plastics (%)	54	100
WIP: other combustible (%)	32	50
WIP: non-combustible (%)	1	100

[1)]WIP, Waste incineration plant; listed are the residential waste fractions;
for waste fractions of other waste types (considered fixed in time), see Joosen and De Jager (2003).

Table 8.6 Composition of incinerated waste.

	1990	1995	2000	2001	2002	2003	2004	2005
Total waste incinerated (Gg)	2.8	2.9	4.9	4.7	5.0	5.0	5.2	5.5
of wich residential waste (Gg):	2.3	2.1	3.1	3.4	3.6	3.6	3.6	3.6
Of which:								
WIP[1)]: paper/cardboard (%)	*25*	*29*	*27*	*28*	*27*	*26*	*26*	*26*
WIP: wood (%)	*2*	*4*	*6*	*5*	*5*	*5*	*5*	*5*
WIP: other organic (%)	*46*	*33*	*32*	*32*	*32*	*32*	*32*	*32*
WIP: plastics (%)	*9*	*10*	*13*	*13*	*13*	*15*	*15*	*15*
WIP: other combustible (%)	*8*	*11*	*10*	*10*	*10*	*10*	*10*	*10*
WIP: non-combustible (%)	*11*	*12*	*12*	*12*	*13*	*13*	*13*	*13*
Energy content (MJ/kg)	8.2	9.8	10.2	10.3	10.3	10.6	10.6	10.6
Fraction organic (%)	58	54	51	50	50	47	47	47
Amount of fossil carbon	162	221	405	408	435	477	477	477
Amount of organic carbon	530	563	929	897	932	924	924	924

[1)]WIP, Waste incineration plant (Not included incineration plant for specific waste streams as sewage sludge or hazardous waste.), listed are the residential waste fractions; for waste fractions of other waste types (considered fixed in time), see Joosen and De Jager (2003).

8.4.3 Uncertainties and time-series consistency

Uncertainties

The Tier 1 uncertainty analysis in 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 Statistics Netherlands.

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.

8.4.5 Source-specific re-calculations

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

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

General description of the source category

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. 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 plant.
The amount of composted organic waste from households increased from nearly 0 million tonnes up to 1.4 million tonnes in 2005. In 2005 there were 24 industrial composting sites in operation; these accounted for 2% of the emissions in the Waste sector in that year (see Table 8.1).

Activity data and (implied) emission factors

Detailed information on activity data and emission factors can be found in the monitoring protocol 7139 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 (SenterNovem, 2005a). This document contains also the amount of compost produced on a yearly basis.

The emission factors are based on the average emissions (per metric tonne of composted organic waste) of a number of facilities that were measured in the late 1990s (during a large-scale monitoring programme in the Netherlands). Recently the emission factors have been measured again (at three facilities, 1 measurment per facility) in the Netherlands. The average of these three measurements for methane was much lower than the applied emission factor, with a wide range. Because of the small number of measurements and the wide range of values these new insights have not been used.

8.5.2 Methodological issues

A more detailed description of the method used and the emission factors can be found in protocol 7139 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.

8.5.5 Source specific re-calculations

There are no source-specific re-calculations compared to the previous 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. RE-CALCULATIONS AND IMPROVEMENTS

Major changes compared to the National Inventory Report 2006

This chapter addresses some changes in emissions compared to the previous submission reported by Brandes *et al.* (2006). In the context of preparing the National System under the Kyoto Protocol, the past few years a lot of methodological changes have been implemented in the National System and documented in the NIR. This process was finalised and documented in the NIR 2006. As a result, only a few re-calculations (improved activity data) have been implemented in the NIR 2007. These re-calculations do not affect the base year emissions.
For more details on the effect and justification of the re-calculations, the reader is referred to *chapters 3–8*.

10.1 Explanation and justification for the re-calculations

For this submission (NIR 2007), the Netherlands uses the CRF reporter software 3.1.

The present CRF tables are based on improved methodologies as described in the monitoring protocols and used in the NIR 2006. There are no methodological changes in the NIR/CRF 2007, but in some cases, improved activity data are available.

This chapter does provide elaborations on the relevant changes in emission figures compared to the NIR 2006. A distinction is made between:
1. Methodological changes: new emission data are reported resulting from revised or new estimation methods; improved emission factors or activity data are also captured in re-calculations as a result of methodological changes;
2. Allocation: changes in the allocation of emissions to different sectors (only affecting the totals per category or sector);
3. Error corrections: correction of incorrect data.

10.1.1 Methodological changes

The following methodological changes were implemented related to data improvement:
- Re-calculation of CO_2 emissions from refineries based on detailed information from annual environmental reports of the companies. This results in recalculated emissions (0.4 to 1.1 Tg higher CO_2 emissions for the years 2002 – 2004) in category 1A1b;
- In category 1A1c, Manufacture of solid fuels and other energy industries information from the annual environmental reports was used to determine the emission factor of ‘own energy use’ in oil and gas production from 2003 onwards (in the NIR 2006, the general emission factor for natural gas of 56.8 was applied).

10.1.2 Source allocation

The source allocation was improved for a part of the emissions formerly allocated in category 1Ab1. These are now allocated in category 1B2. This change is based on detailed information from annual environmental reports of refineries.

10.1.3 Error correction

During the compilation of the CRF based on the PER inventory for 2005 a few minor errors were detected in the emissions reported in the CRF. These include:
- in category 1B2, distribution of oil and gas, the whole time series (except 1990) was corrected (shifted one year);
- in categories 2E3 and 2F9, some minor errors in the use of HFCs (activity data) were corrected for a number of years.

10.2 Implications for emission levels

This chapter outlines the implications of the different improvements, as 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 (chapters 3–8).

10.2.1 Effect of re-calculations on base year and 2004 emission levels

As noted in section 10.1, re-calculations do not affect the base year.

Table 10.1 Differences between NIR 2006 and NIR 2007 for the period 1990–2004 due to re-calculations (unit: Tg CO_2-eq.; for F-gases: Gg CO_2-eq.).

Gas	Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CO_2 Incl.	NIR06	161.8	166.7	164.6	169.0	168.9	172.8	179.9	173.5	175.6	170.0	172.0	177.6	177.3	180.9	183.3
LUCF	NIR07	161.8	166.7	164.6	169.0	168.9	172.8	179.9	173.5	175.6	170.0	172.0	177.6	178.1	182.0	183.6
	Diff.	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**1.1**	**0.3**
CO_2 Excl.	NIR06	159.4	164.4	162.4	166.8	166.7	170.6	177.7	171.1	173.2	167.7	169.6	175.2	174.9	178.5	180.9
LUCF	NIR07	159.4	164.4	162.4	166.8	166.7	170.6	177.7	171.1	173.2	167.7	169.6	175.2	175.7	179.6	181.3
	Diff.	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**1.1**	**0.4**
CH_4	NIR06	**25.4**	25.7	25.2	24.9	24.1	23.8	23.0	22.0	21.2	20.1	19.3	18.9	18.0	17.5	17.3
	NIR07	**25.4**	25.7	25.2	24.9	24.1	23.8	23.0	22.0	21.2	20.1	19.3	18.9	18.0	17.5	17.3
	Diff.	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
N_2O	NIR06	**21.2**	21.6	22.4	23.1	22.3	22.4	22.2	21.9	21.7	20.9	19.9	18.8	18.0	17.4	17.7
	NIR07	**21.2**	21.6	22.4	23.1	22.3	22.4	22.2	21.9	21.7	20.9	19.9	18.8	18.0	17.4	17.7
	Diff.	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
PFCs	NIR06	2,264	2,245	2,043	2,068	1,990	**1,938**	2,155	2,344	1,829	1,471	1,581	1,489	2,186	620	285
Gg	NIR07	2,264	2,245	2,043	2,068	1,990	**1,938**	2,155	2,344	1,829	1,471	1,581	1,489	2,186	620	285
	Diff.	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
HFCs	NIR06	4,432	3,452	4,447	4,998	6,480	**6,020**	7,678	8,300	9,341	4,859	3,824	1,469	1,541	1,319	1,477
Gg	NIR07	4,432	3,452	4,447	4,998	6,480	**6,020**	7,678	8,300	9,341	4,859	3,824	1,469	1,541	1,319	1,477
	Diff.	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
SF6	NIR06	217	134	143	150	191	**301**	312	345	329	317	335	356	332	309	328
Gg	NIR07	217	134	143	150	191	**301**	312	345	329	317	335	356	332	309	328
	Diff.	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Incl.	NIR06	215.4	219.9	218.8	224.2	223.9	227.3	235.3	228.5	229.9	217.8	216.8	218.6	217.3	218.1	220.4
LUCF	NIR07	215.4	219.9	218.8	224.2	223.9	227.3	235.3	228.5	229.9	217.8	216.8	218.6	218.1	219.2	220.8
	Diff.	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**1.1**	**0.4**
Total Excl.	NIR06	213.0	217.6	216.6	222.0	221.8	225.1	233.0	226.0	227.6	215.4	214.4	216.2	214.9	215.7	218.1
LUCF	NIR07	213.0	217.6	216.6	222.0	221.8	225.1	233.0	226.0	227.6	215.4	214.4	216.2	215.7	216.8	218.4
	Diff.	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.8**	**1.1**	**0.3**

Notes: base year values are indicated in bold.

10.3 Implications for emission trends, including time-series consistency

In general, the re-calculations improve both the accuracy and the time-series consistency of the estimated emissions. Table 10.1 presents the changes in this NIR compared to the previous submission for emission levels per compound per year for the period 1990–2004. Table 10.2 presents the changed trends in the greenhouse gas emissions during this period due to the re-calculations that were carried out.

Table 10.2 Differences between NIR 2006 and NIR 2007 with respect to emission trends during the period ***1990–2004*** *(Units: Tg CO_2-eq, rounded).*

Gas	Trend (absolute)			Trend (percentage)		
	NIR 2006	**NIR2007**	*Difference*	**NIR 2006**	**NIR 2007**	*Difference*
CO_2	21.5	21.9	0.4	13.5	13.7	0.2
CH_4	-8.1	-8.1	0	-31.9	-31.9	0
N_2O	-3.5	-3.5	0	-16.5	-16.5	0
HFC	-2.9	-2.9	0	-66.7	-66.7	0
PFC	-2.0	-2.0	0	-87.4	-87.4	0
SF_6	0.1	0.1	0	51.2	51.2	0
Total	**5.1**	**5.5**	**0.4**	**2.4**	**2.5**	**0.1**

[1)]Excluding LULUCF.

10.4 Re-calculations, response to the review process and planned improvements

10.4.1 Re-calculations

Some recalculations and error corrections are anticipated in the next submission of the CRF in order to improve the accuracy and completeness of the inventory:

- Effects of the application of a new model to calculate the emissions in the transport sector (VERSIT+) – also affecting the CH_4 emissions from this sector will be implemented. The effects are very minor (in the order of 6 Gg CO_2-equivalents). The base year will not be changed.

The anticipated recalculations have no effect on the total emissions in CO_2-equivalents for the base year.

10.4.2 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. The public review of the draft NIR 2007 of January 2007 resulted in only a few minor remarks with respect to process emissions and to the question whether CCS is taken into account.
Based on the same draft of January 2007 the following sectors were selected for special focus during the peer review: transport (1A3) and solid waste disposal on land (6A), Waste incineration (6C) and other waste handling (composting) (6D). The peer reviewers concluded in general that the system is operational; methods are correct and well documented. The major recommendation from the peer review of waste is related to an indication that the emission factor for solid waste handling might be in a higher range. The results of the peer review of transport show that the level of detail of the transport protocols seem somewhat more general than most other protocols and that this could be further improved (at the moment, more detailed information is not included in the Protocol itself but in reference documents).

UNFCCC reviews

The NIR 2006 will be reviewed in combination with the Initial Review. This in country review is planned for April 2007.

10.4.3 Completeness of sources

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:

- Oil transport (1B2a3), due to missing activity data;
- Charcoal production (1B2) and use (1A4) , due to missing activity data;
- CO_2 from lime production (2A2), 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 slugdge application on land (4D4), due to missing activity data;
- CH_4 from poultry (4A9), due to missing emission factors;

- N_2O from Industrial wastewater (6B1), due to negligible amounts;
- A survey to check on unidentified sources of non-CO_2 emissions in the Netherlands showed that some minor sources of PFCs and SF_6 are not included in the present greenhouse gas inventory (DHV, 2000).

The above mentioned sources have been examined by the Dutch Working Group Emission Monitoring of Greenhouse Gases and only negleglible amounts have been found. Since no regular monitoring data are available, these sources are not included.

- Precursor emissions (i.e. CO, NO_x, NMVOC and SO_2) from Memo item international bunkers (international transport) have not been included.

10.4.4 Completeness of the CRF files

For the years 1991–1994 the energy data is 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). Due to the structure of the CRF, most aggregated figures for potential emissions of PFCs and SF_6 appear as ‘0.0’ or ‘value’.

10.4.5 Planned improvements

By the end of 2005, the Netherlands National System was fully established, 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). Some minor corrections have been implemented in the submission of this year, because of improved activity data or error corrections.

In this chapter the improvement actions anticipated in the future are summarized, including any additional issues identified in the recent reviews not addressed in the re-calculations.

Monitoring improvement
After implementation of the National System – and the re-calculations and uncertainty estimates that were made accordingly – some sources show up to be (minor) key sources where they were no keys sources in the past (see chapters 3 – 8). Methodological improvements – if needed – will be considered as part of the annually updated QA/QC programme (SenterNovem, 2006). One of issues concerns a more detailed analysis of the possible variation of the EF of natural gas during 1991-2003. In the NIR 2006 an updated EF for natural gas was used. This new factor (56.8) has been established based on detailed assessments for the base year and for 2004. Both years showed the same EF; however given time constraints the EF for intermediate years could be analysed only roughly and it was assumed that no significant fluctuations occurred during these intermediate years. It is planned to analyse this further and if necessary, to correct the time series accordingly. This will not affect the base year emissions or the 2004 emissions.

Monitoring protocols
As part of the improvement process, the methodologies and procedures for estimating greenhouse gas emission in the Netherlands are re-assessed and compared with UNFCCC and IPCC requirements. For the key emission sources and for sinks, the methodologies and processes are elaborated, re-assessed and revised where needed, and then used for the present CRF/NIR. Protocols describing the methodology, data sources and the rationale for their selection are available for most key sources on the website www.greenhousegases.nl. The protocols were given a legal basis in December 2005.

These monitoring protocols will be assessed annually and –when needed– updated. In 2006 the inventory experts' experiences with the monitoring protocols have been evaluated. The results were used for improving the monitoring protocols. The updated protocols have been used to prepare the NIR2007. The changes are minor (mainly related to editorial changes and update of references).

Improving the QA/QC system

As part of the National System, also the QA/QC programme is updated annually, based on the experiences and results of UNFCCC reviews, peer reviews and audits. The QA/QC programme for this year (SenterNovem, 2006) includes a few new issues, such as the further analysis of possible variations in the EF of natural gas in the years 1991-2003 (see above) and a preliminary assessment of consequences of the new 2006 IPCC guidelines. The latter issue is aimed at the longer term and a first step in a possible improvement programma for the longer term. The results of the Tier 2 uncertainty analysis, announced last year, are included in the monitoring protocols.

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ANNEX 1. Key sources

A1.1 Introduction

As explained in the Good Practice Guidance (IPCC, 2001), a key source category is one that 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 preliminary identification of key sources in the Netherlands' inventory, the national emissions are allocated according to the 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 CO_2 emissions from stationary combustion (1A1, 1A2 and 1A4) are aggregated by fuel type. CO_2, CH_4 and 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). Therefore, the 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. Therefore, the most important gas/source combinations in this category are separately assessed. The emissions in the other IPCC sectors are disaggregated as suggested by IPCC.
The IPCC Tier 1 method consists of ranking the list of source category/gas combinations, both for the contribution, to the national total annual emissions and to the national total trend.
The grey 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: 29 sources for annual level assessment (emissions in 2005) and 28 sources for the trend assessment out of a total of 72 sources. Both lists can be combined to get 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 to 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 and Brandes, 2007). The results of the Tier 1 and Tier 2 level and trend assessments are summarised in Table A1.1 and show a total of 39 key sources. As could be expected, the Tier 2 level and trend assessment increases the importance of relatively very uncertain sources. It can be concluded that in using the results of a Tier 2 key source assessment, 3 more sources are added to the list of 36 Tier 1 level and trend key sources:

- CH_4 emissions from stationary combustion (Tier 2 level);
- CO_2 emissions from manufacturing of other chemical products (Tier 2 level)
- CH_4 emissions from manure management: poultry (Tier 2 trend).

Their share in the national annual total becomes more important when taking their uncertainty (50%-100%) into account (Table 1.4).
Next, the most important LULUCF emission sinks and sources are included in the Tier 1 and Tier 2 key source calculations to identify the key sources in IPCC sector 5. This resulted in 3 additional key sources from this sector, see also Table A1.1.
In this report, the key source assessment is based on emission figures from CRF 2007 version 1.2, to be submitted to EU in March 2007.

Table A1.1. Key source list identified by the Tier 1 and 2 level and trend assessments (based on CRF tables 2007 version 1.2. Level assessment for 2005 emissions).

Cate-gory	Gas	Category name	Key source?	Tier 1 Level	Tier 1 Trend	Tier 2 Level	Tier 2 Trend
ENERGY							
1A1a	CO_2	Stationary combustion: Public Electricity and Heat Production: liquids	Key(L1,T)	1	1	0	1
1A1a	CO_2	Stationary combustion: Public Electricity and Heat Production: solids	Key(L)	1	0	1	0
1A1a	CO_2	Stationary combustion : Public Electricity and Heat Production: gases	Key(L,T)	1	1	1	1
1A1a	CO_2	Stationary combustion : Public Electricity and Heat Production: waste incineration	Key(L1,T)	1	1	0	1
1A1b	CO_2	Stationary combustion : Petroleum Refining: liquids	Key(L)	1	0	1	0
1A1b	CO_2	Stationary combustion : Petroleum Refining: gases	Key(L1,T1)	1	1	0	0
1A1c	CO_2	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	Non key	0	0	0	0
1A1c	CO_2	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	Key(L,T)	1	1	1	1
1A2	CO_2	Emissions from stationary combustion : Manufacturing Industries and Construction, liquids	Key(L,T1)	1	1	1	0
1A2	CO_2	Emissions from stationary combustion : Manufacturing Industries and Construction, solids	Key(L,T1)	1	1	1	0
1A2	CO_2	Emissions from stationary combustion : Manufacturing Industries and Construction, gases	Key(L,T1)	1	1	1	0
1A3	CO_2	Mobile combustion: road vehicles: gasoline	Key(L,T1)	1	1	1	0
1A3	CO_2	Mobile combustion: road vehicles: diesel oil	Key(L,T)	1	1	1	1
1A3	CO_2	Mobile combustion: road vehicles: LPG	Key(L1,T)	1	1	0	1
1A3	CO_2	Mobile combustion: water-borne navigation	Non key*	0	0	0	0
1A3	CO_2	Mobile combustion: aircraft	Non key	0	0	0	0
1A3	CO_2	Mobile combustion: railways	Non key	0	0	0	0
1A3	CH_4	Mobile combustion: other	Non key	0	0	0	0
1A3	N_2O	Mobile combustion: other	Non key	0	0	0	0
1A3	CH_4	Mobile combustion: road vehicles	Non key	0	0	0	0
1A3	N_2O	Mobile combustion: road vehicles	Non key*	0	0	0	0
1A4	CO_2	Stationary combustion : Other Sectors, solids	Non key	0	0	0	0
1A4a	CO_2	Stationary combustion : Other Sectors: Commercial/Institutional, gases	Key(L,T)	1	1	1	1
1A4b	CO_2	Stationary combustion : Other Sectors, Residential, gases	Key(L,T1)	1	1	1	0
1A4c	CO_2	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gases	Key(L,T)	1	1	1	1
1A4c	CO_2	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, liquids	Key(L)	1	0	1	0
1A4	CO_2	Stationary combustion : Other Sectors, liquids excl. From 1A4c	Key(T)	0	1	0	1
1A5	CO_2	Military use of fuels (1A5 Other)	Non key	0	0	0	0
1A	CH_4	Emissions from stationary combustion: non- CO_2	Key(L2)	0	0	1	0
1A	N_2O	Emissions from stationary combustion: non- CO_2	Non key	0	0	0	0
1B1	CH_4	Coal mining	Not occuring				
1B1b	CO_2	Coke production	Non key*	0	0	0	0
1B2	CO_2	Fugitive emissions from venting/flaring: CO_2	Key(T)	0	1	0	1
1B2	CH_4	Fugitive emissions venting/flaring	Key(T)	0	1	0	1
1B2	CH_4	Fugitive emissions from oil and gas: gas distribution	Non key	0	0	0	0
1B2	CH_4	Fugitive emissions from oil and gas operations: other	Non key	0	0	0	0
			21				
INDUSTRIAL PROCESSES							
2A1	CO_2	Cement production	Non key	0	0	0	0
2A3	CO_2	Limestone and dolomite use	Non key	0	0	0	0
2A7	CO_2	Other minerals	Non key	0	0	0	0
2B1	CO_2	Ammonia production	Key(L1)	1	0	0	0
2B2	N_2O	Nitric acid production	Key(L,T)	1	1	1	1
2B5	N_2O	Caprolactam production	Key(L,T)	1	1	1	1
2B5	CO_2	Other chemical product manufacture	Key(L2)	0	0	1	0
2C1	CO_2	Iron and steel production (carbon inputs)	Key(L1,T1)	1	1	0	0
2C3	CO_2	CO_2 from aluminium production	Non key	0	0	0	0
2C3	PFC	PFC from aluminium production	Key(T)	0	1	0	1
2F	SF_6	SF6 emissions from SF_6 use	Non key	0	0	0	0
2F	HFC	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	Key(L,T)	1	1	1	1
2E	HFC	HFC-23 emissions from HCFC-22 manufacture	Key(T)	0	1	0	1
2E	HFC	HFC by-product emissions from HFC manufacture	Non key	0	0	0	0
2F	PFC	PFC emissions from PFC use	Non key	0	0	0	0
2G	CO_2	Other industrial: CO_2	Non key	0	0	0	0
2G	CH_4	Other industrial: CH_4	Non key	0	0	0	0
2G	N_2O	Other industrial: N_2O	Non key	0	0	0	0
2G	N_2O	Indirect N_2O from non-agricultural sources	Non key	0	0	0	0
2G	N_2O	Indirect N_2O from N_2O from combustion and industrial processes	Key(L2,T)	0	1	1	1

SOLVENTS AND OTHER PRODUCT USE

Cate-gory	Gas	Category name	Key source?	Tier 1 Level	Tier 1 Trend	Tier 2 Level	Tier 2 Trend
3	CO_2	Indirect CO_2 from solvents/product use	Non key	0	0	0	0
3	CH_4	Solvents and other product use	IE in 2G				
AGRICULTURAL SECTOR							
4A1	CH_4	CH_4 emissions from enteric fermentation in domestic livestock: cattle	Key(L,T)	1	1	1	1
4A8	CH_4	CH_4 emissions from enteric fermentation in domestic livestock: swine	Non key	0	0	0	0
4A	CH_4	CH_4 emissions from enteric fermentation in domestic livestock: other	Non key	0	0	0	0
4B	N_2O	Emissions from manure management	Key(L)	1	0	1	0
4B1	CH_4	Emissions from manure management : cattle	Key(L)	1	0	1	*0*
4B8	CH_4	Emissions from manure management : swine	Key(L,T2)	1	0	1	1
4B9	CH_4	Emissions from manure management : poultry	Key(T2)	0	0	0	1
4B	CH_4	Emissions from manure management : other	Non key	0	0	0	0
4C	CH_4	Rice cultivation	Not occuring				
4D1	N_2O	Direct N_2O emissions from agricultural soils	Key(L,T2)	1	0	1	*1*
4D3	N_2O	Indirect N_2O emissions from nitrogen used in agriculture	Key(L,T)	1	1	1	1
4D2	N_2O	Animal production on agricultural soils	Key(L2,T)	*0*	1	1	1
WASTE SECTOR							
6A1	CH_4	CH_4 emissions from solid waste disposal sites	Key(L,T)	1	1	1	1
6B	CH_4	Emissions from wastewater handling	Non key	0	0	0	0
6B	N_2O	Emissions from wastewater handling	Non key	0	0	0	0
6C	CO_2	Emissions from waste incineration	IE in 1A1				
	CH_4	Misc. CH_4	Non key	0	0	0	0
	N_2O	Misc. N_2O	Non key	0	0	0	0
KEY SOURCE CATEGORIES (EXCL. LULUCF)			**39**	29	28	27	24
LAND USE, LAND USE CHANGE AND FORESTRY							
5A1	CO_2	5A1. Forest Land remaining Forest Land	Key(L,T2)	1	*0*	1	1
5A2	CO_2	5A2. Land converted to Forest Land	Non key	0	0	0	0
5B2	CO_2	5B2. Land converted to Cropland	Non key	0	0	0	0
5C1	CO_2	5C1. Grassland remaining Grassland	Key(L)	1	0	1	0
5C2	CO_2	5C2. Land converted to Grassland	Non key	0	0	0	0
5E2	CO_2	5E2. Land converted to Settlements	Non key	0	0	0	0
5F2	CO_2	5F2. Land converted to Other Land	Key(L)	1	0	1	0
5G	CO_2	5G. Other (liming of soils)	Non key	0	0	0	0
5A1	N_2O	5A1. Forest Land remaining Forest Land	Non key	0	0	0	0
TOTAL KEY SOURCE CATEGORIES (INCL. LULUCF)			**42**	**32**	**28**	**30**	**25**

* changed from key to non-key source, compared to NIR 2006.

A1.1.1 Changes in key sources compared to previous submission

Due to the use of emission data for 2005 in the key source analysis, the following changes occured compared to the previous NIR:

For energy:

- N_2O emissions from 1A3 Mobile combustion: road vehicles: now non-key;
- CO_2 emissions from 1A3 Mobile combustion: water-borne navigation: now non-key;
- CO_2 emissions from 1B1b Coke production: now non-key.

A1.2 Tier 1 key source and uncertainty assessment

In Tables A1.2. and A1.3. the source ranking is done according to the contribution to the 2005 annual emissions total and to the base year to 2005 trend, respectively. This resulted in 29 level key sources and 28 trend key sources (indicated in the grey part at the top).

Table A1.2. Source ranking using IPCC Tier 1 level assessment 2005 (amounts in Gg CO_2-eq).

IPCC	Category	Gas	CO2-eq last year	Share	Cum. Share
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO2	25734	12%	12%
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO2	23976	11%	23%
1A3b	Mobile combustion: road vehicles: diesel oil	CO2	19863	9%	33%
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO2	17887	8%	41%
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO2	15506	7%	49%
1A3b	Mobile combustion: road vehicles: gasoline	CO2	12970	6%	55%
1A1b	Stationary combustion : Petroleum Refining: liquids	CO2	9796	5%	59%
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO2	9588	5%	64%
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO2	7378	3%	67%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gases	CO2	7041	3%	71%
6A1	CH4 emissions from solid waste disposal sites	CH4	5931	3%	73%
4A1	CH4 emissions from enteric fermentation in domestic livestock: cattle	CH4	5677	3%	76%
2B2	Nitric acid production	N2O	5659	3%	79%
4D1	Direct N2O emissions from agricultural soils	N2O	4802	2%	81%
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO2	4297	2%	83%
4D3	Indirect N2O emissions from nitrogen used in agriculture	N2O	3156	1%	85%
2B1	Ammonia production	CO2	3105	1%	86%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, liquids	CO2	2551	1%	87%
1A1b	Stationary combustion : Petroleum Refining: gases	CO2	2487	1%	88%
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO2	2150	1%	89%
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO2	2101	1%	90%
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO2	2056	1%	91%
4B1	Emissions from manure management : cattle	CH4	1448	1%	92%
2C1	Iron and steel production (carbon inputs)	CO2	1208	1%	93%
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	1078	1%	93%
1A3b	Mobile combustion: road vehicles: LPG	CO2	1069	1%	94%
4B8	Emissions from manure management : swine	CH4	932	0%	94%
4B	Emissions from manure management	N2O	753	0%	94%
2B5	Caprolactam production	N2O	705	0%	95%
4D2	Animal production on agricultural soils	N2O	651	0%	95%
2B5	Other chemical product manufacture	CO2	640	0%	95%
1A3	Mobile combustion: water-borne navigation	CO2	637	0%	96%
1A	Emissions from stationary combustion: non-CO2	CH4	563	0%	96%
2G	Indirect N2O from NO2 from combustion and industrial processes	N2O	562	0%	96%
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO2	555	0%	96%
2C3	CO2 from aluminium production	CO2	484	0%	97%
1A3	Mobile combustion: road vehicles	N2O	474	0%	97%
1B1b	CO2 from coke production	CO2	457	0%	97%
2A7	Other minerals	CO2	430	0%	97%
2A1	Cement production	CO2	421	0%	98%
6B	Emissions from wastewater handling	N2O	401	0%	98%
2G	Other industrial: CO2	CO2	381	0%	98%
1A5	Military use of fuels (1A5 Other)	CO2	375	0%	98%
4A8	CH4 emissions from enteric fermentation in domestic livestock: swine	CH4	357	0%	98%
1B2	Fugitive emissions venting/flaring	CH4	342	0%	98%
2F	SF6 emissions from SF6 use	SF6	337	0%	99%
2G	Other industrial: CH4	CH4	312	0%	99%
4A	CH4 emissions from enteric fermentation in domestic livestock: other	CH4	311	0%	99%
2A3	Limestone and dolomite use	CO2	293	0%	99%
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH4	274	0%	99%
1A	Emissions from stationary combustion: non-CO2	N2O	210	0%	99%
6B	Emissions from wastewater handling	CH4	205	0%	99%
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	196	0%	99%
2F	PFC emissions from PFC use	PFC	166	0%	99%
1B2	Fugitive emissions from oil and gas operations: other	CH4	160	0%	100%
3	Indirect CO2 from solvents/product use	CO2	144	0%	100%
1B2	Fugitive emissions venting/flaring: CO2	CO2	129	0%	100%
3, 6D	OTHER N2O	N2O	124	0%	100%
1A3	Mobile combustion: other (railways)	CO2	106	0%	100%
2C3	PFC from aluminium production	PFC	87	0%	100%
6D	OTHER CH4	CH4	68	0%	100%
4B9	Emissions from manure management : poultry	CH4	62	0%	100%
2G	Indirect N2O from NH3 from combustion and industrial processes	N2O	56	0%	100%
1A3	Mobile combustion: road vehicles	CH4	49	0%	100%
1A4	Stationary combustion : Other Sectors, solids	CO2	48	0%	100%
1A3	Mobile combustion: aircraft	CO2	41	0%	100%
2E	HFC by-product emissions from HFC manufacture	HFC	39	0%	100%
4B	Emissions from manure management : other	CH4	17	0%	100%
2G	Other industrial: N2O	N2O	7	0%	100%
1A3	Mobile combustion: other (non-road)	N2O	2	0%	100%
1A3	Mobile combustion: other (non-road)	CH4	1	0%	100%
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO2	1	0%	100%
			212082		

Table A1.3. Source ranking using IPCC Tier 1 trend assessment (amounts in Gg CO_2-eq.).

IPCC	Category	Gas	CO2-eq base year	CO2-eq last year	level assess-ment last year	trend assess ment	% Contr. to trend	Cumu-lative
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO2	13348	23976	11%	5%	17%	17%
1A3b	Mobile combustion: road vehicles: diesel oil	CO2	11832	19863	9%	4%	13%	29%
6A1	CH4 emissions from solid waste disposal sites	CH4	12011	5931	3%	3%	9%	39%
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	5759	196	0%	3%	9%	47%
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO2	19020	15506	7%	2%	5%	52%
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO2	6634	9588	5%	1%	5%	57%
1A3b	Mobile combustion: road vehicles: gasoline	CO2	10902	12970	6%	1%	3%	60%
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO2	207	2150	1%	1%	3%	63%
2C3	PFC from aluminium production	PFC	1901	87	0%	1%	3%	66%
4D3	Indirect N2O emissions from nitrogen used in agriculture	N2O	4861	3156	1%	1%	3%	69%
1A3b	Mobile combustion: road vehicles: LPG	CO2	2738	1069	1%	1%	3%	71%
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO2	8993	7378	3%	1%	2%	73%
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO2	592	2101	1%	1%	2%	76%
1A1b	Stationary combustion : Petroleum Refining: gases	CO2	1042	2487	1%	1%	2%	78%
2C1	Iron and steel production (carbon inputs)	CO2	2514	1208	1%	1%	2%	80%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gases	CO2	8328	7041	3%	1%	2%	82%
4A1	CH4 emissions from enteric fermentation in domestic livestock: cattle	CH4	6767	5677	3%	0%	2%	84%
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO2	1476	555	0%	0%	1%	85%
1B2	Fugitive emissions venting/flaring	CH4	1252	342	0%	0%	1%	86%
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	249	1078	1%	0%	1%	88%
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO2	5033	4297	2%	0%	1%	89%
4D2	Animal production on agricultural soils	N2O	1308	651	0%	0%	1%	90%
1B2	Fugitive emissions venting/flaring: CO2	CO2	775	129	0%	0%	1%	91%
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO2	18696	17887	8%	0%	1%	92%
2B2	Nitric acid production	N2O	6330	5659	3%	0%	1%	93%
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO2	1526	2056	1%	0%	1%	93%
2B5	Caprolactam production	N2O	1240	705	0%	0%	1%	94%
2G	Indirect N2O from NO2 from combustion and industrial processes	N2O	883	562	0%	0%	0%	95%
4D1	Direct N2O emissions from agricultural soils	N2O	4597	4802	2%	0%	0%	95%
1A3	Mobile combustion: water-borne navigation	CO2	405	637	0%	0%	0%	95%
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO2	25776	25734	12%	0%	0%	96%
1A3	Mobile combustion: road vehicles	N2O	271	474	0%	0%	0%	96%
4B8	Emissions from manure management : swine	CH4	1141	932	0%	0%	0%	96%
1A5	Military use of fuels (1A5 Other)	CO2	566	375	0%	0%	0%	97%
4B9	Emissions from manure management : poultry	CH4	243	62	0%	0%	0%	97%
3	Indirect CO2 from solvents/product use	CO2	316	144	0%	0%	0%	97%
1A4	Stationary combustion : Other Sectors, solids	CO2	189	48	0%	0%	0%	97%
2F	PFC emissions from PFC use	PFC	37	166	0%	0%	0%	98%
2A7	Other minerals	CO2	308	430	0%	0%	0%	98%
3, 6D	OTHER N2O	N2O	250	124	0%	0%	0%	98%
4B1	Emissions from manure management : cattle	CH4	1574	1448	1%	0%	0%	98%
6B	Emissions from wastewater handling	N2O	513	401	0%	0%	0%	98%
1A3	Mobile combustion: road vehicles	CH4	157	49	0%	0%	0%	99%
1A1b	Stationary combustion : Petroleum Refining: liquids	CO2	9999	9796	5%	0%	0%	99%
2C3	CO2 from aluminium production	CO2	395	484	0%	0%	0%	99%
6B	Emissions from wastewater handling	CH4	290	205	0%	0%	0%	99%
2G	Other industrial: CO2	CO2	305	381	0%	0%	0%	99%
4A8	CH4 emissions from enteric fermentation in domestic livestock: swine	CH4	439	357	0%	0%	0%	99%
6D	OTHER CH4	CH4	1	68	0%	0%	0%	99%
4B	Emissions from manure management	N2O	694	753	0%	0%	0%	99%
1B1b	CO2 from coke production	CO2	403	457	0%	0%	0%	99%
1A	Emissions from stationary combustion: non-CO2	CH4	522	563	0%	0%	0%	100%
2B1	Ammonia production	CO2	3096	3105	1%	0%	0%	100%
2B5	Other chemical product manufacture	CO2	606	640	0%	0%	0%	100%
2F	SF6 emissions from SF6 use	SF6	301	337	0%	0%	0%	100%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, liquids	CO2	2544	2551	1%	0%	0%	100%
2E	HFC by-product emissions from HFC manufacture	HFC	12	39	0%	0%	0%	100%
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH4	255	274	0%	0%	0%	100%
2A3	Limestone and dolomite use	CO2	276	293	0%	0%	0%	100%
2G	Other industrial: CH4	CH4	297	312	0%	0%	0%	100%
1A3	Mobile combustion: other (railways)	CO2	91	106	0%	0%	0%	100%
2A1	Cement production	CO2	416	421	0%	0%	0%	100%
4B	Emissions from manure management : other	CH4	12	17	0%	0%	0%	100%
4A	CH4 emissions from enteric fermentation in domestic livestock: other	CH4	319	311	0%	0%	0%	100%
2G	Indirect N2O from NH3 from combustion and industrial processes	N2O	52	56	0%	0%	0%	100%
2G	Other industrial: N2O	N2O	3	7	0%	0%	0%	100%
1A	Emissions from stationary combustion: non-CO2	N2O	215	210	0%	0%	0%	100%
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO2	2	1	0%	0%	0%	100%
1A3	Mobile combustion: other (non-road)	N2O	1	2	0%	0%	0%	100%
1A3	Mobile combustion: aircraft	CO2	41	41	0%	0%	0%	100%
1A3	Mobile combustion: other (non-road)	CH4	1	1	0%	0%	0%	100%
1B2	Fugitive emissions from oil and gas operations: other	CH4	162	160	0%	0%	0%	100%
			214308	212082		31%		

A1.3 Tier 2 key source assessment

Using the uncertainty estimate for each key source as a weighting factor (see Annex 7), the key source assessment is performed again. This is called the Tier 2 key source assessment. The results of this assessment are presented in Tables A1.4 and A1.5 for the contribution to the 2005 annual emissions total and to the trend, respectively. Comparison with the Tier 1 assessment presented in Tables A1.2 and A1.3 shows less level and trend key sources (27 and 24, respectively instead of 29 and 28).

Table A1.4. Source ranking using IPCC Tier 2 level assessment 2005 (in Gg CO_2-eq. 0.

IPCC	Category	Gas	CO2-eq last year	Share	Uncer-tainty estimate	Level * Uncer-tainty	Share L*U	Cum. Share L*U
4D3	Indirect N2O emissions from nitrogen used in agriculture	N2O	3156	1%	206%	3%	18%	18%
4D1	Direct N2O emissions from agricultural soils	N2O	4802	2%	61%	1%	8%	27%
2B2	Nitric acid production	N2O	5659	3%	51%	1%	8%	35%
6A1	CH4 emissions from solid waste disposal sites	CH4	5931	3%	34%	1%	6%	41%
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO2	9588	5%	20%	1%	5%	46%
4B1	Emissions from manure management : cattle	CH4	1448	1%	100%	1%	4%	50%
1A1b	Stationary combustion : Petroleum Refining: liquids	CO2	9796	5%	14%	1%	4%	54%
4A1	CH4 emissions from enteric fermentation in domestic livestock: cattle	CH4	5677	3%	21%	1%	3%	57%
2G	Indirect N2O from NO2 from combustion and industrial processes	N2O	562	0%	201%	1%	3%	61%
1A3b	Mobile combustion: road vehicles: diesel oil	CO2	19863	9%	5%	0%	3%	63%
4B8	Emissions from manure management : swine	CH4	932	0%	100%	0%	3%	66%
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO2	17887	8%	5%	0%	3%	69%
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO2	25734	12%	3%	0%	2%	71%
4B	Emissions from manure management	N2O	753	0%	100%	0%	2%	73%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gases	CO2	7041	3%	10%	0%	2%	75%
4D2	Animal production on agricultural soils	N2O	651	0%	100%	0%	2%	77%
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	1078	1%	51%	0%	2%	78%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, liquids	CO2	2551	1%	20%	0%	1%	80%
2B5	Caprolactam production	N2O	705	0%	71%	0%	1%	81%
2B5	Other chemical product manufacture	CO2	640	0%	71%	0%	1%	83%
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO2	4297	2%	10%	0%	1%	84%
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO2	2056	1%	21%	0%	1%	85%
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO2	7378	3%	5%	0%	1%	86%
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO2	15506	7%	2%	0%	1%	87%
1A	Emissions from stationary combustion: non-CO2	CH4	563	0%	50%	0%	1%	88%
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO2	23976	11%	1%	0%	1%	89%
1A3b	Mobile combustion: road vehicles: gasoline	CO2	12970	6%	2%	0%	1%	89%
1A3	Mobile combustion: road vehicles	N2O	474	0%	50%	0%	1%	90%
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO2	2101	1%	11%	0%	1%	91%
1B1b	CO2 from coke production	CO2	457	0%	50%	0%	1%	91%
6B	Emissions from wastewater handling	N2O	401	0%	54%	0%	1%	92%
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO2	2150	1%	10%	0%	1%	93%
2F	SF6 emissions from SF6 use	SF6	337	0%	56%	0%	1%	93%
4A8	CH4 emissions from enteric fermentation in domestic livestock: swine	CH4	357	0%	50%	0%	1%	94%
2G	Other industrial: CH4	CH4	312	0%	51%	0%	0%	94%
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH4	274	0%	50%	0%	0%	95%
1A3	Mobile combustion: water-borne navigation	CO2	637	0%	20%	0%	0%	95%
2G	Indirect N2O from NH3 from combustion and industrial processes	N2O	56	0%	206%	0%	0%	95%
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO2	555	0%	20%	0%	0%	96%
2A7	Other minerals	CO2	430	0%	25%	0%	0%	96%
1A3b	Mobile combustion: road vehicles: LPG	CO2	1069	1%	10%	0%	0%	96%
1A	Emissions from stationary combustion: non-CO2	N2O	210	0%	50%	0%	0%	96%
4A	CH4 emissions from enteric fermentation in domestic livestock: other	CH4	311	0%	30%	0%	0%	97%
1B2	Fugitive emissions from oil and gas operations: other	CH4	160	0%	54%	0%	0%	97%
1B2	Fugitive emissions venting/flaring	CH4	342	0%	25%	0%	0%	97%
2G	Other industrial: CO2	CO2	381	0%	21%	0%	0%	97%
1A5	Military use of fuels (1A5 Other)	CO2	375	0%	20%	0%	0%	98%
2A3	Limestone and dolomite use	CO2	293	0%	25%	0%	0%	98%
2C1	Iron and steel production (carbon inputs)	CO2	1208	1%	6%	0%	0%	98%
2B1	Ammonia production	CO2	3105	1%	2%	0%	0%	98%
3, 6D	OTHER N2O	N2O	124	0%	54%	0%	0%	98%
6B	Emissions from wastewater handling	CH4	205	0%	32%	0%	0%	99%
1B2	Fugitive emissions venting/flaring: CO2	CO2	129	0%	50%	0%	0%	99%
4B9	Emissions from manure management : poultry	CH4	62	0%	100%	0%	0%	99%
2A1	Cement production	CO2	421	0%	11%	0%	0%	99%
2F	PFC emissions from PFC use	PFC	166	0%	25%	0%	0%	99%
3	Indirect CO2 from solvents/product use	CO2	144	0%	27%	0%	0%	99%
1A3	Mobile combustion: road vehicles	CH4	49	0%	60%	0%	0%	99%
1A1b	Stationary combustion : Petroleum Refining: gases	CO2	2487	1%	1%	0%	0%	99%
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	196	0%	14%	0%	0%	100%
2C3	CO2 from aluminium production	CO2	484	0%	5%	0%	0%	100%
1A4	Stationary combustion : Other Sectors, solids	CO2	48	0%	50%	0%	0%	100%
6D	OTHER CH4	CH4	68	0%	32%	0%	0%	100%
1A3	Mobile combustion: aircraft	CO2	41	0%	50%	0%	0%	100%
2C3	PFC from aluminium production	PFC	87	0%	20%	0%	0%	100%
4B	Emissions from manure management : other	CH4	17	0%	100%	0%	0%	100%
2E	HFC by-product emissions from HFC manufacture	HFC	39	0%	22%	0%	0%	100%
1A3	Mobile combustion: other (railways)	CO2	106	0%	5%	0%	0%	100%
2G	Other industrial: N2O	N2O	7	0%	71%	0%	0%	100%
1A3	Mobile combustion: other (non-road)	N2O	2	0%	112%	0%	0%	100%
1A3	Mobile combustion: other (non-road)	CH4	1	0%	112%	0%	0%	100%
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO2	1	0%	20%	0%	0%	100%
			212082			17%		

With respect to Tier 2 level key sources, perhaps surprisingly, the energy industries with the highest share of 30% in the national total are not number 1 when including the uncertainty estimates. As Table A1.4 shows, two large but quite uncertain N_2O sources are now in the top 5 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 50 to 200%, with indirect N_2O emissions having an uncertainty of a factor 2; one or two orders of magnitude higher than the 4% uncertainty estimated for CO_2 from the energy industries.

Table A1.5 Source ranking using IPCC Tier 2 trend assessment (in Gg CO_2-eq.).

IPCC	Category	Gas	CO2-eq base year	CO2-eq last year	level assess-ment last year	trend assess-ment	Uncer-tainty estimate	Trend * uncer-tainty	% Contr. to trend	Cumu-lative
4D3	Indirect N2O emissions from nitrogen used in agriculture	N2O	4861	3156	1%	1%	206%	2%	25%	25%
6A1	CH4 emissions from solid waste disposal sites	CH4	12011	5931	3%	3%	34%	1%	15%	39%
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	5759	196	0%	3%	14%	0%	6%	45%
4D2	Animal production on agricultural soils	N2O	1308	651	0%	0%	100%	0%	5%	50%
2G	Indirect N2O from NO2 from combustion and industrial processes	N2O	883	562	0%	0%	201%	0%	5%	54%
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO2	6634	9588	5%	1%	20%	0%	4%	59%
2F	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	249	1078	1%	0%	51%	0%	3%	62%
1A3b	Mobile combustion: road vehicles: diesel oil	CO2	11832	19863	9%	4%	5%	0%	3%	65%
2B5	Caprolactam production	N2O	1240	705	0%	0%	71%	0%	3%	68%
2C3	PFC from aluminium production	PFC	1901	87	0%	1%	20%	0%	3%	70%
1B2	Fugitive emissions venting/flaring: CO2	CO2	775	129	0%	0%	50%	0%	2%	73%
2B2	Nitric acid production	N2O	6330	5659	3%	0%	51%	0%	2%	75%
1B2	Fugitive emissions venting/flaring	CH4	1252	342	0%	0%	25%	0%	2%	76%
4A1	CH4 emissions from enteric fermentation in domestic livestock: cattle	CH4	6767	5677	3%	0%	21%	0%	2%	78%
4B8	Emissions from manure management : swine	CH4	1141	932	0%	0%	100%	0%	1%	79%
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO2	207	2150	1%	1%	10%	0%	1%	81%
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO2	1476	555	0%	0%	20%	0%	1%	82%
4B9	Emissions from manure management : poultry	CH4	243	62	0%	0%	100%	0%	1%	84%
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incineration	CO2	592	2101	1%	1%	11%	0%	1%	85%
1A3b	Mobile combustion: road vehicles: LPG	CO2	2738	1069	1%	1%	10%	0%	1%	86%
4D1	Direct N2O emissions from agricultural soils	N2O	4597	4802	2%	0%	61%	0%	1%	87%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gases	CO2	8328	7041	3%	1%	10%	0%	1%	88%
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO2	13348	23976	11%	5%	1%	0%	1%	89%
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO2	1526	2056	1%	0%	21%	0%	1%	90%
4B1	Emissions from manure management : cattle	CH4	1574	1448	1%	0%	100%	0%	1%	90%
1A3	Mobile combustion: road vehicles	N2O	271	474	0%	0%	50%	0%	1%	91%
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO2	8993	7378	3%	1%	5%	0%	1%	92%
2C1	Iron and steel production (carbon inputs)	CO2	2514	1208	1%	1%	6%	0%	1%	92%
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO2	19020	15506	7%	2%	2%	0%	1%	93%
1A4	Stationary combustion : Other Sectors, solids	CO2	189	48	0%	0%	50%	0%	1%	93%
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO2	5033	4297	2%	0%	10%	0%	1%	94%
4B	Emissions from manure management	N2O	694	753	0%	0%	100%	0%	0%	94%
3, 6D	OTHER N2O	N2O	250	124	0%	0%	54%	0%	0%	95%
1A3	Mobile combustion: road vehicles	CH4	157	49	0%	0%	60%	0%	0%	95%
6B	Emissions from wastewater handling	N2O	513	401	0%	0%	54%	0%	0%	96%
1A3	Mobile combustion: water-borne navigation	CO2	405	637	0%	0%	20%	0%	0%	96%
3	Indirect CO2 from solvents/product use	CO2	316	144	0%	0%	27%	0%	0%	96%
1A3b	Mobile combustion: road vehicles: gasoline	CO2	10902	12970	6%	1%	2%	0%	0%	97%
4A8	CH4 emissions from enteric fermentation in domestic livestock: swine	CH4	439	357	0%	0%	50%	0%	0%	97%
1A5	Military use of fuels (1A5 Other)	CO2	566	375	0%	0%	20%	0%	0%	97%
2F	PFC emissions from PFC use	PFC	37	166	0%	0%	25%	0%	0%	98%
2A7	Other minerals	CO2	308	430	0%	0%	25%	0%	0%	98%
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO2	18696	17887	8%	0%	5%	0%	0%	98%
1B1b	CO2 from coke production	CO2	403	457	0%	0%	50%	0%	0%	98%
2B5	Other chemical product manufacture	CO2	606	640	0%	0%	71%	0%	0%	98%
6B	Emissions from wastewater handling	CH4	290	205	0%	0%	32%	0%	0%	99%
1A	Emissions from stationary combustion: non-CO2	CH4	522	563	0%	0%	50%	0%	0%	99%
2F	SF6 emissions from SF6 use	SF6	301	337	0%	0%	56%	0%	0%	99%
6D	OTHER CH4	CH4	1	68	0%	0%	32%	0%	0%	99%
2G	Other industrial: CO2	CO2	305	381	0%	0%	21%	0%	0%	99%
1A1b	Stationary combustion : Petroleum Refining: gases	CO2	1042	2487	1%	1%	1%	0%	0%	99%
1A1b	Stationary combustion : Petroleum Refining: liquids	CO2	9999	9796	5%	0%	14%	0%	0%	99%
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH4	255	274	0%	0%	50%	0%	0%	100%
2G	Other industrial: CH4	CH4	297	312	0%	0%	51%	0%	0%	100%
2G	Indirect N2O from NH3 from combustion and industrial processes	N2O	52	56	0%	0%	206%	0%	0%	100%
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO2	25776	25734	12%	0%	3%	0%	0%	100%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, liquids	CO2	2544	2551	1%	0%	20%	0%	0%	100%
2E	HFC by-product emissions from HFC manufacture	HFC	12	39	0%	0%	22%	0%	0%	100%
4B	Emissions from manure management : other	CH4	12	17	0%	0%	100%	0%	0%	100%
2C3	CO2 from aluminium production	CO2	395	484	0%	0%	5%	0%	0%	100%
2A3	Limestone and dolomite use	CO2	276	293	0%	0%	25%	0%	0%	100%
2G	Other industrial: N2O	N2O	3	7	0%	0%	71%	0%	0%	100%
4A	CH4 emissions from enteric fermentation in domestic livestock: other	CH4	319	311	0%	0%	30%	0%	0%	100%
1A	Emissions from stationary combustion: non-CO2	N2O	215	210	0%	0%	50%	0%	0%	100%
2A1	Cement production	CO2	416	421	0%	0%	11%	0%	0%	100%
2B1	Ammonia production	CO2	3096	3105	1%	0%	2%	0%	0%	100%
1A3	Mobile combustion: other (railways)	CO2	91	106	0%	0%	5%	0%	0%	100%
1A3	Mobile combustion: other (non-road)	N2O	1	2	0%	0%	112%	0%	0%	100%
1A3	Mobile combustion: other (non-road)	CH4	1	1	0%	0%	112%	0%	0%	100%
1A3	Mobile combustion: aircraft	CO2	41	41	0%	0%	50%	0%	0%	100%
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO2	2	1	0%	0%	20%	0%	0%	100%
1B2	Fugitive emissions from oil and gas operations: other	CH4	162	160	0%	0%	54%	0%	0%	100%
			214308	212082				7%		

ANNEX 2. Detailed discussion of methodology and data for estimating CO_2 emissions from fossil fuel combustion

In this Annex '**The Netherlands list of fuels and standard CO_2 emission factors**' version August 2006 is included. This list was first published in 2004 and updated with some editorial changes in November 2005. Not included are Annex 2 and 3 of this publication as these hold a copy of Page 1.13 Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual (Volume 3) and of Page 1.6 IPCC GoodPractice Guidance for National Greenhouse Gas Inventories Workbook.

A2.1 Introduction

For national monitoring of greenhouse gas emissions under the framework of the UN Climate Change Agreement (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 national monitoring, and because the data concerning the CO_2 emissions trade also needs to be entered into the e-MJV.
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:

1. A table containing the names (in Dutch and English) of the energy carrier and the accompanying standard energy content and CO_2 emissions factor;
2. A fact sheet per energy carrier, substantiating the values given, presenting similar names and possible specifications, and providing an overview of the codes that organisations use for the individual energy carriers.

This document is meant for people using the Netherlands' list. It contains the starting points for this list and indicates how it should be used for various objectives, e.g. 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.

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;
4. As a result of the 1996 IPCC guidelines and the EC's Directive 2004/156/EG mentioned in 1 and 2 above, the CO_2 emission factors are accurate to one digit after the decimal point;

5. 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.

A2.2.1 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 data was available to update national values (Spakman et al., 2003) but, for others, new values were required. In 2006 a study was commissioned to research methods to determine the CO_2 emission factor for natural gas (Heslinga and van Harmelen, 2006). This resulted in an advice to use natural gas a country specific factor from the year 1990 onwards (Vreuls, 2006). In its meeting 25 April 2006 the Steering Group for Emissions Registration agreed with this advise and approved an update of the National list.

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's Directive 2004/156/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. Oxy gas;
10. Phosphor oven gas;
11. Natural gas.

For industrial gases, chemical waste gas is also split from refinery gas. For the IPCC main group 'other fuels', only the (non-biogenic) waste is differentiated.
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. A weighed average of three specified biogases is used as the standard factor for gaseous biomass, i.e.:
1. Sewage treatment facility (RWZI) biogas;
2. Landfill gas;
3. Industrial organic waste gas.

For coke coals the standard CO_2 emissions factor is also a weighed average, e.g. of coke coals used in coke ovens and in blast furnaces.
The heating values are the same as those used by the CBS for observed fuels in its surveys for collating energy statistics.

A2.2.2 Fact sheets

A fact sheet (consisting of at least two sections) has been drawn up for each energy carrier:
1) General information:
   a. Name of the energy carrier, in Dutch and English;
   b. Other names used (Dutch and English);
   c. Description;
   d. Codes (in Dutch) used to specify the energy carrier;
   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 an energy carrier already exists, then this has been added to the fact sheet (as a third section containing the same information as that described under 1) and 2) above).

A2.2.3 The Netherlands list in national monitoring, European CO_2 emissions trade and in e-MJV

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 2004/156/EG covers the monitoring under the framework of the European CO_2 emissions trade. This directive serves as a starting point for the Netherlands monitoring system for trading in emission rights. 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 country, e.g. as indicated in the relevant Member State's latest national inventory, which has been submitted to the secretariat of the UNFCCC (EC Directive 2004/156/EG, 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 standard 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 2004/156/EG, Appendix I, section 5).
Exactly 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 2004/156/EG and the Netherlands system for monitoring the trade in emission rights.

Table A2.1. Netherlands fuels and standard CO_2 emission factors

Main group (Dutch language)	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
Raffinaderijgrondstoffen	Refinery Feedstocks	kg	44.8	73.3
Raffinaderijgas	Refinery Gas	kg	45.2	66.7
Chemisch restgas	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
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	Phosphor Gas	Nm^3	11.6	149.5
	C. Gaseous Fossil Fuels			
Aardgas	Natural Gas (dry)	Nm^3 ae	31.65	56.8
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 *			
Biomassa vast	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	Wastewater biogas	Nm^3	23.3	84.2
Stortgas	Landfill gas	Nm^3	19.5	100.7
Industrieel fermentatiegas	Industrial organic waste gas	Nm^3	23.3	84.2
	D. Other fuels			
Afval (niet biogeen)	Waste (not biogenic)	kg	34.4	73.6

* biomass: the value of the CO_2 emission factor is shown as a memo item in reports for the climate agreement; the value is zero for emissions trading and for the Kyoto Protocol.

It has been decided to leave these differences for the first trading period, so that the allocation to these companies need not be modified. How these exceptions should be treated is further defined under the framework of the EU CO_2 emissions trading in the Netherlands.

Table A2.2. Comparison of emission factors in the allocation of CO_2 emission rights with the National list

Energy carrier	Unit	Allocation		National list	
		Heating value (GJ/unit)	CO_2 emission factor (kg/GJ)	Heating value (GJ/unit)	CO_2 emission factor (kg/GJ)
LPG	ton	46.00	63.00	45.2	66.7 [1)]
Heavy oil	ton	41.00	77.30	41.0	77.4 [2)]
Light oil	ton	42.50	73.00	42.7	74.3 [1)]
Coal	ton	29.30	94.50	24.5	94.7 [3)]

[1)] Country-specific factor (Olivier, 2004)
[2)] IPCC standard value
[3)] Country-specific factor (TNO, 2002).

(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 etc.). 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.

A2.2.4 Defining and maintaining the Netherlands list

The Ministry of VROM (Spatial Planning, Housing 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 that are involved in the national monitoring activities, i.e. RIVM, CBS, SenterNovem, plus other relevant organisations, such as the (e-)MJV, CO_2 emissions trade and ECN. The EMSG (Emissions Registration Steering Group, the collaborative agencies implementing the national monitoring) compiled the list during its meeting held 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. The values currently included are valid for (at least) the period from 1990 through 2007.
This document was updated in November 2005 with some editiorial changes. This document as well as the Netherlands' list is updated in 2006 based on research for methods to determine the CO_2 emission factor for natural gas in the Netherlands.

Appendix 1: Fact sheet for petrol as a transport fuel

Version: 4

Date: 17 October 2005

General information

Name of energy carrier	Nederlands: Motorbenzine English: Petrol/gasoline (US)	
Energysource-ID:		
Fuels understood to be included under this energy carrier	Unleaded petrol (30900) • Petrol standard • Euro, unleaded • Superplus, unleaded • Super with lead replacement • (Petrol) Other Leaded petrol (30900) • Petrol standard, leaded • Euro, leaded • (Petrol) Other, leaded Aviation fuel (30600)	
Description (using GN standards)	Unleaded petrol (30900): Petrol, standard • 27101141 Petrol (Motor spirit) with a lead content of <= 0.013 g/l and a research-octane level "RON" of <= 95 Euro, unleaded: • 27101145 Petrol (Motor spirit) with a lead content of <= 0.013 g/l and a research-octane level "RON" of > 95 or < 98 Superplus, unleaded: • 27101149 Petrol (Motor spirit) with a lead content of <= 0.013 g/l and a research-octane level "RON" of >= 98 Super, with lead replacement: • 27101149 Petrol (Motor spirit) with a lead content of <= 0.013 g/l and a research-octane level "RON" of >= 98 (Petrol) Other: • 27101145 Petrol (Motor spirit) with a lead content of <= 0.013 g/l and a research-octane level "RON" of > 95 or < 98 Leaded petrol (30900) Petrol standard, leaded: • 27101151 Petrol (Motor spirit) with a lead content of > 0.013 g/l and a research-octane level 'RON' of < 98 (except aviation fuel) Euro, leaded: • 27101159 Petrol (Motor spirit) with a lead content of > 0.013 g/l and a research-octane level 'RON' of >= 98 (except aviation fuel) • (Petrol) Other, leaded: • 27101145 Petrol (Motor spirit) with a lead content of <= 0.013 g/l and a research-octane level 'RON' of > 95 or < 98. Aviation fuel (30600) • 27101131 Aviation spirit.	
Names currently in use	Nether-lands Statistics (CBS):	Fuels in questionnaire form for crude oil statistics: 10+11+14 Fuels in NEH under table numbers 4.3.6 4.3.9
	ER/TNO	
	MJA	
	CO_2 trade	
Names used in previous lists	EMJV	Petrol/motorbenzine
	ER/TNO	Petrol
	MJA	Petrol
	Benchmark	
Unit	Kg	

Specific values and substantiation

Heating value (MJ/[unit])	44.0
Substantiation of heating value	NEH
Carbon content (ton C/TJ)	19.6
Substantiation of carbon content	Calculated based on the C-content % mass and energy conversion factor
CO_2 emissions factor (ton $_{CO2}$/TJ)	72.0
CEF IPCC default	*69.3*
Substantiation of CO_2 emissions factor	The Netherlands deviates here from the IPCC default. The basis for this is the report 'Netherlands' CO_2 emission factors for petrol, diesel and LPG' MNP Memorandum on the Netherlands CO_2 emission factors, Olivier (2004). At the request of the Ministry of VROM, in 2004 ITS Caleb Brett analysed a number of petrol and diesel samples (winter and summer qualities) for both carbon and energy contents. This resulted in the following values: • C-content (% mass): 86.4 • Conversion factor (GJ/1000kg; LHV) 44.0 • Emissions factor (kg CO_2/GJ) 72.0 This emissions factor can be used for all years from 1990 onwards
Validity of CO_2 emissions factor	From 1990 onwards
Density (kg/l)	Gasoline 0.745 kg/l
Substantiation of density	NEH (Netherlands Energy Statistics) 1996

ANNEX 3. Other detailed methodological descriptions for individual source or sink categories

- Annex 3 of the NIR 2005 (Klein Godewijk et al., 2005) provides detailed 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. ;
- 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 in the National Approach and Reference Approach

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 and 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 and A2.3).
In Table A4.1 the results of the Reference Approach calculation are presented for 1990-2005 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 4.5% for 1991 and 1992; and 0.6% for 2004. The largest differences are seen for the early 1990's.

Table A4.1. Comparison of CO_2 emissions: Reference Approach (RA) [1)] versus National Approach (NA) (in Tg).

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Reference Approach																
Liquid fuels [1)]	49.7	50.4	51.0	51.2	52.2	51.4	52.3	51.7	52.3	53.1	53.8	54.6	53.6	55.5	54.9	58.0
Solid fuels [1)]	34.0	31.3	31.4	31.5	33.7	34.7	33.5	32.5	33.3	29.2	30.5	32.2	32.8	34.1	33.4	32.1
Gaseous fuels	71.9	80.3	78.1	80.7	77.7	79.9	88.4	82.8	82.3	80.0	81.0	83.4	83.1	83.6	85.3	81.9
Others	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total RA	**155.6**	**162.0**	**160.6**	**163.4**	**163.6**	**166.0**	**174.2**	**167.1**	**167.9**	**162.3**	**165.3**	**170.2**	**169.5**	**173.3**	**173.7**	**172.1**
National Approach																
Liquid fuels	49.8	49.6	50.0	51.5	52.1	52.3	52.7	52.3	53.8	54.5	54.4	55.5	55.1	57.3	57.0	56.5
Solid fuels	31.0	28.2	28.7	29.2	31.0	32.4	31.0	29.9	31.2	27.3	28.8	30.8	31.0	31.9	31.6	30.1
Gaseous fuels	68.6	76.5	74.4	77.0	73.7	76.0	84.5	78.7	78.2	76.0	76.7	79.7	79.6	80.2	82.0	78.5
Others [2)]	0.6	0.6	0.6	0.7	0.7	0.8	1.1	1.3	1.4	1.5	1.5	1.5	1.6	1.7	2.1	2.1
Total NA	**150.0**	**155.0**	**153.7**	**158.4**	**157.5**	**161.5**	**169.3**	**162.2**	**164.6**	**159.3**	**161.4**	**167.6**	**167.2**	**171.1**	**172.7**	**167.3**
Difference [3)] (%)																
Liquid fuels	-0.2%	1.5%	2.1%	-0.6%	0.2%	-1.7%	-0.7%	-1.1%	-2.8%	-2.5%	-1.0%	-1.7%	-2.6%	-3.1%	-3.6%	2.6%
Solid fuels	9.8%	11.0%	9.3%	8.1%	8.8%	7.2%	8.0%	8.7%	6.6%	7.0%	6.1%	4.5%	5.8%	7.1%	5.9%	6.9%
Gaseous fuels	4.8%	4.9%	5.1%	4.8%	5.3%	5.2%	4.6%	5.2%	5.3%	5.2%	5.5%	4.6%	4.4%	4.3%	4.0%	4.3%
Other	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
Total	**3.8%**	**4.5%**	**4.5%**	**3.2%**	**3.9%**	**2.8%**	**2.9%**	**3.0%**	**2.0%**	**1.9%**	**2.4%**	**1.6%**	**1.3%**	**1.3%**	**0.6%**	**2.9%**

[1)] Specification of national fuel types used in the IPCC fuel type categories:
Gasoline: jetfuel, 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. Last year accidentally the figures included the CO2 from the organic carbon in the waste.
[3)] Defined as: (RA-NA)/NA.

The Reference Approach (RA) and National Approach (NA) data show a 17% RA vs. 14% NA increase in emissions from liquid fuels (1990-2005) and a 13.9% RA vs. 14.5% NA increase from gaseous fuels; CO_2 emissions from solid fuels decreased in this period by 6% in the RA vs. an decrease of 3% in the NA. The emissions from others (i.e. fossil carbon in waste), which is only included in the NA increased from 0.6 Tg in 1990 to 2.1 Tg CO_2 in 2005. 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. Therefore, a corrected comparison will be made below.

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 6C or 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);

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: the 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:

- waste incineration (in the Netherlands included in 1A1a, as ‘other fuels’);
- 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 1%: between -1.3% in 2003 and +0.9% in 2005, with a direct average of (-0.2±0.3) % vs. (2.7±0.6) % in the uncorrected comparison.

The corrected RA and NA comparison per fuel type is presented in Table A4.3. This shows that the largest differences do not concentrate in a particular corner of the period. The corrected 1990-2005 trends also differ only slightly: 10.0% for the corrected National Approach (NA) (= sum of sectoral emissions in source category 1A plus selected 1B and 2 minus fossil waste) and 11.5% for the corrected Reference Approach. We conclude that in total annual emissions the remaining differences are now all smaller than ±1%, except for 2004 which shows a 1.3% difference.

The corrected approaches show differences in emissions from liquid fuels up to -3% for a single year vs. -3% for uncorrected comparisons; for solid fuels differences are up to 3% vs. 11% and for gaseous fuels -1% vs. +5%, respectively, if corrections are made for 2G (non energy uses of lubricants and waxes) in NA-liquids, 1B (coke production), 2A (‘Soda Ash’), 2B5, 2C1 (blast furnaces) and 2D in NA-solids; and 1B2 (gas flaring) and 2B1 (ammonia) in NA-gases (Table A4.2). 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	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Difference RA-NA	5.7	7.0	6.9	5.1	6.1	4.6	5.0	4.9	3.3	3.0	4.0	2.6	2.2	2.2	1.0	4.8
Reference Approach:	155.6	162.0	160.6	163.4	163.6	166.0	174.2	167.1	167.9	162.3	165.3	170.2	169.5	173.3	173.7	172.1
Other: fossil waste cf. NA	0.6	0.6	0.6	0.7	0.7	0.8	1.1	1.3	1.4	1.5	1.5	1.5	1.6	1.7	2.1	2.1
RA incl. fossil waste:	**156.2**	**162.6**	**161.2**	**164.1**	**164.3**	**166.9**	**175.3**	**168.4**	**169.3**	**163.8**	**166.8**	**171.7**	**171.1**	**175.0**	**175.8**	**174.2**
Diff. RAincl.Waste-NA:	5.1	6.4	6.3	4.4	5.4	3.7	3.9	3.6	1.9	1.6	2.5	1.1	0.6	0.4	-1.1	2.7
National Approach:	150.0	155.0	153.7	158.4	157.5	161.5	169.3	162.2	164.6	159.3	161.4	167.6	167.2	171.1	172.7	167.3
CO_2 fossil in sector 1B:																
1B1b. Solid Fuel Transf.	0.4	0.4	0.4	0.4	0.6	0.5	0.7	0.5	0.5	0.4	0.4	0.4	0.4	0.5	0.5	0.5
1B2c Flaring	0.4	0.4	0.4	0.4	0.3	0.3	0.2	0.3	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.1
1B2a-iv Oil refining	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.9	0.9
CO_2 fossil in sector 2:	6.2	5.9	5.4	5.2	5.7	5.7	5.5	6.0	5.7	5.5	5.3	4.7	4.7	4.8	4.8	4.8
A. Mineral Products																
Soda Ash Production	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
B. Chemical industry																
1. Ammonia production	3.1	3.5	3.5	3.4	3.6	3.6	3.4	3.6	3.6	3.6	3.6	3.0	2.9	2.9	3.1	3.1
5. Other, excl. act. carbon	0.4	0.0	0.0	0.0	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.4
C. Metal industry																
1. Inputs in blast furnace	2.2	1.9	1.3	1.2	1.5	1.5	1.5	1.8	1.4	1.3	1.0	1.0	1.1	1.2	0.9	0.8
D. Other Production																
2. Food and Drink	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
G. Other ***(please specify)***																
Other economic sectors **	0.2	0.2	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Not in NA-1A:	6.8	6.6	6.1	5.8	6.4	6.3	6.2	6.7	6.1	5.9	5.7	5.0	5.0	5.2	5.2	5.2
NA+1B+Ind. Proc.	156.8	161.6	159.8	164.2	164.0	167.8	175.4	168.9	170.8	165.2	167.1	172.6	172.3	176.3	177.9	172.4
RA+Fossil waste:	156.2	162.6	161.2	164.1	164.3	166.9	175.3	168.4	169.3	163.8	166.8	171.7	171.1	175.0	175.8	174.2
New difference (abs)	**-0.6**	**1.0**	**1.4**	**-0.1**	**0.4**	**-1.0**	**-0.1**	**-0.5**	**-1.5**	**-1.4**	**-0.3**	**-0.9**	**-1.2**	**-1.3**	**-2.1**	**1.8**
New difference (%)	-0.4%	0.6%	0.9%	0.0%	0.2%	-0.6%	-0.1%	-0.3%	-0.9%	-0.8%	-0.2%	-0.5%	-0.7%	-0.7%	-1.2%	1.0%

** Comprises lubricants and waxes.

Table A.4.3. Comparison of CO_2 emissions: differences between *__corrected__* *Reference Approach (RA) versus* *__corrected__* *National Approach [(RA-NA)/NA)] (in %).*

Fuel type *	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Liquids	-0.5%	1.0%	1.5%	-1.0%	-0.2%	-2.0%	-1.1%	-1.4%	-3.2%	-2.8%	-1.3%	-2.0%	-3.0%	-3.4%	-3.9%	2.2%
Solids	0.8%	2.2%	2.6%	1.8%	1.5%	0.5%	0.7%	0.7%	0.2%	0.3%	0.5%	-0.4%	0.6%	1.4%	0.9%	2.1%
Gas	-0.8%	-0.1%	-0.2%	-0.2%	-0.1%	-0.1%	0.2%	0.0%	0.2%	0.1%	0.3%	0.4%	0.3%	0.2%	-0.2%	-0.2%
Total (incl. waste)	-0.5%	0.5%	0.8%	-0.1%	0.1%	-0.7%	-0.2%	-0.4%	-1.0%	-0.9%	-0.3%	-0.6%	-0.8%	-0.8%	-1.3%	0.9%

Note: Shown in red and blue are the largest and smallest annual differences, respectively.
* Liquids incl. 2G; Solids incl. 1B1,2A,2B5,2C1,2D; Gaseous incl. 1B2, 2B1; Total incl. fossil waste.

A4.2.1 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 (i.e. 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 naviation). 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.

A4.3 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. 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:

- 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, e.g. ammonia, or by accounting for by-product gases (excluding emissions from blast furnaces and coke ovens). It shows indeed that the factors show significant interannual 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 Table A.4.4 the total CO_2 calculated as emitted from the oxidation of the non-energy uses in the Reference Approach are presented per fuel type. According to the Reference Approach dataset, the CO_2 emissions of this group of sources increased by about 30% or 2.8 Tg CO_2 (from 8.9 to 11.7 Tg CO_2), of which most are due to changes in emissions from liquid fuels (Table 3.34). In Table A.4.6 and A4.5 the carbon storage in the RA calculation is shown. Its shows, that in the Netherlands about 25 to 45 Tg CO_2 or about 15 to 25% of all carbon in the apparent consumption of fossil fuels is stored.

Table A4.4. Trends in CO_2 emitted by feedstock use of energy carriers (production and direct uses) according to the correction term in the IPCC Reference Approach for CO_2 from fossil fuel use (in Tg CO_2).

Fuel type	1990	…	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Trend
Liquids [1) 2)]	5.0		5.2	4.9	5.1	5.0	5.6	6.1	6.6	6.8	7.8	7.9	7.9	2.9
Solids [3)]	0.4		0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.0
Gaseous	3.5		3.8	3.7	3.9	3.7	3.7	3.9	3.5	3.4	3.2	3.4	3.4	-0.1
Total	**8.9**		**9.4**	**9.0**	**9.5**	**9.2**	**9.8**	**10.4**	**10.5**	**10.6**	**11.4**	**11.7**	**11.7**	2.8
As % of RA	5.7%		5.7%	5.1%	5.7%	5.5%	6.0%	6.3%	6.2%	6.3%	6.6%	6.8%	6.8%	

1) Using country-specific carbon Oxidation Factors (multi-year average, fuel type averaged).
2) Excluding refineries.
3) Coal oils and tars (from coking coal), coke and other bituminous coal only; excluding emissions from blast furnaces and coke ovens.

Table A4.5. Carbon storage in the IPCC Reference Approach for CO_2 from fossil fuel use (in Tg CO_2).

Fuel type	1990	…	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Trend
Liquids	20.5		22.4	21.1	22.0	24.8	29.4	35.3	38.3	40.7	42.9	44.1	44.1	23.6
Solids	0.6		0.5	0.6	0.6	0.6	0.5	0.5	0.5	0.6	0.6	0.5	0.5	-0.1
Gaseous	2.2		2.4	2.3	2.5	2.4	2.4	2.5	2.2	2.1	2.0	2.1	2.1	-0.1
Total	**23.3**		**25.3**	**24.0**	**25.1**	**27.9**	**32.4**	**38.3**	**41.1**	**43.4**	**45.5**	**46.8**	**46.8**	23.5
% gross RA[1)]	15%		15%	14%	15%	17%	20%	23%	24%	26%	26%	27%	27%	

1) Expressed as part of total carbon in apparent consumption of fossil fuels (without subtracting the stored part).

ANNEX 5. Assessment of completeness and (potential) sources and sinks

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:

- Oil transport (1B2a3), due to missing activity data;
- Charcoal production (1B2) and use (1A4) , due to missing activity data;
- CO_2 from lime production (2A2), 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 slugdge application on land (4D4), due to missing activity data;
- CH_4 from Enteric fermentation poultry (4A9), due to missing emission factors;
- N_2O from Industrial wastewater (6B1), due to negligible amounts.
- A survey to check on unidentified sources of non-CO_2 emissions in the Netherlands showed that some minor sources of PFCs and SF_6 are not included in the present greenhouse gas inventory (DHV, 2000).

The above mentioned sources have been examined by the Dutch Working Group Emission Monitoring of Greenhouse Gases and only negleglible amounts have been found. Since no regular monitoring data are available, these sources are not included.

- Precursor emissions (i.e. CO, NO_x, NMVOC and SO_2) 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; this information is available on the website www.greenhousegases.nl:

Table A6.1 Methodological description (monitoring protocols 15 February 2007, available at the website):

Protocol	IPCC-code	Description	Gas(es)
7100	All	Reference approach	CO_2
7101	1A1 1A2 1A4	Stationary combustion (fossil) *	CO_2 N_2O CH_4
7102	1A1b 1B1b 1B2aiv 2A4i 2B1 2B4i 2B5i 2B5vii 2B5viii 2C1vi 2D2 2Giv	Process emissions (fossil)	CO_2 N_2O CH_4
7103	1A2f 1A4c	Mobile equipment	CO_2 N_2O CH_4
7104	1A3a	Inland aviation	CO_2 N_2O CH_4
7105	1A3b	Road transport	CO_2
7106	1A3b	Road transport	N_2O
7107	1A3b	Road transport	CH_4
7108	1A3c	Rail transport	CO_2 N_2O CH_4
7109	1A3d	Inland navigation	CO_2 N_2O CH_4
7110	1A4c	Fisheries	CO_2 N_2O CH_4
7111	1A5	Defence	CO_2 N_2O CH_4
7112	1B2	Oil & gas production	CO_2 CH_4
7113	1B2	Oil & gas distribution/transport	CO_2 CH_4
7114	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
7115	2B2	Nitric acid	N_2O
7116	2B5	Caprolactam	N_2O
7117	2C3	Aluminium production	PFC
7118	2E1	HCFK-22 production	HFC
7119	2E3	HFC by-product emissions	HFC
7120	2F1	Stationary refrigeration	HFC
7121	2F1	Mobile refrigeration	HFC
7122	2F2	Hard foams	HFC
7123	2F4	Aerosols	HFC
7124	2F8	Sound proof windows	SF_6
7125	2F8	Semi-conductors	SF_6 PFC
7126	2F8	Electrical equipment	SF_6
7127	4A1	Enteric fermentation, cattle	CH_4
7128	4A2-13	Enteric fermentation, other	CH_4
7129	4B	Manure management	N_2O
7130	4B1	Manure management, cattle	CH_4
7131	4B8	Manure management ,swine	CH_4
7132	4B2-7,9-13	Manure management, other	CH_4
7133	4D	Agricultural soils, indirect	N_2O
7134	4D	Agricultural soils, direct	N_2O
7135	5A	Forest	CO_2
7136	5D	Soil	CO_2
7137	6A1	Waste disposal	CH_4
7138	6B	Waste water treatment	CH_4 N_2O
7139	6D	Large-scale composting	CH_4 N_2O
In addition to the emissions described in the protocols, two memo items are included in the National System			
7140	Memo item	International bunker emissions	CO_2 N_2O CH_4
7141	1A, (CO_2 memo item)	Biomass	CO_2 CH_4 N_2O

A6.1 Documentation of uncertainties used in IPCC Tier 1 uncertainty assessments and Tier 2 key source identification

- Olivier, J.G.J. and L.J. Brandes, 2007: Estimate of annual and trend uncertainty for Dutch sources of greenhouse gas emissions using the IPCC Tier 1 approach. RIVM, Bilthoven. In prep.
- 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; July 2006.

A6.2 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, 2002: Uitgangspunten voor de mest- en ammoniakberekeningen 1999 tot en met 2001 zoals gebruikt in de Milieubalans 2001 en 2002, inclusief dataset landbouwemissies 1980-2001. RIVM rapport 773004013. RIVM, Bilthoven.
- Hoek, K. W. van der and M. W. van Schijndel, 2005: 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, 2006. Direct and indirect nitrous oxide emissions from agricultural soils, including an overview of emissions 1990 - 2003. Background document for the Dutch National Inventory Report. RIVM Report No. 680.125.003. Bilthoven, the Netherlands (in preparation).
- 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.
- Peek, K., 2007. Greenhouse gas emissions; temperature correction and national categories. MNP, Bilthoven. In prep.

A6.3 Documentation of present 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.
- Ruyssenaars, 2005: Werkplan Emissie Registratie 2005 – 2006. MNP, Bilthoven, 2005.
- Coenen, P.W.H.G., Memorandum on recalculations as presented in the CRF submission 2006. TNO, Apeldoorn.
- SenterNovem, the Netherlands National System:QA/QC programme 2006/2007 Version 2.0 30 November 2006.

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 neglected[1]. 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 shows 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.	5%	±3%-points of 1% decrease
CO_2	3%	±2.5%-points of 10% increase
CH_4	25%	±10%-points of 34% decrease
N_2O	50%	±15%-points of 17% decrease
F-gases	50%	±7%-points of 77% decrease

Details on this calculation can be found in Table A7.2 and in Olivier and Brandes (2007). It should be stressed that most uncertainty estimates are ultimately based on (collective) expert judgement and therefore also rather uncertain (usually of the order of 50%). However, the reason to make these estimates is to identify the relative 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 prioritise 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 can not be improved; another part, however, 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. This is the topic of the next section.

[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).

Table A7.2. Tier 1 level and trend uncertainty assessment 1990-2005 (for F-gases with base year 1995) with the categories of the IPCC potential key source list (without adjustment for correlations between sources).

IPCC	Category	Gas	CO2-eq base year	CO2-eq last year	AD unc	EF unc	Uncertainty estimate	Combined Uncertainty as % of total national emissions in 2005	Type A sensi-tivity	Type B sensi-tivity	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
1A1a	Stationary combustion: Public Electricity and Heat Production: liquids	CO2	207	2150	0.005	0.1	10%	0.1%	0.9%	1%	0.1%	0.0%	0.1%
1A1a	Stationary combustion : Public Electricity and Heat Production: solids	CO2	25776	25734	1%	3%	3%	0.4%	0.1%	12%	0.0%	0.2%	0.2%
1A1a	Stationary combustion : Public Electricity and Heat Production: gases	CO2	13348	23976	1%	1%	1%	0.1%	5.0%	11%	0.1%	0.1%	0.1%
1A1a	Stationary combustion : Public Electricity and Heat Production: waste incin	CO2	592	2101	10%	5%	11%	0.1%	0.7%	1%	0.0%	0.1%	0.1%
1A1b	Stationary combustion : Petroleum Refining: liquids	CO2	9999	9796	10%	10%	14%	0.7%	0.0%	5%	0.0%	0.6%	0.6%
1A1b	Stationary combustion : Petroleum Refining: gases	CO2	1042	2487	1%	1%	1%	0.0%	0.7%	1%	0.0%	0.0%	0.0%
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: liquids	CO2	2	1	20%	2%	20%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
1A1c	Stationary combustion : Manuf. of Solid Fuels and Other En. Ind.: gases	CO2	1526	2056	0.2	0.05	21%	0.2%	0.3%	1%	0.0%	0.3%	0.3%
1A2	Stationary combustion : Manufacturing Industries and Construction, liquids	CO2	8993	7378	1%	5%	5%	0.2%	-0.7%	3%	0.0%	0.0%	0.1%
1A2	Stationary combustion : Manufacturing Industries and Construction, solids	CO2	5033	4297	2%	10%	10%	0.2%	-0.3%	2%	0.0%	0.1%	0.1%
1A2	Stationary combustion : Manufacturing Industries and Construction, gases	CO2	19020	15506	2%	1%	2%	0.2%	-1.5%	7%	0.0%	0.2%	0.2%
1A4	Stationary combustion : Other Sectors, solids	CO2	189	48	50%	5%	50%	0.0%	-0.1%	0%	0.0%	0.0%	0.0%
1A4a	Stationary combustion : Other Sectors: Commercial/Institutional, gases	CO2	6634	9588	20%	1%	20%	0.9%	1.4%	4%	0.0%	1.3%	1.3%
1A4b	Stationary combustion : Other Sectors, Residential, gases	CO2	18696	17887	0.05	0.01	5%	0.4%	-0.3%	8%	0.0%	0.6%	0.6%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, gase	CO2	8328	7041	10%	1%	10%	0.3%	-0.6%	3%	0.0%	0.5%	0.5%
1A4c	Stationary combustion : Other Sectors, Agriculture/Forestry/Fisheries, liqui	CO2	2544	2551	20%	2%	20%	0.2%	0.0%	1%	0.0%	0.3%	0.3%
1A4	Stationary combustion : Other Sectors, liquids excl. From 1A4c	CO2	1476	555	20%	2%	20%	0.1%	-0.4%	0%	0.0%	0.1%	0.1%
1A5	Military use of fuels (1A5 Other)	CO2	566	375	20%	2%	20%	0.0%	-0.1%	0%	0.0%	0.0%	0.0%
1A	Emissions from stationary combustion: non-CO2	CH4	522	563	3%	50%	50%	0.1%	0.0%	0%	0.0%	0.0%	0.0%
1A	Emissions from stationary combustion: non-CO2	N2O	215	210	0.03	0.5	50%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
1A3b	Mobile combustion: road vehicles: gasoline	CO2	10902	12970	2%	0%	2%	0.1%	1.0%	6%	0.0%	0.2%	0.2%
1A3b	Mobile combustion: road vehicles: diesel oil	CO2	11832	19863	5%	0%	5%	0.5%	3.8%	9%	0.0%	0.7%	0.7%
1A3b	Mobile combustion: road vehicles: LPG	CO2	2738	1069	10%	0%	10%	0.1%	-0.8%	0%	0.0%	0.1%	0.1%
1A3	Mobile combustion: water-borne navigation	CO2	405	637	20%	0%	20%	0.1%	0.1%	0%	0.0%	0.1%	0.1%
1A3	Mobile combustion: aircraft	CO2	41	41	50%	1%	50%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
1A3	Mobile combustion: other (railways)	CO2	91	106	5%	0%	5%	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%
1A3	Mobile combustion: other (non-road)	N2O	1	2	0.5	1	112%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
1A3	Mobile combustion: road vehicles	CH4	157	49	3%	60%	60%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
1A3	Mobile combustion: road vehicles	N2O	271	474	5%	50%	50%	0.1%	0.1%	0%	0.0%	0.0%	0.1%

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Table A7.2. Tier 1 level and trend uncertainty assessment 1990-2005 (for F-gases with base year 1995) with the categories of the IPCC potential key source list (without adjustment for correlations between sources) (continued).

IPCC	Category	Gas	CO2-eq base year	CO2-eq last year	AD unc	EF unc	Uncertainty estimate	Combined Uncertainty as % of total national emissions in 2005	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
1B2	Fugitive emissions venting/flaring	CH4	1252	342	2%	25%	25%	0.0%	-0.4%	0%	-0.1%	0.0%	0.1%
1B2	Fugitive emissions from oil and gas operations: gas distribution	CH4	255	274	2%	50%	50%	0.1%	0.0%	0%	0.0%	0.0%	0.0%
1B2	Fugitive emissions from oil and gas operations: other	CH4	162	160	20%	50%	54%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
1B1b	CO2 from coke production	CO2	403	457	50%	2%	50%	0.1%	0.0%	0%	0.0%	0.2%	0.2%
1B2	Fugitive emissions venting/flaring: CO2	CO2	775	129	50%	2%	50%	0.0%	-0.3%	0%	0.0%	0.0%	0.0%
2A1	Cement production	CO2	416	421	5%	10%	11%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
2A3	Limestone and dolomite use	CO2	276	293	25%	5%	25%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
2A7	Other minerals	CO2	308	430	25%	5%	25%	0.1%	0.1%	0%	0.0%	0.1%	0.1%
2B1	Ammonia production	CO2	3096	3105	0.02	0.01	2%	0.0%	0.0%	1%	0.0%	0.0%	0.0%
2B2	Nitric acid production	N2O	6330	5659	10%	50%	51%	1.4%	-0.3%	3%	-0.1%	0.4%	0.4%
2B5	Caprolactam production	N2O	1240	705	50%	50%	71%	0.2%	-0.2%	0%	-0.1%	0.2%	0.3%
2B5	Other chemical product manufacture	CO2	606	640	50%	50%	71%	0.2%	0.0%	0%	0.0%	0.2%	0.2%
2C1	Iron and steel production (carbon inputs)	CO2	2514	1208	3%	5%	6%	0.0%	-0.6%	1%	0.0%	0.0%	0.0%
2C3	CO2 from aluminium production	CO2	395	484	2%	5%	5%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
2C3	PFC from aluminium production	PFC	1901	87	2%	20%	20%	0.0%	-0.8%	0%	-0.2%	0.0%	0.2%
2F	SF6 emissions from SF6 use	SF6	301	337	50%	25%	56%	0.1%	0.0%	0%	0.0%	0.1%	0.1%
2F	Emissions from substitutes for ozone depleting substances (ODS substitut	HFC	249	1078	10%	50%	51%	0.3%	0.4%	1%	0.2%	0.1%	0.2%
2E	HFC-23 emissions from HCFC-22 manufacture	HFC	5759	196	10%	10%	14%	0.0%	-2.6%	0%	-0.3%	0.0%	0.3%
2E	HFC by-product emissions from HFC manufacture	HFC	12	39	10%	20%	22%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
2F	PFC emissions from PFC use	PFC	37	166	5%	25%	25%	0.0%	0.1%	0%	0.0%	0.0%	0.0%
2G	Other industrial: CO2	CO2	305	381	5%	20%	21%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
2G	Other industrial: CH4	CH4	297	312	0.1	0.5	51%	0.1%	0.0%	0%	0.0%	0.0%	0.0%
2G	Other industrial: N2O	N2O	3	7	50%	50%	71%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
2G	Indirect N2O from NH3 from combustion and industrial processes	N2O	52	56	50%	200%	206%	0.1%	0.0%	0%	0.0%	0.0%	0.0%
2G	Indirect N2O from NO2 from combustion and industrial processes	N2O	883	562	0.15	2	201%	0.5%	-0.1%	0%	-0.3%	0.1%	0.3%
300%	Indirect CO2 from solvents/product use	CO2	316	144	25%	10%	27%	0.0%	-0.1%	0%	0.0%	0.0%	0.0%
4A1	CH4 emissions from enteric fermentation in domestic livestock: cattle	CH4	6767	5677	0.05	0.2	21%	0.6%	-0.5%	3%	-0.1%	0.2%	0.2%
4A8	CH4 emissions from enteric fermentation in domestic livestock: swine	CH4	439	357	0.05	0.5	50%	0.1%	0.0%	0%	0.0%	0.0%	0.0%
4A	CH4 emissions from enteric fermentation in domestic livestock: other	CH4	319	311	5%	30%	30%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
4B	Emissions from manure management	N2O	694	753	0.1	1	100%	0.4%	0.0%	0%	0.0%	0.0%	0.1%
4B1	Emissions from manure management : cattle	CH4	1574	1448	0.1	1	100%	0.7%	-0.1%	1%	-0.1%	0.1%	0.1%
4B8	Emissions from manure management : swine	CH4	1141	932	10%	100%	100%	0.4%	-0.1%	0%	-0.1%	0.1%	0.1%
4B9	Emissions from manure management : poultry	CH4	243	62	10%	100%	100%	0.0%	-0.1%	0%	-0.1%	0.0%	0.1%
4B	Emissions from manure management : other	CH4	12	17	0.1	1	100%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
4D1	Direct N2O emissions from agricultural soils	N2O	4597	4802	10%	60%	61%	1.4%	0.1%	2%	0.1%	0.3%	0.3%
4D3	Indirect N2O emissions from nitrogen used in agriculture	N2O	4861	3156	50%	200%	206%	3.1%	-0.8%	1%	-1.5%	1.0%	1.9%
4D2	Animal production on agricultural soils	N2O	1308	651	10%	100%	100%	0.3%	-0.3%	0%	-0.3%	0.0%	0.3%
6A1	CH4 emissions from solid waste disposal sites	CH4	12011	5931	30%	15%	34%	0.9%	-2.8%	3%	-0.4%	1.2%	1.2%
6B	Emissions from wastewater handling	CH4	290	205	20%	25%	32%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
6B	Emissions from wastewater handling	N2O	513	401	20%	50%	54%	0.1%	-0.1%	0%	0.0%	0.1%	0.1%
6D	OTHER CH4	CH4	1	68	20%	25%	32%	0.0%	0.0%	0%	0.0%	0.0%	0.0%
3, 6D	OTHER N2O	N2O	250	124	20%	50%	54%	0.0%	-0.1%	0%	0.0%	0.0%	0.0%
			214308	212082				4.2%					3.0%

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. 2005	AD uncert.	EF uncert.	EM uncertainty estimate
5A1	5A1. Forest Land remaining Forest Land	CO_2	-2,505	-2,289	25%	62%	67%
5A2	5A2. Land converted to Forest Land	CO_2	-11	-170	25%	58%	63%
5B2	5B2. Land converted to Cropland	CO_2	-36	-36	25%	50%	56%
5C1	5C1. Grassland remaining Grassland	CO_2	4,246	4,246	25%	50%	56%
5C2	5C2. Land converted to Grassland	CO_2	-51	-51	25%	61%	66%
5E2	5E2. Land converted to Settlements	CO_2	-152	-152	25%	50%	56%
5F2	5F2. Land converted to Other Land	CO_2	717	717	25%	50%	56%
5G	5G. Other (liming of soils)	CO_2	183	75	25%	1%	25%
5	TOTAL		2,392	2,341			~100%

ANNEX 8. CRF Summary tables

This annex shows a copy of selected sheets from the CRF data files (the digital annexes to this national inventory report), presenting unrounded figures. The number of digits shown does not represent the uncertainty for the emissions.

A8.1 IPCC Table 7A for base years 1990, 1995 and for 2005

Table A8.1 Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; **Year: 1990.**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**161 781.33**	**1 211.47**	**68.45**	**NA,NE,NO**	**4 432.03**	**C,NA,NE,NO**	**2 264.48**	**C,NA,NE,NO**	**0.01**	**559.33**	**1 137.28**	**465.76**	**190.11**
1. Energy	**151 157.72**	**111.84**	**1.57**							**543.39**	**1 006.10**	**247.01**	**178.88**
A. Fuel Combustion — Reference Approach[2]	155 641.19												
Sectoral Approach[2]	149 980.32	32.36	1.57							543.27	1 004.52	198.76	171.36
1. Energy Industries	52 492.33	3.40	0.41							105.54	11.74	2.58	105.84
2. Manufacturing Industries and Construction	33 045.44	2.70	0.11							88.53	153.62	5.05	45.89
3. Transport	26 009.02	7.51	0.88							272.71	753.70	174.26	13.29
4. Other Sectors	37 867.81	18.70	0.14							76.48	85.46	16.87	6.33
5. Other	565.72	0.05	0.03							IE	IE	IE	IE
B. Fugitive Emissions from Fuels	1 177.40	79.48	0.00							0.13	1.58	48.25	7.52
1. Solid Fuels	402.67	1.44	NA,NO							IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NO
2. Oil and Natural Gas	774.73	78.04	0.00							0.13	1.58	48.25	7.52
2. Industrial Processes	**7 915.33**	**14.13**	**27.44**	**NA,NE,NO**	**4 432.03**	**C,NA,NE,NO**	**2 264.48**	**C,NA,NE,NO**	**0.01**	**12.03**	**129.25**	**87.05**	**7.06**
A. Mineral Products	1 000.43	NO	NO							1.28	3.51	1.03	6.29
B. Chemical Industry	3 701.53	12.13	24.42	NA,NO	NA,NO	NA,NO	NA,NO	NA	NA	9.23	IE,NA,NO	33.11	IE,NA,NO
C. Metal Production	2 908.84	IE,NA,NO	NO				2 246.21		NO	IE,NO	118.79	3.84	IE,NO
D. Other Production[3]	72.54									NO	NO	10.77	NO
E. Production of Halocarbons and SF_6					4 432.03		NO		NO				
F. Consumption of Halocarbons and SF_6				NE,NO	NO	C,NE,NO	18.26	C,NE	0.01				
G. Other	231.99	2.01	3.03	NA,NO	NO	NA,NO	NO	NO	NO	1.51	6.95	38.29	0.77

Table A8.1 Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; **Year: 1990 (continued).**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs [1]		PFCs [1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**316.43**		**0.73**							**NO**	**NO**	**129.98**	**NO**
4. Agriculture		**499.72**	**37.05**							**NA,NO**	**NA,NO**	**0.16**	**NO**
A. Enteric Fermentation		358.35											
B. Manure Management		141.37	2.24									NE,NO	
C. Rice Cultivation		NO										NO	
D. Agricultural Soils [4]		NE,NO	34.81									0.16	
E. Prescribed Burning of Savannas		NO	NO							NO	NO	NO	
F. Field Burning of Agricultural Residues		NO	NO							NO	NO	NO	
G. Other		NO	NO							NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	[5] **2 391.84**	**NA,NE,NO**	**NA,NE,NO**							**IE,NE**	**IE,NE**		
A. Forest Land	[5] -2 516.03	NO	NE,NO							IE,NE	IE,NE		
B. Cropland	[5] -35.57	NA,NE	NA,NE							NE	NE		
C. Grassland	[5] 4 194.85	NE	NE							NE	NE		
D. Wetlands	[5] NE	NE	NE							NE	NE		
E. Settlements	[5] -151.54	NE	NE							NE	NE		
F. Other Land	[5] 716.98	NE	NE							NE	NE		
G. Other	[5] 183.15	NE	NE							NE	NE		
6. Waste	**IE,NA,NO**	**585.78**	**1.66**							**3.91**	**1.93**	**1.56**	**4.17**
A. Solid Waste Disposal on Land	[4] NA,NO	571.93								NA,NO	NA,NO	1.45	
B. Waste-water Handling		13.79	1.66							NO	NO	NO	
C. Waste Incineration	[4] IE	IE	IE							IE	IE	IE	IE
D. Other	NA	0.06	0.00							3.91	1.93	0.11	4.17
7. Other *(please specify)* [7]	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Other non-specified	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
Memo Items: [8]													
International Bunkers	**38 897.84**	**1.06**	**0.31**							**NE**	**NE**	**NE**	**NE**
Aviation	4 540.46	0.22	0.04							NE	NE	NE	NE
Marine	34 357.38	0.84	0.27							NE	NE	NE	NE
Multilateral Operations	**IE**	**IE**	**IE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**3 877.95**												

Table A8.2 Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; **Year: 1995.**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**172 826.13**	**1 132.96**	**72.24**	**882.40**	**6 019.54**	**C,NA,NE,NO**	**1 937.82**	**C,NA,NE,NO**	**0.01**	**470.15**	**861.99**	**332.71**	**128.08**
1. Energy	**162 451.50**	**111.18**	**2.26**							**461.38**	**795.05**	**175.88**	**124.77**
A. Fuel Combustion – Reference Approach[2]	166 049.92												
Sectoral Approach[2]	161 493.33	32.06	2.26							460.85	792.46	140.40	114.58
1. Energy Industries	61 513.04	4.29	0.47							83.92	11.05	3.90	68.89
2. Manufacturing Industries and Construction	28 155.34	2.33	0.07							61.73	155.80	4.83	27.74
3. Transport	29 147.35	5.63	1.54							223.79	544.18	115.98	12.92
4. Other Sectors	42 165.50	19.77	0.14							91.41	81.43	15.68	5.04
5. Other	512.10	0.05	0.03							IE	IE	IE	IE
B. Fugitive Emissions from Fuels	958.16	79.12	IE,NA,NO							0.53	2.59	35.48	10.19
1. Solid Fuels	516.87	1.45	NA,NO							IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NO
2. Oil and Natural Gas	441.29	77.67	IE,NA,NO							0.53	2.59	35.48	10.19
2. Industrial Processes	**7 930.87**	**14.14**	**26.91**	**882.40**	**6 019.54**	**C,NA,NE,NO**	**1 937.82**	**C,NA,NE,NO**	**0.01**	**6.39**	**66.54**	**53.93**	**3.05**
A. Mineral Products	1 481.67	NO	NO							1.31	2.45	0.41	2.73
B. Chemical Industry	3 973.80	12.13	24.25	NA,NO	NA,NO	NA,NO	NA,NO	NA	NA	4.69	IE,NA,NO	17.89	IE,NA,NO
C. Metal Production	2 184.13	IE,NA,NO	NO				1 900.79		NO	0.00	61.32	2.93	IE,NO
D. Other Production[3]	22.40									NO	NO	7.33	NO
E. Production of Halocarbons and SF_6					5 770.76		NO		NO				
F. Consumption of Halocarbons and SF_6				882.40	248.78	C,NE,NO	37.03	C,NE	0.01				
G. Other	268.87	2.01	2.66	NA,NO	NO	NA,NO	NO	NO	NO	0.39	2.76	25.36	0.31

Table A8.2 Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; **Year: 1995 (continued).**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs [1]		PFCs [1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**242.28**		**0.64**							**NO**	**NO**	**100.98**	**NO**
4. Agriculture		**492.66**	**40.80**							**NA,NO**	**NA,NO**	**0.16**	**NO**
A. Enteric Fermentation		347.92											
B. Manure Management		144.74	2.49									NE,NO	
C. Rice Cultivation		NO										NO	
D. Agricultural Soils [4]		NE,NO	38.31									0.16	
E. Prescribed Burning of Savannas		NO	NO							NO	NO	NO	
F. Field Burning of Agricultural Residues		NO	NO							NO	NO	NO	
G. Other		NO	NO							NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	[5] **2 201.48**	**NA,NE,NO**	**NA,NE,NO**							**IE,NE**	**IE,NE**		
A. Forest Land	[5] -2 621.45	NO	NE,NO							IE,NE	IE,NE		
B. Cropland	[5] -35.57	NA,NE	NA,NE							NE	NE		
C. Grassland	[5] 4 194.85	NE	NE							NE	NE		
D. Wetlands	[5] NE	NE	NE							NE	NE		
E. Settlements	[5] -151.54	NE	NE							NE	NE		
F. Other Land	[5] 716.98	NE	NE							NE	NE		
G. Other	[5] 98.20	NE	NE							NE	NE		
6. Waste	**IE,NA,NO**	**514.98**	**1.63**							**2.38**	**0.40**	**1.76**	**0.26**
A. Solid Waste Disposal on Land	[6] NA,NO	500.07								NA,NO	NA,NO	1.27	
B. Waste-water Handling		11.48	1.49							NO	NO	NO	
C. Waste Incineration	[6] IE	IE	IE							IE	IE	IE	IE
D. Other	NA	3.43	0.14							2.38	0.40	0.49	0.26
7. Other *(please specify)* [7]	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Other non-specified	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
Memo Items: [8]													
International Bunkers	**43 011.75**	**1.24**	**0.34**							**NE**	**NE**	**NE**	**NE**
Aviation	7 584.14	0.36	0.06							NE	NE	NE	NE
Marine	35 427.61	0.88	0.28							NE	NE	NE	NE
Multilateral Operations	**IE**	**IE**	**IE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**4 319.96**												

Table A8.3 Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; **Year: 2005.**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals	**178 246.10**	**795.75**	**56.65**	**2 390.40**	**1 353.54**	**C,NA,NE,NO**	**265.35**	**C,NA,NE,NO**	**0.01**	**328.67**	**545.70**	**169.80**	**65.18**
1. Energy	**168 799.90**	**66.21**	**2.21**							**328.08**	**495.34**	**79.73**	**64.06**
A. Fuel Combustion — Reference Approach[2]	172 102.66												
Sectoral Approach[2]	167 268.83	29.20	2.21							328.08	492.61	61.81	57.06
1. Energy Industries	67 354.77	6.95	0.46							57.86	12.27	2.56	36.95
2. Manufacturing Industries and Construction	27 181.60	2.21	0.07							48.28	107.74	3.85	15.16
3. Transport	34 686.17	2.40	1.54							150.14	300.99	41.82	1.60
4. Other Sectors	37 670.99	17.61	0.12							71.80	71.61	13.58	3.34
5. Other	375.30	0.04	0.02							IE	IE	IE	IE
B. Fugitive Emissions from Fuels	1 531.06	37.01	IE,NA,NO							IE,NA,NE,NO	2.73	17.91	7.01
1. Solid Fuels	456.97	1.12	NA,NO							IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NO
2. Oil and Natural Gas	1 074.09	35.89	IE,NA,NO							NA,NE,NO	2.73	17.91	7.01
2. Industrial Processes	**6 961.76**	**14.88**	**22.54**	**2 390.40**	**1 353.54**	**C,NA,NE,NO**	**265.35**	**C,NA,NE,NO**	**0.01**	**0.58**	**50.34**	**25.93**	**1.12**
A. Mineral Products	1 143.11	NO	NO							0.51	1.65	0.12	0.96
B. Chemical Industry	3 745.83	13.11	20.53	NA,NO	NA,NO	NA,NO	NA,NO	NA	NA	IE,NA,NO	0.00	7.93	0.00
C. Metal Production	1 691.97	IE,NA,NO	NO				87.16		NO	IE,NO	44.63	0.92	IE,NO
D. Other Production[3]	33.45									NO	NO	5.27	NO
E. Production of Halocarbons and SF_6					235.49		NO		NO				
F. Consumption of Halocarbons and SF_6				2 390.40	1 118.05	C,NE,NO	178.19	C,NE	0.01				
G. Other	347.40	1.76	2.02	NA,NO	NA,NO	NA,NO	NO	NO	NO	0.07	4.06	11.68	0.16

Table A8.3 Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; **Year: 2005 (continued).**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs [1]		PFCs [1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**143.63**		**0.25**							**NO**	**NO**	**63.18**	**NO**
4. Agriculture		**419.24**	**30.22**							**NA,NO**	**NA,NO**	**0.16**	**NO**
A. Enteric Fermentation		302.13											
B. Manure Management		117.11	2.43									NE,NO	
C. Rice Cultivation		NO										NO	
D. Agricultural Soils [4]		NE,NO	27.79									0.16	
E. Prescribed Burning of Savannas		NO	NO							NO	NO	NO	
F. Field Burning of Agricultural Residues		NO	NO							NO	NO	NO	
G. Other		NO	NO							NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	(5) **2 340.81**	**NA,NE,NO**	**NA,NE,NO**							**IE,NE**	**IE,NE**		
A. Forest Land	(5) -2 458.65	NO	NE,NO							IE,NE	IE,NE		
B. Cropland	(5) -35.57	NA,NE	NA,NE							NE	NE		
C. Grassland	(5) 4 194.85	NE	NE							NE	NE		
D. Wetlands	(5) NE	NE	NE							NE	NE		
E. Settlements	(5) -151.54	NE	NE							NE	NE		
F. Other Land	(5) 716.98	NE	NE							NE	NE		
G. Other	(5) 74.74	NE	NE							NE	NE		
6. Waste	**IE,NA,NO**	**295.42**	**1.42**							**0.01**	**0.02**	**0.81**	**0.00**
A. Solid Waste Disposal on Land	(6) NA,NO	282.43								NA,NO	NA,NO	0.72	
B. Waste-water Handling		9.76	1.29							NO	NO	NO	
C. Waste Incineration	(6) IE	IE	IE							IE	IE	IE	IE
D. Other	NA	3.23	0.13							0.01	0.02	0.09	0.00
7. Other *(please specify)* [7]	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Other non-specified	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
Memo Items: [8]													
International Bunkers	**64 955.96**	**1.76**	**0.51**							**NE**	**NE**	**NE**	**NE**
Aviation	10 875.58	0.52	0.09							NE	NE	NE	NE
Marine	54 080.38	1.24	0.42							NE	NE	NE	NE
Multilateral Operations	**IE**	**IE**	**IE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**8 674.30**												

A8.2 Recalculation tables for base years 1990 and 2004

For this submission (NIR 2007), the Netherlands uses the CRF reporter software 3.1. The recalculation table is included in chapter 10.

A8.3 CRF Trend Tables 10: greenhouse gas emissions and by source and sink categories

Table A8.4 Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: CO_2.***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**151 157.72**	**156 124.46**	**154 754.08**	**159 384.45**	**158 594.98**	**162 451.50**	**170 292.13**	**163 191.35**	**165 443.18**	**159 941.13**
A. Fuel Combustion (Sectoral Approach)	149 980.32	154 986.26	153 680.94	158 363.60	157 527.96	161 493.33	169 257.43	162 192.21	164 641.11	159 276.57
1. Energy Industries	52 492.33	53 103.44	53 076.55	55 243.94	58 024.91	61 513.04	62 477.51	63 497.35	65 813.08	61 863.30
2. Manufacturing Industries and Construction	33 045.44	32 483.90	33 065.06	32 281.20	30 699.90	28 155.34	28 833.10	27 317.13	27 556.75	27 326.74
3. Transport	26 009.02	26 282.22	27 545.19	28 156.27	28 624.05	29 147.35	29 909.42	30 305.19	31 044.85	32 007.31
4. Other Sectors	37 867.81	42 578.16	39 441.04	42 143.83	39 693.23	42 165.50	47 529.17	40 587.39	39 706.50	37 429.71
5. Other	565.72	538.55	553.10	538.36	485.87	512.10	508.24	485.14	519.94	649.50
B. Fugitive Emissions from Fuels	1 177.40	1 138.20	1 073.14	1 020.85	1 067.01	958.16	1 034.69	999.14	802.07	664.57
1. Solid Fuels	402.67	430.02	431.50	445.73	558.50	516.87	650.57	504.53	492.20	445.62
2. Oil and Natural Gas	774.73	708.18	641.65	575.12	508.51	441.29	384.13	494.60	309.87	218.94
2. Industrial Processes	**7 915.33**	**8 016.45**	**7 448.89**	**7 210.29**	**7 924.63**	**7 930.87**	**7 222.74**	**7 760.47**	**7 606.26**	**7 586.81**
A. Mineral Products	1 000.43	1 386.54	1 322.60	1 312.50	1 526.65	1 481.67	1 019.27	1 021.54	1 099.33	1 234.11
B. Chemical Industry	3 701.53	3 707.07	3 767.18	3 669.04	3 874.00	3 973.80	3 743.44	3 995.27	4 090.61	4 038.95
C. Metal Production	2 908.84	2 547.91	1 953.13	1 888.34	2 189.23	2 184.13	2 134.64	2 443.92	2 109.51	1 994.92
D. Other Production	72.54	49.24	53.98	50.19	29.36	22.40	49.37	48.32	41.29	51.39
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	231.99	325.69	352.01	290.22	305.39	268.87	276.02	251.42	265.51	267.44
3. Solvent and Other Product Use	316.43	238.61	215.31	207.58	214.37	242.28	193.97	174.30	189.14	196.86
4. Agriculture										
A. Enteric Fermentation										
B. Manure Management										
C. Rice Cultivation										
D. Agricultural Soils										
E. Prescribed Burning of Savannas										
F. Field Burning of Agricultural Residues										
G. Other										
5. Land Use, Land-Use Change and Forestry[(2)]	**2 391.84**	**2 304.52**	**2 191.55**	**2 163.81**	**2 162.00**	**2 201.48**	**2 231.83**	**2 415.37**	**2 317.74**	**2 321.62**
A. Forest Land	-2 516.03	-2 566.96	-2 673.99	-2 695.22	-2 658.52	-2 621.45	-2 603.44	-2 419.34	-2 510.97	-2 487.47
B. Cropland	-35.57	-35.57	-35.57	-35.57	-35.57	-35.57	-35.57	-35.57	-35.57	-35.57
C. Grassland	4 194.85	4 194.85	4 194.85	4 194.85	4 194.85	4 194.85	4 194.85	4 194.85	4 194.85	4 194.85
D. Wetlands	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Settlements	-151.54	-151.54	-151.54	-151.54	-151.54	-151.54	-151.54	-151.54	-151.54	-151.54
F. Other Land	716.98	716.98	716.98	716.98	716.98	716.98	716.98	716.98	716.98	716.98
G. Other	183.15	146.76	140.82	134.31	95.79	98.20	110.56	109.99	103.99	84.37
6. Waste	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**
A. Solid Waste Disposal on Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
B. Waste-water Handling										
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CO_2 emissions including net CO_2 from LULUCF	**161 781.33**	**166 684.05**	**164 609.83**	**168 966.12**	**168 895.97**	**172 826.13**	**179 940.68**	**173 541.49**	**175 556.31**	**170 046.42**
Total CO_2 emissions excluding net CO_2 from LULUCF	**159 389.48**	**164 379.52**	**162 418.28**	**166 802.31**	**166 733.97**	**170 624.65**	**177 708.84**	**171 126.11**	**173 238.58**	**167 724.80**
Memo Items:										
International Bunkers	**38 897.84**	**40 180.27**	**41 266.58**	**43 136.84**	**41 528.32**	**43 011.75**	**44 262.79**	**47 159.68**	**48 414.10**	**50 031.32**
Aviation	4 540.46	4 844.86	5 648.73	6 214.34	6 534.56	7 584.14	8 079.78	8 739.60	9 560.09	9 832.32
Marine	34 357.38	35 335.41	35 617.85	36 922.50	34 993.76	35 427.61	36 183.01	38 420.08	38 854.01	40 199.00
Multilateral Operations	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
CO_2 Emissions from Biomass	3 877.95	3 844.89	3 880.96	4 103.79	3 988.10	4 319.96	4 911.69	5 336.80	5 538.56	5 756.62

Table A8.4 Emissions of greenhouse gases in the Netherlands; **CRF Trend Table 10: CO_2** *(continued).*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**162 054.56**	**168 173.35**	**168 799.19**	**172 623.50**	**174 198.74**	**168 799.90**	**11.67**
A. Fuel Combustion (Sectoral Approach)	161 365.81	167 591.14	167 248.14	171 113.22	172 691.42	167 268.83	11.53
1. Energy Industries	63 527.49	67 705.26	67 071.29	68 538.18	70 090.39	67 354.77	28.31
2. Manufacturing Industries and Construction	26 794.78	26 095.27	26 815.93	27 414.37	27 165.67	27 181.60	-17.74
3. Transport	32 366.87	32 880.53	33 582.41	34 259.27	34 823.86	34 686.17	33.36
4. Other Sectors	38 093.48	40 436.13	39 279.46	40 464.72	40 174.83	37 670.99	-0.52
5. Other	583.19	473.96	499.05	436.67	436.67	375.30	-33.66
B. Fugitive Emissions from Fuels	688.75	582.21	1 551.05	1 510.28	1 507.32	1 531.06	30.04
1. Solid Fuels	421.71	412.17	430.32	464.43	508.82	456.97	13.48
2. Oil and Natural Gas	267.04	170.04	1 120.73	1 045.85	998.50	1 074.09	38.64
2. Industrial Processes	**7 352.82**	**6 831.71**	**6 740.18**	**6 855.60**	**6 947.66**	**6 961.76**	**-12.05**
A. Mineral Products	1 164.38	1 252.93	1 180.96	1 138.31	1 156.84	1 143.11	14.26
B. Chemical Industry	4 076.89	3 503.26	3 400.77	3 412.11	3 657.29	3 745.83	1.20
C. Metal Production	1 764.79	1 736.94	1 820.90	1 968.35	1 791.37	1 691.97	-41.83
D. Other Production	48.98	42.82	31.79	46.09	41.17	33.45	-53.88
E. Production of Halocarbons and SF_6							
F. Consumption of Halocarbons and SF_6							
G. Other	297.77	295.76	305.75	290.74	301.00	347.40	49.75
3. Solvent and Other Product Use	169.23	157.84	159.98	140.07	143.63	143.63	-54.61
4. Agriculture							
A. Enteric Fermentation							
B. Manure Management							
C. Rice Cultivation							
D. Agricultural Soils							
E. Prescribed Burning of Savannas							
F. Field Burning of Agricultural Residues							
G. Other							
5. Land Use, Land-Use Change and Forestry[(2)]	**2 416.68**	**2 388.47**	**2 382.49**	**2 373.67**	**2 355.65**	**2 340.81**	**-2.13**
A. Forest Land	-2 405.66	-2 416.26	-2 426.86	-2 437.45	-2 448.05	-2 458.65	-2.28
B. Cropland	-35.57	-35.57	-35.57	-35.57	-35.57	-35.57	0.00
C. Grassland	4 194.85	4 194.85	4 194.85	4 194.85	4 194.85	4 194.85	0.00
D. Wetlands	NE	NE	NE	NE	NE	NE	0.00
E. Settlements	-151.54	-151.54	-151.54	-151.54	-151.54	-151.54	0.00
F. Other Land	716.98	716.98	716.98	716.98	716.98	716.98	0.00
G. Other	97.62	80.01	84.62	86.41	78.98	74.74	-59.19
6. Waste	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**IE,NA,NO**	**0.00**
A. Solid Waste Disposal on Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
B. Waste-water Handling							
C. Waste Incineration	IE	IE	IE	IE	IE	IE	0.00
D. Other	NA	NA	NA	NA	NA	NA	0.00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0.00**
Total CO_2 emissions including net CO_2 from LULUCF	**171 993.29**	**177 551.36**	**178 081.84**	**181 992.84**	**183 645.69**	**178 246.10**	**10.18**
Total CO_2 emissions excluding net CO_2 from LULUCF	**169 576.61**	**175 162.90**	**175 699.35**	**179 619.16**	**181 290.03**	**175 905.29**	**10.36**
Memo Items:							
International Bunkers	**52 473.98**	**56 561.83**	**56 445.68**	**53 261.69**	**57 349.22**	**64 955.96**	**66.99**
Aviation	9 749.35	9 538.72	9 981.87	9 817.17	10 503.13	10 875.58	139.53
Marine	42 724.63	47 023.11	46 463.81	43 444.52	46 846.10	54 080.38	57.41
Multilateral Operations	IE	IE	IE	IE	IE	IE	0.00
CO_2 Emissions from Biomass	6 198.49	6 533.10	7 122.63	6 787.43	7 384.68	8 674.30	123.68

Table A8.5 Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: CH_4.***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	111.84	112.80	111.05	111.71	110.62	111.18	108.45	80.94	80.43	72.53
A. Fuel Combustion (Sectoral Approach)	32.36	33.26	31.66	32.50	31.39	32.06	35.11	31.97	31.02	30.20
1. Energy Industries	3.40	3.79	3.69	4.06	3.96	4.29	4.92	5.24	5.27	5.22
2. Manufacturing Industries and Construction	2.70	2.58	2.60	2.50	2.47	2.33	2.41	2.32	2.33	2.30
3. Transport	7.51	6.58	6.42	6.09	5.80	5.63	5.25	4.96	4.74	4.53
4. Other Sectors	18.70	20.25	18.89	19.80	19.11	19.77	22.47	19.41	18.64	18.08
5. Other	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.05	0.07
B. Fugitive Emissions from Fuels	79.48	79.54	79.39	79.21	79.24	79.12	73.35	48.97	49.41	42.33
1. Solid Fuels	1.44	1.44	1.44	1.44	1.45	1.45	1.46	1.45	1.42	1.16
2. Oil and Natural Gas	78.04	78.10	77.95	77.77	77.79	77.67	71.88	47.52	47.99	41.16
2. Industrial Processes	**14.13**	**14.14**	**14.12**	**14.07**	**14.11**	**14.14**	**14.09**	**14.09**	**14.07**	**14.20**
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	12.13	12.13	12.13	12.13	12.13	12.13	12.13	12.13	12.15	12.25
C. Metal Production	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	2.01	2.02	2.00	1.94	1.98	2.01	1.96	1.96	1.93	1.95
3. Solvent and Other Product Use										
4. Agriculture	**499.72**	**506.27**	**494.93**	**496.72**	**480.13**	**492.66**	**475.91**	**470.64**	**451.14**	**447.71**
A. Enteric Fermentation	358.35	363.95	355.51	357.66	346.74	347.92	333.19	328.35	319.27	318.27
B. Manure Management	141.37	142.32	139.42	139.06	133.39	144.74	142.72	142.29	131.87	129.44
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**
A. Forest Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Cropland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
C. Grassland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. Wetlands	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**585.78**	**591.48**	**580.28**	**564.77**	**543.10**	**514.98**	**498.06**	**482.40**	**462.28**	**424.35**
A. Solid Waste Disposal on Land	571.93	572.31	560.46	544.52	526.80	500.07	483.26	467.80	447.78	409.65
B. Waste-water Handling	13.79	18.39	18.33	18.30	13.40	11.48	11.31	11.03	10.97	11.23
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0.06	0.77	1.48	1.95	2.90	3.43	3.49	3.57	3.53	3.47
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CH_4 emissions including CH_4 from LULUCF	**1 211.47**	**1 224.69**	**1 200.38**	**1 187.27**	**1 147.96**	**1 132.96**	**1 096.51**	**1 048.07**	**1 007.93**	**958.79**
Total CH_4 emissions excluding CH_4 from LULUCF	**1 211.47**	**1 224.69**	**1 200.38**	**1 187.27**	**1 147.96**	**1 132.96**	**1 096.51**	**1 048.07**	**1 007.93**	**958.79**
Memo Items:										
International Bunkers	1.06	1.11	1.15	1.18	1.16	1.24	1.27	1.33	1.39	1.43
Aviation	0.22	0.23	0.27	0.30	0.31	0.36	0.38	0.42	0.45	0.47
Marine	0.84	0.87	0.88	0.88	0.84	0.88	0.89	0.92	0.94	0.96
Multilateral Operations	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
CO_2 Emissions from Biomass										

Table A8.5 Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: CH_4*** *(continued)*.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	69.96	70.07	67.68	66.90	64.54	66.21	-40.79
A. Fuel Combustion (Sectoral Approach)	30.67	31.31	30.70	30.08	29.91	29.20	-9.76
1. Energy Industries	5.26	5.61	5.93	5.71	6.01	6.95	104.40
2. Manufacturing Industries and Construction	2.28	2.19	2.24	2.23	2.22	2.21	-18.33
3. Transport	4.10	3.88	3.72	3.51	3.26	2.40	-68.01
4. Other Sectors	18.97	19.58	18.76	18.59	18.39	17.61	-5.83
5. Other	0.06	0.05	0.05	0.04	0.04	0.04	-31.81
B. Fugitive Emissions from Fuels	39.28	38.77	36.98	36.82	34.63	37.01	-53.43
1. Solid Fuels	1.06	1.11	1.06	1.08	1.10	1.12	-22.33
2. Oil and Natural Gas	38.22	37.66	35.92	35.74	33.53	35.89	-54.01
2. Industrial Processes	**14.32**	**14.24**	**14.69**	**15.04**	**14.87**	**14.88**	**5.24**
A. Mineral Products	NO	NO	NO	NO	NO	NO	0.00
B. Chemical Industry	12.42	12.39	12.89	13.20	13.10	13.11	8.16
C. Metal Production	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	0.00
D. Other Production							
E. Production of Halocarbons and SF_6							
F. Consumption of Halocarbons and SF_6							
G. Other	1.90	1.85	1.81	1.85	1.77	1.76	-12.35
3. Solvent and Other Product Use							
4. Agriculture	**432.52**	**438.45**	**414.87**	**417.70**	**419.70**	**419.24**	**-16.11**
A. Enteric Fermentation	305.27	313.00	294.50	302.43	302.29	302.13	-15.69
B. Manure Management	127.25	125.45	120.37	115.27	117.41	117.11	-17.16
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	0.00
D. Agricultural Soils	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	0.00
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	0.00
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	0.00
G. Other	NO	NO	NO	NO	NO	NO	0.00
5. Land Use, Land-Use Change and Forestry	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**0.00**
A. Forest Land	NO	NO	NO	NO	NO	NO	0.00
B. Cropland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0.00
C. Grassland	NE	NE	NE	NE	NE	NE	0.00
D. Wetlands	NE	NE	NE	NE	NE	NE	0.00
E. Settlements	NE	NE	NE	NE	NE	NE	0.00
F. Other Land	NE	NE	NE	NE	NE	NE	0.00
G. Other	NE	NE	NE	NE	NE	NE	0.00
6. Waste	**399.90**	**376.49**	**359.53**	**335.91**	**324.66**	**295.42**	**-49.57**
A. Solid Waste Disposal on Land	385.72	362.68	345.39	322.62	310.55	282.43	-50.62
B. Waste-water Handling	10.50	10.47	10.72	10.06	10.69	9.76	-29.22
C. Waste Incineration	IE	IE	IE	IE	IE	IE	0.00
D. Other	3.67	3.34	3.42	3.23	3.42	3.23	5 603.81
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0.00**
Total CH_4 emissions including CH_4 from LULUCF	**916.69**	**899.25**	**856.77**	**835.56**	**823.77**	**795.75**	**-34.32**
Total CH_4 emissions excluding CH_4 from LULUCF	**916.69**	**899.25**	**856.77**	**835.56**	**823.77**	**795.75**	**-34.32**
Memo Items:							
International Bunkers	1.49	1.58	1.58	1.49	1.58	1.76	66.53
Aviation	0.46	0.45	0.47	0.47	0.50	0.52	139.53
Marine	1.02	1.12	1.10	1.02	1.08	1.24	47.78
Multilateral Operations	IE	IE	IE	IE	IE	IE	0.00
CO_2 Emissions from Biomass							

Table A8.6 *Emissions of greenhouse gases in the Netherlands;* ***CRF Trend Table 10: N_2O.***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**1.57**	**1.68**	**1.84**	**2.00**	**2.13**	**2.26**	**2.30**	**2.29**	**2.32**	**2.29**
A. Fuel Combustion (Sectoral Approach)	1.57	1.68	1.84	2.00	2.13	2.26	2.30	2.29	2.32	2.29
1. Energy Industries	0.41	0.38	0.38	0.40	0.44	0.47	0.47	0.46	0.48	0.43
2. Manufacturing Industries and Construction	0.11	0.10	0.10	0.10	0.09	0.07	0.08	0.07	0.07	0.08
3. Transport	0.88	1.02	1.19	1.33	1.43	1.54	1.57	1.60	1.60	1.61
4. Other Sectors	0.14	0.15	0.14	0.14	0.14	0.14	0.15	0.14	0.13	0.13
5. Other	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04
B. Fugitive Emissions from Fuels	0.00	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	0.00	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO
2. Industrial Processes	**27.44**	**27.69**	**27.86**	**29.54**	**28.23**	**26.91**	**26.79**	**26.65**	**26.51**	**25.65**
A. Mineral Products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Chemical Industry	24.42	24.70	24.90	26.70	25.50	24.25	24.20	24.20	24.10	23.23
C. Metal Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	3.03	2.99	2.96	2.84	2.73	2.66	2.59	2.45	2.41	2.42
3. Solvent and Other Product Use	0.73	0.73	0.73	0.70	0.66	0.64	0.62	0.55	0.52	0.50
4. Agriculture	**37.05**	**37.97**	**39.99**	**40.51**	**39.04**	**40.80**	**40.15**	**39.64**	**38.93**	**37.56**
A. Enteric Fermentation										
B. Manure Management	2.24	2.37	2.50	2.52	2.39	2.49	2.45	2.43	2.62	2.66
C. Rice Cultivation										
D. Agricultural Soils	34.81	35.60	37.49	37.99	36.65	38.31	37.70	37.21	36.31	34.90
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land Use, Land-Use Change and Forestry	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**
A. Forest Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
B. Cropland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
C. Grassland	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. Wetlands	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Settlements	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Other Land	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**1.66**	**1.72**	**1.71**	**1.69**	**1.73**	**1.63**	**1.60**	**1.59**	**1.62**	**1.56**
A. Solid Waste Disposal on Land										
B. Waste-water Handling	1.66	1.69	1.65	1.61	1.61	1.49	1.46	1.44	1.48	1.42
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0.00	0.03	0.06	0.08	0.12	0.14	0.14	0.14	0.14	0.14
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total N_2O emissions including N_2O from LULUCF	**68.45**	**69.79**	**72.13**	**74.44**	**71.78**	**72.24**	**71.47**	**70.72**	**69.90**	**67.55**
Total N_2O emissions excluding N_2O from LULUCF	**68.45**	**69.79**	**72.13**	**74.44**	**71.78**	**72.24**	**71.47**	**70.72**	**69.90**	**67.55**
Memo Items:										
International Bunkers	**0.31**	**0.32**	**0.33**	**0.34**	**0.33**	**0.34**	**0.35**	**0.37**	**0.38**	**0.40**
Aviation	0.04	0.04	0.05	0.05	0.05	0.06	0.07	0.07	0.08	0.08
Marine	0.27	0.28	0.28	0.29	0.27	0.28	0.28	0.30	0.30	0.31
Multilateral Operations	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
CO_2 Emissions from Biomass										

Table A8.6 Emissions of greenhouse gases in the Netherlands; **CRF Trend Table 10: N_2O** *(continued).*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**2.23**	**2.26**	**2.29**	**2.28**	**2.28**	**2.21**	**40.85**
A. Fuel Combustion (Sectoral Approach)	2.23	2.26	2.29	2.28	2.28	2.21	40.90
1. Energy Industries	0.47	0.51	0.53	0.53	0.48	0.46	11.34
2. Manufacturing Industries and Construction	0.07	0.07	0.07	0.07	0.07	0.07	-32.04
3. Transport	1.56	1.55	1.56	1.52	1.57	1.54	74.90
4. Other Sectors	0.10	0.11	0.10	0.13	0.13	0.12	-12.52
5. Other	0.03	0.03	0.03	0.03	0.03	0.02	-32.01
B. Fugitive Emissions from Fuels	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	-100.00
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.00
2. Oil and Natural Gas	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	IE,NA,NO	-100.00
2. Industrial Processes	**25.36**	**23.51**	**22.49**	**21.66**	**22.83**	**22.54**	**-17.86**
A. Mineral Products	NO	NO	NO	NO	NO	NO	0.00
B. Chemical Industry	23.03	21.23	20.23	19.40	20.57	20.53	-15.93
C. Metal Production	NO	NO	NO	NO	NO	NO	0.00
D. Other Production							
E. Production of Halocarbons and SF_6							
F. Consumption of Halocarbons and SF_6							
G. Other	2.34	2.29	2.26	2.26	2.26	2.02	-33.41
3. Solvent and Other Product Use	0.44	0.36	0.29	0.29	0.28	0.25	-65.21
4. Agriculture	**34.52**	**33.13**	**31.40**	**30.41**	**30.37**	**30.22**	**-18.43**
A. Enteric Fermentation							
B. Manure Management	2.51	2.46	2.51	2.06	2.28	2.43	8.48
C. Rice Cultivation							
D. Agricultural Soils	32.01	30.67	28.89	28.35	28.09	27.79	-20.17
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	0.00
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	0.00
G. Other	NO	NO	NO	NO	NO	NO	0.00
5. Land Use, Land-Use Change and Forestry	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**0.00**
A. Forest Land	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	0.00
B. Cropland	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0.00
C. Grassland	NE	NE	NE	NE	NE	NE	0.00
D. Wetlands	NE	NE	NE	NE	NE	NE	0.00
E. Settlements	NE	NE	NE	NE	NE	NE	0.00
F. Other Land	NE	NE	NE	NE	NE	NE	0.00
G. Other	NE	NE	NE	NE	NE	NE	0.00
6. Waste	**1.53**	**1.53**	**1.51**	**1.41**	**1.42**	**1.42**	**-14.27**
A. Solid Waste Disposal on Land							
B. Waste-water Handling	1.38	1.39	1.37	1.28	1.29	1.29	-21.95
C. Waste Incineration	IE	IE	IE	IE	IE	IE	0.00
D. Other	0.15	0.13	0.14	0.13	0.14	0.13	5 607.42
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0.00**
Total N_2O emissions including N_2O from LULUCF	**64.09**	**60.79**	**57.97**	**56.05**	**57.19**	**56.65**	**-17.24**
Total N_2O emissions excluding N_2O from LULUCF	**64.09**	**60.79**	**57.97**	**56.05**	**57.19**	**56.65**	**-17.24**
Memo Items:							
International Bunkers	**0.42**	**0.45**	**0.45**	**0.42**	**0.45**	**0.51**	**66.70**
Aviation	0.08	0.08	0.08	0.08	0.09	0.09	139.53
Marine	0.33	0.37	0.36	0.34	0.36	0.42	56.39
Multilateral Operations	IE	IE	IE	IE	IE	IE	0.00
CO_2 Emissions from Biomass							

Table A8.7 Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: HFCs, PFCs and SF_6.***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Emissions of HFCs(3) - (Gg CO_2 equivalent)	**4 432.03**	**3 451.56**	**4 447.33**	**4 998.04**	**6 480.37**	**6 019.54**	**7 677.81**	**8 300.14**	**9 341.37**	**4 859.17**
HFC-23	0.38	0.30	0.38	0.42	0.54	0.49	0.59	0.57	0.67	0.29
HFC-32	NO	NO	NO	NO	NO	0.00	NO	0.00	0.00	NO
HFC-41	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-43-10mee	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-125	NO	NO	NO	NO	NO	0.00	0.01	0.02	0.04	0.05
HFC-134	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	NO	NO	0.02	0.01	0.04	0.04	0.11	0.17	0.12	0.14
HFC-152a	NO	NO	0.01	0.03	0.02	0.02	0.03	NO	NO	NO
HFC-143	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-143a	NO	NO	NO	0.00	0.01	0.00	0.03	0.01	0.04	0.04
HFC-227ea	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-245ca	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of listed HFCs(4) - (Gg CO_2 equivalent)	NO	NO	NO	21.41	117.36	187.62	489.42	1 272.05	1 157.38	974.28
Emissions of PFCs(3) - (Gg CO_2 equivalent)	**2 264.48**	**2 244.88**	**2 042.86**	**2 068.47**	**1 989.67**	**1 937.82**	**2 155.33**	**2 343.91**	**1 829.23**	**1 470.53**
CF_4	0.28	0.28	0.25	0.25	0.24	0.24	0.26	0.28	0.21	0.15
C_2F_6	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.04
C_3F_8	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
c-C_4F_8	NA,NO	NA,NO	NE,NO	NO	NO	NO	NO	NO	NO	NO
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_6F_{14}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	18.26	21.00	24.15	27.77	31.94	37.03	51.10	101.26	113.87	147.10
Emissions of SF6(3) - (Gg CO_2 equivalent)	**217.32**	**133.91**	**143.09**	**149.90**	**191.20**	**301.26**	**312.40**	**344.85**	**328.84**	**317.03**
SF_6	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Table A8.7 Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: HFCs, PFCs and SF_6*** *(continued).*

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
Emissions of HFCs[3] - (Gg CO_2 equivalent)	**3 823.57**	**1 469.35**	**1 541.42**	**1 379.65**	**1 514.64**	**1 353.54**	**-69.46**
HFC-23	0.21	0.04	0.06	0.04	0.03	0.02	-95.58
HFC-32	0.00	0.01	0.00	0.01	0.01	0.00	100.00
HFC-41	NO	NO	NO	NO	NO	NO	0.00
HFC-43-10mee	NO	NO	NO	NO	NO	NO	0.00
HFC-125	0.06	0.08	0.06	0.07	0.09	0.09	100.00
HFC-134	NO	NO	NO	NO	NO	NO	0.00
HFC-134a	0.12	0.16	0.20	0.25	0.31	0.33	100.00
HFC-152a	0.02	0.01	0.00	0.00	0.01	0.00	100.00
HFC-143	NO	NO	NO	NO	NO	NO	0.00
HFC-143a	0.08	0.05	0.05	0.06	0.07	0.08	100.00
HFC-227ea	NO	NO	NO	NO	NO	NO	0.00
HFC-236fa	NO	NO	NO	NO	NO	NO	0.00
HFC-245ca	NO	NO	NO	NO	NO	NO	0.00
Unspecified mix of listed HFCs[4] - (Gg CO_2 equivalent)	769.40	408.12	216.39	215.86	236.14	173.87	100.00
Emissions of PFCs[3] - (Gg CO_2 equivalent)	**1 580.60**	**1 488.61**	**2 185.52**	**619.53**	**284.68**	**265.35**	**-88.28**
CF_4	0.16	0.15	0.24	0.05	0.01	0.01	-95.98
C_2F_6	0.04	0.04	0.06	0.01	0.00	0.00	-96.70
C_3F_8	NO	NO	NO	NO	NO	NO	0.00
C_4F_{10}	NO	NO	NO	NO	NO	NO	0.00
$c\text{-}C_4F_8$	NO	NO	NO	NO	NO	NO	0.00
C_5F_{12}	NO	NO	NO	NO	NO	NO	0.00
C_6F_{14}	NO	NO	NO	NO	NO	NO	0.00
Unspecified mix of listed PFCs[4] - (Gg CO_2 equivalent)	193.35	162.71	119.70	180.25	179.04	178.19	875.81
Emissions of SF6[3] - (Gg CO_2 equivalent)	**335.15**	**356.25**	**332.31**	**309.24**	**328.36**	**337.25**	**55.19**
SF_6	0.01	0.01	0.01	0.01	0.01	0.01	55.19

Table A8.8 Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: All gases and by sector CO_2-eq.***

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
CO_2 emissions including net CO_2 from LULUCF	161 781.33	166 684.05	164 609.83	168 966.12	168 895.97	172 826.13	179 940.68	173 541.49	175 556.31	170 046.42
CO_2 emissions excluding net CO_2 from LULUCF	159 389.48	164 379.52	162 418.28	166 802.31	166 733.97	170 624.65	177 708.84	171 126.11	173 238.58	167 724.80
CH_4 emissions including CH_4 from LULUCF	25 440.86	25 718.48	25 207.90	24 932.58	24 107.19	23 792.11	23 026.69	22 009.57	21 166.47	20 134.58
CH_4 emissions excluding CH_4 from LULUCF	25 440.86	25 718.48	25 207.90	24 932.58	24 107.19	23 792.11	23 026.69	22 009.57	21 166.47	20 134.58
N_2O emissions including N_2O from LULUCF	21 219.28	21 634.22	22 360.81	23 077.06	22 251.48	22 394.42	22 154.49	21 921.72	21 668.31	20 940.85
N_2O emissions excluding N_2O from LULUCF	21 219.28	21 634.22	22 360.81	23 077.06	22 251.48	22 394.42	22 154.49	21 921.72	21 668.31	20 940.85
HFCs	4 432.03	3 451.56	4 447.33	4 998.04	6 480.37	6 019.54	7 677.81	8 300.14	9 341.37	4 859.17
PFCs	2 264.48	2 244.88	2 042.86	2 068.47	1 989.67	1 937.82	2 155.33	2 343.91	1 829.23	1 470.53
SF_6	217.32	133.91	143.09	149.90	191.20	301.26	312.40	344.85	328.84	317.03
Total (including LULUCF)	**215 355.30**	**219 867.10**	**218 811.82**	**224 192.17**	**223 915.87**	**227 271.27**	**235 267.39**	**228 461.69**	**229 890.53**	**217 768.58**
Total (excluding LULUCF)	**212 963.45**	**217 562.58**	**216 620.27**	**222 028.37**	**221 753.87**	**225 069.79**	**233 035.56**	**226 046.31**	**227 572.79**	**215 446.96**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
1. Energy	153 993.57	159 015.24	157 657.66	162 350.75	161 577.16	165 487.01	173 282.43	165 601.54	167 852.28	162 172.85
2. Industrial Processes	23 633.70	22 726.54	23 014.26	23 879.66	25 632.76	24 829.39	25 969.81	27 305.42	27 617.91	22 484.53
3. Solvent and Other Product Use	541.18	464.65	442.64	424.10	418.80	439.85	387.10	345.15	350.45	350.48
4. Agriculture	21 979.62	22 402.37	22 790.43	22 989.22	22 185.13	22 993.86	22 440.61	22 171.84	21 542.24	21 045.51
5. Land Use, Land-Use Change and Forestry[(5)]	2 391.84	2 304.52	2 191.55	2 163.81	2 162.00	2 201.48	2 231.83	2 415.37	2 317.74	2 321.62
6. Waste	12 815.39	12 953.78	12 715.28	12 384.63	11 940.02	11 319.67	10 955.61	10 622.36	10 209.92	9 393.59
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)[(5)]	**215 355.30**	**219 867.10**	**218 811.82**	**224 192.17**	**223 915.87**	**227 271.27**	**235 267.39**	**228 461.69**	**229 890.53**	**217 768.58**

Table A8.8 Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: All gases and by sector CO_2-eq*** *(continued).*

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	Change from base to latest reported year
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(%)
CO_2 emissions including net CO_2 from LULUCF	171 993.29	177 551.36	178 081.84	181 992.84	183 645.69	178 246.10	10.18
CO_2 emissions excluding net CO_2 from LULUCF	169 576.61	175 162.90	175 699.35	179 619.16	181 290.03	175 905.29	10.36
CH_4 emissions including CH_4 from LULUCF	19 250.51	18 884.20	17 992.15	17 546.68	17 299.23	16 710.65	-34.32
CH_4 emissions excluding CH_4 from LULUCF	19 250.51	18 884.20	17 992.15	17 546.68	17 299.23	16 710.65	-34.32
N_2O emissions including N_2O from LULUCF	19 866.88	18 844.34	17 970.40	17 374.37	17 727.87	17 562.04	-17.24
N_2O emissions excluding N_2O from LULUCF	19 866.88	18 844.34	17 970.40	17 374.37	17 727.87	17 562.04	-17.24
HFCs	3 823.57	1 469.35	1 541.42	1 379.65	1 514.64	1 353.54	-69.46
PFCs	1 580.60	1 488.61	2 185.52	619.53	284.68	265.35	-88.28
SF_6	335.15	356.25	332.31	309.24	328.36	337.25	55.19
Total (including LULUCF)	**216 850.00**	**218 594.11**	**218 103.64**	**219 222.30**	**220 800.47**	**214 474.93**	**-0.41**
Total (excluding LULUCF)	**214 433.32**	**216 205.64**	**215 721.15**	**216 848.63**	**218 444.82**	**212 134.12**	**-0.39**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	Change from base to latest reported year
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(%)
1. Energy	164 215.72	170 345.14	170 929.50	174 734.09	176 262.43	170 876.69	10.96
2. Industrial Processes	21 255.75	17 734.10	18 079.94	16 194.17	16 463.54	16 218.93	-31.37
3. Solvent and Other Product Use	306.89	268.54	248.57	230.25	231.23	221.82	-59.01
4. Agriculture	19 784.12	19 477.75	18 446.27	18 198.80	18 228.40	18 172.24	-17.32
5. Land Use, Land-Use Change and Forestry[(5)]	2 416.68	2 388.47	2 382.49	2 373.67	2 355.65	2 340.81	-2.13
6. Waste	8 870.84	8 380.12	8 016.86	7 491.32	7 259.22	6 644.44	-48.15
7. Other	NA	NA	NA	NA	NA	NA	0.00
Total (including LULUCF)[(5)]	**216 850.00**	**218 594.11**	**218 103.64**	**219 222.30**	**220 800.47**	**214 474.93**	**-0.41**

A8.4 Trend tables for the precursor gases and SO_2

Table A8.9 Emissions of precursor gases in the Netherlands; ***All gases and by sector (Gg).***

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
National Total																
NOx	559.3	460.9	447.1	429.3	412.4	470.2	456.6	417.2	405.6	411.1	396.4	385.2	377.5	375.5	354.8	344.9
CO	1137.3	1026.3	981.9	925.3	896.4	862.0	850.8	772.4	759.4	738.7	715.6	680.1	647.5	626.8	617.2	538.1
NMVOC	465.8	412.1	388.8	361.2	339.9	332.7	293.3	263.6	262.6	248.7	234.6	212.6	202.0	187.0	180.0	176.5
SO2	190.1	140.5	133.5	126.0	118.5	128.1	121.3	102.0	93.7	87.8	71.6	73.4	66.7	62.8	63.6	58.5
1. Energy																
NOx	543.4	446.4	434.1	417.6	402.2	461.4	454.2	414.8	400.6	409.5	391.9	380.9	373.9	375.0	352.5	342.6
CO	1006.1	911.7	879.4	835.1	818.1	795.0	813.9	732.8	646.8	700.4	609.6	577.4	577.6	583.2	555.6	474.0
NMVOC	247.0	205.7	194.9	179.6	170.8	175.9	163.7	145.2	134.9	126.8	121.0	110.3	102.5	97.4	91.0	87.5
SO2	178.9	130.9	125.4	119.6	113.6	124.8	117.9	99.0	91.2	85.9	69.7	71.1	64.1	61.9	62.5	57.5
2. Industial processes																
NOx	12.0	10.9	9.8	8.6	7.5	6.4	2.3	2.4	5.0	0.8	4.5	3.9	3.1	0.5	1.1	1.1
CO	129.3	113.0	101.1	89.2	77.6	66.5	36.9	39.6	112.6	38.0	105.9	102.5	69.6	43.5	61.2	63.7
NMVOC	87.0	80.4	73.7	67.1	60.5	53.9	48.9	45.6	46.7	39.3	40.2	33.2	32.2	28.0	27.4	27.4
SO2	7.1	6.3	5.5	4.7	3.8	3.0	3.4	3.1	2.5	1.9	1.9	2.2	2.5	0.8	1.0	1.0
3. Solvents and Other product use																
NOx	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
NMVOC	130.0	124.2	118.4	112.6	106.8	101.0	78.8	71.1	79.3	81.4	72.2	67.9	66.2	60.6	60.5	60.6
SO2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Agriculture																
NOx	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
CO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
NMVOC	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
SO2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste																
NOx	3.9	3.6	3.3	3.0	2.7	2.4	0.1	0.0	0.1	0.9	0.0	0.4	0.5	0.0	1.2	1.2
CO	1.9	1.6	1.3	1.0	0.7	0.4	0.0	0.0	0.0	0.3	0.0	0.1	0.3	0.0	0.4	0.4
NMVOC	1.6	1.6	1.7	1.7	1.8	1.8	1.8	1.5	1.5	1.1	1.0	1.0	1.0	0.9	0.9	0.9
SO2	4.2	3.4	2.6	1.8	1.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

ANNEX 9. Chemical compounds, Units, Global Warming Potentials, Other conversion factors and Internet links

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
SO_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) GWP's 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 8400, 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:

$C \rightarrow CO_2$:	x 44/12 = 3.67
$C \rightarrow CH_4$:	x 16/12 = 1.33
$C \rightarrow CO$:	x 28/12 = 2.33
$N \rightarrow N_2O$:	x 44/28 = 1.57
$N \rightarrow NO$:	x 30/14 = 2.14
$N \rightarrow NO_2$:	x 46/14 = 3.29
$N \rightarrow NH_3$:	x 17/14 = 1.21
$N \rightarrow HNO_3$:	x 63/14 = 4.50
$S \rightarrow SO_2$:	x 64/32 = 2.00

From full molecular mass to element basis:

$CO_2 \rightarrow C$:	x 12/44 = 0.27
$CH_4 \rightarrow C$:	x 12/16 = 0.75
$CO \rightarrow C$:	x 12/28 = 0.43
$N_2O \rightarrow N$:	x 28/44 = 0.64
$NO \rightarrow N$:	x 14/30 = 0.47
$NO_2 \rightarrow N$:	x 14/46 = 0.30
$NH_3 \rightarrow N$:	x 14/17 = 0.82
$HNO_3 \rightarrow N$:	x 14/63 = 0.22
$SO_2 \rightarrow S$:	x 32/64 = 0.50

ANNEX 10. List of abbreviations

AD	Activity Data
AOO	Waste Co-ordination Platform (in Dutch: *Afval Overleg Orgaan*, AOO)
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
CCDM	Co-ordination Committee for Monitoring of Target Groups
CDM	Clean Development Mechanism (one of three so-called mechanisms of the Kyoto Protocol)
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 a NIR)
CRT	Continuous Regeneration Trap
DLO	Legal name of Wageningen University and Research Centre (Wageningen UR)
dm	dry matter
DOC	Degradable Organic Carbon
EC-LNV	National Reference Centre for Agriculture
ECE	Economic Commission for Europe (UN)
EEA	European Environment Agency
EF	Emission Factor
EGR	Exhaust Gas Recirculation
EIT	Economies-In-Transition (country group comprising the former SU and Eastern Europe)
EMEP	European programme for Monitoring and Evaluation of long-range transmission of air Pollutants
ENINA	Task Group Energy, Industry and Waste Handling
EPA	US Environmental Protection Agency
ER	Emission Registration
ER-I	Emission Registration-Individual firms
ET	Emissions Trading
ETC/ACC	European Topic Centre on Air and Climate Change
EU	European Union
EZ	Ministry of Economic Affairs
FAO	Food and Agricultural Organisation (UN)
F-gases	Group of fluorinated compounds comprising HFCs, PFCs and SF_6
FOI	Facilitating Organisation for Industry
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)
IEF	Implied Emission Factor
IPCC	Intergovernmental Panel on Climate Change
KNMI	Royal Netherlands Meteorological Institute
LEI	Agricultural Economics Institute

LHV	Lower Heating Value
LNV	Ministry of Agriculture, Nature Conservation and Fishery
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 Office of RIVM (in Dutch: *Milieu- en Natuur Planbureau*)
MSW	Municipal Solid Waste
MW	Mega Watt
NA	Not Available; Not Applicable (notation key in CRF); also: National Approach
NAM	Nederlandse Aardolie Maatschappij
ND	No Data
NE	Not Estimated (notation key in CRF)
NEAT	Non-Energy CO_2 emissions Accounting Tables (model of NEU-CO_2 Group)
NEH	Netherlands Energy Statistics
NIR	National Inventory Report (annual greenhouse gas inventory report to the UNFCCC)
NLR	National Aerospace Laboratory
NOGEPA	Netherlands Oil and Gas Exploration and Production Association
ODU	Oxidised During Use (of direct non-energy use of fuels or of petrochemical product)
OECD	Organisation for Economic Cooperation and Development
OF	Oxygen Furnace (gas)
PER	Pollutant Emission Register
RA	Reference Approach (vs. Sectoral or National Approach)
QA	Quality Assurance
QC	Quality Control
RIVM	National Institute for Public Health and the Environment
RIZA	National Institute of Water Management and Waste Treatment
ROB	Reduction Programme non-CO_2 Greenhouse Gases
SA	Sectoral Approach; also: National Approach (vs. Reference Approach)
SCR	Selective Catalytic Reduction
SBSTA	Subsidiary Body for Scientific and Technological Advice (of Parties to the UNFCCC)
SW	Streefwaarde (Dutch for ‘target value’)
SWDS	Solid Waste Disposal Site
TNO	Netherlands Organisation for Applied Scientific Research
TBFRA	Temperate and Boreal Forest Resources Assessment (ECE-FAO)
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nation’s Framework Convention on Climate Change
VROM	Ministry of Housing, Spatial Planning and the Environment
V&W	Ministry of Transport, Public Works and Water Management
WEB	Working Group Emission Monitoring of Greenhouse Gases
WEM	Working Group Emission Monitoring
WUR	Wageningen University and Research Centre (or: Wageningen UR)
WWTP	Waste Water Treatment Plant

ANNEX 11. Voluntary supplementatory information for article 3.3 and 3.4 of the Kyoto Prococol

Introduction

In Decision 15/CP.10 the Conference of the Parties has encouraged Parties included in Annex I to the Convention that have ratified the Kyoto Protocol to submit, on a voluntary basis, with their submission of the National Inventory Report estimates of greenhouse gas emissions by sources and removals by sinks resulting from activities under article3, paragraphs 3 and 4, of the Kyoto Protocol.

This annex presents the supplementary information and follows the guidance given in Annex I and the CRF tables in Annex II of 15/CP.10.

1. General information

1.1. Definition of forest

Forest is land with woody vegetation and with tree crown cover of more than 20 per cent 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. May consist either of closed forest formations where trees of various storeys and undergrowth cover a high proportion of the ground; or of open forest formations with a continuous vegetation cover in which tree crown cover exceeds 20 per cent. Young natural stands and all plantations established for forestry purposes which have yet to reach a crown density of 20 per cent 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.

As presented in Table NIR 1 the following values for the parameters defining forest under the Kyoto Protocol are selected:

Parameter	Selected value
Minimum land area	0.5 h
Minimum crown cover	20%
Minimum height	5 m

Forest holds in this definition a smaller land area than the land use category Forest land (5A) as reported in the NIR and CRF files. Forest land holds 3 subcategories:

a. Forest land as per the definition ahead.
b. Woodlands and trees outside a forest environment.
c. Heathlands/ peat moors and other nature areas.

Both fertilization of forest and biomass burning are not occurring in the Netherlands and therefore in Table NIR.1 the notation key ‘NO’ is used
Liming occurs rarely in the Netherlands in the frame of restoration of forest ecosystems and therefore the notation key ‘NE’ is used.

1.2. Elected activities under article 3.4 (as in table NIR 1)
As reported in the Initial Report (December 2006) the Netherlands did not elected activities under this article

1.3. Description of how the definitions of each activity under article 3.3 have been implemented and applied consistently over time

For the purposes of article 3, paragraph 3, eligible activities are those direct human-induced afforestation, reforestation and/or deforestation activities that meet the requirements set below and that started on or after 1 January 1990 and before 31 December of the last year of the commitment period.

‘Afforestation’ is the direct human-induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human-induced promotion of natural seed sources.

‘Reforestation’ is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989

‘Deforestation’ is the direct human-induced conversion of forested land to non-forested land

As both Afforestation and Reforestation are subject to the same provisions no differentiation will be made between these two and they are researched reported together.

2. Land-related information

2.1. Spatial assessment unit used for determining the area of the units of land under article 3.3

For the purposes of determining the area of deforestation to come into the accounting system under article 3, paragraph 3, the Netherlands determines to use 0.5 ha as spatial assessment unit.

2.2. Methodology used to develop the land transition matrix in table NIR 2

The methodology of the Netherlands 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 observation method is based on land-use maps of two different years, 1990 and 2000 (Kramer and Knol, 2005; Nabuurs et al., 2005; Wyngaert et al., 2006) that split the Netherlands into six types of land use, i.e.:

1) Forests
    a. Forest land as per the definition
    b. Woodlands and trees outside a forest environment.
    c. Heathlands/ peat moors and other nature areas.
2) Grassland
3) Cropland
4) Settlements
5) Swamp/wetlands
6) Other land

Approximately 57% of the territorial area of the Netherlands is agricultural (grassland and cropland), 13% is used for settlements and 10% is forested (including trees outside forests) and 2% comprises dunes, nature reserves, wildlife areas and heather. The remaining area in the Netherlands is open water (19%).

The differences between the land use maps of 1990 and 2000 show the change in forest area and the differentiation between the total areas for the six types of land uses. The annual changes to the forest area and the changes to the way in which carbon flux is recorded for the period 1990-2000 are determined through using forest inventories, databases on biomass, allometric functions, soil carbon, leaf waste, litter and woodcutting. Observations from 2001 onwards are based on the MFV (National Forest Inventory), though the aforementioned sources are also used. The forest inventory process (for the entire country) takes around five years to complete. The plots were included during 2001/2002. It was decided (see Nabuurs et al., 2005) that the figures for 2001-2005 are all the same. In the period 1990-2000 1984 ha were afforested; an average rate of 1.98 kha/y of afforestation (for forest according to definition). For the same period the deforestation was 1100 ha; an average rate of 1.10 kha/y of deforestation (for forest according to definition) (see Wyngaert et al., 2006, Table 2.1)

2.3. Maps and/or database to identify the geographical locations, and the system of identification codes for the geographical locations

The following statistical sources are used (with underlying individual data):

1. HOSP 1988-1999 ('Statistics and Forecast of Harvestable Wood'); also includes figures for 1980; ceased in 1999: minimum parameters: plot location, tree types, number of trees, diameter, tree height. Organisations responsible: Bosdata, together with the Expertise Centre of the Ministry of Agriculture, Nature and Food Quality (EC LNV) and Alterra.
2. National Forest Inventory 2000 (MFV); figures for 2000-2004; next period possibly 2008-2012: minimum parameters: plot location, tree type, number of trees, diameter, treeheight, dead wood, thickness of litter layer. Responsible: EC LNV, and Alterra. Alterra is responsible for the data processing.
3. Mineral C soil: based on country-wide random soil checks (Kuikman et al., 2002). This LSK database is managed by Alterra, Wageningen.
4. The litter database covers the years 1950-1991 (Van den Burg, 1999). Work is continuing on an ad hoc basis (De Waal and Hommel) and through studies into forest reserves. Organisation responsible for data processing: Alterra.
5. Statistical woodcutting is continuing on an ad hoc basis. Organisation responsible: Probos, commissioned by the Ministry of Agriculture, Nature and Food Quality (LNV).
6. Forest certificates for Green Funds: new, additional forests are being planted from 2000 onwards, of which Green Funds has obtained the CO_2 flux (for 50 years). The project organisation (Forest Certificates) is certified through an independent company (SGS). The management, (calculated) CO_2 amount , monitoring etc. takes place on the basis of this certification. Green Funds registers information (such as the location) and conducts the monitoring as per the parameters of the MFV method whenever emissions trading actually occurs.
7. Land-use maps are now produced by the Topographical Service. This provides a solid basis. However, scanning and classifying still occur on an ad hoc basis for research studies. Organisation responsible for the latter: Alterra.

3. Activity-specific information

3.1. Methods for carbon stock change and GHG emission and removal estimates

3.1.1. Description of the methodologies and the underlying assumptions used

A Tier 2 method is used for the carbon pools at inventory plot level. A detailed description of the method is included in Nabuurs et al. (2005). Three carbon poles are distinguished:

1. Living biomass: for biomass the Netherlands uses the IPCC method 1 to calculate the C changes in biomass. These calculations are implemented per inventory plot. The total biomass and the

resulting net C-flux to living biomass are calculated from the tree biomass at certain time periods (t and t+1), the tree density and the carbon fraction in the biomass..

2. Dead organic matter: The stock of dead wood is determined from the MFV (National Forest Inventory) data. The net C flux to dead organic material results from the amount of dead material and the decomposition of dead wood. The mortality rate is determined as a fixed fraction (0.4%) of the amount of standing volume. The decomposition of dead wood is determined by the total time required for the decomposition of standing/lying tree trunks. The density of the dead wood varies considerably according to the extent of the decomposition, and the average is set at half the density of living wood for the respective tree type.
3. Soil organic matter: A rough estimate has been made of the C stock in the mineral soil organic matter. This is around 100 ton C per hectare of forest (Kuikman et al., 2002, pp. 20-21). It is assumed that the stock does not change over time. As the stock does not change, and only changes need to be reported, the value for litter is thus zero. For land-use changes it is assumed that the average values given by Kuikman et al. (2002) for previous land use are included (in the same amounts) under forests. Thus the stock has no tendency to change to a new average. The total national forestry stock can only increase if the amount of forest size increases.

In the national system it was assessed that the Netherlands has a gross afforestation in the period 1990-2000 of 1984 ha or 1.98 kha/y (under forest definition). So in the period 1990-2005 in total 31.7 kha is afforested. Not each of these locations is individually followed. The growth rate of these young forests was estimated at half of the growth rate in existing forests (the forest is on average only 8 years old); this is a growth rate of 1.46 Mg C /ha.y. 70% of this occurs above ground, 30% below ground (Van den Wyngaert et al. 2006, IPCC 2003, 2006).

In the national system it was also assessed that the Netherlands has a gross deforestation in the period 1990-2000 of 1100 ha or 1.10 kha/y (under forest definition). So in the period 1990-2005 in total 17.6 kha is deforested. The Dutch average forest biomass carbon stock is used (71 Mg C/ha). It is assumed that the total carbon stock is lost in the same year.

Not each of the article 3.3. locations is followed individually (although part of them are registered under Groenfonds, see Annex D in Wyngaert et al.,2006). Although, it is not traced if any of the afforested lands is already harvested by now, this is very unlikely as the shortest rotation in the Netherlands is about 25 years for poplar. For this reason the notation key 'NE' in Table 5 (KP-1 A.1.2) is used.

3.1.2. Justification when omitting any carbon pool or GHG emissions/removals

Theoretically there is a fourth carbon pool: that of wood products. However this pool is not estimated/reported. It is assumed that the wood-cutting leads to a direct emission, and thus to the reduction of carbon stocks in the living biomass.

3.1.3. Information on whether or not indirect and natural GHG emissions and removals have been factored out

Indirect and natural GHG emissions and removals have **not** been factored out

3.1.4. Changes in data and methods since the previous submission (recalculations)

As this is the first time that these items are reported, recalculations are not applicable.

3.1.5. Uncertainty estimates

The Netherlands uses a Tier 1 analysis for the uncertainty assessment of the sector LULUCF. The uncertainty in the CO_2 emissions form 'Forest land remaining Forest' is calculated at 67% (for forests according to the Kyoto definition), and the uncertainty from 'Land converted to Forest' is calculated at 63%.

3.1.6. Information on other methodological issues

The differences between the land use maps of 1990 and 2000 show the change in forest area.The annual changes are interpolation of the changes 1990 to 2000 Observations from 2001 onwards are based on the MFV (National Forest Inventory), though the aforementioned sources are also used. The forest inventory process (for the entire country) takes around five years to complete. The plots were included during 2001/2002. It was decided (see Nabuurs et al., 2005) that the figures for 2001-2005 are all the same. So 2005 figures are extrapolation and will be updated when this inventory process will be finalised. It is foreseen that by 2014 the new inventory process is completed and real figures for 2008-2012 will be reported.

Related to 16/CMP.1, Annex I, section B.5, harvesting is distinguished from deforestation in the Netherlands based on information in the official registration based of the Forest Law in combination with the topographic maps (Wyngaert et al., 2006, Appendix E).This provides an opportunity to make an estimate of the area undergoing deforestation as land use change, independent of the amount of wood harvested.

The amount of wood harvested in the Netherlands is recorded annually. Using the average standing volume at harvest an estimate is made of the surface harvested. However, it is not possible to distinguish between harvests from thinnings, clearcuts in regular forest cycle or clearcuts from land use change. To establish the surface of land that looses its forest function another approach is needed.

Since the installation of the so called Forest Law (20 July 1961, Stbl 256/1961) the fate of forested parcels is closely monitored. Forest owners have to request permission before clear cutting a plot and have the obligation to replant it. Lately, the State Forestry Service and ‘Rijkswaterstaat’ have gained partial release of the legal restrictions and the time period for replanting has been extended to 10 years for some forest types. LASER an national organisation of the Ministry of Agriculture, Nature and Food Quality is responsible for the permissions and registration of harvests and replanting under the Forest Law.

The forest Law is not applicable for tree stands inside built-up areas or meeting some other restrictions (e.g. on size, tree species, but also officially approved changes in development plans) and cutting of these stands usually only requires permission from the local administration. As there is no central registration, data about tree stand loss are not (easily) accessible. However, this would concern mostly individual trees to very small patches. Where it concerns slightly larger areas (e.g. change of the official land use in the development plan of an area), the change of forest into other land use types can also be derived from the Dutch topographic maps. The recorded loss of forest area on aerial photographs is checked on the ground and details are added. Based on the state of the location on the ground it is assessed whether the area has really experienced a change in land use (e.g. if houses are being built) or will proceed to the next forest cycle.

3.1.7. For the purpose of accounting as required in paragraph 18 of the annex to draft decision -/CMP.1 (Land use, land-use change and forestry) attached to decision 11/CP.7, an indication of the year of the onset of an activity, if after 2008.

Not yet applicable.

3.2. article 3.3

3.2.1. 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.

All land related accounting started in 1990.

3.2.2. Information on how harvesting or forest disturbance that is followed by the re-establishment of forest is distinguished from deforestation.

In our approach temporarily unstocked parcels remain forests and are not accounted as being deforestation.

3.2.3. Information on the size and geographical location of forest areas that have lost forest cover but which are not yet classified as deforested.

Information on deforestation is the result of a comparison of the land use maps of 1990 and 2000. If there is no conversion from forestry into another land use class the loss of forest is not determined as deforestation. Not each of these locations is individually followed.

3.3. article 3.4
3.3.1. Information that demonstrates that activities under article 3.4 have occurred since 1 January 1990 and are human-induced.

Not applicable.

3.3.2. Information relating to Cropland Management, Grazing Land Management and Revegetation, if elected, for the base year.

Not applicable.

3.3.3. Information relating to Forest Management:
(a) That the definition of forest for this category conforms with the definition in item 1.1 above (b) That forest management is a system of practices for stewardship and use of forest land aimed at fulfilling relevant ecological (including biological diversity), economic and social functions of the forest in a sustainable manner (paragraph 1 (f) of the annex to draft decision -/CMP.1 (Land use, land-use change and forestry), attached to decision 11/CP.7).

Not applicable.

4. Other information
4.1. Key category analysis for article 3.3 activities and any elected activities under article 3.4 (as in, inter alia, table NIR 3, section 5.4 of the IPCC good practice guidance for LULUCF).

Current Key Categories are 5A1('Forest land remaining forest land' ─ level and trend), 5C1 ('Grassland remaining grassland'─ level) and 5F2 ('Land converted to other land'─ level). A further elaboration at sublevel within these Key Categories is possible.

5. Information relating to article 6
5.1. The identification code in the relevant tables of the common reporting format for activities under article 3, paragraphs 3 and 4, of the Kyoto Protocol, contained in Annex II to decision - /CMP.1 (Good practice guidance for land use, land-use change and forestry activities under article 3, paragraphs 3 and 4, of the Kyoto Protocol) should include a specific indication of whether the boundary of the geographical location encompasses land subject to a project under article 6 of the Kyoto Protocol.

As the Netherlands doesn't host Joint Implementation activities, the boundaries of the geographical location don't encompass projects under article 6 of the Kyoto protocol.