RIVM report 773201009 / 2005

Greenhouse Gas Emissions in the Netherlands 1990-2003.

National Inventory Report 2005

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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 2003]

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This investigation has been performed by order and for the account of the Directorate-General for Environmental Protection, Climate Change and Industry Division, of the Netherlands Ministry of Spatial Planning, Housing and the Environment, within the framework of RIVM project 773201, project title ‘International emission reports’.

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Acknowledgements

Many colleagues from a number of organisations (CBS, EC-LNV, LEI, 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 (see *Section 1.6*). This annual project is led by the *Netherlands Environmental Assessment Agency* (MNP) at RIVM. The emission calculations, including those for greenhouse gas emissions, are performed by members of so-called ER Task Forces (see *Section 1.3*). 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 by TNO 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 RIVM/MNP experts: Mr. Jan-Anne Annema (transport), Mr. Guus van den Berghe (now SenterNovem, previously AOO) (waste), Mr. Gert-Jan van der Born (land use), Mr. Laurens Brandes (key sources), Mr. Anco Hoen (transport, bunkers), Mr. Romuald te Molder (trends, miscellaneous), Mrs. Johanna Montfoort (advice on energy, fugitive emissions), Mr. Durk Nijdam (small combustion, solvent and product use), Mr. Jos Olivier (fugitive, energy) Mr. Kees Peek (industrial processes, waste water, other waste) and Mrs. Marian van Schijndel (agriculture). In addition, Mr. Ed Zonneveld and Mr. Joost Huurman of CBS have 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 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. In addition, we thank Mrs. Ruth de Wijs-Christensen and Susan van de Werff for checking and improving the English of the general chapters of the report.

Rapport in het kort

Nederlandse broeikasgasemissies 1990-2003. Nationaal Inventarisatie Rapport 2005.

Dit jaarlijkse rapport over de Nederlandse inventarisatie van broeikasgasemissies is geschreven om te voldoen aan de rapportageverplichtingen van het Klimaatverdrag van de Verenigde Naties (UNFCCC) en van het Bewakingsmechanisme Broeikasgassen van de Europese Unie.

In 2003 waren de totale broeikasgasemissies (exclusief landgebruik) circa 1% hoger dan in het basisjaar (1990, maar 1995 voor de gefluorideerde gassen) en zonder temperatuurcorrectie. In periode 1990-2003 zijn de emissies van CO_2 exclusief landgebruik met 12% toegenomen, terwijl de CH_4 en N_2O-emissies met respectievelijk 32% en 19% afnamen. Van de zogenaamde F-gassen, waarvoor 1995 het referentiejaar is, nam de totale emissie met circa 60% af. De HFK- en PFK-emissies namen met respectievelijk 75% en 25% af in 2003 ten opzichte van 1995, terwijl de emissies van SF_6 met 11% toenamen.

De grootste wijzigingen in totale broeikasgasemissies in 2003 ten opzichte van 2002 worden veroorzaakt door toename van 3,1 Mton (1,7%) van de CO_2-emissies, vooral van de streefwaardesectoren gebouwde omgeving (5%), industrie/energiesector (0,9%) en transportsector (2,0%), terwijl de emissies in de landbouw daalden (-2,2%). De methaanuitstoot is met 0,7 Mton CO_2-eq. (4,2%) afgenomen (met name bij afval en landbouw). Ook de N_2O-uitstoot is in 2003 met 0,7 Mton-CO_2-eq. afgenomen (3,6%) (met name in landbouw en industriële procesemissies).

Dit rapport bevat onder andere trendanalyses voor de emissies van broeikasgassen in de periode 1990-2003 en documentatie van gebruikte berekeningsmethoden, databronnen en toegepaste emissiefactoren. Ook worden de nationale broeikasgasemissies per streefwaardesector samengevat, zoals gebruikt in het Nederlandse nationale klimaatbeleid. Veel aandacht wordt dit jaar besteed aan de documentatie van de vele uitgevoerde herberekeningen.

Trefwoorden: broeikasgassen; emissies; trends; methodiek; klimaatverdrag

Abstract

Greenhouse Gas Emissions in the Netherlands 1990-2003, Netherlands Inventory Report 2005.

This report documents the Netherlands' annual submission of its greenhouse gas emission inventory in accordance with the United Nation's Framework Convention on Climate Change (UNFCCC) and the European Union's Greenhouse Gas Monitoring Mechanism. The report comprises explanations of observed trends in emissions; a description of an assessment of key sources and their uncertainty; documentation of methods, data sources and emission factors applied; and a description of the quality assurance system and the verification activities performed on the data. Special attention is paid to documenting the many recalculations performed to improve transparency and consistency over time and, thus, to better comply with IPCC and UNFCCC guidelines on methodologies and reporting.

From the inventory it can be concluded that total CO_2-equivalent emissions of the six greenhouse gases together increased in 2003 by about 1 % relative to 1990 (1995 for fluorinated gases) (excluding LUCF). Emissions of CO_2 excluding LUCF increased from 1990 to 2003 by 12%, while in the same period CH_4 and N_2O emissions decreased by about 32% and 19%, respectively. For the fluorinated greenhouse gases, for which 1995 is the reference year, total emissions decreased by 60%. Emissions of HFCs and PFCs decreased by 75% and 25% in 2005, respectively, while SF_6 emissions increased by 11% above the 1995 level.

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

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ANNEXES:

Samenvatting (Dutch)

Emissietrends broeikasgassen

De totale broeikasgasemissies (exclusief landgebruik) waren in 2003 circa 1% hoger dan in het basisjaar (1990, maar 1995 voor de F-gassen) en zonder temperatuurcorrectie. In periode 1990-2003 zijn de emissies van CO_2 exclusief landgebruik met 12% toegenomen, terwijl de CH_4 en N_2O-emissies met respectievelijk 32% en 19% afnamen. Van de zogenaamde F-gassen, waarvoor 1995 het referentiejaar is, nam de totale emissie met circa 60% af. De HFK- en PFK-emissies namen met respectievelijk 75% en 25% af in 2003 ten opzichte van 1995, terwijl de emissies van SF_6 met 11% toenamen. Hieronder wordt per IPCC-sector de verklaring voor de trend 1990-2003 gegeven:

- De emissies van *energiegebruik* en *-productie* (sector 1) zijn met circa 13% toegenomen ten opzichte van 1990, met name door de toename van CO_2-emissies van elektriteitscentrales met 15 Mton en de transportsector met 8 Mton (respectievelijk 37% en 31%). De helft van de grote toename bij de elektriciteitscentrales met bijna 30% tussen 1990 en 1998 is het gevolg van een *verschuiving* van warmtekrachtopwekking (WKK) van de industrie naar de elektriciteitssector als gevolg van de verandering van eigendom (joint-ventures). De opmerkelijke daling van de industriële emissies in die periode wordt hierdoor ook verklaard. (Op de totale nationale broeikasgasemissies heeft deze verschuiving geen invloed.) Verdubbeling van de elektriciteitsimport in 1999 van 10 naar 20% voor het binnenlandse elektriciteitsverbruik veroorzaakte een tijdelijke afname van de CO_2-emissies in deze sector en in het landelijk totaal. De stijging van de CO_2-emissies die in de periode vóór 1999 te zien was zet vanaf 2000 weer door. De CH_4-emissies van de energiesector zijn met bijna 50% gedaald, vooral door minder afblazen (‘*venten*’) van aardgas bij de olie- en gaswinning.
- De *industriële procesemissies* (sector 2) zijn 28% gedaald ten opzichte van 1990. Dit komt vooral door de sterke afname van de HFK-emissies (75%) door een sterke emissiereductie bij de productie van HCFK-22, en een afname van de N_2O-emissies van de salpeterzuurproductie. De CO_2-emissies, met name van de productie van ijzer- en staal en van ammoniak, daalden sinds 1990 met 17%. Ook de PFK-emissies zijn met 25% afgenomen, terwijl de SF_6 emissies toenamen met 11%.
- Emissies van *oplosmiddelen en andere producten* (sector 3) dragen maar zeer weinig bij aan het nationale totaal. De emissietrend vertoont een daling door een afname van de indirecte emissies van CO_2 uit oplosmiddelen en van N_2O door minder gebruik voor anesthesie en in spuitbussen.
- De *landbouwemissies* (sector 4) zijn sinds 1990 met 18% afgenomen. Dit komt door de sterke afname van het aantal dieren, vooral van melkvee (met 26%) maar ook van vleesvee en varkens (met circa 20%), waardoor CH_4-emissies afkomstig van fermentatie en mest met ca. 20% zijn gedaald. De N_2O-emissies daalden sinds 1990 met 19%, vooral door lagere indirecte emissies van af- en uitspoeling van stikstof, afname van gebruik van kunstmest (met 29%) en van buiten grazend vee.
- De totale CO_2-bijdrage van *landgebruik* (sector 5) is netto circa 2,8 Mton CO_2-emissies (ca. 1% van het nationale totaal). Dit is de resultante van *emissies* (+8 Mton CO_2) en *vastlegging* (-5 Mton CO_2). Een belangrijke bron is de afbraak van organische stof in bodems (4 Mton CO_2). De grootste vastlegging (‘*sink*’) bedraagt -2 Mton CO_2 en komt voornamelijk door koolstofvastlegging in bossen. In de vorige rapportage (NIR 2004) werd alleen een *sink* (-1,5 Mton CO_2) gerapporteerd.
- De emissies van de *afvalsector* (sector 6) zijn sinds 1990 met circa 42% afgenomen, met name door een afname van 44% van CH_4-emissies van stortplaatsen.
- *Internationale transportemissies* van lucht- en scheepvaart worden volgens de UNFCCC-richtlijn niet tot het nationale totaal gerekend (zogenaamd *memo item*). De CO_2-emissies hiervan zijn sinds 1990 met 37% of 14.5 Mton toegenomen door een toename van de emissies van scheepvaartbunkers (+9 Mton) en vliegverkeer (+5 Mton).

De grootste wijzigingen in totale broeikasgasemissies *in 2003 ten opzichte van 2002* worden veroorzaakt door toename van 3,1 Mton (1,7%) van de CO_2-emissies, vooral van de streefwaardesectoren gebouwde omgeving (5%), industrie/energiesector (0,9%) en transportsector (2,0%), terwijl de CO_2-emissies in de landbouw daalden (-2,2%). De methaanuitstoot is met 0,7 Mton CO_2-eq. (4,2%) afgenomen (met name bij afval en landbouw). Ook de N_2O-uitstoot is in 2003 met 0,7 Mton-CO_2-eq. afgenomen (3,6%) (met name in landbouw en industriële procesemissies).

Belangrijkste methodische wijzigingen ten opzichte van het vorige NIR-rapport

In 2004 en 2005 is door de Emissieregistratie gewerkt aan een groot aantal wijzigingen in de berekeningsmethodiek en de gebruikte activiteitendata en emissiefactoren om te voldoen aan de internationale richtlijnen voor de NIR van Klimaatverdrag (UNFCCC) en Kyoto Protocol voor:

- transparantie (reproduceerbaarheid);
- consistentie (van de tijdreeks, vanaf 1990);
- vergelijkbaarheid tussen landen;
- compleetheid (van bronnen); en
- betrouwbaarheid (zo accuraat als redelijkerwijs mogelijk).

Een interne evaluatie had reeds geleid tot een verbeterprogramma (zie NIR 2004), dat bij de In-Country Review in 2004 door een internationaal team van UNFCCC-experts van de vorige rapportage onderschreven werd. Voor CO_2 hadden die voornamelijk te maken met:

- de niet-transparante rapportage van emissies door bedrijven, zowel qua energiegebruik als de gebruikte emissiefactoren (ERI/MJV);
- inconsistenties in gerapporteerde individuele bedrijfsemissies bij onderscheid tussen verbranding en overige procesemissies van CO_2 (waaronder het zgn. non-energetisch gebruik van brandstoffen) en ontbreken van correcties voor voorgaande jaren in geval van wijzigingen bij de berekeningsmethodiek of datakeuze;
- bijschatting van CO_2-emissies van productgebruik gebaseerd op de in Nederland geproduceerde petrochemische producten (waarvan een groot deel geëxporteerd wordt), in plaats van op de in Nederland gebruikte petrochemische producten;
- onderscheid tussen nationale en internationale scheep- en luchtvaart, die niet conform de internationale rapportage-eisen was. Met name visserij, binnenlandse scheepvaart en militaire lucht- en scheepvaart.

Emissies tot en met 2002:
Er heeft een algemene herberekening plaatsgevonden van vele emissiebronnen. Voor fossiel energiegebruik zijn de emissies zijn nu gebaseerd op de Nationale Energie Statistieken, en landspecifieke emissiefactoren. De algemene trend voor de (oude) periode 1990-2002 in de *CO_2-emissies* is echter nauwelijks veranderd in vergelijking met de vorige NIR (+0,2% voor 1990 en -0,1% voor zichtjaar 2002, excl. landgebruik). De landgebruiksemissies (‘*LUCF*’) zijn echter compleet herberekend en zijn hierdoor veranderd van een *sink* (put) (1,5 Tg CO_2) naar een *source* (bron) (2,8 Tg CO_2).

- De afname van de *CH_4-emissies* in de periode 1990-2002 is 3% minder geworden (van -32% naar -29%).
- De afname van de *N_2O-emissies* in de periode 1990-2002 is 9% groter geworden (van -7% naar -16%).
- Van de *F-gassen* zijn de HFK-emissies marginaal veranderd, de afname van de PFK-emissies is bijgesteld met 17% (van -50% naar -33%); de toename in SF_6-emissies is 7% groter geworden (van 58% naar 65%).

De gecombineerde trend voor de periode 1990-2002 van alle gassen samen (exclusief landgebruik) is nauwelijks veranderd ten opzichte van de vorige NIR, een kleine afname van -0,3% (1,1% ten opzichte van 0,8% de vorige keer). Bij dit *National Inventory Report* zijn nu ook spreadsheets toegevoegd met checktabellen en trendtabellen die op de bijgevoegde CRF-data files gebaseerd zijn.

Sleutelbronnen: door de herberekening zijn er diverse sleutelbronnen (zogenaamde. *key sources*) veranderd.

- *Energie:* 1A–CO_2 Afvalverbranding; 1B-CO_2 emissies methaan bij affakkelen en afblazen ; 1B-CO_2 Cokes produktie zijn nu *nieuwe sleutelbronnen;* 1A-N_2O verbrandingsemissies uit mobiele bronnen, wegtransport is nu een *sleutelbron*, 1A-CO_2 mobile combustion is nu *geen sleutelbron* meer.
- *Industrie:* 2-CO_2 IJzer en Staal productie; 2-CO_2 Ammoniak productie; 2-N_2O Caprolactam productie; 2-N_2O Overige industriële productie zijn nu *nieuwe sleutelbronnen*. 2-CO_2 Overige chemisch productie is nu *geen sleutelbron* meer.
- *Landbouw:* 4-N_2O Emissie uit mest is een *nieuwe sleutelbron*; 4-CH_4 emissie van pensfermentatie is nu *geen sleutelbron* meer.
- *Sinks:* CO_2 van LUCF (landgebruik) is nu een *nieuwe sleutelbron* (een *source* i.p.v. een *sink*).
- *Afval:* 6-N_2O Afvalwater is nu *geen sleutelbron* meer.

Secties*:* Methodiekwijzigingen in *Sectie 1.4*; resultaten van de trendverificatie in *Box 1.2* en in *Hoofdstuk 9* over herberekeningen en verbeteringen; en ook de methodiek- en tijdreeksconsistentie-onderdelen in de sectorale *Hoofdstukken 3* tot en met *8*.

National Inventory Report (NIR)

Dit rapport over de Nederlandse inventarisatie van broeikasgasemissies is opgesteld om te voldoen aan de nationale rapportageverplichtingen in 2005 van het Klimaatverdrag van de Verenigde Naties (UNFCCC) en van het Bewakingsmechanisme Broeikasgassen van de Europese Unie. Dit rapport bevat trendanalyses voor de emissies van broeikasgassen in de periode 1990-2003; 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; en een overzicht van het kwaliteitssysteem en de validatie van de emissiecijfers voor de Nederlandse Emissieregistratie. Een aparte annex bij dit rapport omvat elektronische data over emissies, activiteitendata en afgeleide emissiefactoren in het zogenaamde *Common Reporting Format* (CRF), waar door het VN-Klimaat-secretariaat om wordt verzocht. In de appendices bij dit rapport zijn de CRF-trendtabellen en de IPCC-tabellen '7A' opgenomen voor 1990-2003, alsmede tabellen over herberekeningen en compleetheid van emissiebronnen. 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.*

Onzekerheden

De onzekerheid in de totale ***jaarlijkse*** emissies wordt geschat op ±5%; de onzekerheid in de ***trend*** over de periode 1990/95-2002 wordt op ±4%-punten geschat bij een toename van de broeikasgasemissies van 1%, gebaseerd op de zogenoemde 'Tier 1' methodiek van de IPCC voor trendonzekerheden (met 95% betrouwbaarheidsinterval). Voor de afzonderlijke stoffen wordt de onzekerheid in de jaarlijkse emissies als volgt geschat: voor CO_2 ±5%, CH_4 ±25%, N_2O ±50%; HFK's, PFK's en SF_6: ±50%. De trendonzekerheid wordt voor CO_2, CH_4, N_2O en voor alle F-gassen als groep geschat op respectievelijk ±5%, ±6%, ±15% and ±7%-punten. Deze onzekerheden zijn exclusief het mogelijke effect op de emissies van herberekeningen als gevolg van methodiekwijzigingen.

Broeikasgasemissies volgens indeling in Streefwaardesectoren

In onderstaande *Tabel SAM.1* staan de *nieuwe* nationale broeikasgasemissies per streefwaardesector zoals gebruikt in het Nederlandse nationale klimaatbeleid, volgens het Kyoto Protocol, zonder landgebruik (LUCF) en zonder temperatuurcorrectie, volgens de ER 2005 en zoals gepubliceerd in de NIR 2005 en Milieubalans/Milieucompendium 2005.

Tabel SAM.1. Trend 1990-2003 in Nederlandse broeikasgasemissies volgens indeling in Streefwaardesectoren (d.w.z. exclusief landgebruik) conform Kyoto Protocol (d.w.z. zonder temperatuurcorrectie) (in Mton CO_2-eq.)

NIR/MB 2005	1990	1995	2000	2001	2002	2003	Tr03/90
SW CO_2 Industrie- en energiesector	**92,2**	**97,1**	**96,8**	**100,1**	**99,8**	**100,7**	**9%**
w.v. Industrie en bouw	*39,2*	*34,8*	*32,4*	*31,6*	*32,0*	*32,1*	*-18%*
w.v. Energiesector [1]	*42,0*	*50,7*	*52,3*	*55,9*	*56,9*	*57,3*	*36%*
w.v. Raffinaderijen	*11,0*	*11,6*	*12,1*	*12,6*	*10,9*	*11,2*	*1%*
SW CO_2 Gebouwde omgeving	**27,0**	**30,8**	**27,9**	**30,2**	**29,3**	**30,8**	**14%**
w.v. Consumenten	*19,3*	*20,8*	*19,0*	*19,7*	*18,7*	*19,2*	*-1%*
w.v. Handel-Diensten-Overheid (HDO) [2]	*7,6*	*10,0*	*8,9*	*10,2*	*10,6*	*11,6*	*53%*
SW CO_2 Landbouw	**8,3**	**8,3**	**7,4**	**7,2**	**7,2**	**7,0**	**-16%**
SW CO_2 Verkeer & Vervoer [3]	**30,5**	**33,5**	**36,8**	**36,9**	**37,6**	**38,4**	**26%**
Totaal CO_2	**158,0**	**169,7**	**168,9**	**174,4**	**173,9**	**176,9**	**11,9%**
CH_4 (totaal)	**25,6**	**23,8**	**19,5**	**19,0**	**18,2**	**17,5**	**-32%**
N_2O (totaal)	**21,3**	**22,4**	**19,9**	**18,9**	**18,0**	**17,3**	**-19%**
F-gassen (totaal)	**6,8**	**8,1**	**5,7**	**3,3**	**3,3**	**3,2**	**-53%**
w.v. HFK's	*4,4*	*6,0*	*3,8*	*1,5*	*1,6*	*1,4*	*-68%*
w.v. PFK's	*2,1*	*1,8*	*1,5*	*1,4*	*1,4*	*1,4*	*-34%*
w.v. SF_6	*0,2*	*0,3*	*0,3*	*0,4*	*0,4*	*0,3*	*54%*
BROEIKASGASSEN TOTAAL	**211,7**	**224,0**	**214,0**	**215,5**	**213,5**	**214,8**	**1,5%**

[1] Inclusief afvalverwijdering.

[2] Inclusief drinkwaterbedrijven en rioolwaterzuivering.

[3] Inclusief overige mobiele werktuigen (landbouw, bouw, e.a.), visserij en militaire lucht- en scheepvaart.

Respons naar aanleiding van reviews

De Nederlandse emissieregistratie voor broeikasgassen heeft de volgende reviews gehad door het VN-Klimaat-secretariaat: a) een 'desk review' van de NIR 2000 en 'centralised reviews' van de NIR's 2000 tot en met 2003 en landen-secties in de *Synthesis and Assessment reports* over de NIR's 2001 tot en met 2003. In 2004 is er een 'in-country review' van de NIR 2004 geweest. De belangrijkste opmerkingen betroffen: inconsistentie in tijdreeksen; missende toelichtingen bij CRF-tabellen; incompleetheid van datasets; referenties van emissiefactoren en activiteitendata; en vergelijking van activiteitendata met internationale statistieken. Veel van de suggesties van de reviews zijn opgevolgd door algemene herberekeningen, bijvoorbeeld van de energiegerelateerde emissies op basis van de nationale energiestatistieken. In deze rapportage zijn de CRF-tabellen verder verbeterd door correctie van typ- en eenheidsfouten, verbeterde emissiefactoren en door rekening houden met de lokale omstandigheden.

Verbeteringen in de toekomst

Om op tijd te voldoen aan de richtlijnen voor het '*National System'* voor de monitoring van en rapportage over broeikasgasemissies in het kader van het *Kyoto Protocol* en het *EU Monitoring Mechanisme* is de afgelopen jaren een monitoring programma geïmplementeerd. Een belangrijk deel van de verbeteringen die in de vorige NIR werden aangekondigd, is hiermee geïmplementeerd. In de komende maanden zal onderzocht worden in hoeverre er nog verdere verfijning nodig en mogelijk is van de huidige methoden (met name voor landbouw en *sinks*). In september worden de methodieken definitief vastgesteld als onderdeel van het '*national systeem'* voor broeikasgassen. Daarmee wordt dan de basis gelegd voor het bepalen van de Nederlandse '*Assigned Amount'* (toegestane emissies) onder het *Kyoto Protocol*.

Executive Summary

Major changes compared to the previous National Inventory Report

Emissions for the previous period 1990-2002:
Most sectors have been thoroughly recalculated, to bring the methods for key sources in line with *IPCC Good Practice* requirements to improve transparency and consistency over time:

- *CO_2:* the overall trend in CO_2 emissions (excluding LUCF) hardly changed compared to the previous NIR (+0.2% in 1990 and -0.1% in 2002). Please note that recalculating the *LUCF category 5A Forests* and adding *LUCF emissions from soils, categories 5B to 5D* resulted in a significant change in net emissions/removals from a net sink of about 1.5 Tg CO_2 (partial estimate for 5A), to a net source of about 2.8 Tg CO_2.
- *CH_4:* an increase of 3% in the trend of CH_4 emissions (from -32% to -29%).
- *N_2O:* a decrease of 9% in the trend of N_2O emissions from (-7% to -16%).
- *F-gases:* HFCs emission data only show marginal changes, the trend of PFCs emissions changed from -50% to -33% (increase of 17%) and SF_6 increased from 58% to 65% (plus 7%).

The overall old 1990-2002 trend of all gases (excl. LUCF) hardly changed compared to the previous inventory report, from 1.1% to 0.8% (a small decrease of -0.3%).

New key sources:

- *Energy:* CO_2 from waste incineration, coke production, fugitive emissions from venting and flaring; and N_2O from mobile combustion: road vehicles;
- *Industrial processes* (i.e. non-combustion): CO_2 from iron and steel production (carbon inputs), ammonia production, other chemical manufacture; and N_2O from caprolactam production and indirect N2O from non-agricultural sources;
- *Agriculture:* CH_4 from enteric fermentation: 'other'; and N_2O from manure management;
- *LUCF:* CO_2 from LUCF (now a *source*, not a sink);
- Waste: N_2O from wastewater handling.

Sections:
Methodological changes are described in *Section 1.4. Fuel use* and emissions (CO_2, CH_4, N_2O) from fossil fuels (static combustion, processes and feedstocks) have been recalculated, based now on the *National Energy Statistics*, country-specific emission factors, and on specific circumstances (Sector 1A and 2); *Agricultural emissions* saw major methodological changes, in particular in CH_4 emission factors for enteric fermentation of cattle and of manure management systems (for all animal categories) and in the calculation of indirect agricultural N_2O soil emissions. *LUCF sector* CO_2 emissions/removals have now been estimated for most activities.

ES.1. Background information on greenhouse gas inventories and climate change

This report documents the 2005 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 1997 IPCC Guidelines* and IPCC *Good Practice Guidance* 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* by 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) 2005* therefore provides explanations of the trends in greenhouse gas emissions for the 1990-2003 period and summary descriptions of methods and data sources of (a) Tier 1 assessments of the uncertainty in annual emissions and in emission trends; (b) a preliminary assessment of key sources following the Tier 1 and Tier 2 approaches of the *IPCC Good Practice Guidance*; and (c) Quality Assurance and Quality Control activities. This report gives no specific information on the effectiveness of government policies for reducing greenhouse gas emissions; this information can be found in RIVM's annual *Environmental Balance* (in Dutch: *'Milieubalans'*).

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, which provides links to the RIVM's website (www.rivm.nl), where these files reside. In addition, trend tables and check tables compiled from CRF data and other information presented in this National Inventory Report (NIR) are also available as spreadsheets.

Climate Convention and Kyoto Protocol

The ***Kyoto Protocol*** shares the Convention's objective, principles and institutions, but significantly strengthens the Convention by committing Annex I Parties to individual, legally-binding targets to limit or reduce their greenhouse gas emissions. The EU-15 has a target of -8% in the 1990-2008/2012 period. The EU has redistributed its targets among the 15 Member States. The (burden-sharing) target of Netherlands is -6%. Please note that the definition of what should be reported under the source/sink sector '*Land-use change and forestry*' (5) (LUCF) to the ***United Nations Framework Convention on Climate Change*** is considerably different from the definition of emissions/sinks to be included in the national total under the *Kyoto Protocol*.

Reporting requirements: UNFCCC and IPCC

Annex I Parties to the UNFCCC must submit annually an *inventory* of their greenhouse gas emissions, including data for their base year (1990, except for some Economies-In-Transition) and data up to the last but one year prior to submission. Inventories due 15 April 2005, for example, should contain emission data up to the year 2003. The *UNFCCC Guidelines* prescribe the source categories, calculation methodologies, and the contents and the format for the inventory report. The IPCC often uses the concept of a *'Tiered Approach'*, by which a stepwise approach is meant: *Tier 1* is simplest, requires least data and effort; *Tier 2* is more advanced and/or data intensive; *Tier 3* is still more advanced; etc.

Generally, more detailed/advanced emission calculation methods are recommended – data and capacity permitting – and more detailed/advanced uncertainty assessments or more advanced key source assessments. To aid priority setting, the *IPCC Good Practice Guidance* recommends using higher tier methods in particular for so-called key sources. Uncertainty estimates can serve to refine both the key source identification and prioritise inventory improvement activities. The Netherlands generally applies country-specific, higher tier methods for calculation of greenhouse gas emissions (see *Section 1.5*).

Key sources

For preliminary identification of so-called 'key sources' according to the *IPCC Good Practice approach* we allocated the national emissions according to the IPCC's potential key source list wherever possible. The Netherlands has a high share of feedstock use of fuels, which is a non-combustion category of CO_2, therefore, this source category has been added to the list. 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 adds up to 95% of the national total, are 20 sources for annual level assessment and 22 sources for the trend assessment, out of a total of 59 sources. Both lists can be combined to get an overview of sources, which 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. The result is a list of about 33 source categories out of a total of 59 that could be identified as 'key sources' according to the definition of the *IPCC Good Practice Guidance* report (see *Table 1.4*).

Description of the institutional arrangement for inventory preparation

The preparation of the greenhouse gas emission data in the Netherlands is based on the national *Pollutant Emission Register* (PER). This general process has existed for many years and is organised as a project with an annual cycle. In 2000 a programme was started to adapt the monitoring of greenhouse gases in the Netherlands and transform this into a National System, as stated in Article 5 of the *Kyoto Protocol*. The *Climate Change and Industry Directorate (KvI)* of the Ministry of VROM (VROM/DGM/KVI) is responsible for organising the reporting process. The *Netherlands Environmental Assessment Agency (MNP)* at RIVM is responsible for the PER process (see *Figure ES.1*).

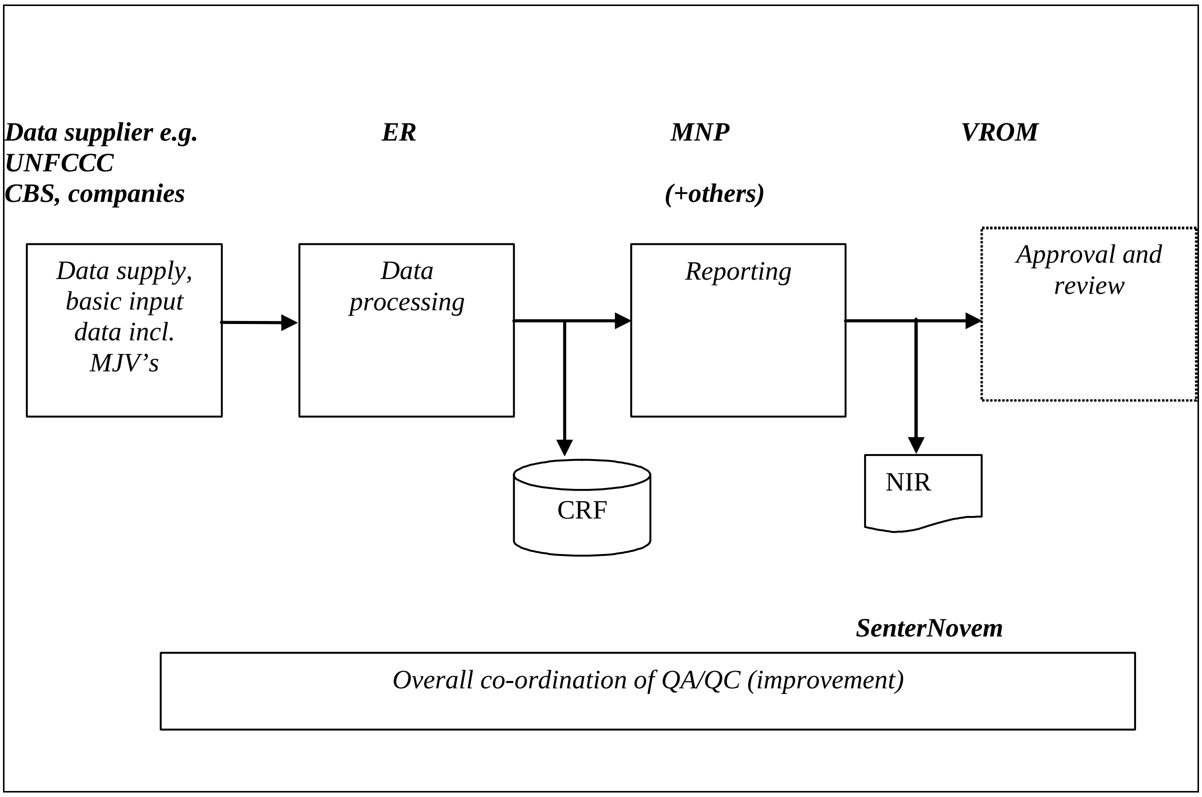


Figure ES.1. Main elements in Greenhouse gas inventory process (NIR 2005)

Organisation of the report

The report starts 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 8* present detailed results for the different sectors. *Chapter 9* presents information on recalculations, improvements and response to issues raised in external reviews. In addition, the report contains nine *Annexes* that provide more detailed information on key sources, methodologies, other relevant reports and detailed emission tables selected from the CRF files.

ES.2. Summary of national emission and removal related trends

CO_2 emissions (excluding LUCF) increased by about 12% from 1990 to 2003, mainly due to the increase in the emissions in the energy (14%, combined combustion and fugitives) and transport sectors (31%). In *Figures 2.3 and 2.4* one can observe that the doubling of imported electricity in 1999 from 10% to 20% of the domestic electricity consumption only temporarily decreased CO_2 emissions from the energy sector and total national CO_2 emissions. In 2000 the annual increase of the pre-1999 years has resumed. CO_2 emissions peaked in 1996 due to a very cold winter, as can be observed in *Figure 2.4*, showing a substantial peak in emissions in 1996 from '*Other sectors'* (residential, services, agriculture/fisheries), particularly vulnerable to weather conditions.

Table ES.1. Total greenhouse gas emissions in CO_2-eq. and indexed 1990-2003 (no temperature correction)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003[1)]**
Nat. Emissions (Tg CO_2-eq)														
CO_2 with LUCF	160.9	165.7	163.8	168.2	168.2	172.3	180.0	173.0	174.9	169.7	171.7	177.1	176.7	179.6
CO_2 excluding LUCF	158.0	162.9	161.1	165.5	165.5	169.7	177.3	170.2	172.2	166.9	168.9	174.4	173.9	176.9
CH_4	25.6	25.9	25.4	25.0	24.2	23.8	23.2	22.1	21.3	20.2	19.5	19.0	18.2	17.5
N_2O	21.3	21.7	22.4	23.1	22.3	22.4	22.2	22.0	21.7	20.9	19.9	18.9	18.0	17.3
HFCs	4.4	3.5	4.4	5.0	6.5	6.0	7.7	8.3	9.3	4.9	3.8	1.5	1.6	1.4
PFCs	2.1	2.1	1.9	1.9	1.9	1.8	2.0	2.2	1.7	1.5	1.5	1.4	1.4	1.4
SF_6	0.2	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.3
Total [group of six] [5) 2)]	**211.7**	**216.2**	**215.4**	**220.7**	**220.6**	**224.0**	**232.7**	**225.0**	**226.5**	**214.8**	**214.0**	**215.5**	**213.5**	**214.8**
Index (1990=100)														
Index CO_2 [2)]	100	103.0	101.8	104.5	104.5	107.1	111.9	107.5	108.7	105.5	106.7	110.1	109.8	111.6
Index CH_4	100	101.0	99.2	97.4	94.6	93.0	90.6	86.2	83.0	78.9	76.2	74.2	71.1	68.1
Index N_2O	100	101.9	105.1	108.5	104.5	105.2	104.1	103.0	101.8	98.3	93.3	88.6	84.3	81.3
Total [group of three]	**100**	**102.7**	**101.9**	**104.2**	**103.5**	**105.4**	**108.7**	**104.5**	**105.0**	**101.5**	**101.6**	**103.6**	**102.5**	**103.3**
Index HFCs	100	77.9	100.3	112.8	147.1	135.6	172.9	187.2	210.9	109.9	86.6	33.7	35.3	32.7
Index PFCs	100	99.0	90.1	91.1	87.6	85.4	94.6	102.9	81.8	69.3	71.9	67.0	66.9	66.0
Index SF_6	100	61.6	65.8	69.0	88.0	138.6	143.7	158.7	151.3	145.9	154.2	164.2	165.1	153.9
Index [group of six] [2)]	**100**	**102.1**	**101.8**	**104.3**	**104.2**	**105.8**	**109.9**	**106.3**	**107.0**	**101.4**	**101.1**	**101.8**	**100.8**	**101.5**
Index (1995 = 100)														
Index HFCs	73.7	57.4	74.0	83.1	108.4	100	127.5	138.0	155.5	81.0	63.9	24.8	26.1	24.1
Index PFCs	117.1	116.0	105.5	106.7	102.6	100	110.8	120.5	95.8	81.2	84.2	78.5	78.4	77.3
Index SF_6	72.1	44.5	47.5	49.8	63.5	100	103.7	114.5	109.2	105.2	111.2	118.5	119.1	111.0
Index [group of new gases]	**83.3**	**70.0**	**80.0**	**87.1**	**105.5**	**100**	**122.9**	**133.2**	**140.5**	**81.9**	**70.2**	**40.2**	**41.2**	**39.2**
Index ('90; new gases '95) [3) 5)]														
Index [BY=100] [group of 6] [2)]	**99.4**	**101.5**	**101.1**	**103.6**	**103.6**	**105.2**	**109.2**	**105.6**	**106.3**	**100.8**	**100.4**	**101.1**	**100.2**	**100.8**
International Bunker CO_2 [4)]	34.3	35.4	35.7	37.0	35.1	35.5	36.3	38.5	39.0	40.3	42.8	47.2	46.6	43.6
Index bunkers CO_2 (1990=100)	100.0	103.2	104.0	107.8	102.2	103.5	105.7	112.2	113.5	117.4	124.8	137.4	135.7	126.9

[1)] Data for 2003 are of a relatively high quality in this submission: due to the late recalculations final statistics and emission factor for 2003 could be used, excl. F-gases (see *Section 1.2).*
[2)] National emissions excluding LUCF (category 5A).
[3)] Base year = 100.
[4)] Emissions from international marine and aviation bunkers are not included in the national totals.
[5)] Base year emissions (1990 for CO_2, CH_4 and N_2O and 1995 for the F-gases, coloured figures): 213.2 Tg CO_2-eq.

CH_4 emissions decreased by 32% in 2003 compared to the 1990 level, mainly due to decrease in the waste (-43%), the agricultural (-18%) and fugitive energy sector (-39%). Although recalculation caused total annual N_2O emissions to increase by about 10-16 Gg, the new time series decreases by about 19% in 2003 compared to 1990, mainly due to the decrease in the indirect emissions from agricultural soils and from the use of synthetic fertilisers and animal production (about -30%), which has been offset by the increase of emissions from animal waste applied to soils, and the decreasing emissions from industrial processes, including indirect N_2O from non-agricultural sources (-21%), which partly compensated increases of emissions from fossil fuel combustion of 47% (mainly from transport). Of the fluorinated greenhouse gases, for which 1995 is the reference year, emissions of HFCs and PFCs decreased in 2003 by about 75% and 25% respectively, while SF_6 emissions increased by 11%. Total emissions of all F-gases decreased by about 60% compared to the 1995 level.

Table ES.2. Total greenhouse gas emissions ***with*** *temperature correction, in CO_2-eq. and indexed, 1990-2003*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Emissions (Tg CO_2-eq)														
Temperature correction CO_2 [1]	6.2	0.4	4.3	1.1	3.6	2.6	-4.3	2.4	3.6	5.1	5.2	2.3	4.2	1.5
CO_2 with LUCF (T-corrected)	167.1	166.1	168.0	169.2	171.7	175.0	175.7	175.4	178.5	174.9	177.0	179.5	180.9	181.2
CO_2 excluding LUCF (T-corrected)	164.2	163.3	165.3	166.6	169.1	172.4	173.0	172.5	175.8	172.2	174.2	176.7	178.2	178.4
Total [group of six] [2]	**217.9**	**216.6**	**219.7**	**221.7**	**224.2**	**226.7**	**228.4**	**227.4**	**230.2**	**220.0**	**219.3**	**217.8**	**217.7**	**216.4**
Index (1990 = 100)														
Index CO_2 excluding LUCF (T-corrected)	100	99.4	100.7	101.5	103.0	105.0	105.4	105.1	107.1	104.9	106.1	107.6	108.5	108.7
Total [group of six] [2]	**100**	**99.9**	**101.0**	**101.7**	**102.1**	**103.6**	**103.4**	**102.6**	**103.6**	**101.0**	**101.2**	**101.6**	**101.5**	**101.0**
Index ('90; F-gases '95)														
Index [BY=100] [group of six] [2] [3]	**102.3**	**101.6**	**103.1**	**104.1**	**105.2**	**106.4**	**107.2**	**106.7**	**108.0**	**103.3**	**102.9**	**102.2**	**102.2**	**101.5**

[1] Using the method described in *Annex 2.2* (not the new method used in RIVM's '*Milieubalans 2005'*).

[2] Excluding LUCF.

[3] Base year (excl. LUCF, uncorrected for temperature) = 213.2 Tg CO_2-eq. = 100.

ES.3. Overview of source and sink category emission estimates and trends

Table 2.7 provides an overview of the CO_2-eq. emission trends per IPCC source category. It clearly shows the *Energy sector* (sector 1) to be by far the largest contributor to national total greenhouse gas emissions with a share that increased from 70% in 1990 to about 80% in 2003. In contrast, emissions of the other sectors decreased, the largest being those of *Industrial Processes* (from 11 to 8% share), *Waste* (from 6 to 3% share) and *Agriculture* (from 10 to 8% in 2003). In *Figures 2.4* and *2.10* the trend in *total* CO_2-eq. emissions (i.e. for all six gases jointly) is presented per IPCC source category. From *Figure 2.10* it can be concluded that the sectors showing the largest growth in CO_2-eq. emissions since 1990 are *Transport* (1A3) and *Energy industries* (1A1) (both about 30%). However, half of this marked increase by the utilities 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). The *Energy sector* (1) as a whole showed a growth of about 13%. CO_2 emissions from the '*Other sectors'* (1A4) increased by 7% but these are substantially influenced by weather effects: when the temperature correction is included, these emissions decreased by 3%. Clear exceptions to the growth in the *Energy sector* are the *Waste sector* (6), *Industrial Processes* (2) and *Agriculture* (4), which showed decreases in CO_2-eq. emissions of 42%, 28%, and 18% respectively.

Energy Sector (CRF sector 1)

The emissions from the Energy sector are dominated by CO_2 from fossil fuel combustion, with fugitive emissions from gas and oil (methane and CO_2) contributing a few per cent and CH_4 and N_2O from fuel combustion adding one per cent. In 2003 the Energy sector accounted for 80% of total emissions (without LUCF) in the Netherlands. The subsector *Energy Industries* (1A1) is the largest source category within the Energy sector, accounting for 40% of emissions from the Energy sector and 32% of total emissions (excl. LUCF) in the Netherlands. Subsectors *Manufacturing Industries and Construction* (1A2), *Transport* (1A3), and *Other sectors* (1A4) (residential, services and agriculture/fisheries) contributed 16%, 20% and 24%, respectively, to total Energy sector emissions in 2003.

Since 1990, emissions from the Energy sector have increased by about 13%, mainly due to the increase in CO_2 emissions in the electricity and heat production sector (37%) and transport sector (31%).

The largest increase in emissions (15 Tg) occurred in the electricity and heat production sector (1A1a). However, half of the marked increase of almost 30% between 1990 and 1998 was mainly 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). The decrease in the electricity production sector (1A1a) in 1999 is due to the marked increase of imported electricity since 1999, which almost doubled compared with 1998, and to a relatively large shift from coal to residual chemical gas and natural gas in 1999. The increase in net import of electricity since 1999 (see *Table 3.7*) resulted in a mitigation by about 10%-points, which is equivalent to about 4 Tg of CO_2 coming from domestic fossil-fuel generated electricity. The decrease of over 15% in fossil fuel-related emissions in the manufacturing industry (1A2) in the early 1990's is again caused by the shift of cogeneration emissions to the public electricity and heat production sector due to a change of ownership (joint-ventures).

Between 2002 and 2003, total Energy sector emissions increased by 1.8% mainly as a result of increased emissions for space heating (1A4) due to the relatively mild winter in 2002 and the more normal winter in 2003 (see *Table 3.2*), and further increases in the electricity production and transport sectors. Fugitive CH_4 emissions from oil and natural gas decreased by 49% since 1990, and 0.7% between 2002 and 2003.

Table ES 3. Summary of emission trend per source category and gas (unit: Tg CO_2-eq.)

Source category	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
1A. Energy: fuel combustion	**149.6**	**154.7**	**153.6**	**158.5**	**157.6**	**161.7**	**169.6**	**162.4**	**164.9**	**159.5**	**161.7**	**167.9**	**167.5**	**170.5**
CO_2: 1. Energy industries	51.6	52.3	52.4	54.7	57.5	61.1	62.2	63.0	65.3	61.5	63.2	67.3	66.6	67.3
CO_2: 2. Manufacturing industries	32.8	32.2	32.8	32.1	30.5	27.9	28.6	27.1	27.3	27.1	26.6	25.9	26.7	27.1
CO_2: 3. Transport	26.0	26.3	27.5	28.2	28.6	29.1	29.9	30.3	31.0	32.0	32.4	32.9	33.6	34.2
CO_2: 4. Other sectors	37.4	42.1	39.0	41.7	39.3	41.6	46.9	40.1	39.2	37.0	37.6	39.9	38.8	40.2
CO_2: 5. Other	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.5	0.4
CH_4	0.7	0.7	0.7	0.7	0.6	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6
N_2O	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.8
1B. Energy: fugitives emissions	**3.3**	**3.3**	**3.2**	**3.0**	**3.1**	**3.0**	**3.0**	**2.1**	**2.1**	**2.0**	**1.9**	**1.9**	**1.9**	**1.9**
CO_2	1.2	1.2	1.2	1.0	1.1	1.0	1.1	0.8	0.8	0.8	0.8	0.8	0.8	0.9
CH_4	2.1	2.1	2.1	2.0	2.0	2.0	1.9	1.3	1.3	1.1	1.1	1.1	1.1	1.1
N_2O	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
2. Industrial processes [1)]	**23.6**	**22.5**	**22.9**	**23.7**	**25.5**	**24.9**	**26.5**	**27.6**	**27.6**	**22.6**	**21.4**	**17.7**	**17.4**	**16.9**
CO_2	8.0	8.0	7.4	7.2	7.9	8.2	7.9	8.3	7.7	7.7	7.5	6.9	6.8	6.7
CH_4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
N_2O	8.5	8.6	8.6	9.2	8.8	8.3	8.3	8.3	8.2	8.0	7.9	7.3	7.0	6.7
HFCs	4.4	3.5	4.4	5.0	6.5	6.0	7.7	8.3	9.3	4.9	3.8	1.5	1.6	1.4
PFCs	2.1	2.1	1.9	1.9	1.9	1.8	2.0	2.2	1.7	1.5	1.5	1.4	1.4	1.4
SF_6	0.2	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.3
3. Solvent & other product use [1)]	**0.5**	**0.5**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.4**	**0.4**	**0.3**	**0.3**	**0.2**	**0.3**
CO_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
CH_4	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
N_2O	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
4. Agriculture	**21.8**	**22.2**	**22.6**	**22.7**	**22.0**	**22.7**	**22.3**	**22.0**	**21.4**	**20.9**	**19.8**	**19.3**	**18.4**	**17.8**
CH_4: A. Enteric fermentation	7.3	7.4	7.3	7.1	7.1	7.0	6.9	6.7	6.6	6.5	6.4	6.5	6.2	6.1
CH_4: B. Manure management	3.0	3.0	3.0	3.0	2.8	3.0	3.0	3.0	2.8	2.7	2.7	2.6	2.5	2.4
N_2O: B. Manure management	0.7	0.7	0.7	0.8	0.7	0.7	0.7	0.7	0.8	0.8	0.7	0.7	0.7	0.6
N_2O: D. Agricultural soils	10.9	11.1	11.7	11.8	11.4	11.9	11.7	11.6	11.3	10.8	9.9	9.5	8.9	8.8
5. LUCF	**2.9**	**2.8**	**2.7**	**2.6**	**2.6**	**2.7**	**2.7**	**2.8**	**2.7**	**2.7**	**2.8**	**2.8**	**2.8**	**2.8**
CO_2	2.9	2.8	2.7	2.6	2.6	2.7	2.7	2.8	2.7	2.7	2.8	2.8	2.8	2.8
6. Waste	**12.8**	**13.0**	**12.7**	**12.4**	**11.9**	**11.3**	**11.0**	**10.6**	**10.2**	**9.4**	**8.9**	**8.4**	**8.0**	**7.4**
CO_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
CH_4	12.3	12.4	12.2	11.9	11.4	10.8	10.5	10.1	9.7	8.9	8.4	7.9	7.5	7.0
N_2O	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4
7. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
NAT. TOTAL EMISSIONS [2)]	**214.6**	**219.0**	**218.1**	**223.3**	**223.3**	**226.7**	**235.4**	**227.9**	**229.3**	**217.5**	**216.8**	**218.3**	**216.2**	**217.6**
Memo item, not incl. in nat. total:														
International bunkers	**38.9**	**40.3**	**41.4**	**43.3**	**41.7**	**43.1**	**44.4**	**47.3**	**48.6**	**50.2**	**52.6**	**56.7**	**56.6**	**53.4**
Marine	**34.3**	**35.4**	**35.7**	**37.0**	**35.1**	**35.5**	**36.3**	**38.5**	**39.0**	**40.3**	**42.8**	**47.2**	**46.6**	**43.6**
Aviation	**4.6**	**4.9**	**5.7**	**6.2**	**6.6**	**7.6**	**8.1**	**8.8**	**9.6**	**9.9**	**9.8**	**9.6**	**10.0**	**9.9**

[1)] 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*'.

[2)] The national total does not include the CO_2 sink reported under category 5A. This CO_2 sink is not complete and refers to the definition under the *UN Framework Convention on Climate* Change (UNFCCC), which is different from the amount to be calculated under the *Kyoto Protocol (*see *Section 1.1.2).*

Industrial processes (CRF sector 2)

The greenhouse gas emissions from Industrial Processes have decreased by 30% since 1990. CO_2 emissions from industrial processes, mainly from ammonia production, iron and steel production but also from cement production and the use of dolomite and limestone, and N_2O emissions, mainly from nitric acid manufacture, are the main contributors to this source category. In 2003 emissions from the Industrial Processes sector contributed 8% of total national emissions (without LUCF), the same proportion as in 2002, compared with 11% in 1990. Emissions of CO_2 and N_2O accounted each for 40% per cent of CO_2 equivalent emissions from the sector, and CH_4, HFCs, PFCs and SF_6 for 2%, 9%, 8% and 2% of the sector emissions, respectively, in 2003. F-gas emissions had a share of almost 33% in total source category emissions in 1995. Emissions of N_2O from industrial processes accounted for 39% of national total N_2O emissions. Thus, at present, CO_2 and N_2O emissions cover each about 40% of the sector total, the rest mainly stemming from HFCs and PFCs.

From 1990 to 2003, emissions of the sector declined by 28%, and from 2002 to 2003 they decreased by 3.0%. The strong decreasing trend in HFC emissions of 2/3 reduction since 1990 and 3/4 reduction since 1995, notably of HFC-23 from HCFC-22 manufacture, is primarily responsible for the decreasing trend in this source category. Total CO_2 emissions from the sector decreased by 17% from 1990 to 2003, mainly due to decreasing emissions from the iron and steel and chemical industries, and by 1.3% from 2002 to 2003. N_2O emissions fell by 21% from 1990 to 2003, mainly due to a decrease of 20% in emissions from nitric acid production but also other sources decreased by a similar percentage, and decreased by 3.7% from 2002 to 2003. CH_4 emissions, although trivial, decreased by 5% from 1990 to 2003. HFC emissions decreased by 76% from 1995 to 2003 and decreased by 7% from 2002 to 2003; PFC emissions decreased by 23% from 1995 to 2003 and by 1.4% from 2002 to 2003; and SF_6 emissions increased by 11% from 1995 to 2003 and decreased by 7% from 2002 to 2003. The decreases of HFC and PFC emissions are mainly due to decreases in by-product emissions from HCFC-22 and aluminium manufacture, respectively. HFC and PFC emissions from the *use* of these compounds have increased substantially over time, as a result of substitution for traditional (H)CFCs and halons.

Solvents and other product use (CRF sector 3)

In 2003 emissions from the Solvent and Other Product Use sector contributed only 0.1% of total national emissions (without LUCF), compared with 0.3% in 1990. Indirect emissions of CO_2 and N_2O for dispersive uses accounted for 64% and 36% of CO_2 equivalent emissions from the sector, respectively. From 1990 to 2003, emissions of the sector declined by 54%, and from 2002 to 2003 they decreased by 0.6%. CO_2 emissions from the sector decreased by almost 50% from 1990 to 2003, mainly due to decreasing indirect emissions, in particular from paints, due to the emission reduction programme for NMVOC. N_2O emissions fell by 60% from 1990 to 2003 due to better dosing of anaesthesia and decreasing use of N_2O in spray tins.

Agriculture (CRF sector 4)

In 2003 emissions from the Agriculture sector contributed 8% of total national emissions (without LUCF), compared with 10% in 1990. Emissions of N_2O accounted for 54% per cent of CO_2 equivalent emissions from the sector in 2003, and CH_4 for the remainder. Emissions of N_2O from agriculture, mainly from animal wastes applied to soils and indirect emissions from nitrogen leaching and run-off (LRO) of agricultural soils, accounted for 54% of national total N_2O emissions. CH_4 emissions from agriculture, for ¾ from enteric fermentation and ¼ from animal waste management systems, accounted for 49% of the national total CH_4 emissions in 2003.

From 1990 to 2003, emissions of the sector declined by 18%, and from 2002 to 2003 they decreased by 2.8%. Total CH_4 emissions from the sector decreased by 18% from 1990 to 2003, mainly due to decreasing numbers of dairy cattle (-26%) and also decreasing livestock numbers of non-dairy cattle, swine and poultry (of about 20%). Total N_2O emissions from the sector decreased by 19% from 1990 to 2003, largely due to a decrease in emissions from LRO, synthetic fertilisers and livestock on grasslands. These changes are mainly due to decreasing use of synthetic fertilisers (-29%) and less livestock, both on grasslands (-45%) and the less animal waste applied to soils (-25%) [although the changing practices in animal manure spreading on the fields (incorporation into the soil with the aim of reducing ammonia emissions soils instead of spreading on the fuels) increased the related emissions]. Subsequently, also the indirect N_2O emissions from LRO and from atmospheric deposition also decreased by 30% and 40%, respectively. The decrease since 1998 is mainly due to a reduction of the use of synthetic fertilisers. From 2002 to 2003 N_2O and CH_4 emissions from the sector decreased by 4% and 0.3%.

Land Use Change and Forestry (LUCF) (CRF sector 5)

In 2003 the Land Use Change and Forestry (LUCF) sector accounted for 1.3% per cent of gross total emissions (i.e. including LUCF). The subcategory 'CO_2 Emissions/Removals from Soils' (5D) is the major emissions source category in the sector (4.5 Tg), accounting for about 2/3 of all emissions/removals from the LUCF sector, whereas the net removals of subcategory 'Changes in Forest and Other Woody Biomass Stocks'(5A) account for about 1/3 (-2.3 Tg). In addition, emissions from 'Forest and Grassland Conversion' (5B) contribute 0.9 Tg; removals from 'Abandonment of Managed Land' (5C) are the smallest contribution to the sector total (-0.3 Tg) in 2003.

From 1990 to 2003, emissions from the LUCF sector decreased by 5% (-0.1 Tg CO_2) from 2.9 Tg CO_2 to 2.8 Tg CO_2, primarily due to increased removals from abandonment of managed land (-0.3 Tg) and a small decrease of emissions from CO_2 emissions from soils (-0.1 Tg), which were partly compensated by a less removals from changes in forest and other woody biomass stocks (+0.2 Tg).

Waste (CRF sector 6)

In 2003 the waste sector accounted for 3% of total national emissions (without LUCF) compared with 6% in 1990. Emissions of CH_4 and N_2O accounted for 95% and 5% of CO_2 equivalent emissions from the sector, respectively. Emissions of CH_4 from waste, almost all (97%) from landfills (6A), accounted for 40% of national total CH_4 emissions in 2003. The small N_2O emissions from the waste sector are from domestic and commercial wastewater.

From 1990 to 2003, emissions from the waste sector decreased by 42% mainly due to 44% reduction in CH_4 from landfills. This is the result of a) a reduction of 44% of municipal solid waste (MSW) disposal at landfills through increased recovery and recycling of waste for composting and/or incineration, b) decreasing the organic waste fraction of the waste disposed, and c) increased methane recovery from the landfills (from 5% in 1990 to 21% in 2003). From 2002 to 2003 the waste sector emissions decreased by 8%.

Other (CRF sector 7)

Not applicable, after the major recalculations and reallocation of sources to other CRF sectors.

International transport (bunkers)

International transport is not part of the national total but is reported under the UNFCCC as a separate Memo item '*bunkers*'. Total CO_2 emissions from this source category have increased by 37% or 14.5 Mton since 1990. In particular, marine bunker emissions contributed to this increase (+28% or 9.3 Mton) due to the marine bunkers large share in this category, but percentage-wise the emissions from international aviation increased much more (+115% or about 5 Mton). Total international transport emissions increased as fraction of the national total greenhouse gas emissions plus international transport (but excluding LUCF) from 20% in 1990 to 23% in 2003.

ES.4. Other information

The UNFCCC prescribes using specific definitions of the emissions included in the inventory. These definitions differ from emission inventories for other international reporting requirements, such as the UNECE/CLRTAP and the EU-NEC Directive, and also inventories for specific national reporting purposes. The main differences are: the method used for calculating emissions from transport, limiting

CO_2 emissions to non-organic anthropogenic sources, in the inventory that has to be submitted to the UNFCCC. Furthermore, for different economic sectors, the IPCC source categories make a clear distinction between fuel combustion and non-combustion emissions (see *Section 1.1.6*), while, in the Netherlands, analyses of the so-called 'Target Sectors' are mostly based on the total emissions per sector. Until 2004, the various approaches resulted in figures for the reported national total greenhouse gas emissions that differed from one publication to another. It has been decided, therefore, that from this reporting year onwards, the IPCC approach will be used as a base by all Dutch national publications (such as the Environmental Balance and the internet publication Environmental Data Compendium (RIVM, 2005).

For easy reference, in *Table ES.4,* we provide the national greenhouse gas emissions in the format of the so-called '*Streefwaardesectoren*' [Target value sectors], which is used within the Netherlands to monitor the emission trends of sectors for which the government has set targets for 2010 as part of the domestic national total target for achieving the emission target under the *Kyoto Protocol*. In a separate note, the causes and effects of the recalculations made since the NIR 2004 are explained (RIVM/MNP, 2005). In *Table ES.4*, the correspondence between Dutch *Streefwaardesectoren* and Target Sectors and IPCC/CRF sectors and source categories is summarised.

Table ES.4. Trends in greenhouse gas emissions grouped per'Streefwaarde sector' (in Tg = Mton CO_2-eq.).

Streefwaardesector / Target Sector	1990	1995	2000	2001	2002	2003	Tr 03/90
SW CO_2 Industry and energy sectors	**92.2**	**97.1**	**96.8**	**100.1**	**99.8**	**100.7**	**9%**
o.w. Industry and Construction	*39.2*	*34.8*	*32.4*	*31.6*	*32.0*	*32.1*	*-18%*
o.w. Energy sector [1)]	*42.0*	*50.7*	*52.3*	*55.9*	*56.9*	*57.3*	*36%*
o.w. Refineries	*11.0*	*11.6*	*12.1*	*12.6*	*10.9*	*11.2*	*1%*
SW CO_2 Buildings	**27.0**	**30.8**	**27.9**	**30.2**	**29.3**	**30.8**	**14%**
o.w. Housholds	*19.3*	*20.8*	*19.0*	*19.7*	*18.7*	*19.2*	*-1%*
o.w. Trade-Services-Government (HDO)[2)]	*7.6*	*10.0*	*8.9*	*10.2*	*10.6*	*11.6*	*53%*
SW CO_2 Agriculture	**8.3**	**8.3**	**7.4**	**7.2**	**7.2**	**7.0**	**-16%**
SW CO_2 Traffic & Transport [4)]	**30.5**	**33.5**	**36.8**	**36.9**	**37.6**	**38.4**	**26%**
Total CO_2	**158.0**	**169.7**	**168.9**	**174.4**	**173.9**	**176.9**	**11.9%**
CH_4 (total)	**25.6**	**23.8**	**19.5**	**19.0**	**18.2**	**17.5**	**-32%**
o.w. Energy sector[1)]	*14.8*	*13.2*	*9.8*	*9.3*	*8.9*	*8.5*	*-51%*
o.w. Agriculture	*10.3*	*10.1*	*9.1*	*9.1*	*8.7*	*8.5*	*-18%*
o.w. Other	*0.6*	*0.6*	*0.6*	*0.6*	*0.6*	*0.5*	*-10%*
N_2O (total)	**21.3**	**22.4**	**19.9**	**18.9**	**18.0**	**17.3**	**-16%**
o.w. Industry and Construction[3)]	*8*	*8*	*7*	*7*	*7*	*6*	*-21%*
o.w. Agriculture	*12*	*13*	*11*	*10*	*10*	*9*	*-10%*
o.w. Other	*2*	*2*	*2*	*2*	*2*	*2*	*0%*
F-gases (total)	**6.8**	**8.1**	**5.7**	**3.3**	**3.3**	**3.2**	**-53%**
o.w. HFCs	*4.4*	*6.0*	*3.8*	*1.5*	*1.6*	*1.4*	*-68%*
o.w. PFCs	*2.1*	*1.8*	*1.5*	*1.4*	*1.4*	*1.4*	*-34%*
o.w. SF_6	*0.2*	*0.3*	*0.3*	*0.4*	*0.4*	*0.3*	*54%*
SW Other greenhouse gases (total)	**53.7**	**54.4**	**45.1**	**41.2**	**39.5**	**37.9**	**-29.4%**
GREENHOUSE GAS TOTAL	**211.7**	**224.0**	**214.0**	**215.5**	**213.5**	**214.8**	**1.5%**

[1)] Including waste handling.
[2)] Including drinkingwater companies and wastewater treatment plants (WWTPs).
[3)] Including indirect N_2O from transport and energy sector.
[4)] Including off-road machinery used in agriculture and for building, road and waterway construction and including fisheries, all internal navigation and military shipping and aviation.

General uncertainty evaluation

Based on a simple Tier 1 calculation of annual uncertainties, the actual *annual uncertainty* of total annual emissions per compound and of the total is currently estimated by RIVM at:

CO_2	±5%	HFCs	±50%
CH_4	±25%	PFCs	±50%
N_2O	±50%	SF_6	±50%

The resulting uncertainty in national total annual CO_2-eq. emissions is estimated to be about 5%. If we rank the sources according to their contribution to the uncertainty in total national emissions the top-10 of sources contributing most to total *annual uncertainty* in 2003 is:

IPCC	IPCC Source category	Uncertainty (as % of total national emissions in 2003)
4D	Indirect N_2O from nitrogen used in agriculture	3.1%
1A	CO_2 from stationary combustion: other sectors	1.9%
5	CO_2 from Land Use Change and Forestry	1.8%
4D	Direct N_2O from agricultural soils	1.3%
2X	N_2O from nitric acid production	1.2%
6A	CH_4 from solid waste disposal sites	1.1%
1A	CO_2 from stationary combustion: energy industries, excl. waste incin.	1.0%
4B	CH_4 from manure management: cattle	0.7%
4A	CH_4 from enteric fermentation in domestic livestock: cattle	0.5%
1A	CO_2 from mobile combustion: road vehicles	0.4%

The result is a *trend uncertainty* in the total CO_2-eq. emissions for 1990-2003 (1995 for F-gases) of ±4% points. This means that the increase in total CO_2-eq. emissions between 1990 and 2003, which is calculated to be 1%, will be between -3% and +5%. 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 ±5%, ±6%, ±15% and ±7% points, respectively. More details on the level and trend uncertainty assessment can be found in *Annex 1* on key sources. The top-10 of sources contributing most to *trend uncertainty* in the national total is:

IPCC	IPCC Source category	Uncertainty (as % into trend in total national emissions)
1A	CO_2 from stationary combustion: other sectors	2.7%
4D	Indirect N_2O from nitrogen used in agriculture	1.9%
5	CO_2 from Land Use Change and Forestry	1.8%
1A	CO_2 from stationary combustion: energy industries, excl. waste incin.	1.3%
6A	CH_4 from solid waste disposal sites	1.0%
1A	CO_2 from stationary combustion: manufact. industries and construction	0.5%
2B	N_2O from nitric acid production	0.5%
1A	CO_2 from mobile combustion: road vehicles	0.4%
2B	N_2O from caprolactam production	0.3%
4D	Direct N_2O from agricultural soils	0.3%

If we compare this list with the 10 largest contributors to annual uncertainty, we can conclude that six of the 10 key sources are included in both lists.

Completeness

The Netherlands greenhouse gas emission inventory now includes all sources identified by the *Revised 1996 IPCC Guidelines (IPCC, 1997).* Most sources lacking in the last submission are now included in the inventory and the CRF. Sources not estimated are:

- CO_2 from lime production (2A2), due to missing activity data;
- indirect CO_2 from NMVOC from oil transport, distribution of oil products (1B2a), negligible source;
- CO_2 from asphalt roofing and road paving with asphalt (2A6 and 2A7), due to negligible source;
- CH_4 from poultry (4A9), due to missing emission factors;
- N_2O from industrial wastewater (6B), due to negligible source;
- CH_4 and N_2O emissions from LUCF (5A-5D).

Recalculations and improvements

Because nearly all data were being recalculated and completely refreshed in the CRF, in the present CRF errors in the previous submission have also been corrected. Apart from these changes, emissions for the last year reported in the NIR 2004, i.e. 2002, have also been recalculated and then updated as more detailed statistics and information on recent emission factor trends became available. As described in the sector chapters of this NIR, several methodological changes have been implemented for this submission. The methodologies are explained in the relevant chapters. These changes are justified, because they improve the inventory for greenhouse gas in terms of:

- transparency (1A, 2);
- completeness (4B, 4D/2G, 5, 6B, 6D);
- consistency (1A, 1B, 2, 4A), and;
- compliance with IPCC guidelines (higher tiers for key sources and source allocation) (1B, 3, 4A, 4B);
- accuracy (1A, 1B, 4A, 4B, 4D, 6B).

In particular, substantial improvements have been achieved in increasing the transparency and consistency of categories 1A and 2, the methodologies for gas distribution, enteric fermentation from cattle and indirect N_2O, in compliance with IPCC Good Practice, and in significantly increasing the completeness of 'CO_2 from LUCF'. All the recalculations are part of the ongoing improvement plan, as described in Section 9.4.7. *Table ES.5* elaborates the differences between the submissions from last year and the current NIR, on the level of the different greenhouse gases. More detailed explanations are elaborated in the sector chapters, *Chapters 3 to 8*.

Table ES.5. Differences between NIR 2004 and NIR 2005 for 1990-2002 due to recalculations

Gas	**Source**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
CO_2 [Tg]	NIR 2004	**159.2**	166.2	165.0	166.6	167.5	172.0	180.2	165.0	171.0	166.0	169.3	175.6	175.2
Incl. LUCF	NIR 2005	**160.9**	165.7	163.8	168.2	168.2	172.3	180.0	173.0	174.9	169.7	171.7	177.1	176.7
	Difference	***1.1%***	***-0.3%***	***-0.7%***	***0.9%***	***0.4%***	***0.2%***	***-0.1%***	***4.8%***	***2.3%***	***2.2%***	***1.4%***	***0.8%***	***0.8%***
CO_2 [Tg]	NIR 2004	**160.6**	167.7	166.4	168.5	169.5	173.2	181.6	166.2	172.4	167.3	170.7	177.1	176.7
Excl. LUCF	NIR 2005	**158.0**	162.9	161.1	165.5	165.5	169.7	177.3	170.2	172.2	166.9	168.9	174.4	173.9
	Difference	***-1.6%***	***-2.8%***	***-3.2%***	***-1.7%***	***-2.3%***	***-2.1%***	***-2.3%***	***2.4%***	***-0.1%***	***-0.2%***	***-1.1%***	***-1.5%***	***-1.5%***
CH_4 [Gg]	NIR 2004	**1302**	1326	1283	1261	1233	1190	1181	1105	1068	1020	968	949	891
	NIR 2005	**1220**	1233	1211	1189	1155	1135	1106	1052	1013	963	929	905	868
	Difference	***-6.3%***	***-7.0%***	***-5.6%***	***-5.7%***	***-6.4%***	***-4.7%***	***-6.4%***	***-4.8%***	***-5.1%***	***-5.6%***	***-4.0%***	***-4.6%***	***-2.6%***
N_2O [Gg]	NIR 2004	**52.9**	53.7	56.9	59.3	58.0	58.4	57.4	57.2	56.6	55.7	53.4	51.0	49.3
	NIR 2005	**68.7**	70.0	72.2	74.6	71.9	72.3	71.6	70.8	70.0	67.6	64.2	60.9	58.0
	Difference	***30.0%***	***30.3%***	***27.0%***	***25.9%***	***23.9%***	***23.9%***	***24.6%***	***23.7%***	***23.7%***	***21.2%***	***20.2%***	***19.4%***	***17.6%***
PFCs [Mg]	NIR 2004	351.2	351.5	301.9	304.3	269.8	**265.4**	292.0	312.9	247.3	206.5	220.5	208.2	173.3
	NIR 2005	312.6	309.4	281.3	284.3	273.4	**266.2**	294.7	319.2	252.9	205.9	220.1	205.9	205.0
	Difference	***-11.0%***	***-12.0%***	***-6.8%***	***-6.6%***	***1.3%***	***0.3%***	***1.0%***	***2.0%***	***2.3%***	***-0.3%***	***-0.2%***	***-1.1%***	***18.3%***
HFCs [Mg]	NIR 2004	378.8	295.0	405.9	473.5	680.1	**700.2**	1113.0	1495.5	1585.2	1214.7	1056.1	649.3	533.0
	NIR 2005	378.8	295.0	405.9	473.5	704.1	**694.5**	1104.3	1486.5	1575.3	1173.5	1025.5	638.0	529.9
	Difference	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***3.5%***	***-0.8%***	***-0.8%***	***-0.6%***	***-0.6%***	***-3.4%***	***-2.9%***	***-1.7%***	***-0.6%***
SF_6 [Mg]	NIR 2004	9.1	5.6	6.0	6.3	8.0	**12.6**	13.1	14.4	13.8	13.3	14.0	14.9	14.4
	NIR 2005	9.1	5.6	6.0	6.3	8.0	**12.6**	13.1	14.4	13.8	13.3	14.0	14.9	15.0
	Difference	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.2%***	***4.4%***
Total	NIR 2004	210.0	216.7	216.2	218.7	219.9	223.3	232.8	216.8	222.4	211.4	212.0	214.7	212.4
[Tg CO_2-eq.]	NIR 2005	214.6	219.0	218.1	223.3	223.3	226.7	235.4	227.9	229.3	217.5	216.8	218.3	216.2
Incl. LUCF	***Difference***	***2.2%***	***1.1%***	***0.9%***	***2.1%***	***1.5%***	***1.5%***	***1.1%***	***5.1%***	***3.1%***	***2.9%***	***2.3%***	***1.6%***	***1.8%***
Total.	NIR 2004	211.4	218.2	217.7	220.5	221.9	224.5	234.2	218.0	223.8	212.7	213.4	216.1	213.8
[Tg CO_2-eq]	NIR 2005	211.7	216.2	215.4	220.7	220.6	224.0	232.7	225.0	226.5	214.8	214.0	215.5	213.5
Excl. LUCF	*Difference*	***0.2%***	***-0.9%***	***-1.0%***	***0.1%***	***-0.6%***	***-0.2%***	***-0.6%***	***3.2%***	***1.2%***	***1.0%***	***0.3%***	***-0.3%***	***-0.1%***

Note: base year values are indicated in bold.

The following methodological changes were made for greenhouse gases:

- Fuel use and emissions (CO_2, CH_4, N_2O) from fossil fuels (static combustion, processes and feed-stocks) have been recalculated, based on National energy statistics, country-specific emission factors, and on specific circumstances (Sectors 1A and 2). It was possible to carry out these recalculations in detail for the years 1990 and 1995 to 2003. For some sources, for the years 1991-1994, a more aggregated approach had to be used, because of a lack of detailed energy statistics;
- In the *CO_2 Reference Approach* we also used updated carbon storage factors for the non energy use of fossil fuels;
- Emissions from domestic and international transport (all gases, all years) have been recalculated, based on updated emission factors; gas/oil data for other mobile sources (category 1A3) have also been recalculated;
- Emissions from fisheries and from military shipping and aviation, have been recalculated, i.e. explicitly estimated now, and reported as domestic emissions instead of being included in international bunker emissions (categories 1A4a and 1A5, respectively);
- Emissions (CO_2, CH_4, N_2O) from oil and natural gas production have been recalculated, based on detailed data from the industry (category 1B2). Emissions from venting and flaring have also been distinguished now for the total time series;
- CH_4 emissions from gas distribution have been recalculated, based on detailed data about network materials and emission factors gained from a German study (category 1B2b);
- CO_2 and CH_4 emissions from Industrial Processes have been recalculated from statistical information and default emission factors, rather than from emission data supplied by individual firms (all years, Sector 2); this also includes CO_2 from the use of fossil fuels for feedstock in the chemical industry, and the use of fuels for other purposes than for energy in other source categories (Sector 2);
- CO_2 from using different products (indirect emissions from NMVOC) has been recalculated. This calculation was previously based on domestically manufactured chemical products, but now it is based on the products actually used in the Netherlands (Sector 3);
- CH_4 from enteric fermentation by cattle and manure management has been recalculated, based on country-specific Tier 2 emission factors, calculated for each year (Sector 4);
- N_2O (mostly indirect) from agricultural soils has been recalculated to comply with the IPCC Good Practice methods (category 4D). Indirect N_2O emissions from agricultural sources of NO_x and NH_3 not listed in Sector 4 have also been recalculated (category 2G);
- N_2O from manure management has been recalculated from more detailed activity data on manure systems (category 4B);
- The LUCF CO_2 data, as required in the *IPCC Good Practice* for LULUCF, have been recalculated and up-dated (Sector 5);
- New emission figures have been added for CH_4 and N_2O in waste-water handling (industrial WWTP, septic tanks, and human sewage) and large-scale waste composting (categories 6B and 6D);
- HFC and PFC emissions for the years 1990-2002 have been revised using improved data from that industrial branch (Sector 2).

These recalculations had little or no effect on the emissions of the precursor gases. However, in the previous submission, the emissions of precursors from international navigation were included in the national total by mistake; the largest changes in precursor emissions have come about because these emissions have now been excluded. However, these reallocations have not yet been made for 1991-1994, so there is a discontinuity in the domestic emissions of these gases for these years.

Recalculation of base year and year 2002

Base year (1990 for CO_2, CH_4 and N_2O; 1995 for F-gases)

The total CO_2-eq. emissions (including LUCF) in the base year 1990 increased by 4.6 Tg CO_2-eq, or 2.2 %, compared to last submission. The total CO_2-eq. emissions (excluding LUCF) increased by 0.2%. This can be explained by the following most relevant changes **(all are expressed as CO_2 equivalents)**:

- **CO_2 (excluding LUCF):** - 9.4 Tg in the *Energy* sector (1A) due to major recalculations using energy statistics, which also led to it being reallocated from the CO_2 emissions in *Waste* (6) to *Energy*; and + 0.9 Tg in *Fugitive emissions from fuel* (1B) due to recalculations based on improved sector data (see *Section 3.1* for more detailed information). The recalculations also increased the amounts of CO_2 emissions shown in *Industrial Processes* (2) by 6.5 Tg and in *Solvent and Other Product Use* by 0.3 Tg.
- **CO_2 (including LUCF):** Recalculating the *LUCF category 5A Forest* and adding *LUCF emissions from soils, categories 5B to 5D* resulted in a significant change in net emissions/removals from a net sink of about 1.5 Tg CO_2 in the previous submission that was based only on a partial estimate for 5A, to a net source of about 2.8 Tg CO_2. This is mainly due to the addition of emissions now estimated for cultivating organic soils in category 5D, partly compensated by a larger net sink in category 5A due to other biomass expansion factors and the inclusion of dead wood. These changes were made for the total time series.
- **CH_4:** recalculations related to the use of fossil fuel resulted in lower emission figure – a decrease of -1.5 Tg CO_2-eq. – in *Energy (1)* and *Industrial Processes (2)*. The net decrease in CH_4 from *Agriculture (4)* arose from an increase of 0.8 Tg in *Manure Management* (4B) and a decrease of -1.1 Tg in *Enteric Fermentation (4A)* due to new, country-specific recalculations; CH_4 in the category *Waste* (6) showed an increase of by 0.15 Tg after *Wastewater Handling* emissions had been recalculated. The emissions in the *Others* sector (7) are now allocated in *Industrial Processes* (2). Other CH_4 emission figures were affected by the recalculations and reallocations to a lesser extent.
- **N_2O:** the national emissions increase of 28% occurred mainly in *Agriculture (4)*, where a new calculation for emissions from *Agricultural soils (4D)* had been introduced (4.3 Tg) and where *Manure Management (4B)* (0.5 Tg) had been recalculated. Recalculations in the other categories only slightly changed the emission data. N_2O emissions formerly reported under 7 are now included in the categories *Agriculture (4)* and *Other industrial processes* (2G), because the method of calculation has been revised.
- **F-gases:** Changes in 1995 – the base year for the emissions of fluorinated gases – brought about because of recalculating, amount to -0.03 Tg CO_2-eq. for HFCs and -0.01 Tg for PFCs. SF_6 emissions did not change in 1995.
- **Bunkers:** Recalculating also caused the memo item *Bunkers* to decrease by -0.9 Tg (virtually all CO_2).

Please note that these recalculations were also carried out for subsequent years. However, in almost all cases, they were restricted to the emissions of CO_2, CH_4, N_2O and the F-gases. The values for precursor emissions showed no change, except for the emissions from transport (all years).

Year 2002: A full recalculation based on final statistics

The data for 2002 are now based on the final 2002 energy and production statistics. This implies that almost all emission data related to these statistics will show changes. Furthermore, the 2002 data were also recalculated using the methods described in the former paragraph, and in *Section 3.1*. The decrease in the total CO_2-eq. emissions (excluding LUCF) for 2002 was -0.3 Tg CO_2-eq., or -0.1%, compared with the last submission. The main changes (all shown as CO_2 equivalents) are for CO_2:

- -7.7 Tg in *Energy* (1A and 1B) due to using a new calculation method;
- +4.8 Tg in *Industrial Processes* (2) due to recalculations based on the new method.
- +0.2 Tg in *Solvent and Other Product Use* (3) due to using a new calculation method;
- +4.2 Tg from *LUCF* (5) because *Emissions and Removals from cultivated histosols* was included in the inventory.

The largest changes for CH_4 are found in:

- -1.5 Tg due to the recalculations in the sector *Fugitive fuel emissions* (1B) based on new data from oil and gas production and the gas distribution sector;
- +0.5 Tg due to recalculations of *Manure management* (4B) and *Enteric Fermentation* (4A);
- +0.3 Tg due to recalculating the emissions from *Waste* (6B and 6D).

For N_2O:

- +2.9 Tg increase in emissions from *Agricultural soils* (4D, indirect emissions) and *Manure management* (4B) due to recalculations;
- +0.7 Tg increase allocated to *Other industrial processes* (2G) following the recalculation of indirect N_2O emissions.

For HFCs, PFCs and SF_6: -0.01, +0.2 Tg and +0.02 Tg, respectively, following recalculations based on new data from that industrial branch.

Implications for emission trends, including time-series consistency

The recalculations, in general, account for an improvement in the overall emission trends: data for all greenhouse gases for the complete period 1990-2002 are now consistent in methodology and allocation. The differences in national total emissions per compound are presented in *Table ES.4* for each year in the period 1990 to 2002. The change in the 1990-2002 trend for the greenhouse gas emissions compared to the previous submission is presented in *Table ES.6*. From this table it can be concluded that due to recalculations the trend in the total national emissions decreased by -0.3% compared to the NIR 2004. The largest absolute changes in emission trends are observed for N_2O and CH_4 induced by the agriculture category.

Table ES.6. Differences between NIR 2004 and NIR 2005 for the emission trends 1990-2002

Gas	**Trend (absolute)**			**Trend (percentage)**		
CO_2-eq. [Gg][1)]	**NIR 2004**	**NIR 2005**	*Difference*	**NIR 2004**	**NIR 2005**	*Difference*
CO_2	16,076	15,929	*-146*	10.0%	10.1%	*0.1%*
CH_4	-8,633	-7,409	*1,224*	-31.6%	-28.9%	*2.7%*
N_2O	-1,112	-3,341	*-2,228*	-6.8%	-15.7%	*-8.9%*
HFCs	-2,859	-2,865	*-6*	-64.5%	-64.7%	*-0.1%*
PFCs	-1,216	-699	*517*	-50.3%	-33.1%	*17.3%*
SF_6	126.3	141.5	*15.2*	58.1%	65.1%	*7.0%*
Total	2,380.7	1,756.4	*-624.3*	1.1%	0.8%	*-0.3%*

[1)] Excluding LUCF.

Emission trends for indirect greenhouse gases and SO_2

The CO and NMVOC emissions were reduced in 2003 by 46% and 53% respectively, compared to 1990. For SO_2 this is even 66%, and for NO_x, the 2003 emissions are 35% lower than the 1990 level. We recall that 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 differ to some extent from the IPCC approach. Due to recalculations, which have not been performed for 1991-1994 for all sources, the trends show a discontinuity for these years.

Except for NMVOC, most of the emissions stem from fuel combustion, of which the uncertainty in the emission factor for NO_x, CO and NMVOC is often estimated to be in the range of 10-50%. For SO_2 emission factors from fuel combustion (basically the sulphur content of the fuels) the uncertainty is estimated at 5%. For most compounds the uncertainty in the activity data is small compared to the accuracy of 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 about 25% for NMVOC.

Table ES.7. Emission trends for indirect greenhouse gases and SO_2 (Gg)

Compound	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Total NO_x	560.1	431.6	422.9	406.6	380.4	475.0	455.3	418.2	410.1	413.6	395.3	384.1	373.0	366.3
Total CO	1127.0	785.1	751.5	708.4	691.4	849.0	832.1	753.7	744.6	721.3	696.4	660.6	628.4	611.2
Total NMVOC	482.7	278.1	261.6	246.7	242.8	355.8	321.9	290.3	289.1	278.3	259.1	241.0	229.1	225.2
Total SO_2	189.5	107.7	100.7	98.3	86.5	127.8	120.5	101.7	93.5	88.2	73.1	73.2	65.7	64.8

Response to the issues raised in UNFCCC reviews

The Netherlands greenhouse gas inventory has been subjected to the following reviews by the Climate Secretariat: (a) a Desk Review and Centralised Review of the NIR 2000 and (b) reviewed in the country section of the Synthesis & Assessment Report on the NIR's of 2001 and 2002. In 2003 a Centralised Review was conducted of the NIR 2003, followed by an in-country review of the NIR 2004 in the fall of 2004. In general, the findings of the different UNFCCC reviews have been well observed and described. In particular, last years' in-country review was very helpful in identifying and confirming priority areas for improvement. The Netherlands' response to the general remarks in the executive summary and overview sections of the in-country review report is summarised below:

- ***Incompleteness of CRF***
  'Two potentially significant subcategories in the Agricultural soils category (N_2O emissions from crop residues and histosols and indirect N_2O from atmospheric deposition) and categories 5B to 5D of the LUCF sector are not reported in the inventory.'
  These categories are now included in the NIR. Furthermore, revised estimates have been included for CH_4 and N_2O from wastewater handling (6B) and human sewage (6D). The very small source of CH_4 and N_2O from horse manure has now also been included.
- ***Revision of feedstock emissions***
  In the recalculation of the fuel-related emissions, the method of calculation and allocation of emissions of CO_2 by feedstock has also been provided.
- ***Inconsistency in time series***
  'There are apparent gaps in the data for the years 1991-1994 that are related to the integration of the Dutch Pollutant Emission Register (PER) data set. These gaps are recognised in the NIR, but the consistency of the time series is affected by the procedures used to fill the gaps for those years'.
  For this submission, recalculations for the complete time series have been carried out for all major sectors. This has produced consistent time series in all sectors. In particular, this applies to greenhouse-gas emissions from stationary combustion in the energy and industry subsectors (1A1 and 1A2) and CO_2 and CH_4 emissions from industrial processes and the use of solvents and products (CRF sectors 2 and 3).
- ***Missing notation keys and other documentation in CRF tables***
  In this submission, additional notation keys have been included. Furthermore, the explanation of the NE (Not Estimated) and IE (Included Elsewhere) entries in the documentation boxes has been improved by including, in more detail, the allocation used by the party. This complies with the CRF recalculation tables.
- ***The use of the category 'Other' in the CRF to group existing IPCC categories***
  In recalculating, this issue has now been largely resolved for the fossil-fuel related emissions. However, for some industrial processes, not all detailed data can be disclosed due to confidentiality. Nevertheless, as shown in the in-country review, the Netherlands is able to present all relevant detailed data to the review teams.

Planned improvements

To comply in good time with the requirements for the National Systems under the Kyoto Protocol and under the EU Monitoring Mechanism, a monitoring improvement programme has been implemented in recent years (for more information see *Section 1.6*). The improvement programme was started in 2000, based on the outcome of workshops on the quality of the methodology and data used for calculating greenhouse-gas emissions in the Netherlands (see e.g. Van Amstel *et al*., 2000a,b). A long list of possible actions has been elaborated and the interdepartmental committee, the *Working Group on Emission Monitoring of Greenhouse Gases* (WEB), was set up to prioritise the actions[1]. Since then,

[1] To focus the work, the WEB has initiated three Expert Project Groups to focus on CO_2, non-CO_2 and Sinks, respectively. Both the WEB and the Project Groups are composed of people from the relevant ministries and from institutes that are also involved in the inventory-related process. This ensures that the appropriate expertise will be incorporated and that there will be communication with the relevant parties.

the WEB has regularly reassessed the quality of both the contents of the inventory and the procedures followed in compiling them. Where necessary, the programme has been adapted, using results from previous actions and UNFCCC reviews. The UNFCCC In-Country Review in 2004 confirmed and endorsed the relevance of the actions taken to improve this programme. At present, most of the actions planned, including most of the cross-cutting issues mentioned by the UNFCCC review team (see previous section), have been implemented. It is anticipated that the National System will be in line with UNFCCC and EU requirements by September 2005. In this section, we summarise the current status of this programme and indicate the most important actions that still have to be taken to bring about further improvements in this programme, including any additional issues identified by the In-Country Review.

Monitoring improvement

In previous years, the various actions taken to bring about improvements have led to changes in the methodologies and processes for estimating greenhouse-gas emissions and sinks in the Netherlands. For the present NIR/CRF 2005, several major and many small recalculations have been undertaken, focusing, in particular, on key sources such as CO_2 emissions from stationary fuel combustion and the use of fuels as feedstock and other non-energy uses (Sector 1A and 2), CH_4 emissions from fugitive sources (Sector 1B), CH_4 and N_2O emissions in agriculture (Sector 4) and the LUCF Sector (#5).

Although most of the planned actions to bring about improvements have been concluded a few methodology-related actions have still to be undertaken. The most significant improvement projects planned for implementation and finalisation in 2005 are (a) last analyses of emissions and sinks in the LUCF Sector and the final conclusions on their strengths; (b) using country-specific CH_4 factors for gas distribution, and improving the transparency of other parts of the fugitive emissions sector, (c) possibly a more accurate accounting of specific agricultural sources; (d) an update of the uncertainty analyses.

Monitoring protocols

As part of the improvement process, the methodologies and procedures for estimating greenhouse-gas emission in the Netherlands have been reassessed and compared with UNFCCC and IPCC requirements. For the key emission sources, and for sinks, the methodologies and processes have been elaborated, re-assessed and revised where necessary, and used for the present NIR/CRF. Protocols describing the methodology, data sources and the rationale for their selection are available for most key sources (Ruyssenaars, 2005). The remainder, i.e. protocols for the other, mostly non-key, sources and an update of present protocols should methodologies be changed (e.g. due to further refinement), is planned to be finalised by September 2005, in time for use in the next NIR/CRF.

Improving the QA/QC system

The recent restructuring and reorganisation of the maintenance of the *Pollutant Emission Register* (PER) system in the Netherlands (see *Section 1.6*) delayed various activities to improve on QA/QC. These could only be implemented recently. By September 2005, however, the QA/QC programme will be updated, and all the procedures and process will be established in good time to meet the National System requirements. In addition to QA/QC activities already in place, it is anticipated that by then:

- the QC process for greenhouse gases will be supported further, using updated checklists and tools;
- the processes for key-source selection and uncertainty estimates will have been reviewed and updated where necessary (also identified by the UNFCCC review team);
- approaches will be assessed and implemented to limit, as far as possible, the use of estimated data for calculations for the most recent year, which then have to be recalculated the following year (as has also been identified by the UNFCCC review);
- the update of the description of QA/QC of external agencies will have been finalised;
- collaborative intra-EU review options will have been assessed and, where possible, implemented as part of the national QA/QC system by the end of 2005 the documentation and archiving will have been updated.

1. INTRODUCTION

Major changes compared to the previous National Inventory Report

Changes in historical data up to 2002
Apart from the regular update of last year's emission dataset (extending over one year (*t-1*), including updates of the year *t-2*), the current data reflect the following major changes in calculation methods to improve transparency and consistency over time and, thus, to better comply with the *IPCC guidelines* and *UNFCCC guidelines*:

- Emissions of most sectors have been thoroughly recalculated, to bring the methods for key sources in line with *IPCC Good Practice* requirements. In particular, the calculation methods for CO_2 emissions from using fossil fuel for stationary combustion (CRF, Sector 1A) and from industrial processes (CRF, Sector 2) and indirect N_2O from agriculture have been substantially revised. There have also been large changes in CH_4 from fugitive gas production and gas distribution (CRF, Sector 1B) and from livestock (CRF, Category 4A) and CO_2 from land use (LUCF; CRF, Sector 5).
- Some source categories have been reallocated (CRF, Sectors 1A, 1B, 2, 4, 7, bunkers), in particular CO_2 emissions from fuels used for feedstock, emissions from off-road machinery and fisheries, and indirect N_2O emissions (from agriculture and from other sources).
- Resulting emission data: a decrease in CO_2 emissions of approximately 3 Tg, on average, for the complete times series (2.9 Tg in 1990 and 3.2 Tg in 2002, both 1.8%). This change has been brought about largely by recalculating emissions from industrial processes and emissions from the *domestic* use of petrochemical products. Another change is that emissions from fisheries and military aviation and shipping, which were previously accounted for under international bunkers, have now been included in the national total.
- The CH_4 emission data show smaller changes: a decrease of about 80 Gg in 1990 and 45 in 2002.This change has mainly been brought about by revising the data for emissions from gas venting and gas distribution (both 40 Gg less) and from within agriculture. The N_2O emissions show an increase due to revising the data on agricultural soils and indirect emissions from non-agricultural sources (of NO_x and NH_3) (+15 and +3.2 Tg in 1990 and +9 and +2.3 Tg, in 2002, respectively). The F-gas emission data only show marginal changes.
- The trends in CO_2 emissions and in total CO_2-eq. emissions were insignificant for the period 1990-2002 (0.1%), but the trend in CH_4 emissions changed from -32% to -29%. The trend in N_2O emissions decreased from -7% to -16%.
- The Sectoral Background Data Tables in the CRF spreadsheets are now much more complete, transparent and consistent over time.

Key source changes
For changes in the key sources, see the changes listed at the beginning of the sector chapters 3 to 8, inclusive.

Changes in the sections of the report
See Chapters 3 to 8: 'Methods and Recalculations', and Chapter 9: 'Recalculations and Improvements'.

1.1 Background information on greenhouse gas inventories and climate change

This report documents the 2005 Greenhouse-Gas Emission Inventory for the Netherlands, submitted 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 the *Revised 1996 IPCC Guidelines* and the IPCC *Good Practice Guidance* reports (IPCC 1997, 2000), provide a format for defining source categories and for calculating, documenting and reporting emissions. The guidelines aim at facilitating the verification, technical assessment and expert reviewing of the inventory information by independent *Expert Review Teams* of the UNFCCC. To this end, the inventories should be *transparent, consistent, comparable, complete* and *accurate,* as elaborated in the *UNFCCC Guidelines* for reporting (UNFCCC 1999) and be prepared using *good practice,* as described in IPCC (2000).

This report therefore provides explanations of the trends in greenhouse gas emissions for the 1990-2003 period and summary descriptions of methods and data sources of (a) Tier 1 assessments of the uncertainty in annual emissions and in emission trends; (b) a preliminary assessment of key sources following the Tier 1 and Tier 2 approaches of the *IPCC Good Practice Guidance* (IPCC, 2000); and (c) Quality Assurance and Quality Control activities. Major recalculations have been performed for most source sectors.

For detailed assessments to what extent changes in emissions, as explained in this report, are due to implementation of policy measures, we refer to the annual *Environmental Balance* published by RIVM (RIVM, 2004, in Dutch), the *Third Netherlands' National Communication on Climate Change Policies* (VROM, 2001) and a special assessment by Jeeninga *et al.* (2002).

The required so-called *Common Reporting Format* (CRF) spreadsheet files, containing data on emissions, activity data and implied emission factors, accompany this report as electronic annexes[1]. The complete set of CRF files as well as the NIR in pdf format can be found at website www.greenhousegases.nl, which also provides links to the relevant parts of the RIVM's website (www.rivm.nl). In addition, trend tables and check tables compiled from CRF data and other information presented in this National Inventory Report (NIR) are available as spreadsheets in one zipped file trend-tables-nir-nld-review-v3.zip (at the website).

1.1.1 Greenhouse gases and climate change: Global Warming Potential

The six main greenhouse gases whose emissions should be reported under the *Climate Convention* are:

- Carbon dioxide (CO_2);
- Methane (CH_4);
- Nitrous oxide (N_2O);
- Hydrofluorocarbons (HFCs);
- Perfluorocarbons (PFCs);
- Sulphur hexafluoride (SF_6).

The greenhouse gases listed above are often called the 'six greenhouse gases', but the HFCs and PFCs, actually comprise two groups of gases. Although each of these greenhouse gases, individually, has a heating effect on the atmosphere, one kg of a mixture of different gases will make a contribution to this phenomenon, and a different contribution, depending on which gases are in the mixture. SF_6, HFCs and PFCs, also referred to as 'F-gases', are the most heat-absorbent gases, CH_4 traps over 21 times more heat per molecule than CO_2, and N_2O absorbs 310 times more heat per molecule than CO_2.

Since each greenhouse gas differs in its ability to absorb heat in the atmosphere, there is a need for a common emission unit for environmental policies that are designed to control greenhouse-gas emissions. This is the *Global Warming Potential* or *GWP*, which expresses the emissions of a gas in equivalents of CO_2 emissions. The exact definition of this concept is subject to discussion; it can, for instance, be expressed as the total warming effect over a certain period of time, e.g. 20, 100 or 500 years, and may or may not include indirect effects. The Parties (i.e. mostly countries) to the *UNFCCC* and the *Kyoto Protocol* have adopted the GWP values with a 100-year time horizon, as reported by the IPCC in its *Second Assessment Report* (UNFCCC 1999). The relevant GWP values used in this report are summarised in *Appendix 8*.

In addition to these so-called *direct* greenhouse gases, other gases contribute to heating the atmosphere. Some of these, such as CFCs and HCFCs, are already subject to reduction in other protocols which will be phased out according to the Montreal Protocol and its subsequent amendments. Other compounds, such as CO, NO_x and NMVOC, act *indirectly* as greenhouse gases or as cooling agents in the atmosphere. These are precursors of the greenhouse gas 'tropospheric ozone', and of SO_2, which leads to aerosol formation, and a cooling effect. These compounds are also often the subject of regional protocols that control the emissions over time (e.g. the *UNECE Protocols* of the *Convention of Long-Range Transboundary Air Pollution*, CLRTAP). Therefore, for the *Climate Convention* and the *Kyoto Protocol,* it was decided to limit detailed reporting to the six main greenhouse gases mentioned above and only to request summarised information on the national emissions of CO, NO_x, NMVOC and SO_2.

1.1.2 The Climate Convention and the Kyoto Protocol

In 1992, United Nations, at its headquarters in New York, adopted the ***United Nations Framework Convention on Climate Change*** (UNFCCC). Later that year, in June, at the Earth Summit in Rio de

[1] These files, with file names '*Netherlands - submission 2005 v3 .0 - NNNN.xls*' with NNNN = 1990 .. 2003, have been compressed into three zip files: crf-nld-2005-v3-90-94.zip; crf-nld-2005-v3-95-99.zip; crf-nld-2005-v3-00-03.zip.

Janeiro, the Convention was opened for endorsement, in the form of signatures by representatives of those countries that agreed to participate. This Convention. which sets the *ultimate objective* of stabilising atmospheric concentrations of greenhouse gases at levels that would prevent human interference from becoming ‘dangerous’ to the climate system, came into force in March 1994. These levels should be achieved within a time frame that allows ecosystems to adapt naturally to climate change, so that food production is not threatened and economic development can proceed in a sustainable manner. For this reason, the levels are not quantified in the Convention. To achieve this objective, all Parties to the Convention – those countries that have ratified, accepted, approved, or acceded to, the treaty – are subject to an important set of general commitments, which place a fundamental obligation on both industrialised and developing countries to respond to climate change.

The Convention divides countries into two main groups: those that are listed in its Appendix I, known as *Annex I Parties*, and those that are not, known as *non-Annex I Parties*. Some Annex I Parties are also listed in the Convention’s Annex II, and are known as *Annex II Parties*. The Convention currently lists 41 *Annex I Parties*. These are the industrialised countries that, historically, have contributed the most to climate change. They include both the relatively wealthy industrialised countries that were members of the *Organisation for Economic Co-operation and Development* (OECD) in 1992, plus countries with *Economies-In-Transition* (the EITs), including the Russian Federation, the Baltic States, and several Central and Eastern European States.

The ***Kyoto Protocol*** to the UNFCCC was adopted at the third session of the Conference of the Parties (COP) to the UNFCCC in Kyoto, Japan, in December 1997. By 16 February 2005, 90 days after the date on which the Russian Federation ratified the Protocol, the Protocol was already in force. The Russian signature was important, because it brought the number of Parties to the Convention that have deposited their instruments of ratification, acceptance approval or accedence, incorporating Annex I Parties, which together account for at least 55 % of the total carbon dioxide emissions in 1990 from that group, to 55; so from the total number of potential ratifications of the Protocol, the majority are now reacting positively. Those Parties that have not yet signed the Kyoto Protocol can accede to it at any time, as the Protocol is subject to ratification, acceptance, approval or accedence by Parties to the Convention.

The *Kyoto Protocol* shares the Convention’s objective, principles and institutions, but significantly strengthens the Convention by committing Annex I Parties to individual, legally-binding targets to limit or reduce their greenhouse gas emissions. However, only Parties to the Convention that have also become Parties to the Protocol, (that is, by ratifying, accepting, approving, or acceding to it), will be bound by the Protocol’s commitments, now it has entered into force. The individual targets for Annex I Parties are listed in the *Kyoto Protocol*’s Annex B. These add up to a total cut of at least 5% from 1990 levels in the so-called ***commitment period*** (2008-2012). The maximum amount of emissions (measured in carbon dioxide equivalents) that a Party may emit over the commitment period in order to comply with its emission target is known as a Party’s ***assigned amount.*** Most countries, including the EU-15, have a target of -8% in the 1990-2008/2012 period. The EU has redistributed its targets among the 15 Member States. The (burden-sharing) target of Netherlands is -6%. Other targets are: USA -7% (has indicated its intention not to ratify the Kyoto Protocol); Canada, Hungary, Japan, Poland -6%; Croatia -5%; New Zealand, Russian Federation, Ukraine 0%; Norway +1%; Australia +8% (has indicated its intention not to ratify the Kyoto Protocol); and Iceland +10%. The targets cover emissions of the six main greenhouse gases mentioned above (from: UNFCCC 2003).

The key differences between the Kyoto Protocol and the Climate Convention are:

- an assigned amount for 2008-2002 vs. non-quantitative emission requirements;
- another way of accounting for CO_2 ‘sinks’ in land use, land-use change and in the forestry (LULUCF) sector (including CO_2 in the agricultural sector);
- options to fulfil the Kyoto Protocol requirements by the so-called Kyoto Mechanisms of Emissions Trading (referred to as ET, JI and CDM);
- requirements for institutional and procedural arrangements for compiling national inventories (the so-called *National System Guidelines*);
- a stricter compliance mechanism under the Kyoto Protocol.

Sources and sinks of Land Use Change and Forestry (LUCF)

According to the Kyoto Protocol, Parties may offset their emissions by increasing the amount of greenhouse gases removed from the atmosphere using so-called carbon 'sinks' in the LULUCF sector. However, only certain activities in this sector are eligible (those defined in article 3.3 of the Kyoto Protocol): *afforestation*, *reforestation* and *deforestation,* and *forest management*, *cropland management*, *grazing land management* and *revegetation* (added to the list of eligible activities under article 3.4 of the Kyoto Protocol, during the Marrakesh Accords). Greenhouse gases removed from the atmosphere by means of eligible sink activities generate credits known as ***removal units.*** Similarly, any greenhouse gas emission from eligible activities must be offset by greater emission cuts or removals elsewhere.

It is important to note that Chapter 7 of this report only reflects the LUCF reporting requirements under the UNFCCC. These requirements differ considerably from the reporting requirements under the Kyoto Protocol, which relate to activities under article 3.3 and 3.4 of the protocol. This means that figures on emissions and removals in this chapter should not be considered to be indicative of the size of emissions / removals that have to be reported in future under the Kyoto Protocol.

1.1.3 Reporting requirements: UNFCCC and IPCC

Annex I Parties to the UNFCCC must submit an annual *inventory* of their greenhouse gas emissions, including data for their base year (in most cases, 1990, with the exception of some EITs) and data up to the last but one year prior to submission. For example, the inventories due on 15 April 2005 should contain emission data up to the year 2003. Since 2000, annual inventories have also been subject to a *technical review*.

Annex I Parties are also required to regularly submit reports known as *National Communications,* which detail their climate change policies and measures. The National Communication also contains summaries of information given in the inventory. Most Annex I Parties have now submitted three national communications. The third National Communication was due on 30 November 2001. National communications are subject to an individual *in-depth review* by teams of experts, including in-country visits.

UNFCCC

The *UNFCCC Guidelines* prescribe the source categories, calculation methodologies, and the contents and format of the inventory report. For the definition of the source categories and calculation methodologies, the *UNFCCC Guidelines* generally refer to the *IPCC Guidelines for Greenhouse Gas Inventories* and the *IPCC Good Practice Guidance* reports. These reports are also available on the web (see *Appendix 8*). The UNFCCC reporting requirements for Annex I countries consist of submitting an NIR that documents, explains and justifies the reported emission inventory dataset, and a set of so-called *Common Reporting Format* (CRF) files, which contain fairly detailed information on emissions, activity data, so-called implied or aggregated emission factors and any additional material. Countries have the choice of either printing their *National Inventory Report* (NIR) or publishing it in its entirety, electronically, by placing it on a designated public website.

IPCC

The IPCC often uses the concept of a *'Tiered Approach'*, in other words, a stepwise approach:

- *Tier 1* is the simplest and requires the least data and effort;
- *Tier 2* is more advanced and/or data-intensive;
- *Tier 3* is even more advanced, etcetera.

In general, the emission calculation methods that are recommended are those that are more detailed/advanced, as are the uncertainty and key source assessments – data or capacity permitting. The rationale behind this generic approach to methods, uncertainty assessments and key source assessments is to gear the recommendations to countries which have more detailed datasets and more capacity to calculate emissions, but also to those where less data and manpower are available. This also serves as a means for balancing efforts in industrialised countries, by not going into irrelevant details, thereby saving capacity for other, more important but relatively weak, parts of the inventory.

To help countries to set priorities, the *Good Practice Guidance* recommends using higher Tier methods, in particular for so-called key sources. Uncertainty estimates can serve to refine not only the identification of key sources, but also to prioritise activities aimed at improving the inventory. This report also provides guidance in inventory compilation, reporting, documenting, assuring quality and quality control (QA/QC) comparable to the formal ISO 9001-2000 quality assurance system.

The Netherlands generally applies country-specific, higher Tier methods for calculating greenhouse gas emissions (see *Section 1.5*).

1.1.4 Role of the European Union

Since the European Union (EU) is also a Party to the UNFCCC and the Kyoto Protocol and, just as the national Parties, has to submit similar datasets and reports for the collective 15 EU Member States, it imposes some additional guidelines on EU Member States through the *EU Greenhouse Gas Monitoring Mechanism* to guarantee that it can meet its reporting commitments. These are:

- submission of the national dataset (CRF files) and basic documentation that covers a large part of the NIR by 15 January, ahead of the official final submission deadline (15 March and 15 April) to the EU and UNFCCC, respectively, thereby giving the EU time to prepare and submit its inventory for the 15 EU Member States, and the EU NIR submission, to the UNFCCC. This dataset has to be more or less final, but limited changes (corrections, improvements in the data) are allowed;
- submission of the same national dataset (CRF files and NIR) by 15 March for submission to the EU Climate Secretariat. This precedes the UNFCCC deadline of 15 April allowing time to prepare the EU inventory and the EU NIR;
- requirements at Member State level for a National System to be in place by the end of 2005.

In addition, the EU has developed an internal Burden Sharing system to reallocate the assigned amounts to its Member States in such a way that the EU target of -8% for 2008-2012 will be met. The EU has also decided to introduce an emission trade system within EU Member States.

1.1.5 Definitions and emissions included in the inventory

The UNFCCC prescribes using specific definitions of the emissions included in the inventory. These definitions differ from emission inventories for other international reporting requirements, such as the UNECE/CLRTAP and the EU-NEC Directive, and also inventories for specific national reporting purposes. The main differences are: the method used for calculating emissions from transport, limiting CO_2 emissions to non-organic anthropogenic sources, in the inventory that has to be submitted to the UNFCCC. The *UNFCCC* and the *Kyoto Protocol* do not include CO_2 emissions from combustion of biomass fuels (such as fuelwood, wood, wood waste, agricultural waste and biogas) in the totals from fuel combustion, since these are by default assumed to be produced in a sustainable way. However, to the extent that they are not produced sustainably, i.e. according to the *UNFCCC Guidelines,* this should be taken into account when reporting on *Land Use Change and Forestry* (LUCF), not under fuel combustion.

Furthermore, the IPCC source categories make a clear distinction between fuel combustion and non-combustion emissions from an economic sector (see *Section 1.1.6*), where the Netherlands' so-called 'Target Sectors' are mostly analysed by their total emissions. Until 2004 the different approaches resulted in different figures for the reported national total greenhouse gas emissions in different publications. As from this reporting year, it has been decided that all national publications (such as the Environmental Balance and the internet publication Environmental Data Compendium (RIVM, 2005) will be based on the IPCC approach. This means that road transport emissions use fuel delivery data as the basis for calculating the emissions from this source category, as the UNFCCC reporting guidelines require.

For easy reference we provide in *Table 1.1* the national greenhouse gas emissions in the format of the so-called *'Streefwaardesectoren'* (Target value sectors), which is used within the Netherlands to monitor the emission trends of sectors for which the government has set targets for 2010 as part of the domestic national total target for achieving the emission target under the Kyoto Protocol. An important feature of these *Streefwaarde Sectors* is that only CO_2 emissions are allocated to economic sectors. The non-CO_2 greenhouse gases are collectively allocated to a separate sector called 'other greenhouse gases'. In a separate note the causes and effects of the recalculations made since the NIR 2004 are explained (MNP, 2005). In *Table 1.2* the correspondence between Dutch *Streefwaarde Sectors* and Target Sectors (*'Doelgroepen'* in Dutch) and IPCC/CRF sectors and source categories is summarised.

Table 1.1. Trends in Netherlands' greenhouse gas emissions grouped per'Streefwaarde sector' (Tg=MtonCO_2-eq.)

Streefwaardesector */ Doelgroep (Target Sector)*	1990	1995	2000	2001	2002	2003	Tr 02/90
SW CO_2 Industry and energy sectors	**92.2**	**97.1**	**96.8**	**100.1**	**99.8**	**100.7**	**8%**
o.w. Industry and Construction	*39.2*	*34.8*	*32.4*	*31.6*	*32.0*	*32.1*	*-18%*
o.w. Energy sector [1)]	*42.0*	*50.7*	*52.3*	*55.9*	*56.9*	*57.3*	*35%*
o.w. Refineries	*11.0*	*11.6*	*12.1*	*12.6*	*10.9*	*11.2*	*-1%*
SW CO_2 Buildings	**27.0**	**30.8**	**27.9**	**30.2**	**29.3**	**30.8**	**9%**
o.w. Housholds	*19.3*	*20.8*	*19.0*	*19.7*	*18.7*	*19.2*	*-3%*
o.w. Trade-Services-Government (HDO)[2)]	*7.6*	*10.0*	*8.9*	*10.2*	*10.6*	*11.6*	*39%*
SW CO_2 Agriculture	**8.3**	**8.3**	**7.4**	**7.2**	**7.2**	**7.0**	**-14%**
SW CO_2 Traffic & Transport [4)]	**30.5**	**33.5**	**36.8**	**36.9**	**37.6**	**38.4**	**23%**
Total CO_2	**158.0**	**169.7**	**168.9**	**174.4**	**173.9**	**176.9**	**10.1%**
CH_4 (total)	**25.6**	**23.8**	**19.5**	**19.0**	**18.2**	**17.5**	**-29%**
o.w. Energy sector[1)]	*14.8*	*13.2*	*9.8*	*9.3*	*8.9*	*8.5*	*-39%*
o.w. Agriculture	*10.3*	*10.1*	*9.1*	*9.1*	*8.7*	*8.5*	*-16%*
o.w. Other	*0.6*	*0.6*	*0.6*	*0.6*	*0.6*	*0.5*	*3%*
N_2O (total)	**21.3**	**22.4**	**19.9**	**18.9**	**18.0**	**17.3**	**-16%**
o.w. Industry and Construction[3)]	*8*	*8*	*7*	*7*	*7*	*6*	*-17%*
o.w. Agriculture	*12*	*13*	*11*	*10*	*10*	*9*	*-16%*
o.w. Other	*2*	*2*	*2*	*2*	*2*	*2*	*-9%*
F-gases (total)	**6.8**	**8.1**	**5.7**	**3.3**	**3.3**	**3.2**	**-50%**
o.w. HFCs	*4.4*	*6.0*	*3.8*	*1.5*	*1.6*	*1.4*	*-65%*
o.w. PFCs	*2.1*	*1.8*	*1.5*	*1.4*	*1.4*	*1.4*	*-33%*
o.w. SF_6	*0.2*	*0.3*	*0.3*	*0.4*	*0.4*	*0.3*	*65%*
SW Other greenhouse gases (total)	**53.7**	**54.4**	**45.1**	**41.2**	**39.5**	**37.9**	**-26.4%**
GREENHOUSE GAS TOTAL	**211.7**	**224.0**	**214.0**	**215.5**	**213.5**	**214.8**	**0.8%**

[1)] Including waste handling.
[2)] Including drinking water companies and waste water treatment plants (WWTP's).
[3)] Including indirect N_2O from transport and energy sector.
[4)] This Target Sector includes off-road machinery used in agriculture and for building, road and waterway construction and including fisheries, all internal navigation and military shipping and aviation.

1.1.6 Correspondence between the Dutch Target Sectors and IPCC source categories

The *UNFCCC Guidelines* for reporting greenhouse-gas emissions (UNFCCC 1997) require the use of source categories as defined in the *Revised 1996 IPCC Guidelines for National Greenhouse-Gas Inventories* (IPCC, 1997). The IPCC guidelines make a subdivision into 6 main source categories, separating combustion (or fuel-related) and non-combustion (or 'process') emissions:

1. Energy
2. Industrial processes
3. Solvents and other product use
4. Agriculture
5. Land-Use Change and Forestry (LUCF)
6. Waste

The first category comprises both fossil fuel and biofuel use, and is subdivided into *1A Fuel combustion* and *1B Fugitive emissions from fuels.* For users in the Netherlands, where emission sources are usually subdivided into so-called Target Sectors, *Table 1.2* presents the correspondence between the Dutch Target Sector emissions to the nomenclature of UNFCCC/IPCC source categories used in this report. Due to data-processing limitations, some subcategories have been defined somewhat differently from the source category definition in the *Revised 1996 IPCC Guidelines* (IPCC 1997).

Table 1.2. Correspondence between the Netherlands' Target Sector emissions and IPCC source categories.

SW CO_2/Target Sector	Code	IPCC: Combustion emissions	Code	IPCC: Process emissions
SW CO_2 Ind. & Energy:				
Industry	1A2 excl. 1A2f-ii	Fuel combustion; Manufacturing industries and construction [2)] Excluding mobile off-road machinery (1A2f-ii)	1B1b 2 excl.2G4 2F 2G4 3	Solid fuel transformation [5)] Industrial processes [2) 3)] Use of HFCs, PFCs and SF_6 Part of CO_2 from lubricants Part of Solvents & other product use [6)]
Refineries [8)]	1A1b	Fuel combustion; Energy industries; sub b (Petroleum refining)	1B2a-iv	Fugitive emissions from oil & natural gas; refineries
Energy sector - power generation - fossil fuel production/ transmission	 1A1a	 Fuel combustion; Energy industries; a (electricity and heat production) -	 2A4 1B2	 Industrial processes [3)] Fugitive emissions from oil & natural gas
Waste handling - landfills - waste incineration ('*AVIs*') - Other	 1A1a- oth. fuel -	 - Fuel combustion; Energy industries; a (electricity and heat production) [4)] -	 6A [6C] 6D	 Waste; Solid waste disposal [6)] [Allocated to 1A1a [4)]] Waste; Other: large scale composting
Construction	1A2f	Fuel combustion; Manufacturing industries and construction: part of i (stationary) and part of ii (off-road machinery)	2 3	Industrial processes (small part) Part of Solvents & other product use [6)]
SW CO_2 Buildings:				
Consumers	1A4b	Fuel combustion; Other sectors; b (residential)	3	Part of Solvents & other product use [6)]
Trade, Services, Government ('*HDO*')	1A4a	Fuel combustion; Other sectors; a (commercial/institutional)	2G4 3	Part of CO_2 from lubricants Part of Solvents & other product use [6)]
Drinkingwater treatment	1A4a	Fuel combustion; Other sectors; part of a (commercial/institutional)	2G5	Industrial processes [7)]
Wastewater treatment plants (WWTP) ('*RWZI*')	1A4a	Fuel combustion; Other sectors; a (commercial/institutional)	6B	Waste; Wastewater handling
SW CO_2 Agriculture:				
Agriculture	1A4c-i	Fuel combustion; Other sectors; c-i (stationary).	3 4	Part of Solvents & other product use [6)] Agriculture [1)]
SW CO_2 Transport:				
Transport and Traffic	1A3 1A2f-ii 1A3c-ii 1A5	Fuel combustion; Transport Off-road machinery non-agriculture Off-road machinery agricult. & fisheries Military shipping and aviation	2G2,3 2G4 3	Part of indirect N_2O Part of CO_2 from lubricants Part of Solvents & other product use [6)]

1) Livestock (2A), manure management (2B) and agricultural soils (4D); excluding LUCF emissions.
2) CO_2 from non-energy and chemical feedstock use of fuels is partly reported under *1A2 Fuel combustion* and partly under sector 2 *Industrial processes*.
3) CO_2 from limestone use for flue gas desulphurisation in the energy sector is reported under *2 Industrial processes*, sub 2A3. Also excluding parts of 2G2, 2G3 (indirect N_2O) and 2G4 (CO_2).
4) It has been assumed that all waste incineration facilities also produce electricity or heat used for energy purposes; therefore these are reported under category 1A1a as 'Other fuels'.
5) Coke production.
6) Indirect CO_2 from solvents and other product use is mostly allocated to Target Sectors Consumers, Trade, services and government (HDO), Industry and Construction; a small part is allocated to Waste handling (landfills) and Transport and traffic.
7) CH_4 from degassing of groundwater.
8) For domestic reporting in recent years the Target Sector 'Refineries' has been included in the Target Sector 'Industry'.

1.1.7 CRF files: printed version of summary tables and completeness

Appendices 5 and *7* of this report present a printed version (summary) of the following CRF files:

- Completeness Table 9 for 1990 (in *Appendix 5*);
- IPCC Summary Tables 7A for 1990-2003 (CRF Summaries 1);
- Recalculation Tables and Explanation Table 8.a and 8.b for 1990, 1995, 2000 and 2002;
- Trend Tables 10 for each gas individually, and for all gases and sources in CO_2-eq.;
- Trend Tables 10 for precursor gases and SO_2.

Section 9.4 provides details on the extent to which the CRF data files for 1990-2003 have been completed. For this NIR report, a special effort was made to:

- finish the planned recalculations and bring all key sources into line with *IPCC Good Practice* by using transparent, higher tier methodologies;
- to improve on the use of notation keys, where applicable.

In general, the completeness of the CRF tables, including Sectoral Background Tables, is now achieved by using national activity statistics, especially for IPCC categories 1A1, 1A2 and 2, rather than the ER-I data *('Emission Registration-Individual'*), with its limited level of detail (see *Table 9.5*). These are the sectors that used to be mostly reported by individual firms, of which the level of detail, completeness and quality varied considerably (see *Section 1.6* on Quality Assurance).

For PFCs and SF_6, not all *potential* emissions (= total consumption data) are reported at present, due to the limited number of companies for which consumption figures are currently available, and of the ones that are reported, not all are used for estimating actual emissions (so-called Confidential Business Information). For this reason, some of these entries are labelled 'C', but it should be noted that, as a result of the CRF structure, most of the summed figures for potential emissions show '0.0' or '!VALUE'. However, the *actual* emissions from all known sources have been reported.

1.1.8 Territorial aspects; import/exports

The territory of the Netherlands from which emissions are reported is the legal territory. 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. Emissions from all electricity generation in the Netherlands are accounted for, including the electricity fraction that is produced domestically and then exported. Until 1999, the Netherlands imported about 10% of its electricity, but after that date, due to the liberalisation of the European electricity markets, 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.

1.1.9 Presentation of figures: rounding off and summation

Please note that the same number of decimal digits is used in the all tables (or compound column). Therefore, the number of (decimal) digits shown does not correspond with the number of significant digits of the numbers presented. It should also be noted that the numbers in the tables may not exactly add up to the (sub)totals, because they were rounded off independently. We refer to *Section 1.7* for information on uncertainty in sectoral and national total emissions.

1.1.10 Organisation of the report

The structure of this report complies with the format required by the UNFCCC (2002). In accordance with that format, in this chapter we present the institutional arrangements for compiling the inventory, a brief description of the methodologies used, the data sources, the key sources identified, the QA/QC plan, and a general evaluation of the uncertainty and completeness of the inventory. Chapter 2 discusses the trends in total emissions at an aggregated level, expressed in CO_2-equivalents, by gas and by source. Chapters 3 to 8 discuss the emission sources/sinks for each main IPCC sector, including a description of sources/sinks, methodological issues and uncertainty, and time-series consistency (an explanation of emission trends). In principle, we have included in these chapters, in the report itself, all additional information tables from the present CRF files. The main report concludes with Chapter 9, which details recalculations undertaken since the last submission of the NIR, and further improvements that have been planned.

Finally, the appendices to the report include the following compulsory topics: information on key sources, a detailed description of the methodologies used, and a comparison with the so-called IPCC Reference Approach for CO_2 (which estimates emissions from fuel use by using, as activity data, the apparent consumption by fuel type, with a correction for carbon storage in feedstock products). We also include here the (national) Sectoral Approach, completeness and any other information that has to be considered as part of the NIR. For ease of reference, we have also inserted appendices showing copies of key CRF tables, including IPCC summary tables '7A' for specific years, recalculation tables and trend tables. Other appendices provide units, other factors, internet links to reporting guidelines and a list of abbreviations.

1.2 Description of the institutional arrangement for inventory preparation

The responsibilities and institutional arrangements for this CRF and NIR are summarised below.

Overall responsibility

The Ministry that has overall responsibility for climate change policy issues is the *Ministry of Housing, Spatial Planning and the Environment* (VROM). It is the co-ordinating body in preparing the CRF and NIR and other national databases and related documents. This responsibility includes the monitoring and reporting required to meeting the obligations set by the UNFCCC and the Kyoto Protocol.

Responsibility for emission estimates

A *Pollutant Emission Register* (PER) system has been in operation in the Netherlands, since 1974. This system encompasses the process of data collection, data processing, registering and reporting emission data in the Netherlands 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. This system is also the basis for reporting on greenhouse gas emissions. The PER uses input data from various external sources (see next section). Up to 1 April, 2004 the PER system was a collaborative project operated by various ministries and institutes, the tasks and responsibilities of which were divided over various organisations. The VROM Inspectorate (VI) was responsible for the overall co-ordination. Although the Ministry of VROM remains overall responsible, from 1 April 2004, the full co-ordination of the PER was outsourced to the *Emission Registration* (ER) at the *Netherlands Environmental Assessment Agency* (MNP) at RIVM. This has facilitated a clearer division, definition and concentration of tasks and responsibilities.

The main objective of the ER is to produce an annual set of unequivocal emission data, which are up to date, complete, transparent, comparable, consistent and accurate. The ER is doing this in collaboration with the ER Task Forces consisting of experts from several institutes, e.g., CBS (*Statistics Netherlands*) and TNO (*Netherlands Organisation for Applied Scientific Research)* (see *Section 1.3.3*). Major decisions on priorities and estimation methodologies are made within the *Emission Registration Steering Group*. This Steering Group involves directors from the commissioning ministries adjacent to VROM: the *Ministry of Transport, Public Works and Water Management* (VenW) and, in future, also the *Ministry of Agriculture, Nature and Food Quality* (LNV), and the director of MNP at RIVM.

Responsibility for the NIR

The National Inventory Report is prepared by RIVM/MNP, with contributions from other organisations such as CBS, SenterNovem, TNO and various agricultural institutes.

Responsibility for 'building/upgrading the National System'

A monitoring improvement programme has been implemented since 2001 to adapt the greenhouse gas inventory system in good time to meet the requirements for National Systems under the Kyoto Protocol and the EU requirement for a National System at Member State level to be in place by the end of 2005. This programme is co-ordinated by *SenterNovem*. Further information about this programme is described in *Section 1.6.1* (results achieved) and *Section 9.4.7* (further improvements planned).

In August 2004, the Ministry of VROM assigned executive tasks in connection with the 'National Inventory Entity' (NIE), required for the Kyoto Protocol, to *SenterNovem*, for the period up to 1 April 2006. In addition to co-ordinating the establishment of a national system, these tasks include the overall co-ordination of (improved) quality control and quality assurance activities as part of the National System and co-ordinating the support/response to the UNFCCC review process.

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 includes three major steps that are described in more detail in the following sections.

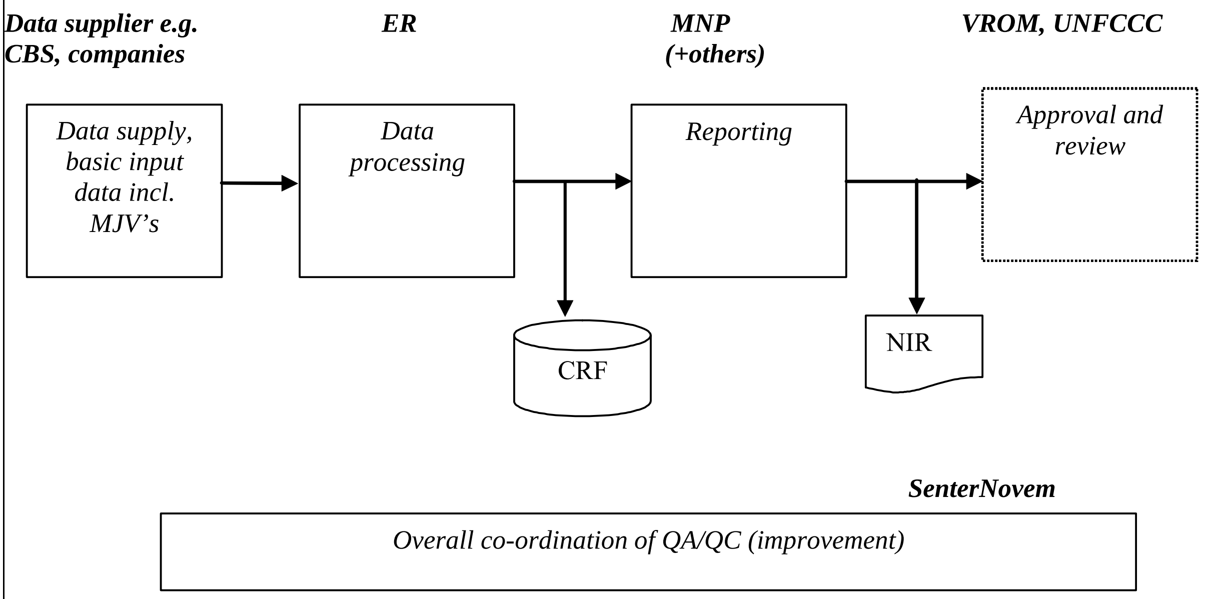


Figure 1.1. Main elements in the greenhouse gas inventory process (NIR 2005).

1.3.2 Data 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***, provided under other (i.e. not specifically greenhouse-gas related) obligations and legal arrangements. These include national statistics from *Statistics Netherlands* (CBS) and some other sources of data on sinks, water and waste. The provision of relevant data for greenhouse gases will be assured through covenants. For greenhouse gases, relevant agreements are in place with CBS (general statistics), as well as with *SenterNovem* for waste management. An agreement with the *Ministry of Agriculture, Nature and Food Quality* (LNV) and related institutions is in preparation.
- ***Data from individual companies***, provided in the form of annual environmental reports ('MJV's'). A large number of companies are legally required to submit an annual environmental report. These data are validated by the competent authorities. These are usually provincial authorities that also issue permits to these companies. In addition a number of companies with large combustion plants are required to report information under the BEES/A regulations. Some other companies provide data voluntarily, within the framework of environmental covenants. For calculating the CO_2 emissions from industry, energy, refineries and waste handling, the data in the environmental reports are mainly used for verifying the calculated emissions. If reports from major industries hold plant-specific information on activity data and emission factors of a high enough quality and transparency, these data may be used in the sectoral emission estimates. Industrial process emissions of non-CO_2 greenhouse gases are mainly based on these environmental reports (e.g. N_2O, HFC-23 and PFCs released as by-products) (see *Section 1.4*).

- ***Additional greenhouse-gas-related data***, provided by other institutes and consultants that are specifically contracted to provide information on sectors not sufficiently covered in the above data sources. For greenhouse gases, contracts and financial arrangements are made (by MNP/ER) with, for instance, some agricultural institutes and with the TNO, as well as (by SenterNovem) with some consultants (on F-gas emissions from cooling and product use, and on improvement actions, etc.). During 2004, the Ministry of LNV also issued contracts to some agricultural institutes, in particular for developing a monitoring system for the LUCF data set.

These data sources provide the activity data and some of the emission factors, which are then used as input for the methodologies selected for estimating greenhouse-gas emissions and sinks.

The data collection process for emissions at large industrial-point sources, the so-called ER-I (*'Emission Registration-Individual'*), has changed substantially since 1995. *Box 1.1* and *Figure 1.2* illustrate these changes further. Amongst others, the number of individual sources in the PER database has decreased over the years: from about 700 in 1990, to about 550 in 1995 and down again to about 350 last year. As explained in *Box 1.1*, in the transition period, during which companies were changing from one reporting system and format to another, the quality of emission data has declined, with respect to that required for the NIR/CRF.

Box 1.1. Major changes in data collection and submission of emissions and activity data by large companies

The method for the collection of emissions from large industrial point sources has changed since 1995 (see *Figure 1.2*). Before 1995, the 'ER-I' data collection for air emissions of about 700 large companies, including about 200 large combustion plants which submitted information on fuel consumption and NO_x and SO_2 emissions under the 'BEES A' regulation. In 1995 the number of point sources was reduced to 550.

Since 1996, this data collection has been gradually replaced by data reported by industry in their *annual environmental reports* (*MJVs*). The *Pollutant Emission Register* (PER) has used these reports since 1996 and included relevant data in the ER-I database. Starting for the 1999 emissions, after approval by the Provinces the *Facilitating Organisation for Industry* (FOI) processes the data from the MJVs in a database. TNO uses this administrative FOI database to check the consistency and to include emissions data in the PER. Thus. from 2000-2002 the PER dataset includes individual registered emissions based on a) the MJVs reported by companies, b) a regional PER (from the province Noord-Brabant) c) data collected for the BEES A companies and d) data reported by a number of additional industries related to their environmental covenants. The process to increase the number of companies as well as the quality of data continues, amongst others by introducing an electronic format. In the 2003 PER no data from additional industries are collected.

By implementing a new methodology in 2004, as described in *Section 1.4*, MJV data for fuel-related emissions (CO_2, CH_4, N_2O) are mainly used for validation purposes and plant-specific emission factors. MJV data are still the major data source for the precursor gasses.

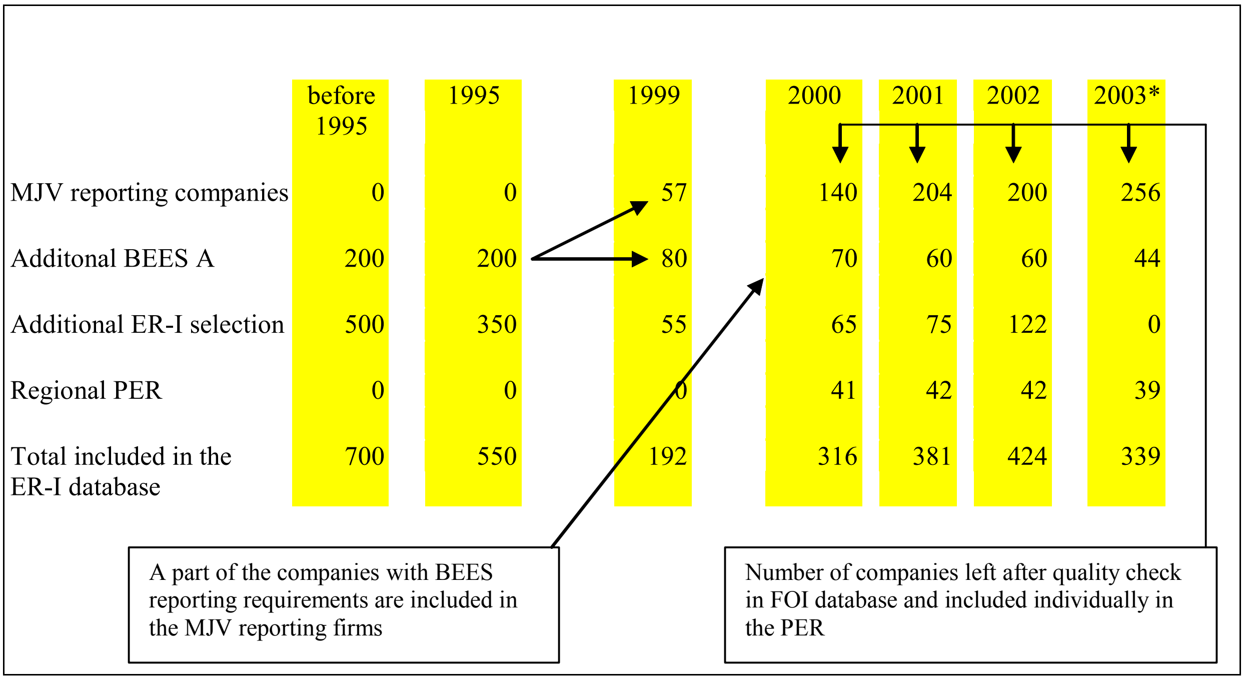


Figure 1.2. Changes in time in data sources used for the individually registered point sources in the PER (for abbreviations see Box 1.1)

1.3.3 Data processing and storage

The *Emission Registration* (ER) division of MNP conducts this part of the process, notably the elaboration of emission estimates and data preparation in the CRF. The ER also holds the responsibilities for quality control of the data processing and the resulting CRF. The emission data are stored in a central database, thus facilitating, in an efficient and effective manner, the national and international emission reporting requirements.

The actual emission calculations and estimates, using the input data, are implemented in five Task Forces, each dealing with specific sectors:

- Agriculture (agriculture, sinks);
- Consumers and Services (non-industrial use of products);
- Energy, industry and waste, 'ENINA' (combustion, process emissions, waste handling);
- Transport (also including bunker emissions);
- Water (less relevant for greenhouse gas emissions).

The task forces consist of experts from several institutes. In 2004, in addition to the RIVM-MNP, these included TNO (*Netherlands Organisation for Applied Scientific Research),* CBS (*Statistics Netherlands*), RIZA (*Institute of Inland Water Management*), FO-I (the *Facilitating Organisation for Industry*, which submitted annual environmental reports), AOO (*Organisation on Waste Management*) and various agricultural research institutes. The Task Forces are responsible for assessing emission estimates based on the input data and emission factors provided. RIVM-MNP commissioned TNO with the task of collecting data from the various task forces and to complete the CRF.

The methodologies and procedures used for data collection and processing, from which the emissions are estimated, are defined in monitoring protocols (Ruyssenaars, 2005). These are elaborated, together with relevant experts and institutes, as part of the monitoring improvement programme (see Sections *1.6.1* and *9.4.7*.).

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

The National Inventory Report is prepared by the RIVM/MNP. Experts from relevant ER task forces and from *SenterNovem* are also involved. In improving the QA/QC activities, *SenterNovem*, as acting NIE, has been assigned the overall co-ordination. This includes co-ordinating the monitoring improvement programme and the QA/QC programme for the greenhouse-gas inventory and the national system. The Ministry of VROM formally approves the NIR before it is submitted, in some cases following consultation with other bodies. SenterNovem, acting as the NIE, is responsible for coordinating responses to the EU, and additional information requested by the UNFCCC after the NIR and CRF have been submitted. *SenterNovem* is also responsible (in collaboration with RIVM) for coordinating support offered to the UNFCCC reviewing process.

1.4 Brief general description of methodologies and data sources used

The general methodology for calculating emissions in air and water in the Dutch *Pollutant Emission Register* (PER) – or *Emission Registration* ('ER' in Dutch) – is described in Van der Most *et al.* (1998, in Dutch). Several studies have been undertaken since 2001 to find an optimal way of preparing a national system for calculating greenhouse-gas emissions that complies the requirements laid down by the Kyoto Protocol. That process became with two workshops on greenhouse- gas emissions and sinks in the Netherlands, held in 1999 (Van Amstel *et al*., 2000a,b). These and other key reports documenting the methodologies and data sources used in the Netherlands are listed in *Appendix 6* and are electronically available in pdf format on the website www.greenhousegases.nl. This website will also contain the protocols that describe, amongst other methodologies, the data-sources and QA/QC procedures that will be used from now on to estimate greenhouse-gas emissions in the Netherlands (Ruyssenaars, 2005). These protocols will be finalized in 2005, in order to fulfil the 'national system' requirements listed under article 5 of the Kyoto Protocol.

Table 1.3. CRF Summary table 3 with methods and emission factors applied

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O	
	Method applied (1)	Emission factor (2)	Method applied (1)	Emission factor (2)	Method applied (1)	Emission factor (2)
1. Energy						
A. Fuel Combustion						
1. Energy Industries	T2	PS, CS,D	T2	CS	T1	D
2. Manufacturing Industries and Construction	T2	PS, CS,D	T2	CS	T1	D
3. Transport	T2	CS, D	CS/T3(road);CS/T1/T2(non-r)	CS (road),D	CS/T3(road);CS/T1(non-r)	CS(road)/D(rest)
4. Other Sectors	T2	D, CS	T2	CS	T1	D
5. Other	CS/T2	CS	T2	CS	T1	D
B. Fugitive Emissions from Fuels						
1. Solid Fuels	CS/T2	CS	T1	C	IE	
2. Oil and Natural Gas	CS/T3	CS	CS/T3	CS	CS/T1	CS
2. Industrial Processes						
A. Mineral Products	T2(clincer)/T1/CS/D	PS,CS,D	CS	PS, CS	NO	
B. Chemical Industry	CS/T2/T1	CS	CS	PS, CS	CS/T2/T1	PS,D,CS
C. Metal Production	T2 (carbon inputs)/T1	CS	NE		NO	
D. Other Production	NO					
E. Production of Halocarbons and SF_6						
F. Consumption of Halocarbons and SF_6						
G. Other	CS	PS, CS	CS	CS	T1c	D
3. Solvent and Other Product Use	CS	CS			CS	CS
4. Agriculture						
A. Enteric Fermentation			cattle CS/T2; rest: T1	cattle: CS/T2; rest: CS/D		
B. Manure Management			CS/T2	CS	CS/T2	D
C. Rice Cultivation			NO			
D. Agricultural Soils	NE		IE	CS	CS/T1b(Direct and indirect)	CS (indirect), D (direct)
E. Prescribed Burning of Savannas			NO		NO	
F. Field Burning of Agricultural Residues			NO		NO	
G. Other	NO		NO		NO	
5. Land-Use Change and Forestry						
A. Changes in Forest and Other Woody Biomass Stocks	CS/T2	CS/T2				
B. Forest and Grassland Conversion	CS/T2	CS/T2	NE		NE	
C. Abandonment of Managed Lands	CS/T2	CS/T2				
D. CO_2 Emissions and Removals from Soil	CS/T2	CS/T2				
E. Other	NE		NE		NE	
6. Waste						
A. Solid Waste Disposal on Land	NE		CS, T2	CS		
B. Wastewater Handling			CS	CS	CS	CS
C. Waste Incineration	IE		IE		IE	
D. Other	CS	CS	CS	CS	CS	CS
7. Other *(please specify)*						
	NA		CS	CS	CS/T1b	CS

	HFCs		PFCs		SF_6	
2. Industrial Processes	Method applied (1)	Emission factor (2)	Method applied (1)	Emission factor (2)	Method applied (1)	Emission factor (2)
A. Mineral Products						
B. Chemical Industry	CS/T2	PS	NO		NO	
C. Metal Production			CS/T2	M, PS	NO	
D. Other Production						
E. Production of Halocarbons and SF_6	CS/T2	PS	NO		NO	
F. Consumption of Halocarbons and SF_6	CS/T2	CS, D	T2	D	T2	PS,CS,D
G. Other	NO		NO		NO	

<u>Explanation of notation keys used</u>:

To specify the method applied:

- **D** (IPCC default); **RA** (Reference Approach)
- **T1** (IPCC Tier 1)
- **T1a, T1b, T1c** (IPCC Tier 1a, Tier 1b and Tier 1c, respectively)
- **T2** (IPCC Tier 2)
- **T3** (IPCC Tier 3)
- **C** (CORINAIR); **CS** (Country Specific); **M** (Model)

To specify the emission factor used:

- **D** (IPCC default)
- **C** (CORINAIR)
- **CS** (Country Specific)
- **PS** (Plant Specific)
- **M** (Model).

Other keys: **NO** = Not Occurring; **NE** = Not Estimated; **IE** = Included Elsewhere.

To prepare this year's CRF, major methodological changes and recalculations have been carried out. These changes are described in detail in Chapters 2 to 8. *Table 1.3* shows the CRF Summary 3 table for the methods and emission factors used.

Please note that the methodology used for the *'t-1'* inventory (in this submission the 2002 figures) is often somewhat different from the methodological descriptions in these reports. The *t-1* methodology is partly based on extrapolation, since not all annual statistics and year-specific emission factors may be available in time (see *Annexes 2 and 3*). However, due to the late recalculation this does not apply to the 2003 data in this submission.

1.4.1 Carbon dioxide emissions

Carbon dioxide emissions are mainly caused by the combustion of fuel and are calculated on the basis of detailed sectoral energy statistics and emission factors which are mostly national defaults. For the most import fuels (natural gas, coal, coal products, diesel, petrol) country-specific CO_2 emission factors are used; otherwise default IPCC emission factors are used. From this year onwards, all static and mobile fuel combustion emissions of greenhouse gases will be calculated using fuel consumption data from national sectoral energy statistics and national default emission factors for CO_2. The fuel combustion calculation includes the combustion of blast furnace/oxygen furnace gas in steel plants and power generators and the refinery gas and residual chemical gas emitted by refineries and the petrochemical industry, respectively. This includes an energy/carbon balance term for refinery gas that is apparently unaccounted for.

For national policy purposes, emissions from *road transport* are generally calculated from transport statistics on vehicle-km. The means that, in the national approach, for road transport, CO_2 emissions are first calculated from energy consumption derived from transport statistics expressed in vehicle-km and assumptions concerning fuel efficiency per vehicle-km travelled. However, since the *Revised IPCC Guidelines* ask countries to report greenhouse-gas emissions from combustion on the basis of fuel consumption within the national territory, a correction has been made to convert emissions related to vehicle-km to emissions related to statistics for fuel sales. For a few sources, such as off-road vehicles used in agriculture and construction, the fishing fleet's fuel consumption, domestic shipping, and aviation, the standard sectoral energy statistics had to be split under specific source categories, to comply with the IPCC and UNFCCC guidelines for reporting.

CO_2 emissions related to transformation losses in coke production are based on national energy statistics of coal inputs and coke and coke oven gas produced and a carbon balance calculation of the losses. Gas flaring and venting emissions of CO_2 are based on the annual reports by the production companies.

CO_2 from ammonia production (2B1) is estimated from the amount of natural gas used as feedstock (equivalent to IPCC Tier 1b) and a country-specific emission factor based on a 17% fraction of carbon in the gas-feedstock oxidised. CO_2 emissions from iron and steel production (2C1) calculated for the carbon losses from coke and coal input used as reducing agent in blast and oxygen furnaces are calculated using a Tier 2 IPCC method and country-specific carbon contents of the fuels, thus also 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). For the CO_2 emissions from the anodes used for primary aluminium production (2C2), the Tier 1a IPCC method is now used. For CO_2 from lubricants and waxes (2G) oxidation factors of 50% and 100% are assumed, respectively. Emissions from cement production (2A1) are calculated based on domestic clinker production. CO_2 emissions from the use of limestone and dolomite (2A2) are calculated from apparent consumption corrected for consumption for steel production and use in the agricultural sector, which emissions are separately reported, and default IPCC emission factors. Emissions from flue gas desulphurisation units (wet process) installed in public power plants are calculated from gypsum production and a fixed emission factor.

The (indirect) CO_2 emissions from non-energy petrochemical products during their use are now calculated from the carbon fraction in non-combustion NMVOC emissions from solvents and other products, and are reported under '*Solvents and the use of other products*' (source category 3).

In addition, fossil-based CO_2 emissions from *waste incineration* (e.g. plastics) are calculated, on the basis of an analysis by Joosen and De Jager (2003), from the total amount of waste incinerated in each waste stream, split into six waste types, each with a specific carbon content and fraction of fossil C in the total C content.

More information on the methodology for estimating CO_2 emissions from fossil fuel combustion is provided in *Appendix 2.1*. Finally, for the purposes of (domestic) environmental policy, a *temperature correction* is made for the use of fuel for spatial heating, but only for CO_2 emissions resulting from the consumption of natural gas. The restriction to natural gas is because this is by far the dominant type of fuel used for heating internal space. A description of this method is provided in *Appendix 2.2*, and the calculation results are presented in *Section 3.1.1*.

1.4.2 CO_2 sources and sinks from LUCF

At present, the Netherlands estimates CO_2 removals and emissions for all LUCF categories. The approach that is followed to calculate the CO_2 from changes in forestry and other woody biomass stocks (5A) is based on the carbon cycle of a managed forest and wood products system. The reporting is considered as being at Tier 2 level. The basic assumption is that the net flux can be derived from converting the change in growing stock volume in the forest to carbon. Apart from minor deviations, the definition used for forests is in accordance with international standards. The carbon pools are distinguished by biomass above ground, biomass below ground, litter, dead wood, and organic carbon in soils. Carbon stock changes are calculated for biomass above ground, biomass below ground, and dead wood in forests. For litter and organic carbon in soils, it is assumed that the stock does not change. For determining forest and nature areas, detailed land-use maps (25 × 25 m) were used. The land use in forests that is reported is combined with the national forest-inventory databases, in which stem-volume data are converted to whole- tree carbon by selecting all the allometric equations from a large European equation-and- biomass database. The net carbon flux to dead wood is calculated as what remains of the input of dead wood due to mortality minus the decay of dead wood.

The LUCF category CO_2 from forest and grassland conversion (5B) includes only those emissions caused by deforestation, and the category CO_2 from abandonment of managed land (5C) includes only those removed by afforestation. To calculate these emissions and removals, a similar approach is followed, and the same datasets are used, as those for calculating the emissions and removals arising from changes in forestry (5A).

The LUCF category CO_2 emissions and removals from soil (5D) includes emissions and removals resulting from cultivating organic soils, adding lime to agricultural soils and all land-use changes, including changes in forest soils. The amount of organic matter that has been oxidized in cultivated organic soils (subcategory 5D2) is calculated by comparing the amount of organic matter and subsidence in a soil profile in the past, with the situation in more recent years. Activity data needed to quantify CO_2 emission from this first subcategory is derived from soil maps, (soil-profile) datasets based on long-term monitoring data, which contain attribute information and empirical relations between groundwater tables, ditch water levels and subsistence. The information on the area of peatland (from 1990 to the present) was based on land-use maps (compiled from information gathered by using remote sensing techniques) and on soil (profile) chemical and pedological analysis. The addition of lime to agricultural soils (subcategory 5D3) is based on data concerning the application of limestone and dolomite-based fertilizers in agriculture. Subcategory 5D5 includes the soil related sinks and sources caused by changes in land use between 1990 and 2000. Relevant inputs for this calculation are: the change in area and location of each of the land-use categories identified, the soil map and soil C content. A major input for this calculation is the land-use transition matrix, which is derived from the detailed land-use maps for 1990 and 2000 mentioned above. A constant C stock over time has been assumed for each land use and soil-type combination. The changes in C stock as result of (changes in) management have not been included, because data are not available yet. The reporting is considered as being at Tier 2 level.

1.4.3 Methane

Methane emissions from fuel combustion are estimated using the energy statistics and default IPCC emission factors, with the exception of road transport. Road traffic emissions of CH_4 are calculated and reported according to the *Revised IPCC Guidelines* (i.e. initially based on vehicle-km, then calibrated into fuel-supply statistics). For more details, we refer to the description provided for CO_2. Fugitive methane emissions from oil and gas are estimated for on and offshore sites, separately. For gas distribution a Tier 2 method is used based on the length of the network by type of material and emission factors per km pipeline.

Negligible industrial processes CH_4 emissions are calculated for the production of carbides, carbon black, ethylene, dichloro-ethene, styrene and methanol (2B) using Tier 1 methods and default IPCC/CORINAIR-EMEP emission factors. A very small source identified in the Netherlands is degassing of drinking water, which is reported in category 2G.

The estimate of methane from agriculture is based on the national statistics for animal numbers; manure production is estimated from data in *Statistics Netherlands* (CBS) and from specifically developed country emission factors. Information on the methodologies and datasets used for key sources is provided in the monitoring protocols (Ruyssenaars 2005), and specific details can be found in: Smink *et* *al.* (2005) – for information on key source enteric fermentation by dairy cattle; Van der Hoek en Van Schijndel (2004) – for information on manure management in all (key and non-key) sources; and Van Amstel *et al.* (1993) – for information on non-key sources of enteric fermentation.

Methane emissions from landfills (6A) are calculated using a first-order decomposition model (first-order decay function) containing the annual input of all amounts deposited, the characteristics of the landfilled waste, and the amount of landfill gas extracted. For all years, the integration time for the emission calculation is the period, 1945 up to the year for which the calculation is made. Methane emissions from wastewater treatment (including sludge) (6B) are very small because of the high fraction recovered (from 80% in 1990 to 98% at present). A country-specific methodology is used for the CH_4 emissions which is equivalent to the IPCC Tier 2 method. For septic tanks (6B) the emission factor for CH_4 is expressed as 7.5 kg/year per person connected to a septic tank, assuming an MCF of 0.5 and B_o of 0.25. A country-specific methodology is used industrial composting (6D) with emission factors from VROM (2002).

The reduced methane emissions from agricultural soils are regarded as 'natural' (non-anthropogenic) and are estimated on the basis of the methane background document (Van Amstel *et al.* 1993). Since the IPCC methodology only considers CO_2 sinks, these reduced CH_4 emissions have been included in the 'natural emissions' total, although they act as a methane sink. Therefore, they are not reported. Other 'natural emissions' are methane emissions from wetlands and water.

1.4.4 Nitrous oxide

Nitrous oxide emissions from fuel combustion are estimated using the energy statistics and default IPCC emission factors, with the exception of road transport. Road traffic emissions of N_2O are calculated and reported according to the *Revised IPCC Guidelines* (i.e. initially based on vehicle-km, and then calibrated into fuel-supply statistics) and country-specific emission factors. For more details on the emission factors from road transport, see *Section 3.4*.

N_2O emissions from the production of chemicals include N_2O from nitric acid, caprolactam production and solvents, as reported by the manufacturing industry and included in the Dutch Emission Registration system (PER) (Spakman *et al,* 2003). Moreover, indirect N_2O emissions from non-agricultural emissions of NO_x and NH_3 are now estimated cf. the IPCC Tier 1b method and reported under category 2G. The minor N_2O emissions from the use of products comprising N_2O used as anaesthetics and as propelling agents in aerosol cans are estimated in sector 3.

Nitrous oxide from agriculture is estimated from national statistics (in the CBS statistics) for animal numbers, manure production (volumes), manure N-excretion, chemical fertilisers, crop production areas and ammonia emissions. For direct N_2O emissions, the country-specific activity data are combined with emission factors that have been developed country-specifically for most direct N_2O emissions. The exceptions are N-fixing crops and crop residues, where IPCC default emission factors are used. For indirect N_2O emissions, the country-specific activity data are combined with IPCC default values on fracleach and emission factors. Information on the methodologies and datasets used for key sources is provided in the monitoring protocols (Ruyssenaars 2005, in prep.) and in more detail in Van der Hoek et al. (2005) on agricultural soils and manure management (partly with reference to Kroeze 1994).

N_2O emissions from human sewage are reported under '*Wastewater handling*' (6B). For more details on the exact definition, see Spakman *et al. (*2003) or Kroeze (1994).

1.4.5 HFCs, PFCs and SF_6

By-product HFC and PFC emissions from HCFC-22 production and primary aluminium production, respectively, are based on measured data reported by halocarbon and aluminium producing companies. In addition, the halocarbon producers report handling emissions of HFCs.

Emissions from HFC and PFC consumption are calculated using Tier 2 and country-specific methodologies, as summarised in *Section 4.6*. Emissions of SF_6 are based on estimates of SF_6 consumption for the existing stock of Gas Insulated Switchgear (GIS) equipment, the addition of new GIS equipment and manufacturing GIS equipment for semiconductors and for producing SF_6 for soundproofed double-glazed windows. The last-mentioned source has been included for 1995 onwards. The methodologies are described in more detail in Spakman *et al.* (2003).

1.4.6 Data sources

The following primary data sources supply the annual activity data used in the emission calculations:

- fossil fuel data: (a) national energy statistics from CBS (National Energy Statistics; Energy Monitor); (c) agricultural gas and diesel consumption (LEI);
- residential biofuel data: (a) annual survey of residential woodstove and fireplace penetration from the Association for Comfortable Living [*Vereniging Comfortabel Wonen*]; (b) 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 CBS statistics for traffic and transportation;
- industrial production statistics: (a) annual inventory reports from individual firms; (b) national CBS statistics;
- consumption of HFCs: annual reports from the accountants' firm, KPMG (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;
- forest and wood statistics: (a) forest area 1980, 2000 and after 2000: CBS (1985), Dirksen *et al.* (2001) and Dirksen (2005) [*in prep*.], respectively, supplemented with agricultural statistics on orchards and nurseries from LEI/CBS (2000); CBS (1985, 1989), Daamen (1998) and Edelenbosch (1996) for the intermediary years; (b) stem-volume, annual growth and fellings: Dirksen (2005) [*in prep*.],);
- soils: a) area of organic soils: De Vries (2004); b) soil maps: De Groot *et al.* (2005);
- waste production and handling: Working Group on Waste Registration (WAR), CBS, RIVM;
- methane recovery from landfills: VVAV.

Many recent statistics are available on the internet at (www.cbs.nl), CBS's statistical website '*Statline*', and at CBS/RIVM's *Environmental Data* website (www.rivm.nl). However, it should be noted that, domestically, sometimes different units and definitions are used 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 LUCF sinks.

1.5 A brief description of the key source categories

To identify the so-called 'key sources' in accordance with the *IPCC Good Practice Approach* (IPCC 2000), wherever possible, we allocated the national emissions according to the IPCC's potential key source list. The changes in key sources compared with those listed in the previous NIR are:

For energy:

- 1A - CO_2 Waste incineration: new key source;
- 1A - CO_2 Mobile combustion: other: now non-key;
- 1A - N_2O Mobile combustion: road vehicles: now key;
- 1B - CO_2 Coke production: new key source;
- 1B - CO_2 Fugitive emissions from venting and flaring: new key source.

For industrial processes (i.e. non-combustion):

- 2 - CO_2 Other Industrial: now non-key;
- 2 - CO_2 Iron and steel production (carbon inputs): new key source;
- 2 - CO_2 Ammonia production: new key source;
- 2 - N_2O Caprolactam production: new key source;
- 2 - CO_2 Other chemical manufacture: new key source;
- 2 - N_2O Other industrial: new key source.

Table 1.4. Key source identification using the IPCC Tier 1 and 2 approach.

	IPCC	Gas	Source category	Key	Tier 1	Tier 2	Method/Tier	Emission factor
			ENERGY SECTOR					
1	1A1	CO_2	Emissions from stationary combustion : Energy Industries, excl. Waste incin.	Key (L,T)	L, T	L, T	CS	CS
	1A1	CO_2	Emissions from waste incineration, reported in 1A1a	Key(L1,T1)	L,T		CS	CS
1	1A2	CO_2	Emissions from stationary combustion : Manufacturing Industries and Constr.	Key (L,T)	L, T	L, T	CS	CS
1	1A3	CO_2	Mobile combustion: road vehicles	Key (L,T)	L, T	L, T	CS, T2	CS
1	1A3	CO_2	Mobile combustion: water-borne navigation	Key (L2)		L	CS	CS
1	1A3	CO_2	Mobile combustion: aircraft	Non-key			CS	CS
1	1A3	CO_2	Mobile combustion: other	Non-key			CS	CS
2	1A3	CH_4	Mobile combustion: road vehicles	Non-key			CS, T3 (road)	CS
2	1A3	CH_4	Mobile combustion: other	Non-key			CS	CS
3	1A3	N_2O	Mobile combustion: road vehicles	Key (T1,L2)	T	L	CS, T3 (road)	CS
3	1A3	N_2O	Mobile combustion: other	Non-key			CS	CS
1	1A4	CO_2	Emissions from stationary combustion : Other Sectors	Key (L,T1)	L, T	L	CS	CS
2	1A	CH_4	Emissions from stationary combustion: non-CO_2	Key (L2)		L	CS	CS
3	1A	N_2O	Emissions from stationary combustion: non-CO_2	Non-key			CS	PS, D
2	1B1	CH_4	Coal mining	Not Occuring	NO			
5	1B1	all	Coke production	Key (L2)		L	CS	CS
	1B2	CO_2	Fugitive emissions from venting/flaring: CO_2	Key(L,T1)	T	L	CS	CS
2	1B2	CH_4	Fugitive emissions from oil and gas: gas production	Key (T1)	T		CS	CS
2	1B2	CH_4	Fugitive emissions from oil and gas: gas distribution	Key (L2)		L	CS, T1	CS
2	1B2	CH_4	Fugitive emissions from oil and gas operations: other	Non-key			CS	CS
			INDUSTRIAL PROCESSES					
1	2A	CO_2	Emissions from cement production	Non-key			CS	PS, CS
1	2G	CO_2	Other industrial: CO_2	Non-key			CS	CS
1	2A	CO_2	Emissions from limestone and dolomite use	Non-key			CS	CS
1	2A	CO_2	Other minerals: CO_2	Non-key			CS	CS
5	2C	CO_2	Iron and steel production (carbon inputs)	Key (L1,T1)	L,T		CS	CS
	2C	CO_2	Aluminium production: CO_2	Non-key			CS	CS
2	2G	CH_4	Other industrial: CH_4	Non-key			CS	CS
3	2B	N_2O	Emissions from nitric acid production	Key (L,T1)	L, T	L	CS, T1	D, PS
	2B	CO_2	Emissions from ammonia production	Key (L1,T1)	L,T		CS	CS
	2B	N_2O	Emissions from caprolactam production	Key(L,T1)	L,T	L	CS	CS
	2B	CO_2	Other chemical product manufacture	Key(T1)	T		CS	CS
3	2G	N_2O	Other industrial: N_2O (NOx)	Key(L2,T1)	T	L	CS	CS
	2G	N_2O	Indirect N_2O from non-agricultural sources (NH_3)	Non-key			CS	CS
4	2C	F-gas	PFC emissions from aluminium production	Key (L,T1)	L,T	L	CS	M, PS
4	2E	F-gas	HFC-23 emissions from HCFC-22 manufacture	Key (T)	T	T	CS	PS
4	2E	F-gas	HFC by-product emissions from HFC manufacture	Non-key			CS	PS
4	2F	F-gas	Emissions from substitutes for ODS substitutes: HFC	Key (L,T1)	L,T	L	CS, T2	CS
4	2F	F-gas	PFC emissions from PFC use	Non-key			T2	D
4	2F	F-gas	SF_6 emissions from SF_6 use	Key (L2)		L	T2	PS, CS, D
			SOLVENTS AND OTHER PRODUCT USE					
1	3	CO_2	Indirect CO2 from solvents/product use	Non-key			CS	CS
2	3	CH_4	Solvents and other product use	Included in 2G	IE			
			AGRICULTURAL SECTOR					
1	4A	CH_4	CH_4 emissions from enteric fermentation: cattle	Key (L,T1)	L, T	L	CS, T2	CS
1	4A	CH_4	CH_4 emissions from enteric fermentation: other	Key (L)	L	L	T1	CS
1	4B	CH_4	Emissions from manure management : cattle	Key (L)	L	L	CS, T2	CS
1	4B	CH_4	Emissions from manure management : swine	Key (L,T1)	L,T	L	CS, T2	CS
1	4B	CH_4	Emissions from manure management : other	Non-key			CS, T2	CS
2	4B	N_2O	Emissions from manure management	Key(L2)		L	CS, T2	CS
2	4C	CH_4	Rice cultivation	Not Occuring	NO			
2	4D	N_2O	Direct N_2O emissions from agricultural soils	Key (L)	L	L	CS, T1b	CS
2	4D	N_2O	Indirect N_2O emissions from nitrogen used in agriculture	Key (L,T1)	L,T	L	CS, T2	D
5	4E	all	Prescribed burning of savannas	Not Occuring	NO			
5	4F	n-CO_2	Emissions from agricultural residue burning	Not Occuring	NO			
			LUCF					
5	5	all	LUCF	Key (L)	L	L	CS	CS
			WASTE SECTOR					
2	6A	CH_4	CH_4 emissions from solid waste disposal sites	Key (L,T1)	L, T	L	CS (T2)	CS
2	6B	CH_4	Emissions from wastewater handling	Non-key			CS	CS
3	6B	N_2O	Emissions from wastewater handling	Key(L2)		L	CS	CS
5	6C	all	Emissions from waste incineration	Included in 1A1	IE			
			OTHER					
2	7	CH_4	Misc. CH_4 [1)]	Non-key			CS	CS
3	7	N_2O	Misc. N_2O [2)]	Key (L,T1)	L,T	L	CS	CS

[1)] 6D Other waste

[2)] 4D animal production - waste dropped on soils + 3D Solvents

Notion keys:

L, T = Level, Trend	CS = country-specific	PART = Partial	M = Measured
1 = IPCC Tier 1	PS = Point source	IE = Included Elsewhere	
T2 = IPCC Tier 2	D = IPCC Source Category Default	NO = Not Occurring	

Legend for notation keys used for method and emission factors: see bottom part of the table and the footnotes of *Table.2.*

For agriculture:
- 4 - CH_4 Emissions from enteric fermentation: other: now key;
- 4 - N_2O Emissions from manure management: now key.

For waste
- 6 - N_2O Emissions from wastewater handling: now key.

And, finally, another new key source is CO_2 from LUCF (N.B. now a *source*, not a sink as in NIR2004).

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 adds up to 95% of the national total, are 20 sources for annual level assessment and 22 sources for the trend assessment, out of a total of 59 sources. For an overview of sources that meet any of these two criteria, both lists can be combined. The IPCC Tier 2 method for identifying key sources requires incorporating uncertainty into each of these sources before ordering the list of each of their shares in the total. This has been done using the uncertainty estimates discussed above.

The results of the Tier 1 and Tier 2 levels and the trend assessments are summarised in *Table 1.4*. As could be expected, the importance of small, but relatively very uncertain sources receives more weight in the Tier 2 level and trend assessments. Some of these sources, which are below the 95% cut-off line in the Tier 1 assessment, were shifted above this line in the Tier 2 assessment

1.5.1 Key source identification and methodological choice

The result is a list of about 33 source categories out of a total of 59 that could be identified as 'key sources' according to the definition of the *IPCC Good Practice Guidance* report. Depending on what criteria is used to determine them (level, trend, or both; or qualitative criteria such as expected high growth or decrease rates) more or fewer source categories are selected. In any case, general conclusions can already be drawn about the methodology and the type of emission factor added to *Table 1.3.*

1.5.2 Limitations

We recall that Tier 2 key source assessments are subject to the limitations of the Tier 1 uncertainty estimates, as discussed in Section 1.7. Nevertheless, there are clear indications of the increasing importance of some smaller, but very uncertain, sources.

1.6 Information on the QA/QC plan

The QA/QC activities of the PER system have always been a cornerstone of the quality control and assurance of the Netherlands inventory. To meet the requirements laid down by the Kyoto Protocol and the EU Monitoring Mechanism (Decision no 280/2004/EC) in good time, amongst others the EU requirement for a National System at Member State level to be in place by the end of 2005, additional actions were needed to improve the quality of the inventory. This section describes the first general setting of the present QA/QC programme activities: the (quality) improvement programme for the inventory, and other elements of the QA/QC plan used for the CRF/NIR.

1.6.1 Monitoring improvement programme and general QA/QC

To comply in a timely fashion with the additional requirements of the Kyoto Protocol and the EU Monitoring Mechanism a programme was started in 2001 to adapt the monitoring of greenhouse gases in the Netherlands and transform it into a National System, as described under Article 5 of the Kyoto Protocol. The implementation of this programme is the responsibility of the Netherlands *Ministry for Housing, Spatial Planning and the Environment* (VROM), who have delegated the practical co-ordination of the programme to *SenterNovem*. An interdepartmental committee, the *Working Group Emission Monitoring of Greenhouse Gases* was created to direct the activities. Many institutes were involved. This programme consists of three main elements. The present status of each is given below:

- An improvement programme, to raise the quality of methods and data, where necessary. Methods, data on activities and emission factors were assessed, and adapted where necessary. Meanwhile, most of the studies and projects have been finalised and the results have been used for the CRF and NIR 2005. The remaining actions are described in *Section 9.4.7.*

- The elaboration and implementation of monitoring protocols, to improve the transparency of the inventory. This involves assessing and, where necessary, redefining processes and methodologies, procedures, tasks, roles and responsibilities with regard to inventories of greenhouse gases. Transparent descriptions and procedures of these different aspects are being laid down in so-called 'protocols' for each gas and sector, and in process descriptions for other relevant tasks in the National System. Meanwhile, the methodologies and working processes used for estimating the emissions of the key sources in the present CRF and NIR 2005 have also undergone such a process. The website on the National System provides further information and relevant background documents about protocols: www.greenhousegases.nl. Further finalisation of the protocols, sinks and non-key sources, is anticipated in 2005, before the next cycle of emission estimations (for the CRF 2006).

- Improving the QA/QC system for the inventory, the NIR and the National System. The first phase (finished in 2002) included an assessment of the present situation compared with the requirements of the UNFCCC/IPCC. The second phase, due to be finalised in 2005, involves the description of relevant processes and procedures, including any necessary adaptation of the QA/QC procedures. As part of this process, a QA/QC programme that complies with the National System requirements is being developed and implemented. This is also due to be finalised in 2005. (For the NIR 2005, a brief QA/QC plan has been used, based on the draft QA/QC programme). The third phase, implemented in parallel, comprises the formal and legal arrangements needed for the structurally embedding the protocols. This is being carried out by the Ministry, for finalisation in 2005.

1.6.2 QA/QC plan and data collection and processes activities

As indicated, an improved QA/QC programme and system are currently being developed as part of the monitoring improvement programme. These should ensure that the inventory meets the requirements laid down by the UNFCCC, EU and the Kyoto Protocol, notably those related to transparency, consistency, comparibility, completeness and accuracy of inventories. It should also facilitate continuous improvement. The full QA/QC system will be in operation by the end of 2005 as part of the National System. For the CRF/NIR 2005 a brief QA/QC plan has been used, based on a draft for the more detailed QA/QC programme that is being devised for the National System. The activities included in the QA/QC plan for the NIR 2005 have been discussed and approved by the WEB [2] .There are four groups of activities: (1) QC activities; (2) QA activities; (3) Documentation and archiving; (4) Evaluation and improvement. The major issues and outcomes are discussed below.

Quality control activities

The QC activities related to the present CRF/NIR 2005 are aimed at:

- Finalising the upgrade of methods and processes and their description on monitoring protocols (to improve transparency). As a result, (where appropriate) the upgraded methods have already been used for the present CRF/NIR[3]. The planning is to make the set of protocols for key sources available on the website www.greenhousegases.nl in April 2005.
- Upgrading the (description) of the QA/QC of outside agencies. This project is ongoing, but the intention is to finalise it later in 2005. To improve the continuity of data flows and interaction between basis data supply and the emission calculations, a covenant has been prepared between CBS and the ER. The responsibility for the quality of data in the annual environmental reports lies with the companies. Data validation is the responsibility of the regional or local authorities. In the past, the inventory had to deal with differences in quality of environmental reports. To better deal with these elements, and to improve the consistency further, the methodology and process for estimating emissions of combustion have been revised in the present CRF and NIR (see Chapters 3 and 9).

[2] The *Working Group Emission Monitoring of Greenhouse Gases* (see *Section 1.6.1)*

[3] LULUCF as far as possible, given the fact that the guidelines were only finalised at CoP10. For some agricultural sources (manure), additional changes are being considered for mid 2005.

- Performing the general QC checks and, where appropriate, source-specific QC. The latter are described in the sector-specific chapters. To support the general QC checks, two checklists have been developed and introduced, that together aim to cover the required general QC checks: a release form that checks completeness of the monitoring protocols (including completeness of the information about methods, AD, EF, etc.) and a checklist that covers issues relating to consistency, completeness, correctness of the CRF data, etcetera. The general QC for the present inventory is mainly performed in the ER and is similar to that carried out in recent years (see *Box 1.2*).

QC results for the present inventory

General QC activities are included in the annual project plan for the ER. This plan describes the tasks and responsibilities of the parties involved in the ER process, the members of the Task Forces, the monitoring protocols for the greenhouse gases, emission estimation methods of other substances, products and the time schedule. From 1997 to 1 April 2004, the ISO 9001 quality assurance system was used to ascertain the quality of the monitoring process related to the PER. All procedural activities by the VROM Inspectorate, TNO and RIVM were subject to ISO 9001 standards, as well as the maintenance of the PER database by RIVM. However, the Task Force's activities, such as actually collecting data and calculating the emissions were not part of the formal ISO 9001 system during that period. In the new organisation of the PER (since April 2004), these Task Force activities will be brought in line with the ISO standards, in accordance with RIVM/MNP's ISO system. Transferring to this system is now underway. The Quality Control (QC) activities of the ER can be divided into the following phases:

- QC by Task Force members on input data and the emission calculations before submitting the data to the database at TNO;
- QC on the completeness and consistency of the database at TNO;
- QC by Task Forces on the complete dataset, including the CRF, before the trend-verification workshop takes place;
- QC by Task Forces at the trend-verification workshop.

Delivering the data to TNO for the database and giving feedback to the Task Forces are carried out in accordance with the procedure 'Data handling and presentation' from the quality assurance system of the Netherlands Pollutant Emission Register, as included in the work plan ER 2005 (RIVM-MNP, 2004). The Task Forces have filled a standard-format database supplied by TNO, with emission data for1990-2003. The Task Force first checked the emission file before it was submitted, TNO then carried out QC activities, such as checks on completeness, consistency and formats. The (corrected) data were processed into a comprehensive draft data file. The Task Forces have access to information about the relevant emissions in the draft data file, and this can be accessed on the internet in order to check how the TNO are handling the data. Observed errors and information regarding the (status of) the performed quality controls by the Task Forces are reported to TNO. All corrections made in the draft data file are documented and are accessible to the Task Forces on the internet.

In July 2004, a preliminary trend analysis workshop was held on the complete inventory of all emissions into air and water, including greenhouse gas emissions, and, in November 2004 and March 2005 an additional inventory was compiled, primarily for GHG-emissions (based on the revised methods, recalculations and a complete time series since 1990) and sinks. Detailed instructions about which QC checks needed to be performed in the (preparations of these) workshops were outlined in the workshop-programmes.

Where the Task Force members could explain a large change in the trend, it was removed from the list. After the workshop, inexplicable changes in trends were studied in more detail at emission-source level. Points of special interest concerning combustion emissions were discussed with the chairman of the Task Forces. In some cases, the differences could be explained or the emission figures were corrected and sent to the chairmen of the Task Forces. The proposed changes have been sent to the chairmen of the Task Forces and then approved. The new emission database was then sent to TNO, which processed the second data delivery into a new comprehensive data file. The chairmen approved the new data file, after which the emission data were released by TNO to the participating agencies. Finally, the Task Forces made a list of recommended improvements for the 2005 inventory compilation.

Box 1.2. Trend verification workshops July and November 2004: results of QC checks.

The Task Forces were provided in advance with the emission data in the new draft data file for each source category (including the relevant time series). In this way the Task Forces could check for level errors and consistency in the algorithm/method used for calculations throughout the time series. The Task Forces performed checks for, amongst others, CO_2, CH_4 and N_2O emissions from all sectors. The totals for the sectors were compared with last year's dataset. Where significant differences were found, the Task Forces evaluated the emission data in more detail. The results of these checks were discussed at the workshop and documented.

TNO also made time series of emissions per substance for the individual Target Sectors and the CRF. The Task Forces examined these time series. During the trend analyses the greenhouse gas emissions for all the years 1990-2003 were checked on the level of the IPCC Summary Tables 7A for outliers in two ways: (a) the levels per year were compared with the levels published the previous year; (b) based on the trends for each gas in the period 1990-2003. Special emphasis was on checking the year 1990 (1995 for F-gasses). The checks of outliers were carried out at a more detailed level of the sub-sources of all sectoral 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

Remarkable trend changes and outliers observed were noted and discussed at the workshop, resulting in an action list. Items on this list had to be processed within two weeks or become a footnote this year (2003) and will be dealt with in the 2004 inventory.

Results of the trend analysis workshop November 2004

Sixty actions were formulated and discussed at the workshop; all actions have been carried out. From the actions leading to corrections, the most relevant for greenhouse gases are listed below:

Task Force on Energy, Industry and Waste Handling (ENINA):
CBS action: Check EF and AD of CO_2 emissions from biomass.
Check EF and AD for 1990 of CO_2 emissions from other industrial processes and other mineral products; check CO_2 emissions 1990 for iron and steel.
Correct fuel bunkers versus fisheries.
Adjust data of CO_2 emissions for fossil waste incineration (reported in energy industries).
TNO action: Correct coupling for PFC between CRF and intermediate database for aluminium production.
Check for SF_6 the coupling between CRF and intermediate database.

Task Force on Residential, Commercial and Construction sectors:
No actions.

Task Force on Traffic and Transport:
TNO action: Emissions from off-road machinery is IE; extract and replace by those calculated by the Task Force.
Differentiate between avgas and kerosene.
Correct coupling for CO_2 between CRF and intermediate database for fisheries and inland shipping.

Task Force on Agriculture:
TNO action: N_2O emissions from N stock in agricultural soils (4D) and from biogenic processes polluted surface water (7) are replaced by recalculation of N_2O indirect emissions (4D and 2G).
Correct error in N_2O emissions from fertiliser and animal waste emissions in 1997 and 1998.
Check the LUCF data added in CRF.
RIVM-MNP: NH_3 from young cattle needs new recalculation.
Update N_2O emissions from fertiliser use (new data available).

Quality assurance activities

The QA/QC plan aims at extending the peer review process, both internally and within the EU. Major activities in addition to those that are QA related under the ISO system of the ER (such as evaluations and internal audits) are described below:

Dutch experts not directly involved in the emission inventory process performed a basic peer review of the NIR. This process is an addition to peer review actions undertaken during the annual Trend Analysis Workshop, in which the inventory experts from various sectors check and tune the draft estimates. A brief public review was organized by posting the draft NIR on the web site for comments, with the request to mail this to a selected group of external experts.

Due to the substantial recalculations undertaken, the peer and public review could only be performed briefly in February 2005. The comments have been dealt with as far as possible in the present NIR; some other issues are planned for the next NIR (see *Chapter 9*).

It was also the intention to assess possibilities for intra-EU mutual collaborative reviews of parts of the inventory with Belgium, but these intra EU reviews have not been assessed very well yet because of other pressing obligations in both countries. Preparations are underway for the next CRF/NIR.

As part of the improvement programme for the monitoring protocols, extensive analyses have been made in recent years of the methodologies used in a number of key sectors. For the CRF/NIR 2005, the results of these analyses were used to improve the methods of estimating emissions from agriculture and combustion (as mentioned above). For the LUCF sector, the new Good Practice guidelines for LULUCF have been applied as far as possible. Various background studies on the monitoring data for LULUCF have been carried out in the last few years.

Documentation and archiving

The improved monitoring protocols have been documented and will be published on www.greenhousegases.nl. To improve transparency, the newly implemented checklists for QC checks have been documented and archived. The QA/QC plan foresees upgrading the documentation and archiving system.

Evaluation and improvement

The work attached to producing the inventory has been organised as an annual cycle, which includes an annual internal evaluation of the process, which also takes into account the results of any internal and external review and evaluation. The results are used for the annual update of the QA/QC programme (including the improvement programme) and the annual work plans. The (monitoring) improvement plan has already been described in the previous subsection.

1.7 Evaluating general uncertainty

The IPCC Tier 1 methodology for estimating uncertainty in annual emissions and trends has recently been applied to the more detailed IPCC list of possible key sources listed in IPCC (2000). This was done to get a more detailed first-order estimate of the uncertainty in the annual emissions as well as in the trend. Secondly, these uncertainties could be used for a first Tier 2 analysis to identify 'key sources' as defined in the *IPCC Good Practice Guidance* report (IPCC, 2000).

1.7.1 Data used

To estimate total uncertainty in both *annual* emissions and in emission *trends,* we applied the *IPCC Tier 1 uncertainty approach* at the level of the IPCC list of possible key sources (see *Section 1.5*).
The following information sources were used for estimating the uncertainty in activity data and emission factors (Olivier and Brandes, 2005):

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

These were supplemented with expert judgement from RIVM and CBS emission experts (also for the new key sources). Next, the uncertainty in the emissions in 1990 and 2003 was estimated according to the IPCC Tier 1 methodology. This was done 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 *Table 1.4.* The Tier 1 calculation of ***annual uncertainty*** in CO_2-eq. emissions results in an overall uncertainty of 6%, based on calculated uncertainties of 4%, 18%, 53% and 11% for CO_2 (including LUCF), CH_4, N_2O and F-gases, respectively. However, these figures do not include the correlation between source categories (e.g. cattle numbers for enteric fermentation and animal manure production) or a correction for not-reported sources. Therefore, the actual uncertainty of total *annual* emissions per compound and of the total will be somewhat higher; it is currently estimated by RIVM at:

CO_2	±5%	HFCs	±50%
CH_4	±25%	PFCs	±50%
N_2O	±50%	SF_6	±50%

The calculated uncertainty in CO_2-emissions is higher than in the previous NIR due to inclusion of CO_2 emissions from LUCF (high uncertainty) and a higher uncertainty estimate for activity data of 'Stationary combustion: Other Sectors'. The uncertainty in N_2O emissions increased due to recalculation of N_2O-emissions from agricultural soils, which has a relative high uncertainty. Because of the use of better activity data, the uncertainty estimate for SF_6 has been halved.

If we rank the sources according to their contribution to the uncertainty in total national emissions (using the column 'Combined Uncertainty as % of total national emissions in 2003' in *Table A1.4)* the top 10 sources contributing most to total *annual uncertainty* in 2003 are:

IPCC	IPCC Source category	Uncertainty (as % of total national emissions in 2003)
4D	Indirect N_2O from nitrogen used in agriculture	3.1%
1A	CO_2 from stationary combustion: other sectors	1.9%
5	CO_2 from Land Use Change and Forestry	1.8%
4D	Direct N_2O from agricultural soils	1.3%
2X	N_2O from nitric acid production	1.2%
6A	CH_4 from solid waste disposal sites	1.1%
1A	CO_2 from stationary combustion: energy industries, excl. waste incin.	1.0%
4B	CH_4 from manure management: cattle	0.7%
4A	CH_4 from enteric fermentation in domestic livestock: cattle	0.5%
1A	CO_2 from mobile combustion: road vehicles	0.4%

Table A1.4 of *Annex 1* summarises the estimate of the *trend uncertainty 1990-2003* calculated according to the IPCC Tier 1 approach in the *IPCC Good Practice Guidance* (IPCC, 2000). The result is a trend uncertainty in the total CO_2-eq. emissions (including LUCF) for 1990-2003 (1995 for F-gases) of ±4% points. This means that the increase in total CO_2-eq. emissions between 1990 and 2003, which is calculated to be 1%, will be between -3% and +5%. 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 ±5%, ±6%, ±15% and ±7% points, respectively. More details on the level and trend uncertainty assessment can be found in *Annex 1* on key sources. The top 10 sources contributing most to *trend uncertainty* in the national total (using the column 'Uncertainty introduced into the trend in total national emissions' in *Table A1.4*) are:

IPCC	IPCC Source category	Uncertainty (as % into trend in total national emissions)
1A	CO_2 from stationary combustion: other sectors	2.7%
4D	Indirect N_2O from nitrogen used in agriculture	1.9%
5	CO_2 from Land Use Change and Forestry	1.8%
1A	CO_2 Stationary combustion: energy industries, excl. waste incineration	1.3%
6A	CH_4 from solid waste disposal sites	1.0%
1A	CO_2 from stationary combustion: manufact. industries & construction	0.5%
2B	N_2O from nitric acid production	0.5%
1A	CO_2 from mobile combustion: road vehicles	0.4%
2B	N_2O from caprolactam production	0.3%
4D	Direct N_2O from agricultural soils	0.3%

Table 1.5. Tier 1 level uncertainty assessment of source categories of the IPCC potential key source list (without adjustment for correlations between sources) (1990 level; 1995 for F-gases) (in Tg CO_2-eq.)

IPCC	Source category	Gas	CO_2-eq. 90/95	CO_2-eq. 2003	AD unc	EF unc	EM unc
1A	Emissions from stationary combustion : Energy Industries, excl. Waste incin.	CO_2	51 034	65 752	3%	2%	4%
1A	Emissions from stationary combustion : Manufacturing Industries and Construction	CO_2	32 768	27 056	3%	1%	3%
1A	Emissions from stationary combustion : Other Sectors	CO_2	37 996	40 588	10%	1%	10%
1A	Emissions from waste incineration, reported in 1A1a	CO_2	592	1 595	10%	5%	11%
1A	Mobile combustion: road vehicles	CO_2	25 472	33 433	2%	2%	3%
1A	Mobile combustion: water-borne navigation	CO_2	403	580	50%	2%	50%
1A	Mobile comustion: aircraft	CO_2	41	41	50%	2%	50%
1A	Mobile combustion: other	CO_2	91	103	50%	2%	50%
1B	CO2 from coke production	CO_2	403	464	50%	2%	50%
1B	Fugitive emissions venting/flaring: CO_2	CO_2	839	405	50%	2%	50%
2X	Cement production	CO_2	507	434	5%	10%	11%
2X	Limestone and dolomite use	CO_2	440	563	25%	5%	25%
2X	Other minerals	CO_2	269	352	25%	5%	25%
2X	Ammonia production	CO_2	3 058	2 686	2%	1%	2%
2X	Other chemical product manufacture	CO_2	480	248	50%	50%	71%
2X	Iron and steel production (carbon inputs)	CO_2	2 514	1 558	3%	5%	6%
2X	CO_2 from aluminium production	CO_2	395	410	2%	5%	5%
2X	Indirect CO_2 from solvents/product use	CO_2	316	160	25%	10%	27%
2X	Other industrial: CO_2	CO_2	380	431	5%	20%	21%
5	Land Use Change and Forestry	CO_2	2 894	2 761	100%	100%	141%
	Total CO2		**160 893**	**179 621**			**0.0%**
							-> 5%
1A	Emissions from stationary combustion: non-CO_2	CH_4	508	541	3%	50%	50%
1A	Mobile combustion: road vehicles	CH_4	157	72	5%	60%	60%
1A	Mobile combustion: other	CH_4	1	1	50%	100%	112%
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	1 252	437	2%	25%	25%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	647	520	2%	50%	50%
1B	Fugitive emissions from oil and gas operations: other	CH_4	176	104	20%	50%	54%
2X	Other industrial: CH_4	CH_4	297	311	10%	50%	51%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	CH_4	6 561	5 418	5%	20%	21%
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	761	644	5%	30%	30%
4B	Emissions from manure management : cattle	CH_4	1 573	1 432	10%	100%	100%
4B	Emissions from manure management : swine	CH_4	1 141	918	10%	100%	100%
4B	Emissions from manure management : other	CH_4	255	73	10%	100%	100%
6A	CH_4 emissions from solid waste disposal sites	CH_4	12 011	6 775	15%	30%	34%
6B	Emissions from wastewater handling	CH_4	290	207	20%	25%	32%
7X	Other CH_4	CH_4	1	0	20%	25%	32%
	Total CH_4		**25 630**	**17 455**			**0%**
							-> 25%
1A	Emissions from stationary combustion: non-CO_2	N_2O	246	288	3%	50%	50%
1A	Mobile combustion: road vehicles	N_2O	271	470	5%	50%	50%
1A	Mobile combustion: other	N_2O	1	2	50%	100%	112%
2X	Nitric acid production	N_2O	6 330	5 060	10%	50%	51%
2X	Caprolactam production	N_2O	1 240	954	50%	50%	71%
2X	Indirect N_2O from non-agricultural sources	N_2O	52	56	25%	200%	202%
2X	Other industrial: N_2O	N_2O	886	644	50%	50%	71%
4B	Emissions from manure management	N_2O	670	598	10%	100%	100%
4D	Direct N_2O emissions from agricultural soils	N_2O	4 604	4 817	10%	60%	61%
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	4 976	3 252	50%	200%	206%
6B	Emissions from wastewater handling	N_2O	513	397	20%	50%	54%
7X	Other N_2O	N_2O	1 524	781	20%	50%	54%
	Total N_2O		**21 312**	**17 321**			**0%**
							-> 50%
2X	SF_6 emissions from SF_6 use	SF_6	301	334	50%	25%	56%
2X	PFC from aluminium production	PFC	1 769	1 204	2%	20%	20%
2X	PFC emissions from PFC use	PFC	37	192	5%	25%	25%
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	240	890	10%	50%	51%
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	5 759	460	10%	10%	14%
2X	HFC by-product emissions from HFC manufacture	HFC	12	100	10%	50%	51%
	Total F-gases		**8 118**	**3 180**			**0%**
			-> 50% for HFCs ,PFCs and SF_6				
	Total Netherlands (CO_2-eq.)		**215953**	**217577**			**0.0%**
							-> 6%

If we compare this list with the ten largest contributors to annual uncertainty, we can conclude that six of these ten key sources are included in both lists.

1.7.3 Limitations

The uncertainty estimates presented in *Table 1.4* and *Table A1.4* have been calculated according to the Tier 1 uncertainty estimate of IPCC. In this method, uncertainty ranges are summed for all sectors or gases using the standard calculation for error propagation: 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 division ('Gaussian'), (b) 2σ smaller than 60%, (c) independent (non-correlated) sector-to-sector and substance-to-substance. Indeed, for a number of sources, it is clear that activity data or emission factors are correlated, which increases the overall uncertainty of the sum to an unknown extent. For some sources, it is also already known that the probability distribution is abnormal; in particular, when uncertainties are very high (in the order of 100%) it is clear that the distribution will be skewed towards zero.

Even more important is that, although the uncertainty estimates have been based on the documented uncertainties mentioned above, uncertainty estimates are unavoidably, and in the end, based on the expert judgement of representativeness of the particular source category for these circumstances in the Netherlands. Sometimes, however, to support these estimates, only limited reference to actual data for the Netherlands was possible. Focusing on the order of magnitude of the individual uncertainty estimates, we believe that this dataset provides a reasonable first assessment of the uncertainty of key source categories in the Netherlands.

However, a Tier 2 uncertainty assessment and a comparison with a Tier 1 uncertainty estimate, based on similar data, showed that, the errors made in data for the Netherlands situation, in the simplified Tier 1 approach, are quite small (Olsthoorn and Pielaat, 2003). This conclusion holds for both annual uncertainties and the trend uncertainty (see the comparisons presented in *Table 1.6* and *Table 1.7*, respectively). This range of confidence is similar to the trend uncertainty found in comparable studies for the UK, Norway and Austria (Rypdal and Winiwarter, 2001).

Table 1.6. Effects of simplifying Tier-1 assumptions on the uncertainties of emissions for 1999.

Greenhouse gas	Tier 1 uncertainty*	Tier 2 uncertainty
Carbon dioxide	2.7%	1.6%
Methane	16.2%	14.6%
Nitrous oxide	35.5%	29.3%
F-gases	20.3%	20.0%
Total	**4.5%**	**3.6%**

* Calculated in NIR 2001.
Source: Olsthoorn and Pielaat (2003), using data from NIR 2001 (Olivier *et al*., 2001).

Table 1.7. Effects of simplifying Tier-1 assumptions on the 1990-1999 emission trend and trend uncertainties.

Emission trend	Tier 1 uncertainty*	Tier 2 uncertainty
CO_2-eq.	6.1%	5.8%
Confidence range	4.5% - 8.4%	3.5%- 8.6%.
Range (±) (relative)	**2.6%-pnt.** (65%)	**2.8%-pnt.** (45%)

* Calculated in NIR 2001.
Source: Olsthoorn and Pielaat (2003), using data from NIR 2001 (Olivier *et al*., 2001).

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, more independent verification of the emission level and emission trends, e.g. by 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 outcomes of these studies can be found in, for example, Berdowski *et al.* (2001), Roemer and Tarasova (2002) and Roemer *et al.* (2003).

1.8 General assessment of the completeness

At present, the greenhouse-gas-emission inventory for the Netherlands includes *all* the sources identified by the *Revised IPCC Guidelines* (IPCC 1997), *except* for the following (see *Table A5.1*):

- CO_2 from *lime production* (2A2), due to missing activity data;
- indirect CO_2 from NMVOC from oil transport, distribution of oil products (1B2a), negligible source;
- CO_2 from *asphalt roofing and road paving with asphalt* (2A6 and 2A7), negligible source;
- CH_4 from *poultry* (4A9), due to missing emission factors;
- N_2O from *industrial wastewater* (6B), negligible source;
- CH_4 and N_2O emissions from *LUCF* (5A-5D);
- *CH_4 emissions from soils*. These have deceased in the last 40 years, due to drainage and the lowering of water tables, so they have been included in the natural total; thus not as net (i.e. positive) anthropogenic emissions, because, on the contrary, they act, in fact, as methane sinks;
- Emissions from *multilateral operations* (Memo item) have not been estimated separately but are included in the national total (1A5);
- *Precursor* (non GHG) emissions from *international bunkers* (international transport) have not been estimated/ reported for this inventory.

2. TRENDS IN GREENHOUSE GAS EMISSIONS

Major changes compared to the previous National Inventory Report

Changes in historical data

Most sectors have been thoroughly recalculated with resulting emission data:
- CO_2 emissions decreased by almost 3 Tg, on average, for the complete times series (2.9 Tg in 1990 and 3.2 Tg in 2002, both 1.8%).
- CH_4 emissions decreased, from about 80 Gg in 1990 to 45 Gg in 2002;
- N_2O emissions increased, from about 16 Gg in 1990 to 10 Gg in 2001;
- F-gas emissions show only marginal changes.

The trends in CO_2 emissions and in total CO_2-eq. emissions were insignificant for the period 1990-2002 (0.1%), but the 1990-2002 trend in CH_4 emissions changed from -32% to -29%. The decreasing 1990-2002 trend in N_2O emissions changed from -7% to -16%. The new 1990-2003 trends are presented below.

2.1 Emission trends for aggregated greenhouse gas emissions

The trend in total CO_2-eq. emissions of greenhouse gases and comparison of the contribution of the various gases has been calculated using the IPCC *Global Warming Potentials* (GWP) according to the Second Assessment Report (UNFCCC, 1999) for a time horizon of 100 years.

In *Table 2.1* the trends in national total CO_2-equivalent emissions are summarised for 1990-2003. The trends have also been visualised in *Figures 2.1* and *2.2*, showing the relative contribution of each gas to annual total emissions. Detailed trends in CO_2-equivalents by gas and by source category are provided in *Annex 7.3*. Total CO_2-equivalent emissions of the six greenhouse gases together were in 2003 1% point higher as in the base year 1990 (1995 for fluorinated gases). The 2003 emissions would be 1%-point higher (1.5 Tg CO_2) when corrected for temperature (the mild winter). Without policy measures the emissions in 2000 would have been more than 10% higher (RIVM, 2004).

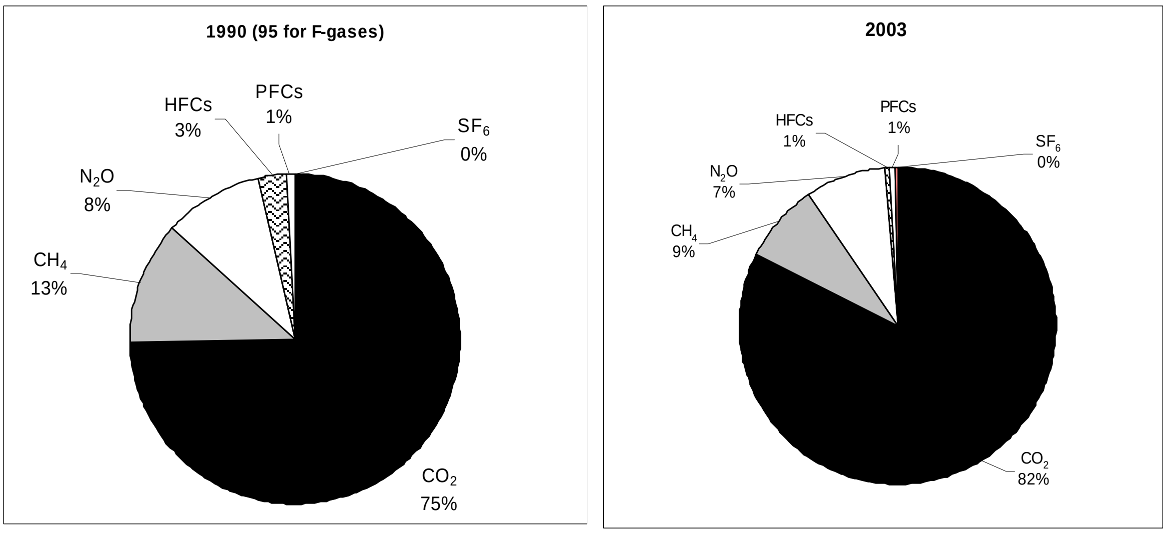


Figure 2.1. Shares of greenhouse gases in total emissions in 1990 (left) and 2003 (right)

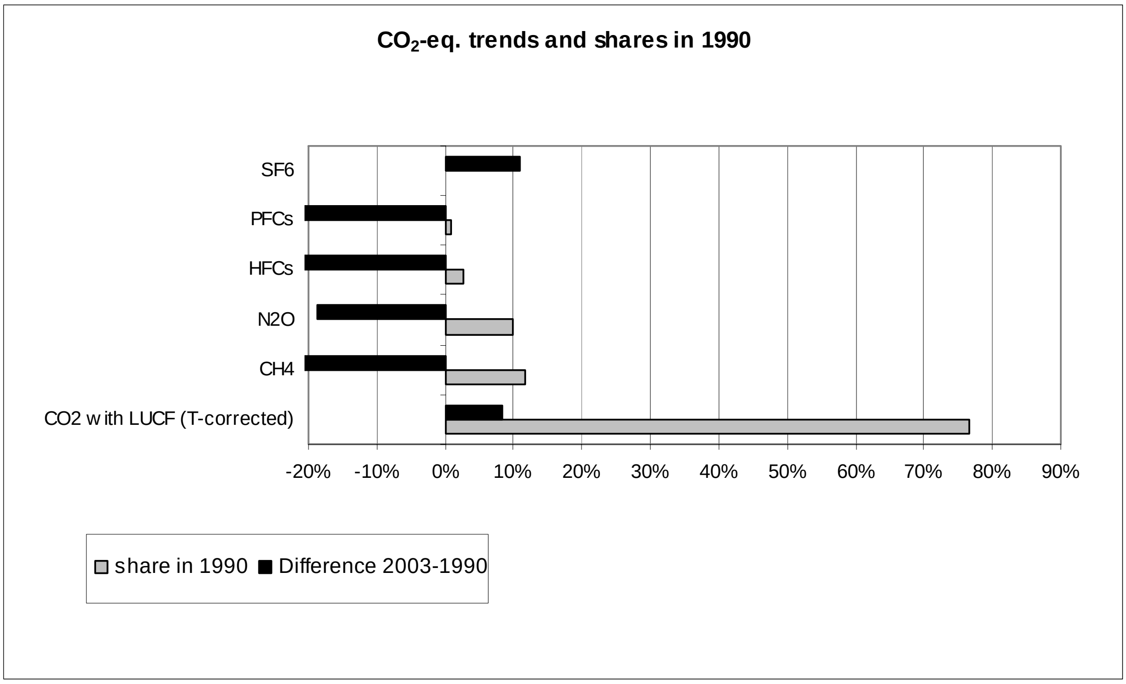


Figure 2.2. Shares and trends in greenhouse gas emissions per gas 1990-2003 (1995-2003 F-gases) and CO_2 also with temperature correction

To exclude the climatic influence that partially masks the anthropogenic trend in the CO_2 emissions, the same trends per gas have also been analysed with CO_2 emissions corrected for outside temperature[1]. Using temperature-corrected CO_2 emissions in 1990 and 2003, the structural anthropogenic trend of total greenhouse gas emissions in the past 13 years is estimated to be -1%, i.e. 2%-point lower than the actual trend of about 1% increase (*Tables 2.1 and 2.2*).

CO_2 emissions (excl. LUCF) increased by about 12% from 1990 to 2003, mainly due to the increase in the emissions in the electricity and heat production sector of almost 15 Tg (37%) and transport sector of 8 Tg (31%). However, half of this marked increase by the utilities 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). The decrease in the electricity production sector (1A1a) in 1999 is due to the marked increase of imported electricity since 1999, which almost doubled compared with 1998, and to a relatively large shift from coal to residual chemical gas and natural gas in 1999. In *Figures 2.3 and 2.4* one can observe that the doubling of imported electricity in 1999 from 10% to 20% of the domestic electricity consumption only temporarily decreased CO_2 emissions from the energy sector and total national CO_2 emissions. In 2000 the annual increase of the pre-1999 years has resumed. CO_2 emissions peaked in 1996 due to a very cold winter, as can be observed in *Figure 2.4*, showing a substantial peak in emissions in 1996 from '*Other sectors'*, particularly vulnerable to weather conditions.

[1] In *Table 2.2* the same trends per gas have been summarised but now with CO_2 emissions corrected for outside temperature in order to exclude the climatic influence that partially masks the trend in these emissions. This analysis leads to the conclusion that weather effects in base and present year are responsible for an extra 3%-point increase in total actual CO_2 emissions (excl. LUCF), i.e. from 8.7% to 11.6% (see CO_2 indices in *Tables 2.1 and 2.2*).

Table 2.1. Total greenhouse gas emissions in CO_2-eq. and indexed 1990-2003 (no temperature correction)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003[1]
Nat. Emissions (Tg CO_2-eq)														
CO_2 with LUCF	160.9	165.7	163.8	168.2	168.2	172.3	180.0	173.0	174.9	169.7	171.7	177.1	176.7	179.6
CO_2 excluding LUCF	158.0	162.9	161.1	165.5	165.5	169.7	177.3	170.2	172.2	166.9	168.9	174.4	173.9	176.9
CH_4	25.6	25.9	25.4	25.0	24.2	23.8	23.2	22.1	21.3	20.2	19.5	19.0	18.2	17.5
N_2O	21.3	21.7	22.4	23.1	22.3	22.4	22.2	22.0	21.7	20.9	19.9	18.9	18.0	17.3
HFCs	4.4	3.5	4.4	5.0	6.5	6.0	7.7	8.3	9.3	4.9	3.8	1.5	1.6	1.4
PFCs	2.1	2.1	1.9	1.9	1.9	1.8	2.0	2.2	1.7	1.5	1.5	1.4	1.4	1.4
SF_6	0.2	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.3
Total [group of six] [2] [5]	**211.7**	**216.2**	**215.4**	**220.7**	**220.6**	**224.0**	**232.7**	**225.0**	**226.5**	**214.8**	**214.0**	**215.5**	**213.5**	**214.8**
Index (1990=100)														
Index CO_2 [2]	100	103.0	101.8	104.5	104.5	107.1	111.9	107.5	108.7	105.5	106.7	110.1	109.8	111.6
Index CH_4	100	101.0	99.2	97.4	94.6	93.0	90.6	86.2	83.0	78.9	76.2	74.2	71.1	68.1
Index N_2O	100	101.9	105.1	108.5	104.5	105.2	104.1	103.0	101.8	98.3	93.3	88.6	84.3	81.3
Total [group of three]	**100**	**102.7**	**101.9**	**104.2**	**103.5**	**105.4**	**108.7**	**104.5**	**105.0**	**101.5**	**101.6**	**103.6**	**102.5**	**103.3**
Index HFCs	100	77.9	100.3	112.8	147.1	135.6	172.9	187.2	210.9	109.9	86.6	33.7	35.3	32.7
Index PFCs	100	99.0	90.1	91.1	87.6	85.4	94.6	102.9	81.8	69.3	71.9	67.0	66.9	66.0
Index SF_6	100	61.6	65.8	69.0	88.0	138.6	143.7	158.7	151.3	145.9	154.2	164.2	165.1	153.9
Index [group of six] [2]	**100**	**102.1**	**101.8**	**104.3**	**104.2**	**105.8**	**109.9**	**106.3**	**107.0**	**101.4**	**101.1**	**101.8**	**100.8**	**101.5**
Index (1995 = 100)														
Index HFCs	73.7	57.4	74.0	83.1	108.4	100	127.5	138.0	155.5	81.0	63.9	24.8	26.1	24.1
Index PFCs	117.1	116.0	105.5	106.7	102.6	100	110.8	120.5	95.8	81.2	84.2	78.5	78.4	77.3
Index SF_6	72.1	44.5	47.5	49.8	63.5	100	103.7	114.5	109.2	105.2	111.2	118.5	119.1	111.0
Index [group of new gases]	**83.3**	**70.0**	**80.0**	**87.1**	**105.5**	**100**	**122.9**	**133.2**	**140.5**	**81.9**	**70.2**	**40.2**	**41.2**	**39.2**
Index ('90; new gases '95) [3] [5]														
Index [BY=100] [group of 6] [2]	**99.4**	**101.5**	**101.1**	**103.6**	**103.6**	**105.2**	**109.2**	**105.6**	**106.3**	**100.8**	**100.4**	**101.1**	**100.2**	**100.8**
International Bunker CO_2 [4]	34.3	35.4	35.7	37.0	35.1	35.5	36.3	38.5	39.0	40.3	42.8	47.2	46.6	43.6
Index bunkers CO_2 (1990 = 100)	100.0	103.2	104.0	107.8	102.2	103.5	105.7	112.2	113.5	117.4	124.8	137.4	135.7	126.9

[1] Data for 2003 are of a somewhat lower quality than for other years. However, this *'t-1'* dataset is of a relatively high quality in this submission: due to the late recalculations final statistics and emission factors for 2003 could be used, excl. F-gases (see *Section 1.2)*.

[2] National emissions excluding LUCF (category 5A).

[3] Base year (excl. LUCF) = 100.

[4] Emissions from international marine and aviation bunkers are not included in the national totals.

[5] Base year emissions (1990 for CO_2 excl. LUCF, CH_4 and N_2O and 1995 for F-gases, coloured figures): 213.2 Tg CO_2-eq.

*Table 2.2. Total greenhouse gases emissions **with** temperature correction, in CO_2-eq. and indexed 1990-2003*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Emissions (Tg CO_2-eq)														
Temperature correction CO_2	6.2	0.4	4.3	1.1	3.6	2.6	-4.3	2.4	3.6	5.1	5.2	2.3	4.2	1.5
CO_2 with LUCF (T-corrected)	167.1	166.1	168.0	169.2	171.7	175.0	175.7	175.4	178.5	174.9	177.0	179.5	180.9	181.2
CO_2 excluding LUCF (T-corrected)	164.2	163.3	165.3	166.6	169.1	172.4	173.0	172.5	175.8	172.2	174.2	176.7	178.2	178.4
Total [group of six] [1]	**217.9**	**216.6**	**219.7**	**221.7**	**224.2**	**226.7**	**228.4**	**227.4**	**230.2**	**220.0**	**219.3**	**217.8**	**217.7**	**216.4**
Index (1990 = 100)														
Index CO_2 excluding LUCF (T-corrected)	100	99.4	100.7	101.5	103.0	105.0	105.4	105.1	107.1	104.9	106.1	107.6	108.5	108.7
Total [group of three] [1]	100	99.9	101.0	101.7	102.1	103.6	103.4	102.6	103.6	101.0	101.2	101.6	101.5	101.0
Index [group of six] [1]	**100**	**99.4**	**100.8**	**101.7**	**102.9**	**104.0**	**104.8**	**104.4**	**105.6**	**101.0**	**100.6**	**100.0**	**99.9**	**99.3**
Index ('90; F-gases '95)														
Index [BY=100] [group of six] [1] [2]	102.3	101.6	103.1	104.1	105.2	106.4	107.2	106.7	108.0	103.3	102.9	102.2	102.2	101.5

[1] Excluding LUCF.

[2] Base year (excl. LUCF, uncorrected for temperature) = 213.2 Tg CO_2-eq. = 100.

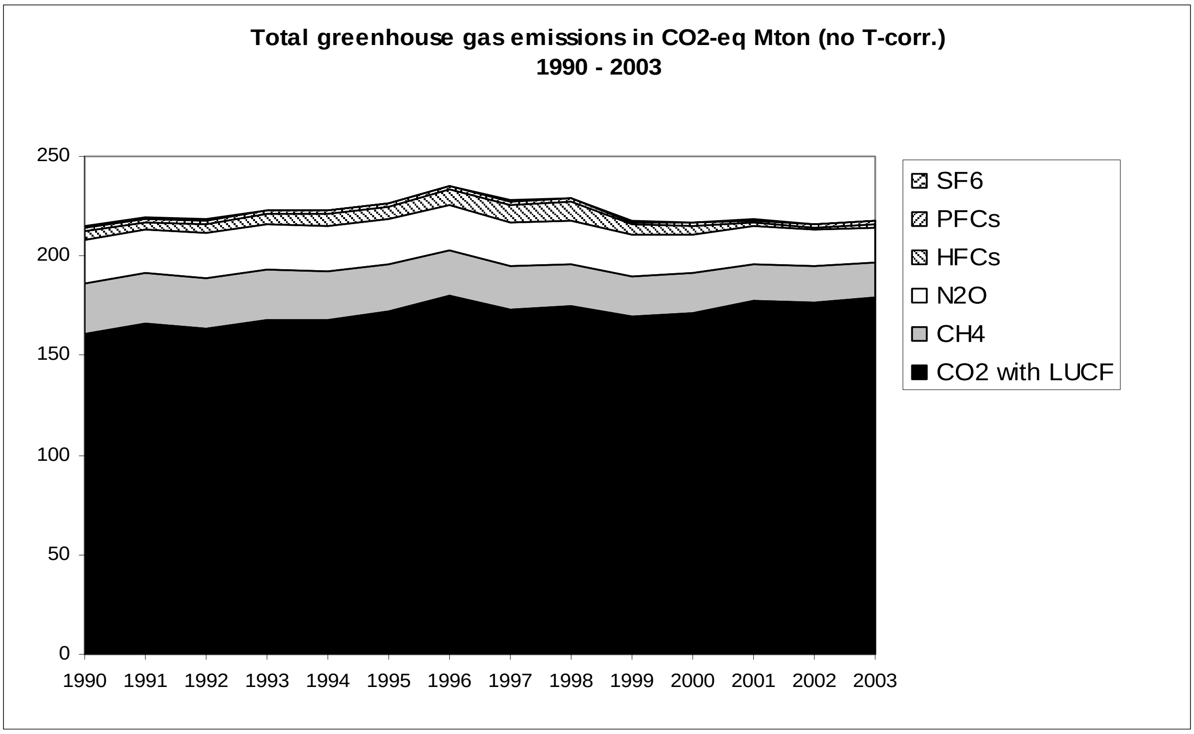


Figure 2.3. Trend in greenhouse gas emissions per gas 1990-2002 (no temperature correction)

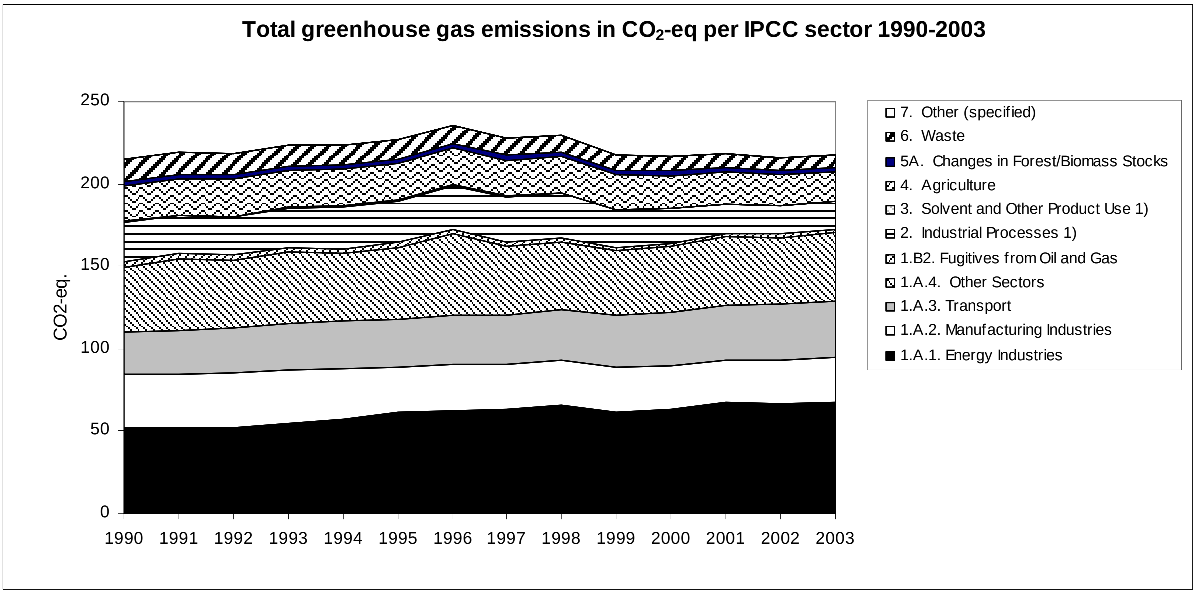


Figure 2.4. Trend in CO_2-eq. emissions per sector 1990-2002 (no temperature correction)

CH_4 emissions decreased by 32% in 2003 compared to the 1990 level, mainly due to decrease in the waste (-43%), the agricultural (-18%) and fugitive energy sector (-39%). Although recalculation caused total annual N_2O emissions to increase by about 10-16 Gg, the new time series decreases by about 19% in 2003 compared to 1990, mainly due to the decrease in the indirect emissions from agricultural soils and from the use of synthetic fertilisers and animal production (about -30%), which has been offset by the increase of emissions from animal waste applied to soils, and the decreasing emissions from industrial processes, including indirect N_2O from non-agricultural sources (-21%), which partly compensated increases of emissions from fossil fuel combustion of 47% (mainly from transport).

Of the fluorinated greenhouse gases, for which 1995 is the reference year, emissions of HFCs and PFCs decreased in 2003 by about 75% and 25% respectively, while SF_6 emissions increased by 11%. Total emissions of all F-gases decreased by about 60% compared to the 1995 level.

Impact of recalculations

Most sectors have been thoroughly recalculated with resulting emission data:

- CO_2 emissions decreased by almost 3 Tg, on average, for the complete times series (2.9 Tg in 1990 and 3.2 Tg in 2002, both 1.8%);
- CH_4 emissions decreased from about 80 Gg in 1990 to 45 Gg in 2002;
- N_2O emissions increased from about 16 Gg in 1990 to 10 Gg in 2001;
- F-gas emissions only show marginal changes.

The changes in trends in CO_2 emissions and in total CO_2-eq. emissions were insignificant for the period 1990-2002 (0.1%), but the trend in CH_4 emissions changed from -32% to -29%. The trend in N_2O emissions decreased from -7% to -16% (see *Figure 2.5a*.). More details can be found in Chapter 9 and the sectoral Chapters 3-8.

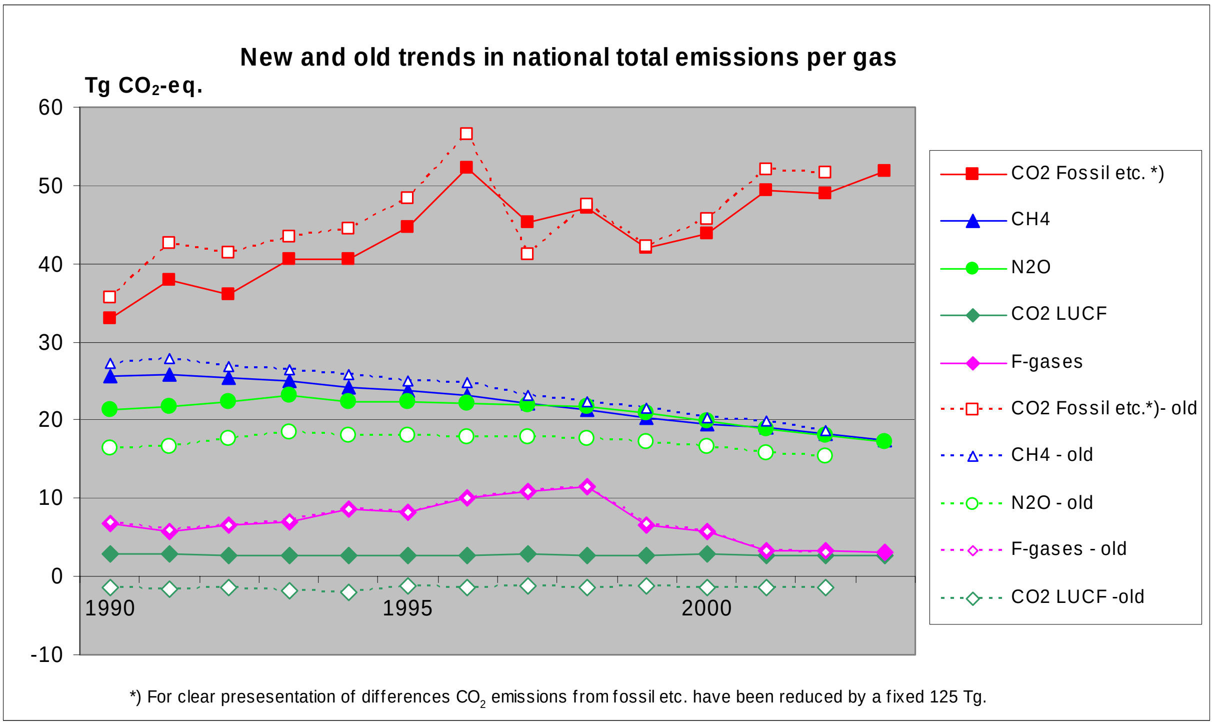


Figure 2.5a. Effect of recalculations on trends in greenhouse gas emissions per gas.

Uncertainty

The uncertainty in the ***trend*** of CO_2-equivalent emissions of the six greenhouse gases together is about ± 4%-points in the 1% increase, 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 total group of F-gases, as calculated with the *Tier 1 IPCC Good Practice* method described in *Section 1.7*, is estimated ±5%, ±6%, ±15% and ±7% points, respectively (*Figure 2.5b*). However, it should be kept in mind that the 2003 emissions include additional uncertainty as explained in *Section 1.7*. For CO_2 the estimate of uncertainty in ***annual*** emissions is ±5%. The uncertainty in ***annual*** emissions of CH_4 and N_2O is estimated at ±25% and ±50%, respectively, and for HFCs, PFCs and SF_6 ±50% (see *Section 1.7*)

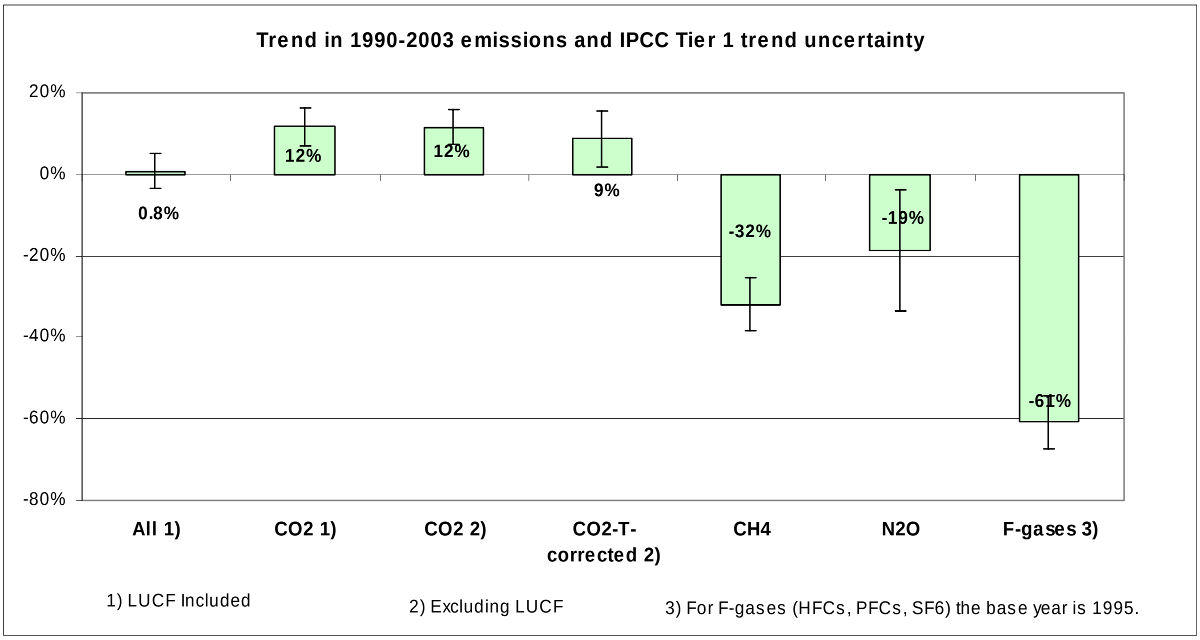


Figure 2.5b. Trends in greenhouse gas emissions per gas 1990-2003 (1995-2003 for F-gases) and their uncertainty according to the IPCC Tier 1 trend uncertainty analysis, and, shows CO_2 with temperature correction).

2.2 Emission trends by gas

Carbon dioxide

In *Table 2.3* and *Figure 2.6* the actual trend in actual CO_2 emissions is presented per source category. In 2003, total actual national CO_2 emissions increased since 1990 by 12%[2]. The largest increase in emissions (15 and 8 Tg) occurred in the energy and transport sectors. The decrease in the electricity production sector (1A1a) in 1999 is due to the marked increase of imported electricity since 1999, which almost doubled compared with 1998, and to a relatively large shift from coal to oil and natural gas in 1999. The decrease in fuel combustion emissions of about 5 Tg (17%) in industry (1A2) appears to be 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), which also explains a large part of the increase of the emissions from the energy sector. With a temperature correction, there's a 9% increase of CO_2 emissions (excl. LUCF) for 1990-2003, which is 2% points lower than without this correction. The influence of the weather on annual emissions, for example as suggested by the bump in 1996 in *Figure 2.4*, can indeed be traced back by annual variation in residential, commercial and agricultural emissions, as presented in *Figure 2.5*. Both the cold winter in 1996 and the mild winter in 1990 caused the emissions from the 'small combustion sector' to clearly deviate from the trend[3]. For more details refer to *Section 3.2.4*.

In 2003, total CO_2 emissions increased by 1.7% (3 Tg) compared to 2002, whereas the 2002 emissions showed a trend of +3.7% or +6.4 Tg (according to the data for 2001 provided in the previous NIR 2003, the change in 2001 was estimated at +3.5% or +6 Tg). This was mainly caused by the increased energy use in the service, energy and transport sectors. The emissions from industrial processes decreased by 1%.

[2] This translates to an increase of 9% with both years temperature-corrected and an increase of 13% with only 2003 emissions temperature-corrected (i.e. compared to the base year level of uncorrected 1990 emissions).
[3] Actual CO_2 emissions increased by 12% in the period 1990-1996, while from 1996 until 2003 the CO_2 emissions first decreased until 1999 but then increased again to reach the 1997 level again in 2003.

Table 2.3. CO_2 emissions and sinks per IPCC sector 1990-2003(no temperature correction) (Tg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NET NAT. EMISSIONS Incl. LUCF	***160.9***	***165.7***	***163.8***	***168.2***	***168.2***	***172.3***	***180.0***	***173.0***	***174.9***	***169.7***	***171.7***	***177.1***	***176.7***	***179.6***
NET NAT. EMISSIONS Excl. LUCF	**158.0**	**162.9**	**161.1**	**165.5**	**165.5**	**169.7**	**177.3**	**170.2**	**172.2**	**166.9**	**168.9**	**174.4**	**173.9**	**176.9**
1. All Energy (comb. & fugitive)	**149.6**	**154.7**	**153.5**	**158.1**	**157.4**	**161.3**	**169.2**	**161.8**	**164.3**	**159.0**	**161.2**	**167.3**	**167.0**	**170.0**
A Fuel combustion total	148.4	153.5	152.3	157.1	156.3	160.3	168.1	161.0	163.5	158.2	160.4	166.5	166.1	169.1
1a Electricity and heat production	39.8	40.3	40.8	42.0	45.1	48.1	49.0	49.4	51.1	48.1	49.3	52.9	54.0	39.8
1b Refineries	11.0	11.1	10.4	11.5	11.3	11.6	11.6	12.0	12.2	11.5	12.1	12.6	10.9	11.0
1c Other transformation	0.8	1.0	1.2	1.2	1.1	1.3	1.7	1.7	2.0	1.8	1.8	1.9	1.7	0.8
2 Industry	32.8	32.2	32.8	32.1	30.5	27.9	28.6	27.1	27.3	27.1	26.6	25.9	26.7	27.1
3 Transport	26.0	26.3	27.5	28.2	28.6	29.1	29.9	30.3	31.0	32.0	32.4	32.9	33.6	34.2
4a Commercial/Institutional	7.4	9.4	8.4	9.4	8.3	9.7	11.3	9.8	9.9	8.1	8.5	10.2	10.4	11.4
4b Residential	19.3	21.7	19.5	20.7	19.7	20.7	24.1	20.2	19.2	19.0	19.0	19.7	18.7	19.1
4c Agriculture/Forestry/Fishing	10.7	11.0	11.1	11.6	11.3	11.2	11.5	10.2	10.1	9.9	10.1	9.9	9.7	9.6
5 Other	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.5	0.4
B Fugitive fuel emissions	**1.2**	**1.2**	**1.2**	**1.0**	**1.1**	**1.0**	**1.1**	**0.8**	**0.8**	**0.8**	**0.8**	**0.8**	**0.8**	**0.9**
1 Solid fuel transformation	0.4	0.4	0.4	0.4	0.5	0.5	0.7	0.5	0.5	0.4	0.4	0.4	0.4	0.5
2 Oil and Gas	0.8	0.8	0.7	0.6	0.6	0.5	0.5	0.3	0.3	0.4	0.4	0.4	0.4	0.4
2. Industrial processes	**8.0**	**8.0**	**7.4**	**7.2**	**7.9**	**8.2**	**7.9**	**8.3**	**7.7**	**7.7**	**7.5**	**6.9**	**6.8**	**6.7**
3. Solvent and other product use	**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**
5. Land use change and forestry	**2.9**	**2.8**	**2.7**	**2.6**	**2.6**	**2.7**	**2.7**	**2.8**	**2.7**	**2.7**	**2.8**	**2.8**	**2.8**	**2.8**
6. Waste	**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**
7. Other	**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**
Memo item, not included in national total:														
International bunkers	**38.8**	**40.2**	**41.3**	**43.1**	**41.5**	**43.0**	**44.3**	**47.2**	**48.4**	**50.0**	**52.5**	**56.6**	**56.4**	**53.3**
CO_2 Marine	34.2	35.3	35.6	36.9	35.0	35.4	36.2	38.4	38.9	40.2	42.7	47.0	46.5	43.4
CO_2 Aviation	4.5	4.8	5.6	6.2	6.5	7.6	8.1	8.7	9.6	9.8	9.7	9.5	10.0	9.8

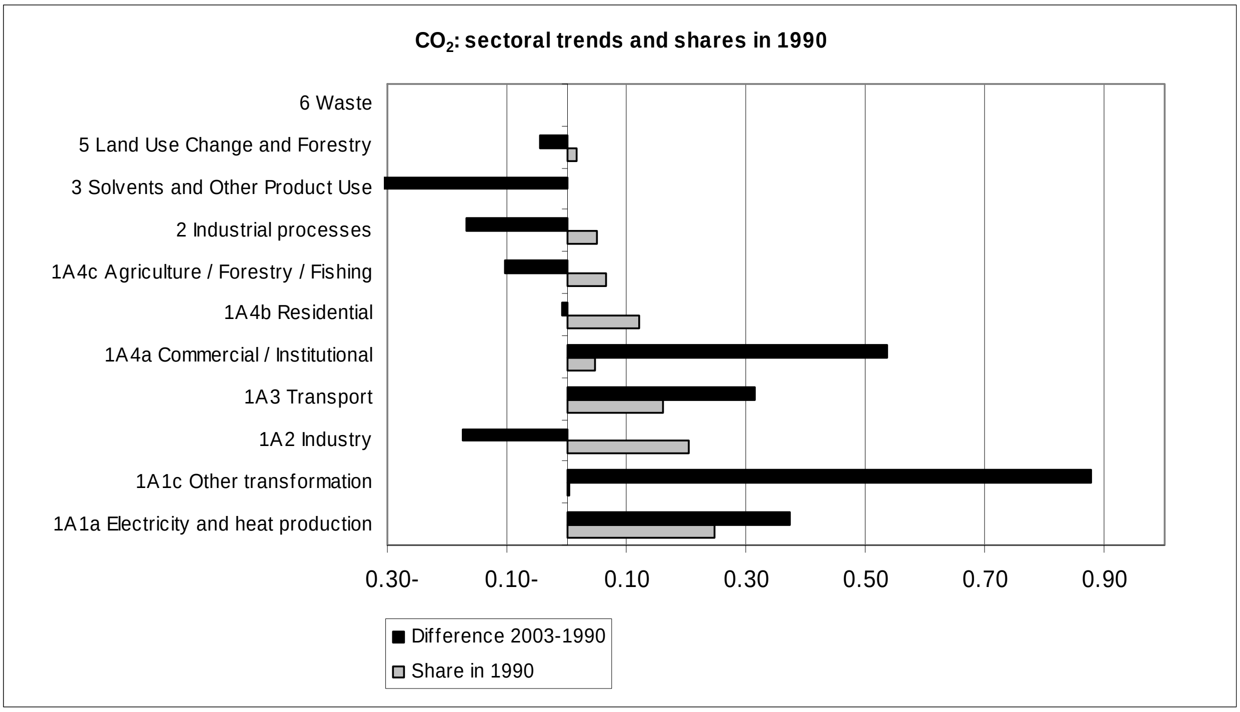


Figure 2.6. CO_2 emission shares and trends per IPCC sector, 1990-2003 (%).

Methane

In *Table 2.4* and *Figure 2.7* the trend in methane emissions is presented per source category. In 2003, total CH_4 emissions decreased by 32% compared to the 1990 level. Sectors that contributed most to the decrease were the waste sector (-43%), agricultural sector (-18%) and the energy sector (-39%) and with 5.4, 4 and 1.1 Tg CO_2-eq. respectively. In 2003, total CH_4 emissions decreased by 4% compared to 2002, mainly due to decreases in the waste and agricultural sectors.

Table 2.4. CH_4 emissions per IPCC sector 1990-2003(Gg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NET NATIONAL EMISSIONS	**1220**	**1233**	**1211**	**1189**	**1155**	**1135**	**1106**	**1052**	**1013**	**963**	**929**	**905**	**868**	**831**
1. All Energy (comb. & fugitive)	**130.5**	**131.2**	**128.8**	**128.8**	**126.7**	**126.4**	**123.7**	**94.7**	**91.0**	**83.6**	**80.9**	**81.3**	**80.2**	**79.9**
A Fuel combustion total	31.7	32.5	31.1	31.9	30.8	31.2	34.0	30.9	29.9	29.2	29.4	30.1	29.3	29.3
1 Energy	2.8	3.1	3.1	3.5	3.4	3.5	3.9	4.3	4.4	4.4	4.5	4.7	5.0	5.0
2 Industry	2.7	2.6	2.6	2.5	2.5	2.3	2.4	2.3	2.3	2.3	2.3	2.2	2.2	2.2
3 Transport	7.5	6.6	6.4	6.1	5.8	5.6	5.2	5.0	4.7	4.5	4.1	3.9	3.7	3.5
4a Commercial/Institutional	0.7	1.0	0.9	1.0	0.9	1.0	1.2	1.0	1.0	0.9	0.9	1.2	1.1	1.2
4b Residential	16.9	18.2	16.9	17.7	17.1	17.7	20.2	17.4	16.4	16.1	16.6	17.1	16.4	16.5
4c Agriculture/Forestry/Fishing	1.0	1.0	1.0	1.1	1.0	1.0	1.1	0.9	0.9	0.9	0.9	0.9	0.9	0.9
B Fugitive fuel emissions	98.8	98.7	97.8	96.9	95.9	95.2	89.7	63.8	61.1	54.4	51.5	51.3	50.9	50.6
1 Solid fuel transformation	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.5	1.4	1.2	1.1	1.1	1.1	1.1
2 Oil and gas	97.4	97.3	96.3	95.5	94.4	93.7	88.2	62.3	59.7	53.2	50.4	50.2	49.9	49.5
2. Industrial processes	**14.1**	**14.1**	**14.1**	**14.1**	**14.1**	**14.1**	**14.1**	**14.1**	**14.1**	**14.2**	**14.3**	**14.2**	**14.7**	**14.8**
3. Solvent and other product use	**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**
4. Agriculture	**490.1**	**496.0**	**487.8**	**480.9**	**470.8**	**479.2**	**470.4**	**460.8**	**446.0**	**440.9**	**434.3**	**433.0**	**413.3**	**404.1**
A Enteric fermentation	348.7	353.7	347.0	340.3	335.9	334.4	327.6	318.4	314.0	311.3	307.0	307.5	292.9	288.7
B Manure management	141.4	142.3	140.8	140.6	134.8	144.8	142.8	142.4	132.0	129.5	127.3	125.5	120.4	115.4
5. Land use change and forestry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**585.8**	**591.5**	**580.3**	**564.8**	**543.1**	**515.0**	**498.1**	**482.4**	**462.3**	**424.3**	**399.9**	**376.5**	**359.5**	**332.5**
A Solid waste disposal on land	571.9	572.3	560.5	544.5	526.8	500.1	483.3	467.8	447.8	409.6	385.7	362.7	345.4	322.6
B Waste water handling	13.8	18.4	18.3	18.3	13.4	11.5	11.3	11.0	11.0	11.2	10.5	10.5	10.7	9.9
7. Other	**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**

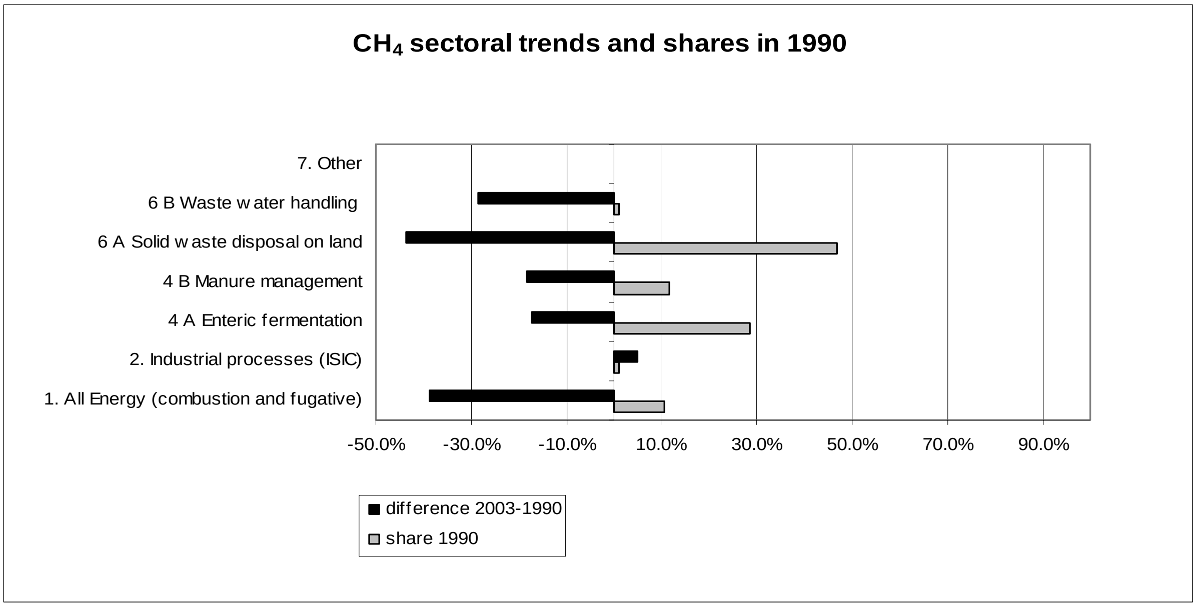


Figure 2.7. CH_4 emission shares and trends per IPCC sector, 1990-2003 (%)

Nitrous oxide

In *Table 2.5* and *Figure 2.8* the trend in nitrous oxide emissions is presented per source category. In 2003, total N_2O emissions *decreased* by about 19% compared to 1990, mainly due to the decrease in the emissions from industrial processes (including indirect N_2O from non-agricultural sources) and agriculture of 1.8 and 2.1 Tg CO_2-eq., respectively. This partly compensated increases due to fossil fuel combustion (mainly from transport) of 0.2 Tg CO_2-eq. (see *Table 2.7* and *Figure 2.10*). In 2003, total N_2O emissions decreased by 4% compared to 2002, mainly due to decreases in the agricultural and industrial processes sectors.

Table 2.5. N_2O emissions per IPCC sector, 1990-2003 (Gg)

IPCC sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NET NATIONAL EMISSIONS	**68.7**	**70.0**	**72.2**	**74.6**	**71.9**	**72.3**	**71.6**	**70.8**	**70.0**	**67.6**	**64.2**	**60.9**	**58.0**	**55.9**
1. All Energy (comb. & fugitive)	**1.7**	**1.8**	**2.0**	**2.1**	**2.2**	**2.3**	**2.4**	**2.4**	**2.5**	**2.4**	**2.4**	**2.5**	**2.5**	**2.5**
A Fuel combustion total	1.7	1.8	2.0	2.1	2.2	2.3	2.4	2.4	2.5	2.4	2.4	2.5	2.5	2.5
1 Energy transformation	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7
2 Industry	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
3 Transport	0.9	1.0	1.2	1.3	1.4	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.5
4 Small combustion	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1
5 Other	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
B Fugitive fuel emissions	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
2. Industrial processes	**27.4**	**27.7**	**27.9**	**29.5**	**28.2**	**26.9**	**26.8**	**26.6**	**26.5**	**25.7**	**25.4**	**23.5**	**22.5**	**21.7**
3. Solvent and other product use	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.6**	**0.6**	**0.6**	**0.5**	**0.5**	**0.4**	**0.4**	**0.3**	**0.3**
4. Agriculture	**37.3**	**38.1**	**40.0**	**40.6**	**39.0**	**40.8**	**40.1**	**39.6**	**38.9**	**37.5**	**34.4**	**33.0**	**31.2**	**30.2**
5. Land-use change and forestry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**1.7**	**1.7**	**1.7**	**1.7**	**1.7**	**1.6**	**1.6**	**1.6**	**1.6**	**1.6**	**1.5**	**1.5**	**1.5**	**1.3**
7. Other	**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**

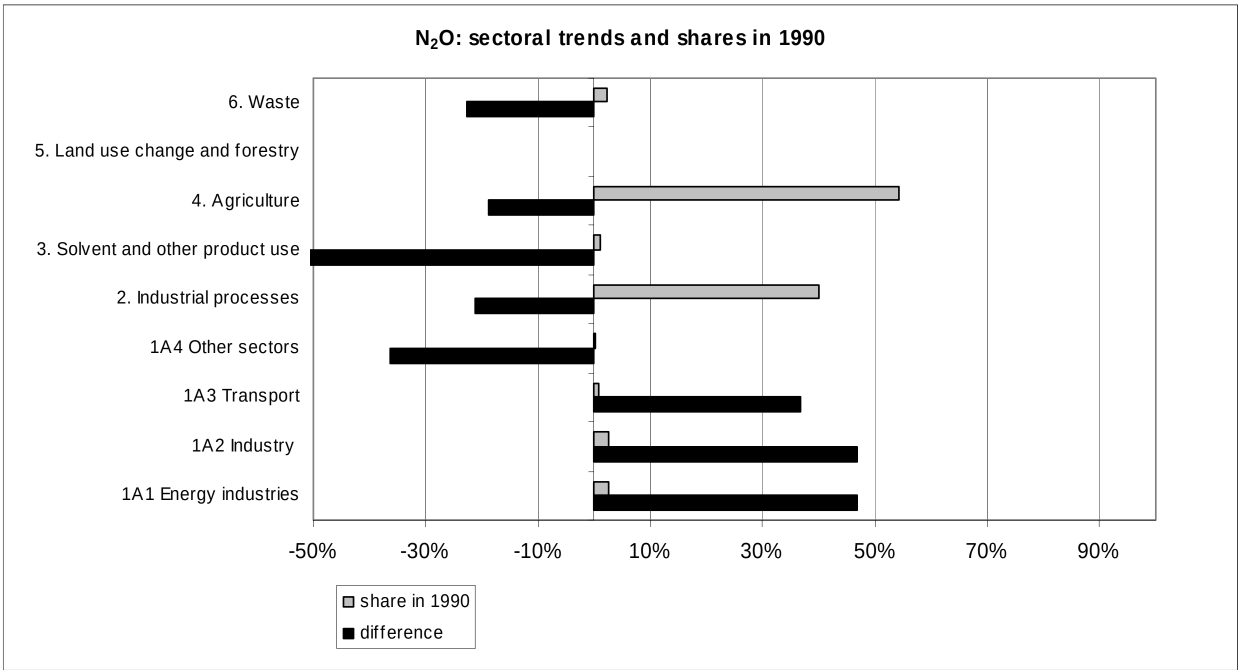


Figure 2.8. N_2O emission shares and trends per IPCC sector, 1990-2003 (%)

F-gases

In *Table 2.6* and *Figure 2.9* the trend in F-gas emissions is presented per source category. In 2003, total emissions of all F-gases decreased by about 60% compared to the 1995 level (a 53% decrease compared to 1990), which is equivalent to 5 Tg CO_2-eq. Emissions of HFCs and PFCs decreased by about 75% and 23% in 2003, respectively, while SF_6 emissions increased by 11%. In 2003, HFC, PFC and SF_6 emissions decreased by 7%, 1% and 7% compared to 2002, respectively.

Table 2.6. Actual emissions of HFCs, PFCs and SF_6, 1990-2003 (Tg CO_2-eq.)

Compound	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
HFC total	4.4	3.5	4.4	5.0	6.5	6.0	7.7	8.3	9.3	4.9	3.8	1.5	1.6	1.4
PFC total	2.1	2.1	1.9	1.9	1.9	1.8	2.0	2.2	1.7	1.5	1.5	1.4	1.4	1.4
SF_6 total	0.2	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.3
Total HFC/PFC/SF_6	6.8	5.7	6.5	7.1	8.6	8.1	10.0	10.8	11.4	6.7	5.7	3.3	3.3	3.2

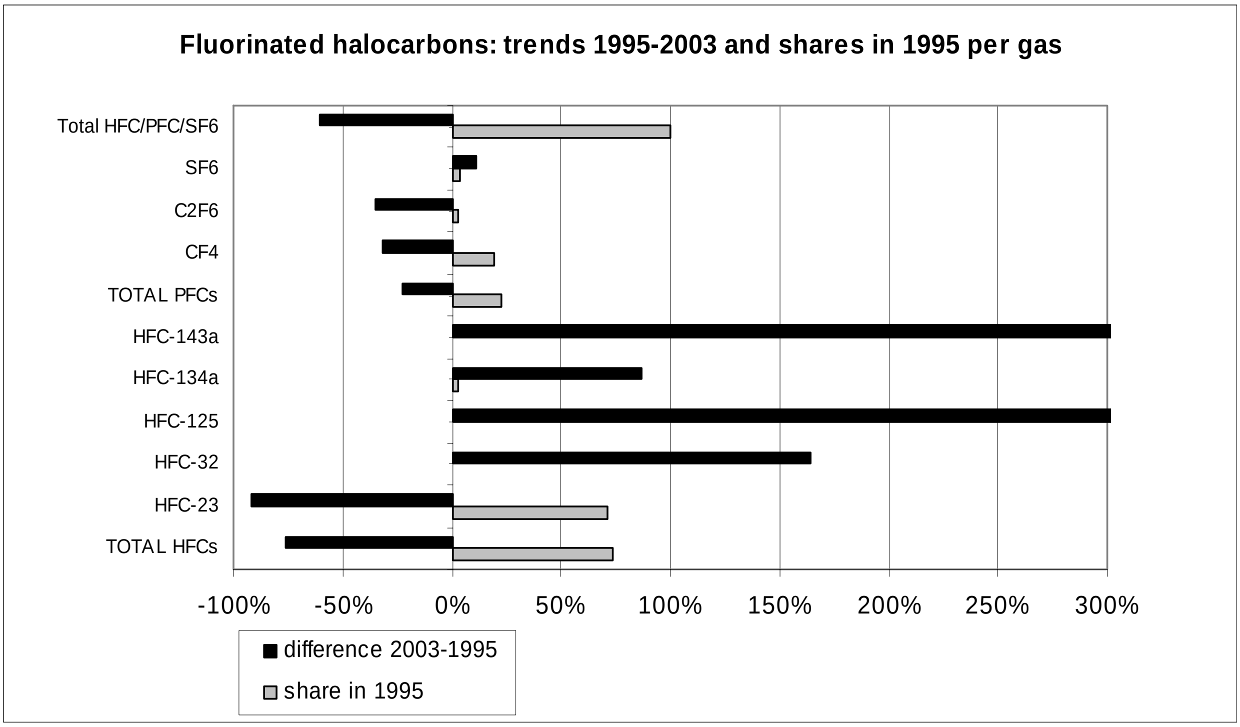


Figure 2.9. Shares and trends in actual emissions of fluorinated gases, 1995-2003 (%)

2.3 Emission trends by source

Table 2.7 provides an overview of the CO_2-eq. emission trends 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 with a share that increased from 70% in 1990 to about 80% in 2003. In contrast, emissions of the other main categories decreased, the largest being those of industrial processes (from 11 to 8% share), waste (from 6 to 3% share) and agriculture (from 10 to 8% in 2003).

In *Figures 2.4* and *2.10* the trend in *total* CO_2-eq. emissions (i.e. for all six gases jointly) is presented per IPCC source category. From *Figure 2.10* it can be concluded that the sectors showing the largest growth in CO_2-eq. emissions since 1990 are the transport sector and energy industries (both 30%). Energy as a whole showed a growth of about 14%. Clear exceptions are the waste sector, industrial processes and agriculture, which showed a decrease in CO_2-eq. emissions of 42%, 28%, and 18% respectively. Emissions from the residential and service sectors increased by 14% but these are substantially influenced by weather effects: when the temperature correction was included, these emissions increased by 3%.

2.3.1 Energy Sector

The emissions from the Energy sector are dominated by CO_2 from fossil fuel combustion, with fugitive emissions from gas and oil (methane and CO_2) contributing a few per cent and CH_4 and N_2O from fuel combustion adding one per cent.

In 2003 the Energy sector accounted for 80% of total emissions (without LUCF) in the Netherlands. The subsector *Energy Industries* (1A1) is the largest source category within the Energy sector, accounting for 40% of emissions from the Energy sector and 32% of total emissions (excl. LUCF) in the Netherlands. Subsectors *Manufacturing Industries and Construction* (1A2), *Transport* (1A3), and *Other sectors* (1A4) (residential, services and agriculture/fisheries) contributed 16%, 20% and 24%, respectively, to total Energy sector emissions in 2003.

Table 2.7. Summary of emission trend per source category and gas (unit: Tg CO_2-eq.)

Source category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1A. Energy: fuel combustion	**149.6**	**154.7**	**153.6**	**158.5**	**157.6**	**161.7**	**169.6**	**162.4**	**164.9**	**159.5**	**161.7**	**167.9**	**167.5**	**170.5**
CO_2: 1. Energy industries	51.6	52.3	52.4	54.7	57.5	61.1	62.2	63.0	65.3	61.5	63.2	67.3	66.6	67.3
CO_2: 2. Manufacturing industries	32.8	32.2	32.8	32.1	30.5	27.9	28.6	27.1	27.3	27.1	26.6	25.9	26.7	27.1
CO_2: 3. Transport	26.0	26.3	27.5	28.2	28.6	29.1	29.9	30.3	31.0	32.0	32.4	32.9	33.6	34.2
CO_2: 4. Other sectors	37.4	42.1	39.0	41.7	39.3	41.6	46.9	40.1	39.2	37.0	37.6	39.9	38.8	40.2
CO_2: 5. Other	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.5	0.4
CH_4	0.7	0.7	0.7	0.7	0.6	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6
N_2O	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.8
1B2. Fugitives emissions	**3.3**	**3.3**	**3.2**	**3.0**	**3.1**	**3.0**	**3.0**	**2.1**	**2.1**	**2.0**	**1.9**	**1.9**	**1.9**	**1.9**
CO_2	1.2	1.2	1.2	1.0	1.1	1.0	1.1	0.8	0.8	0.8	0.8	0.8	0.8	0.9
CH_4	2.1	2.1	2.1	2.0	2.0	2.0	1.9	1.3	1.3	1.1	1.1	1.1	1.1	1.1
N_2O	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
2. Industrial processes [1)]	**23.6**	**22.5**	**22.9**	**23.7**	**25.5**	**24.9**	**26.5**	**27.6**	**27.6**	**22.6**	**21.4**	**17.7**	**17.4**	**16.9**
CO_2	8.0	8.0	7.4	7.2	7.9	8.2	7.9	8.3	7.7	7.7	7.5	6.9	6.8	6.7
CH_4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
N_2O	8.5	8.6	8.6	9.2	8.8	8.3	8.3	8.3	8.2	8.0	7.9	7.3	7.0	6.7
HFCs	4.4	3.5	4.4	5.0	6.5	6.0	7.7	8.3	9.3	4.9	3.8	1.5	1.6	1.4
PFCs	2.1	2.1	1.9	1.9	1.9	1.8	2.0	2.2	1.7	1.5	1.5	1.4	1.4	1.4
SF_6	0.2	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.3
3. Solvent & other product use [1)]	**0.5**	**0.5**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.4**	**0.4**	**0.3**	**0.3**	**0.2**	**0.3**
CO_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
CH_4	IE (7)	IE (7)	IE (7)	IE (7)	IE (7)	IE (7)	IE (7)	IE (7)	IE (7)	IE (7)	IE (7)	IE (7)	IE (7)	IE (7)
N_2O	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
4. Agriculture	**21.8**	**22.2**	**22.6**	**22.7**	**22.0**	**22.7**	**22.3**	**22.0**	**21.4**	**20.9**	**19.8**	**19.3**	**18.4**	**17.8**
CH_4: Enteric fermentation	7.3	7.4	7.3	7.1	7.1	7.0	6.9	6.7	6.6	6.5	6.4	6.5	6.2	6.1
CH_4: Manure management	3.0	3.0	3.0	3.0	2.8	3.0	3.0	3.0	2.8	2.7	2.7	2.6	2.5	2.4
N_2O: Manure management	0.7	0.7	0.7	0.8	0.7	0.7	0.7	0.7	0.8	0.8	0.7	0.7	0.7	0.6
N_2O: Agricultural soils	10.9	11.1	11.7	11.8	11.4	11.9	11.7	11.6	11.3	10.8	9.9	9.5	8.9	8.8
5. LUCF	**2.9**	**2.8**	**2.7**	**2.6**	**2.6**	**2.7**	**2.7**	**2.8**	**2.7**	**2.7**	**2.8**	**2.8**	**2.8**	**2.8**
CO_2	2.9	2.8	2.7	2.6	2.6	2.7	2.7	2.8	2.7	2.7	2.8	2.8	2.8	2.8
6. Waste	**12.8**	**13.0**	**12.7**	**12.4**	**11.9**	**11.3**	**11.0**	**10.6**	**10.2**	**9.4**	**8.9**	**8.4**	**8.0**	**7.4**
CO_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
CH_4	12.3	12.4	12.2	11.9	11.4	10.8	10.5	10.1	9.7	8.9	8.4	7.9	7.5	7.0
N_2O	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.4
7. Other	**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**
NAT. TOTAL EMISSIONS [2)]	**214.6**	**219.0**	**218.1**	**223.3**	**223.3**	**226.7**	**235.4**	**227.9**	**229.3**	**217.5**	**216.8**	**218.3**	**216.2**	**217.6**
Memo item, not included in total:														
International bunkers	**38.9**	**40.3**	**41.4**	**43.3**	**41.7**	**43.1**	**44.4**	**47.3**	**48.6**	**50.2**	**52.6**	**56.7**	**56.6**	**53.4**
Marine	**34.3**	**35.4**	**35.7**	**37.0**	**35.1**	**35.5**	**36.3**	**38.5**	**39.0**	**40.3**	**42.8**	**47.2**	**46.6**	**43.6**
CO_2	34.2	35.3	35.6	36.9	35.0	35.4	36.2	38.4	38.9	40.2	42.7	47.0	46.5	43.4
CH_4	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
N_2O	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
Aviation	**4.6**	**4.9**	**5.7**	**6.2**	**6.6**	**7.6**	**8.1**	**8.8**	**9.6**	**9.9**	**9.8**	**9.6**	**10.0**	**9.9**
CO_2	4.5	4.8	5.6	6.2	6.5	7.6	8.1	8.7	9.6	9.8	9.7	9.5	10.0	9.8
CH_4	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
N_2O	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

[1)] 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*'.

[2)] The national total does not include the CO_2 sink reported under category 5A. This CO_2 sink is not complete and refers to the definition under the *UN Framework Convention on Climate* Change (UNFCCC), which is different from the amount to be calculated under the *Kyoto Protocol (*see *Section 1.1.2).*

Since 1990, emissions from the Energy sector have increased by about 13%, mainly due to the increase in CO_2 emissions in the electricity and heat production sector (37%) and transport sector (31%). The largest increase in emissions (15 Tg) occurred in the electricity and heat production sector. Half of the marked increase of almost 30% between 1990 and 1998 was 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). The decrease in the electricity production sector (1A1a) in 1999 is due to the marked increase of imported electricity since 1999, which almost doubled compared with 1998, and to a relatively large shift from coal to residual chemical gas and natural gas in 1999.

The increase in net import of electricity since 1999 (see *Table 3.7*) resulted in a mitigation by about 10%-points, which is equivalent to about 4 Tg of CO_2 coming from domestic fossil-fuel generated electricity. The decrease of over 15% in fossil fuel-related emissions in the manufacturing industry (1A2) in the early 1990's is again caused by the shift of cogeneration emissions to the public electricity and heat production sector due to a change of ownership (joint-ventures).

Between 2002 and 2003, total Energy sector emissions increased by 1.8% mainly as a result of increased emissions for space heating (1A4) due to the relatively mild winter in 2002 and the more normal winter in 2003 (see *Table 3.2*), and further increases in the electricity production and transport sectors.

Since 1990 fugitive CH_4 emissions from oil and natural gas decreased by 49% and decreased 0.7% between 2002 and 2003.

2.3.2 Industrial processes

The greenhouse gas emissions from Industrial Processes have decreased by 30% since 1990. As can be seen in *Table 2.7,* CO_2 emissions from industrial processes, mainly from ammonia production, iron and steel production but also from cement production and the use of dolomite and limestone, and N_2O emissions, mainly from nitric acid manufacture, are the main contributors to this source category.

In 2003 emissions from the Industrial Processes sector contributed 8% of total national emissions (without LUCF), the same proportion as in 2002, compared with 11% in 1990. Emissions of CO_2 and N_2O accounted each for 40% per cent of CO_2 equivalent emissions from the sector, and CH_4, HFCs, PFCs and SF_6 for 2%, 9%, 8% and 2% of the sector emissions, respectively, in 2003. F-gas emissions had a share of almost 33% in total source category emissions in 1995. Emissions of N_2O from industrial processes accounted for 39% of national total N_2O emissions. Thus, at present, CO_2 and N_2O emissions cover each about 40% of the sector total, the rest mainly stemming from HFCs and PFCs.
From 1990 to 2003, emissions of the sector declined by 28%, and from 2002 to 2003 they decreased by 3.0%. The strong decreasing trend in HFC emissions of 2/3 reduction since 1990 and 3/4 reduction since 1995, notably of HFC-23 from HCFC-22 manufacture, is primarily responsible for the decreasing trend in this source category.

Total CO_2 emissions from the sector decreased by 17% from 1990 to 2003, mainly due to decreasing emissions from the iron and steel and chemical industries, and by 1.3% from 2002 to 2003. N_2O emissions fell by 21% from 1990 to 2003, mainly due to a decrease of 20% in emissions from nitric acid production but also other sources decreased by a similar percentage, and decreased by 3.7% from 2002 to 2003. CH_4 emissions, although trivial, decreased by 5% from 1990 to 2003.

HFC emissions decreased by 76% from 1995 to 2003 and decreased by 7% from 2002 to 2003; PFC emissions decreased by 23% from 1995 to 2003 and by 1.4% from 2002 to 2003; and SF_6 emissions increased by 11% from 1995 to 2003 and decreased by 7% from 2002 to 2003. The decreases of HFC and PFC emissions are mainly due to decreases in by-product emissions from HCFC-22 and aluminium manufacture, respectively. HFC and PFC emissions from the *use* of these compounds have increased substantially over time, as a result of substitution for traditional (H)CFCs and halons.

2.3.3 Solvents and other product use

In 2003 emissions from the Solvent and Other Product Use sector contributed only 0.1% of total national emissions (without LUCF), compared with 0.3% in 1990. Indirect emissions of CO_2 and N_2O for dispersive uses accounted for 64% and 36% of CO_2 equivalent emissions from the sector, respectively. We note that direct non-energy use of fuels (e.g. lubricants, waxes, etc.) are not reported in this category but are included in the industrial process emissions reported under the other subcategory (2G).

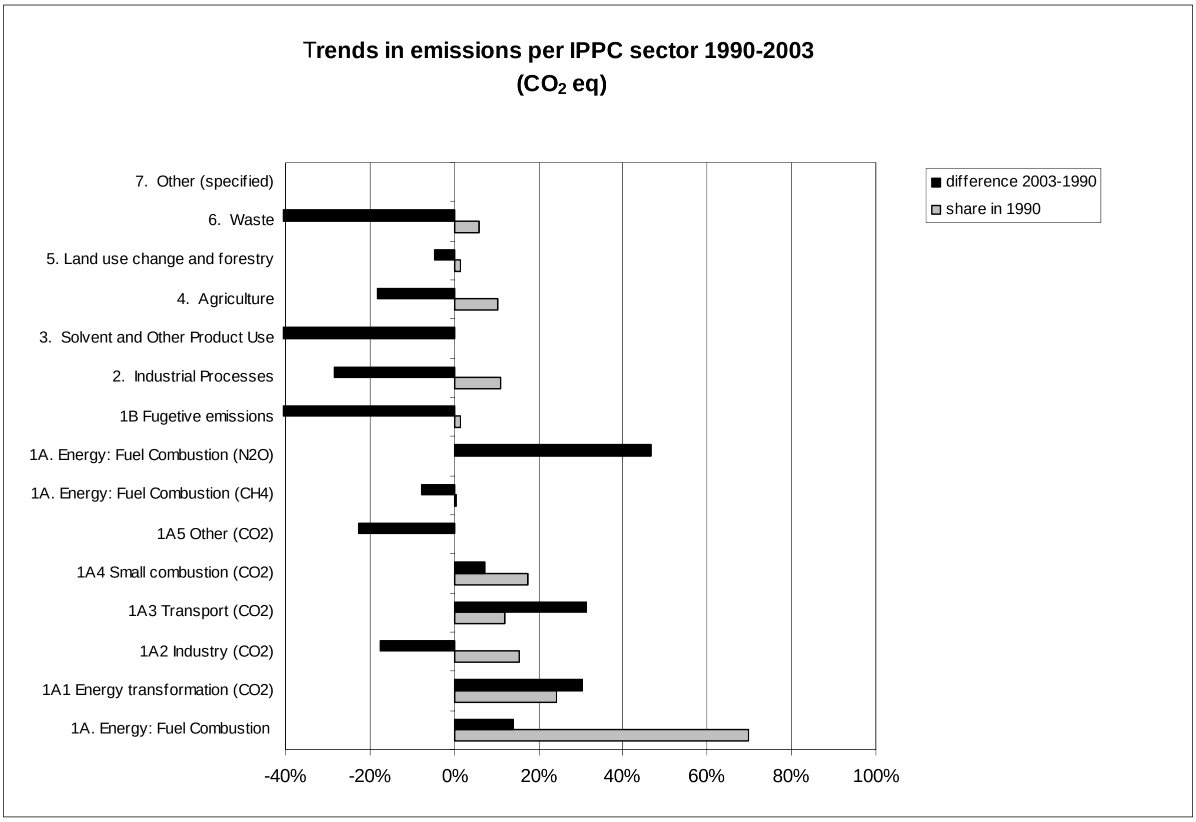


Figure 2.10. Shares and trends of greenhouse gas emissions per sector 1990-2003 (1995-2003 for F-gases), in CO_2-eq. (no temperature correction).

From 1990 to 2003, emissions of the sector declined by 54%, and from 2002 to 2003 they decreased by 0.6%. CO_2 emissions from the sector decreased by almost 50% from 1990 to 2003, mainly due to decreasing indirect emissions, in particular from paints, due to the emission reduction programme for NMVOC. N_2O emissions fell by 60% from 1990 to 2003 due to better dosing of anaesthesia and decreasing use of N_2O in spray tins.

The emissions from '*Solvent and other product use'* (category 3) should also be discussed in conjunction with (very small) methane emissions reported under category 2G, since the IPCC tables do not allow for methane emissions under category 3.

2.3.4 Agriculture

In 2003 emissions from the Agriculture sector contributed 8% of total national emissions (without LUCF), compared with 10% in 1990. Emissions of N_2O accounted for 54% per cent of CO_2 equivalent emissions from the sector in 2003, and CH_4 for the remainder. Emissions of N_2O from agriculture, mainly from animal wastes applied to soils and indirect emissions from nitrogen leaching and run-off (LRO) of agricultural soils, accounted for 54% of national total N_2O emissions. CH_4 emissions from agriculture, for ¾ from enteric fermentation and ¼ from animal waste management systems, accounted for 49% of the national total CH_4 emissions in 2003.

From 1990 to 2003, emissions of the sector declined by 18%, and from 2002 to 2003 they decreased by 2.8%. Total CH_4 emissions from the sector decreased by 18% from 1990 to 2003, mainly due to decreasing numbers of dairy cattle (-26%) and also decreasing livestock numbers of non-dairy cattle and swine (of about 20%).

Total N_2O emissions from the sector decreased by 19% from 1990 to 2003, largely due to a decrease in emissions from LRO, synthetic fertilisers and cattle on grasslands. These changes are mainly due to decreasing use of synthetic fertilisers (-29%) and less cattle on grasslands (-45%) and less animal waste applied to soils (-25%) [although the change in method of injecting manure into the soils instead of surface spreading (incorporation into the soil with the aim of reducing ammonia emissions from soils) increased the related emissions]. Subsequently, also the indirect N_2O emissions from LRO and from atmospheric deposition also decreased by 30% and 40%, respectively. The decrease since 1998 is mainly due to a reduction of the use of synthetic fertilisers. From 2002 to 2003 N_2O and CH_4 emissions from the sector decreased by 4% and 0.3%.

2.3.5 Changes in biomass stocks (LUCF)

In 2003 the Land Use Change and Forestry (LUCF) sector accounted for 1.3% per cent of gross total emissions (i.e. including LUCF). The subcategory 'CO_2 Emissions/Removals from Soils' (5D) is the major emissions source category in the sector (4.5 Tg), accounting for about 2/3 of all emissions/removals from the LUCF sector, whereas the net removals of subcategory 'Changes in Forest and Other Woody Biomass Stocks'(5A) account for about 1/3 (-2.3 Tg). In addition, emissions from 'Forest and Grassland Conversion' (5B) contribute 0.9 Tg; removals from 'Abandonment of Managed Land' (5C) are the smallest contribution to the sector total (-0.3 Tg) in 2003.

From 1990 to 2003, emissions from the LUCF sector decreased by 5% (-0.1 Tg CO_2) from 2.9 Tg CO_2 to 2.8 Tg CO_2, primarily due to increased removals from abandonment of managed land (-0.3 Tg) and a small decrease of emissions from CO_2 emissions from soils (-0.1 Tg), which were partly compensated by a less removals from changes in forest and other woody biomass stocks (+0.2 Tg). Between 2002 and 2003 no changes in emissions/removals by the LUCF sector are reported due to lack of new monitoring data.

2.3.6 Waste

In 2003 the waste sector accounted for 3% of total national emissions (without LUCF) compared with 6% in 1990. Emissions of CH_4 and N_2O accounted for 95% and 5% of CO_2 equivalent emissions from the sector, respectively. Emissions of CH_4 from waste, almost all (97%) from landfills (6A), accounted for 40% of national total CH_4 emissions in 2003. The small N_2O emissions from the waste sector are from domestic and commercial wastewater. Please note that 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.

From 1990 to 2003, emissions from the waste sector decreased by 42%, mainly due to 44% reduction in CH_4 from landfills (6A1 Managed Waste Disposal on Land). This is the result of a) a reduction of 44% of municipal solid waste (MSW) disposal at landfills through increased recovery and recycling of waste for composting and/or incineration, b) decreasing the organic waste fraction of the waste disposed, and c) increased methane recovery from the landfills (from 5% in 1990 to 21% in 2003). From 2002 to 2003 the waste sector's emissions decreased by 8%.

2.3.7 Other

Not applicable, after the major recalculations and reallocation of sources to other CRF sectors.

2.3.8 International transport

International transport is not part of the national total but is reported under the UNFCCC as a separate Memo item '*bunkers*'. Total CO_2 emissions from this source category have increased by 37% or 14.5 Tg since 1990. In particular, marine bunker emissions contributed to this increase (+28% or 9.3 Tg) due to the marine bunkers large share in this category, but percentage-wise the emissions from international aviation increased much more (+115% or about 5 Tg). Total international transport emissions increased as fraction of the national total greenhouse gas emissions plus international transport (but excluding LUCF) from 20% in 1990 to 23% in 2003.

2.4 Emission trends for indirect greenhouse gases and SO_2

Trends in total emissions of CO, NO_x, NMVOC and SO_2 are presented in *Table 2.8* and in *Figure 2.11*. Because of the problems identified with annual environmental reports (see *Box 1.1*) emissions of CO are not validated; however, experts on these emissions suggested that possible errors are small. The CO and NMVOC emissions were reduced in 2003 by 46% and 53% respectively, compared to 1990. For SO_2 this is even 66%, and for NO_x, the 2003 emissions are 35% lower than the 1990 level. We recall that 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 differ to some extent from the IPCC approach (see *Section 3.2.3*). Due to recalculations, which have not been performed for 1991-1994 for all sources, the trends show a discontinuity for these years. Except for NMVOC, most of the emissions stem from fuel combustion, of which the uncertainty in the emission factor for NO_x, CO and NMVOC is often estimated to be in the range of 10-50%. For SO_2 emission factors from fuel combustion (basically the sulphur content of the fuels) the uncertainty is estimated at 5%. For most compounds the uncertainty in the activity data is small compared to the accuracy of 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 about 25% for NMVOC (TNO, 2004; RIVM, 2004).

Table 2.8. Trend in emissions of ozone and aerosol precursors.

Compound	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Emissions in Gg														
Total NO_x	560.1	431.6	422.9	406.6	380.4	475.0	455.3	418.2	410.1	413.6	395.3	384.1	373.0	366.3
Total CO	1127.0	785.1	751.5	708.4	691.4	849.0	832.1	753.7	744.6	721.3	696.4	660.6	628.4	611.2
Total NMVOC	482.7	278.1	261.6	246.7	242.8	355.8	321.9	290.3	289.1	278.3	259.1	241.0	229.1	225.2
Total SO_2	189.5	107.7	100.7	98.3	86.5	127.8	120.5	101.7	93.5	88.2	73.1	73.2	65.7	64.8
Index (1990 = 100)														
Index total NO_x	100	77.1	75.5	72.6	67.9	84.8	81.3	74.7	73.2	73.8	70.6	68.6	66.6	65.4
Index total CO	100	69.7	66.7	62.9	61.3	75.3	73.8	66.9	66.1	64.0	61.8	58.6	55.8	54.2
Index total NMVOC	100	57.6	54.2	51.1	50.3	73.7	66.7	60.1	59.9	57.7	53.7	49.9	47.5	46.7
Index total SO_2	100	56.8	53.1	51.8	45.6	67.4	63.6	53.6	49.3	46.5	38.6	38.6	34.6	34.2

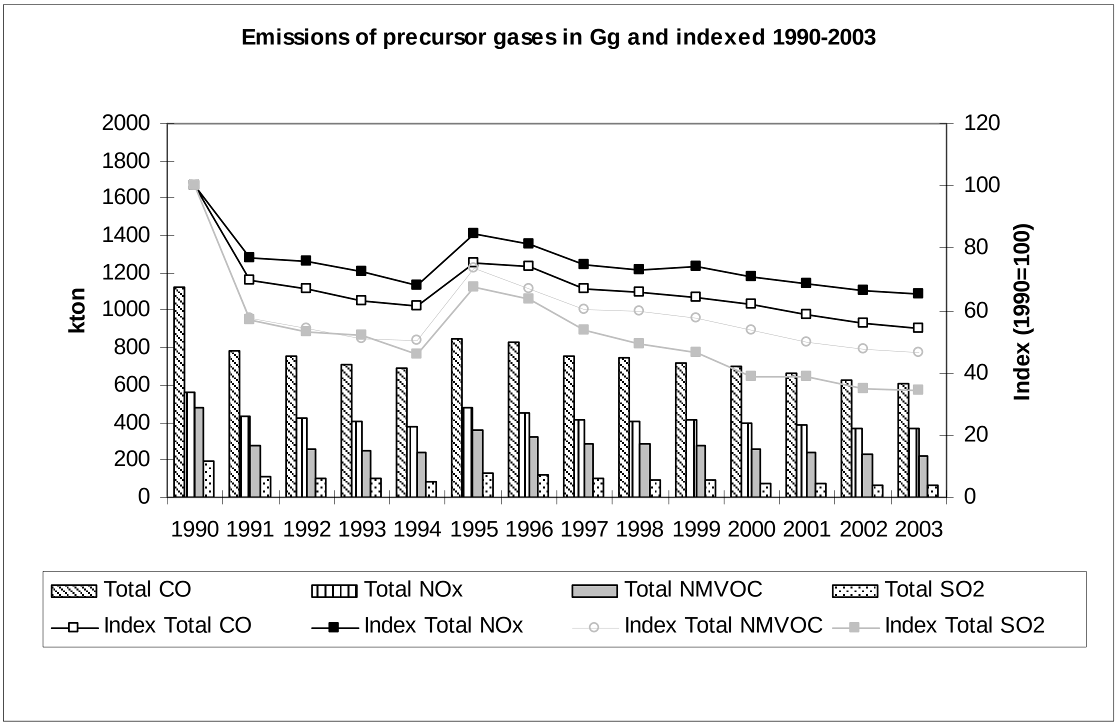


Figure 2.11. Trends in total emissions of NO_x, CO, NMVOC and SO_2.

3. ENERGY [CRF sector 1]

Major changes in Energy sector compared to previous National Inventory Report

Emissions: Decreased CO_2 emissions for the complete fuel combustion (1A) time series (6% and 4% lower, i.e. -9 Tg in 1990 and -7 Tg in 2002, i.e. respectively), in particular due to reallocation of industrial process emissions from the manufacturing industry (iron and steel and chemicals) to the industrial processes sector. Other reallocations are a shift of joint-venture cogeneration by the (chemical) industry to public power generation and off-road machinery from other transport to other manufacturing industry (1A2f) and the agricultural sector (1A4c). Emissions from fisheries and military aviation and shipping, previously included in international bunkers are now separately estimated and reported as part of the fuel combustion sector 1A (both about 0.5 Tg). Smaller changes are found in decreased CH_4 emissions due to revision of emissions from gas venting and gas distribution (both 40 Gg less). In addition, the Standard Data Tables in the CRF spreadsheets are now complete, transparent and consistent over time.
Key sources: 1A1-CO_2 from fossil waste incineration, 1B1-CO_2 from coke production and 1B2-CO_2 Fugitive from venting/flaring are now *key sources;* 1A2-CO_2 Feedstocks, 1A2-CO_2 Iron and Steel, 1A3-CO_2 Mobile combustion other (i.e. off-road machinery) are *removed from the key source list* due to reallocation to other source categories (sectors 2 and 3 and off-road to 1A2f and 1A4c).
Methodologies: Major methodological changes are found in the fuel combustion subsectors energy industries (1A1) and manufacturing industry (1A2) and in fugitives from coke production (1B1) due to the use of national energy statistics and national emission factors instead of individual company data. Others are in fugitive emissions from oil and gas production (venting and flaring) and oil refining (1B2) en gas distribution (1B2) due to the use of higher tier methods and/or other industry data, that greatly improved the time series consistency (though not so much the annual uncertainty). Minor changes occurred in all sectors due to the use of improved activity data and small changes in emission factors of CO_2 and CH_4 for stationary combustion; recalculation sections were added for all (sub)sectors.

3.1 Overview of sector

Subcategories of the energy sector are subdivided into two main subsectors: fuel combustion (1A) and non-combustion or fugitive (1B) fuel-related sources:

A. Combustion fuel-related emissions:
- Energy industries (power generation, refineries, oil and gas production, coke ovens) (1A1);
- Manufacturing industry and construction (1A2);
- Transport (domestic) (1A3);
- Other sectors (residential, services, agriculture/fisheries) (1A4);
- Other (military ships and aircraft) (1A5);

B. Non-combustion fuel-related emissions from the energy production and transformation industries:
- Solid fuels (coke manufacture) (1B1);
- Oil and gas (production, gas processing, oil refining, transport, distribution) (1B2).

The trends in greenhouse gas emissions from the energy sector are summarised in *Table 3.1*. Obviously, fuel combustion is the dominant source here for CO_2 emissions, whereas most methane emissions stem from fugitive sources. From this table it can be observed that the emissions from the energy industries, notably electric power generation, and from transport have increased substantially over time. Emissions from the other sectors tend to vary considerably over the years because of the variation of the winter weather over time, requiring more or less space heating. As the IPCC inventory guidelines do not require corrections of the emissions for this yearly variation in space heating, *no* corrections are reported in the CRF tables. To assess the effects of implemented policies on the trend of *anthropogenic* emissions a correction has been calculated for CO_2 emissions from gas combustion for space heating to filter out the effect of interannual changes due to variation in the weather. The results of the additional estimation from this so-called ‘temperature correction for CO_2’ can be found in *Section 3.1.1*.

Table 3.1. Trends in greenhouse gas emissions from the energy sector (unit: Tg CO_2-eq.)

Source category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1A. Energy: Fuel Combustion	**149.6**	**154.7**	**153.6**	**158.5**	**157.6**	**161.7**	**169.6**	**162.4**	**164.9**	**159.5**	**161.7**	**167.9**	**167.5**	**170.5**
CO2: 1. Energy Industries	51.6	52.3	52.4	54.7	57.5	61.1	62.2	63.0	65.3	61.5	63.2	67.3	66.6	67.3
CO2: 2. Manufacturing Industries	32.8	32.2	32.8	32.1	30.5	27.9	28.6	27.1	27.3	27.1	26.6	25.9	26.7	27.1
CO2: 3. Transport	26.0	26.3	27.5	28.2	28.6	29.1	29.9	30.3	31.0	32.0	32.4	32.9	33.6	34.2
CO2: 4. Other Sectors	37.4	42.1	39.0	41.7	39.3	41.6	46.9	40.1	39.2	37.0	37.6	39.9	38.8	40.2
CO2: 5. Other	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.5	0.4
CH4	0.7	0.7	0.7	0.7	0.6	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6
N2O	0.5	0.6	0.6	0.7	0.7	0.7	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.8
1B2. Energy: Fugitives from Coal, Oil & Gas	**3.3**	**3.3**	**3.2**	**3.0**	**3.1**	**3.0**	**3.0**	**2.1**	**2.1**	**2.0**	**1.9**	**1.9**	**1.9**	**1.9**
CO2	1.2	1.2	1.2	1.0	1.1	1.0	1.1	0.8	0.8	0.8	0.8	0.8	0.8	0.9
CH4	2.1	2.1	2.1	2.0	2.0	2.0	1.9	1.3	1.3	1.1	1.1	1.1	1.1	1.1
N2O	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

The CO_2 emissions reported here are only the fossil-fuel related emissions, including CO_2 emissions from waste combustion for energy purposes of the waste fraction that contains fossil carbon. According to the IPCC guidelines the CO_2 emissions from biomass combustion, including organic waste combustion, are assumed not to contribute to net CO_2 emissions and are therefore not included in the national total. In other words, the production of biomass is assumed to be sustainable, (the carbon that is oxidised during combustion will be absorbed by plants for growth within a limited number of years). If this is not the case, resulting net CO2 emissions are taken into account by a correction made in the CO_2 emissions reported in the *Land Use Change and Forestry* sector (IPCC category 5). The inventory also provides separate information on CO_2 from combustion of organic carbon sources (biomass combustion), which is discussed in *Section 3.1.2*.

The greenhouse gas emissions from subcategories 1A1, 1A2 and 1B2 are not based on individual company reports 'annual environmental reports' ('MJVs') (the part of the national pollutant emission register called 'ER-I'), since these generally do not provide transparent and complete fuel use and emissions data at the required the level of detail (see *Section 1.2*). As of this year all stationary and mobile fuel combustion emissions of greenhouse gases were calculated using fuel consumption data from national sectoral energy statistics and national default emission factors for CO_2, CH_4 and N_2O, except for CO_2 from large industries where plant-specific or source-specific emission factors have been used when available and reliable and for gas combustion in the residential sector where cooking losses were estimated as part of the CH_4 emissions. Source-specific N_2O emission factors are applied to road transport and other transport categories (see *Section 3.2.3*). Most of the energy statistics for public power generation, refineries and industries are based on individual company data collected via regular energy surveys. For a few sources, such as off-road machinery used in agriculture and construction, fuel consumption by the fishing fleet and domestic shipping and aviation, the standard sectoral energy statistics needed to be split to comply with the IPCC and UNFCCC guidelines for reporting under specific source categories. More details on methodologies, data sources used and country-specific source allocation issues are provided in *Annex 2*.

We note that within the time series of energy balances, *Statistics Netherlands* (CBS) considers the datasets for 1995 to year *t-3* (i.e. now to 2002) the most accurate, then the data for 1990, and next data for the most recent year (i.e. 2003). Sectoral datasets for the years 1991 to 1994 are relatively the most uncertain, which is due to different sectoral definitions used at that time and limited efforts by *Statistics Netherlands* (CBS) and others to improve the original dataset, amongst others the elimination of the statistical differences between apparent consumption, and the sum of sectoral energy consumption by fuel type. This improvement of the energy statistics carried out has affected all source categories (see NIR 2002 for details on sectoral consequences in CO_2 emissions; Olivier *et al.*, 2002).
The Netherlands now reports CO_2 emissions related to feedstock use of fossil fuels and other non-energy use under '*Industrial processes*' (source category 2) as required by the UNFCCC reporting guidelines, unless the production and combustion of residual gases in chemical industries or refineries resulting from these processes are accounted for and included in the national energy statistics. In those cases, following the principle that emissions from all fuel combustion should be reported under the energy sector 1A, these emissions have indeed been allocated here (see *Sections 3.2.1* and *3.2.2* for more details).

As of this year, CO_2 emissions from carbon losses from coke and coal input as reducing agent in blast and oxygen furnaces in the iron and steel industry, although producing blast furnace and oxygen furnace gas as by-products which are subsequently used as fuels for energy purposes, are also reported under CRF sector 2 '*Industrial processes'*. This is in accordance with the IPCC *Good Practice Guidance*, which state that the primary purpose of these solid fuels here is the reduction of the iron ore and the pig iron. However, the carbon contained in the blast furnace and oxygen furnace gas is not reported in sector 2 but subtracted from the carbon balance calculation for the steel industry, since the production and consumption of these gases are included in the national energy statistics and the CO_2 emissions from their combustion are automatically reported in the energy sector.

Finally, we note that the (indirect) CO_2 emissions from non-energy products during their use are now calculated from the carbon fraction in non-combustion NMVOC emissions from solvent and other product and reported under '*Solvents and other product use*' (source category 3).

The characteristics of the Netherlands' country-specific circumstances are reflected in both the energy balance and the related emissions presented in *Table 3.1*. The Netherlands produces large amounts of natural gas (and also some oil), both onshore (e.g. Groningen gas) and offshore (so-called 'small gas fields'). The Netherlands has closed its last active coal mines in the late 1960's. Due to the large domestic source, natural gas has a very large share in energy consumption in all non-transport sectors: other sectors (mainly for space heating), in industry and power generation. The Netherlands has one of the highest shares of coal-fired power stations in public electricity production. Natural gas production generates related emissions such as methane fugitive emissions and relatively low-level CO_2 emissions from its combustion. Furthermore, the Netherlands makes use of the location of Rotterdam harbour at the mouth of the Rhine, for housing its five major refineries, which export about half their products to the European market. As a consequence, the Netherlands also has a relatively large petrochemical industry and Rotterdam is the world's largest supply of marine bunker oils. Moreover, Schiphol Airport is Western Europe's largest supplier of aviation bunker fuels (jetfuel). The large petrochemical industry is responsible for the Netherlands having the highest share of CO_2 from non-energy/feedstock use of fuels of all industrialised countries, i.e. OECD or Annex I countries, when referring to the Kyoto Protocol (Olivier and Peters, 2005).

Box 3.1.Key source identification in the energy sector using the IPCC Tier 1 and 2 approach (L = Level, T = Trend)

1A1 CO_2	**Emissions from stationary combustion: Energy Industries, excl. waste incin.**	**Key (L,T)**
1A1 CO_2	***Emissions waste incineration, reported in 1A1a***	***Key (L1,T1) ****
1A2 CO_2	**Emissions from stationary combustion: Manufacturing Industries and Constr.**	**Key (L,T)**
1A3 CO_2	**Mobile combustion: road vehicles**	**Key (L,T)**
1A3 CO_2	**Mobile combustion: waterborne navigation**	**Key (L2)**
1A3 CO_2	Mobile combustion: aircraft	Non-key
1A3 CO_2	*Mobile combustion: other (off-road now included elsewhere; see 1A2f and 1A4c)*	-
1A3 CH_4	Mobile combustion: road vehicles	Non-key
1A3 CH_4	Mobile combustion: other	Non-key
1A3 N_2O	Mobile combustion: road vehicles	Non-key
1A4 CO_2	**Emissions from stationary combustion : other sectors**	**Key (L,T1)**
1A CH_4	**Emissions from stationary combustion: non-CO_2**	**Key (L2)**
1A N_2O	Emissions from stationary combustion: non-CO_2	Non-key
1B1 CH_4	*Coal mining*	*Non occurring*
1B1 CO_2	***Coke production: CO_2***	***Key (L2) ****
1B2 CO_2	***Fugitive emissions from venting/flaring: CO_2***	***Key (L2,T1) ****
1B2 CH_4	**Fugitive emissions from oil and gas: gas production**	**Key (T1)**
1B2 CH_4	**Fugitive emissions from oil and gas: gas distribution**	**Key (L2)**
1B2 CH_4	Fugitive emissions from oil and gas operations: other	Non-key

** Changes compared with previous NIR.*

Key sources

Box 3.1 presents the key and non-key sources in the energy sector on the basis of level, trend or both. Since CO_2 emissions make up the largest fraction of the national total emissions, it is not surprising that all CO_2 sources are indeed key sources. This includes the combustion of by-products from blast furnaces in the iron and steel industry (blast furnace gas and oxygen furnace gas) and from the chemical industry (chemical residual gases) for energy purposes.

Of the non-CO_2 combustion sources, only the summed CH_4 emissions from all combustion sources represent a key source. Two-thirds of this stems from fuel combustion in the residential sector, predominantly from gas losses during cooking (1A4b), but also from biofuel combustion that has a much higher emission factor than fossil fuels. Of the non-combustion sources, only the CH_4 emissions from gas production and CH_4 emissions from gas distribution are key sources.
These sources will be discussed per main subcategory in the following sections. Stationary and mobile combustion per fuel type will be discussed per IPCC subsector (1Ax). In case of CO_2 emissions from the combustion of residual gases or by-products such as blast furnace gas, the allocations to sector 1 and 2 and completeness in reporting is explained in the corresponding subsectors of 1A2.

3.1.1 Temperature correction for CO_2

All CO_2 figures presented in the CRF tables and most tables in this report are without a temperature correction. However, the annual variation of heating-degree days in the Netherlands can be considerable, in particular in the category *1A4 'Other sectors'*, where most of the fuel is used for space heating. In 1990 in particular, the winter was relatively very warm, with the 1992, 1994, 1999, 2000 and 2002 winters relatively warm, only the winter of 1996 was relatively cold.

For policy purposes, trends in CO_2 emissions are therefore often corrected for climate variation in fuel consumption for space heating. In *Table 3.2* we present the temperature correction used by RIVM in the trend analysis of sectoral CO_2 emission trends, which is only applied to natural gas consumption since the quantity of other fuels used for space heating is negligible. A full description of the methodology for this correction is provided in *Annex 2.2* and in Spakman *et al*. (2003).

This correction factor for gas consumption varies between -11% in 1996 and +20% in 1990. In 2002 a 4.3 Tg or 2.4% correction of total national CO_2 emissions took place, while in 1990 this correction was 6.2 Tg or 4.6% of total national emissions. Positive figures in the table indicate raised natural gas consumption and thus raised CO_2 emissions due to a relatively warm winter in that calendar year. With the temperature correction, the 1990-2003 increase in CO_2 emissions is 2% less than without this correction.

Table 3.2. Temperature correction for energy and related CO_2 emissions per IPCC sector relative to a 30 year moving average as reference level.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Heating-Degree Days (HDD-t) [HDD]	2677	3163	2829	3076	2835	2917	3504	2929	2821	2676	2659	2880	2720	2913
HDD: 30-year moving average (HDD-av)	3211	3198	3203	3177	3156	3140	3123	3135	3133	3118	3098	3076	3068	3046
T correction factor (=HDD-av/HDD-t)	**1.20**	**1.01**	**1.13**	**1.03**	**1.11**	**1.08**	**0.89**	**1.07**	**1.11**	**1.17**	**1.17**	**1.07**	**1.13**	**1.05**
Reported CO_2 emissions from natural gas [Tg CO_2]														
1A1 Energy	15.1	17.8	18.7	20.0	19.3	19.8	22.4	24.0	24.6	24.9	24.7	26.4	26.9	26.9
1A2ae Industry - heavy	15.5	15.3	15.3	14.5	14.3	13.7	14.0	13.5	13.4	13.0	13.2	12.4	12.0	12.0
1A2f Industry - light	3.3	3.8	3.8	3.7	3.6	3.5	3.7	3.6	3.7	3.7	3.8	3.7	3.5	3.5
1A4a Commercial/institutional	6.6	9.0	8.1	9.1	8.1	9.2	10.8	9.2	9.3	7.7	8.1	9.7	9.9	11.1
1A4b Residential sector	18.5	21.0	18.8	20.0	19.0	20.2	23.7	19.9	18.9	18.7	18.7	19.4	18.4	18.8
1A4c Agriculture and forestry	8.2	8.2	8.3	8.6	8.2	8.2	8.7	7.4	7.4	7.0	7.3	7.1	7.1	7.0
Total reported CO_2 from gas combustion	**67.1**	**75.0**	**73.0**	**75.8**	**72.5**	**74.7**	**83.3**	**77.6**	**77.3**	**75.1**	**75.8**	**78.7**	**77.8**	**79.3**
CO_2 Correction [Tg CO_2]														
1A1 Energy	0.15	0.01	0.12	0.03	0.11	0.08	-0.12	0.08	0.14	0.21	0.20	0.09	0.17	0.06
1A2ae Industry - heavy	0.31	0.02	0.20	0.05	0.16	0.10	-0.15	0.10	0.15	0.21	0.22	0.08	0.15	0.05
1A2f Industry - light	0.33	0.02	0.25	0.06	0.20	0.14	-0.20	0.13	0.21	0.31	0.31	0.13	0.23	0.08
1A4a Commercial/institutional	1.08	0.08	0.88	0.25	0.75	0.58	-0.97	0.54	0.85	1.05	1.11	0.54	1.05	0.42
1A4b Residential sector	2.95	0.19	1.94	0.51	1.66	1.18	-2.06	1.10	1.63	2.35	2.35	1.02	1.81	0.66
1A4c Agriculture and forestry	1.35	0.07	0.90	0.23	0.76	0.52	-0.78	0.43	0.67	0.96	1.00	0.40	0.75	0.26
Total correction CO_2 emissions	**6.2**	**0.4**	**4.3**	**1.1**	**3.6**	**2.6**	**-4.3**	**2.4**	**3.6**	**5.1**	**5.2**	**2.3**	**4.2**	**1.5**
Indication of alternative correction [a]	*4.1*	*-1.7*	*2.0*	*-1.0*	*1.6*	*0.5*	*-6.3*	*0.0*	*1.1*	*2.6*	*2.7*	*-0.1*	*1.6*	*-0.8*

Note: HDD = Heating Degree Day; T = Temperature; [a] Alternative correction method: based on a long term optimum trend projection analysis as reference level.

In *Figure 3.1* the trend in national total CO_2 is presented as calculated and with temperature correction. We present total CO_2 emissions since part of the fossil-fuel-related emissions, which make up 3 to 5 per cent (in 2003 and 1990, respectively), of the national total CO_2 emissions (without LUCF) are reported in the fugitive, industrial processes and product use sectors (CRF 1B, 2 and 3). This clearly shows that in 1990 and 1996 due to relatively warm and cold winters, respectively, much less and more gas was consumed than with normal weather conditions. Apart from those deviations, the corrected trends are quite smooth, except for the increase in 1998 and decrease in 1999, for which explanations are provided in the time-series consistency sections in this chapter.

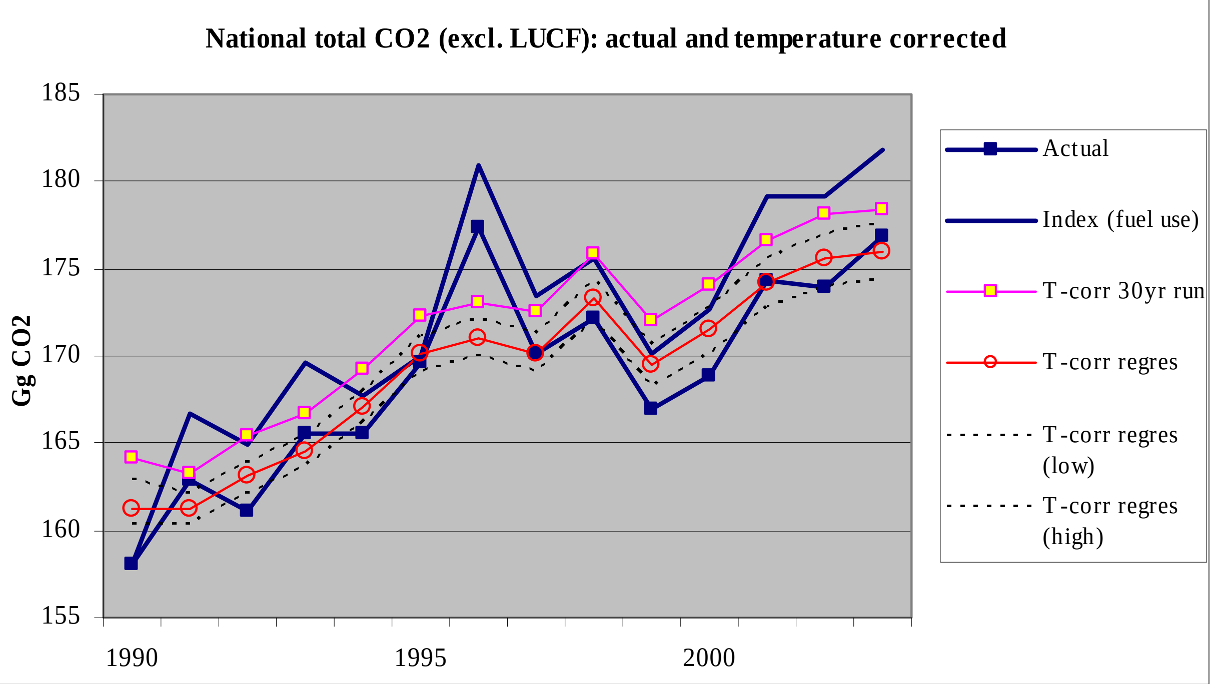


Figure 3.1. Trend in national total CO_2 emissions: actual and corrected for temperature using a 30 year moving average as normal and according to another method (Visser, 2004)

Planned improvements

The temperature correction method is a proxy to correct for changes of outdoor temperature, notably in the space heating season. Although temperature correction using the concept of Heating Degree Day (HDD) is well known, the application of the method requires additional assumptions on parameter values such as threshold temperature. Also for the definition of the 'normal' number of HDD several options are available, each having its pros and cons. The Netherlands reports corrections for a 30 year moving average of reference level (not a fixed 3 full decade period) (see Annex 4 for more details). The method used is estimated to have an accuracy of about ± 1Mton CO_2, excluding large structural changes of the annual average temperature over time scales of a decade or so. For more details on the apparent accuracy of the present method used we refer to *Section 3.2.4.3*.

However, in view of observed increases of the annual average temperature, both globally and in the Netherlands, the question was raised whether or not to take into this effect more explicitly than by comparing HDD with the average of the previous 30 years. Recently, a new weather and HDD analysis was made for the last 100 years, indicating a stronger decrease of the reference level in the 1990s than presently used, the impact of which is shown in the last row of *Table 3.2* (Visser, 2004). The results of this assessment will be presented in more detail in the next NIR.

3.1.2 CO_2 emissions from biomass

In the Netherlands, biomass fuels are used in various subsectors: electric power generation (e.g. waste wood and other organic waste, e.g. co-combusted in coal-fired power plants), the pulp and paper industry (e.g. paper sludge), the wood construction industry (e.g. wood waste), waste incineration (the organic part of the municipal waste), wastewater treatment plants and by landfill operators (e.g. recovered methane) and the residential sector (fuelwood and charcoal). For the residential sector no temperature correction is made for the fuel consumption estimates.

However, energy statistics in the Netherlands only include *organic waste gas* as biomass fuel. Other types of biomass are not identified as such in the national energy statistics. These are included as an indigenous production of heat. Subsequently this heat is being used for e.g. electricity production. However, in a separate monitoring of renewable energy use in the Netherlands the amounts of biomass fuels are now also annually accounted, also in energy units (see e.g. CBS, 2004). Currently, fuel data from individual companies and other sources are used in the compilation of the Netherlands greenhouse gas inventory and the associated CRF files. Fuel data reported by individual companies may include information on the use of biomass fuel, but this information is far from consistent. However, the activity data from the waste incineration plants have been reassessed and both total amounts of waste combusted and the fossil and organic carbon fractions have been revised (see *Sections 3.2.1* and *8.4* for more details). *Table 3.3* provides information on the biomass data currently reported in the CRF files. The data clearly show that the 1991-1994 time series for the energy industries is interrupted for reasons discussed in the previous NIR and these data are apparently included in the 'Other' subcategory (1A5).

Table 3.3. Organic CO_2 emissions (Gg) reported as 'CO_2 from biomass' (from CRF 1A combustion)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
1A Fuel combustion	5.6	6.4	6.3	6.6	6.2	5.5	6.0	6.7	6.9	6.9	7.8	8.2	8.3	8.2
1A1. Energy industries	2.8	2.8	2.8	3.0	2.8	3.0	3.6	4.3	4.4	4.7	5.0	5.1	5.8	5.8
1A2 Manufacturing industries	0.2	1.2	1.1	1.3	1.1	0.2	0.1	0.2	0.3	0.2	0.5	0.3	0.2	0.2
1A3 Transport	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A4 Other sectors:	2.6	2.5	2.5	2.4	2.3	2.3	2.3	2.3	2.2	2.1	2.3	2.7	2.3	2.2
a. Commercial/Institutional	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.6	0.2	0.2
b. Residential	2.5	2.4	2.3	2.2	2.2	2.1	2.1	2.1	2.0	1.9	2.1	2.1	2.1	2.0
c.Agriculture/Forestry/Fisheries	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total memo CO_2 from biomass	**5.6**	**6.4**	**6.3**	**6.6**	**6.2**	**5.5**	**6.0**	**6.7**	**6.9**	**6.9**	**7.8**	**8.2**	**8.3**	**8.2**

NO= Not Occurring

The fuel data, which are reported for biomass combustion (other than from organic waste gas) are incomplete, not transparent and not consistent (see NIR 2003, page 3-15). This amount is increased in the period 1990 to 2003 from 52 to 77 PJ due to the trend to use more and more recycled organic materials as supplementary fuel in different combustion processes. Please note that these amounts are not included in the reference approach.

Planned improvements

Since 2004, the Netherlands started to compile annually national statistics on renewable energy use by sector according to the Protocol for Monitoring of Renewable Energy (Abeelen and Bosselaar, 2004). As part of the start of this activity, also consistent time series for consumption of renewable energy since 1990 were established (CBS, 2004). It is planned to use this new dataset for estimating biomass burning emissions in the next NIR. This will update all activity data except for waste incineration, which was already brought in line with these new time series as of this year.

3.2 Fuel combustion [CRF sector 1A]

The trends per IPCC source category in emissions from fuel combustion and fugitive fuel sources have been summarised in *Table 3.4.* In 2003 the Energy sector accounted for 80% of total emissions (without LUCF) in the Netherlands. The subsector 1A1 Energy Industries is the major source category in the Energy sector, accounting for 40% of emissions from the Energy sector and 32% of total emissions (excl. LUCF) in the Netherlands. Subsectors 1A2 Manufacturing Industries and Construction, 1A3 Transport, and 1A4 Other contributed 16%, 20% and 24%, respectively, to the total Energy sector emissions in 2003.

Since 1990, emissions from the Energy sector have increased by about 13%, mainly due to the increase in CO_2 emissions in the electricity and heat production sector (37%) and transport sector (31%). The largest increase in emissions (15 Tg) occurred in the electricity and heat production sector. However, half of the marked increase of almost 30% between 1990 and 1998 was 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). The decrease in the electricity production sector (1A1a) in 1999 is due to the marked increase of imported electricity since 1999, which almost doubled compared with 1998, and to a relatively large shift from coal to residual chemical gas and natural gas in 1999. The decrease of over 15% in fossil fuel-related emissions in the manufacturing industry (1A2) in the early 1990's are again caused by the shift of cogeneration emissions to the public electricity and heat production sector due to a change of ownership (joint-ventures).

Table 3.4. Trend in emissions and sinks for the energy sector (CO_2 in Tg; Others in Gg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2														
All Energy (combustion & fugitive)	**149.6**	**154.7**	**153.5**	**158.1**	**157.4**	**161.3**	**169.2**	**161.8**	**164.3**	**159.0**	**161.2**	**167.3**	**167.0**	**170.0**
A. Fuel combustion total	**148.4**	**153.5**	**152.3**	**157.1**	**156.3**	**160.3**	**168.1**	**161.0**	**163.5**	**158.2**	**160.4**	**166.5**	**166.1**	**169.1**
1a Electricity and heat production	39.8	40.3	40.8	42.0	45.1	48.1	49.0	49.4	51.1	48.1	49.3	52.9	54.0	54.6
1 bc Other transformation	11.9	12.1	11.6	12.7	12.4	13.0	13.2	13.6	14.2	13.3	13.8	14.4	12.6	12.8
2 Industry	23.1	28.5	29.2	28.5	26.7	17.4	18.7	27.1	17.2	16.3	15.2	14.5	14.7	14.6
3 Transport	26.0	26.3	27.5	28.2	28.6	29.1	29.9	30.3	31.0	32.0	32.4	32.9	33.6	34.2
4a Commercial/Institutional	7.4	9.4	8.4	9.4	8.3	9.7	11.3	9.8	9.9	8.1	8.5	10.2	10.4	11.4
4b Residential	19.3	21.7	19.5	20.7	19.7	20.7	24.1	20.2	19.2	19.0	19.0	19.7	18.7	19.1
4c Agriculture/Forestry/Fisheries	10.7	11.0	11.1	11.6	11.3	11.2	11.5	10.2	10.1	9.9	10.1	9.9	9.7	9.6
5 Other	0.6	0.5	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.5	0.4
B Fugitive fuel emissions	**1.2**	**1.2**	**1.2**	**1.0**	**1.1**	**1.0**	**1.1**	**0.8**	**0.8**	**0.8**	**0.8**	**0.8**	**0.8**	**0.9**
1 Solid fuel transformation	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
2 Oil and natural gas	0.8	0.8	0.7	0.6	0.6	0.5	0.5	0.3	0.3	0.4	0.4	0.4	0.4	0.4
CH_4														
All Energy (combustion & fugitive)	**130.5**	**131.2**	**128.8**	**128.8**	**126.7**	**126.4**	**123.7**	**94.7**	**91.0**	**83.6**	**80.9**	**81.3**	**80.2**	**79.9**
A. Fuel combustion total	**31.7**	**32.5**	**31.1**	**31.9**	**30.8**	**31.2**	**34.0**	**30.9**	**29.9**	**29.2**	**29.4**	**30.1**	**29.3**	**29.3**
1. Energy	2.8	3.1	3.1	3.5	3.4	3.5	3.9	4.3	4.4	4.4	4.5	4.7	5.0	5.0
2 Industry	2.7	2.6	2.6	2.5	2.5	2.3	2.4	2.3	2.3	2.3	2.3	2.2	2.2	2.2
3 Transport	7.5	6.6	6.4	6.1	5.8	5.6	5.2	5.0	4.7	4.5	4.1	3.9	3.7	3.5
4a Commercial/Institutional	0.7	1.0	0.9	1.0	0.9	1.0	1.2	1.0	1.0	0.9	0.9	1.2	1.1	1.2
4b Residential	16.9	18.2	16.9	17.7	17.1	17.7	20.2	17.4	16.4	16.1	16.6	17.1	16.4	16.5
4c Agriculture/Forestry/Fisheries	1.0	1.0	1.0	1.1	1.0	1.0	1.1	0.9	0.9	0.9	0.9	0.9	0.9	0.9
B Fugitive fuel emissions	**98.8**	**98.7**	**97.8**	**96.9**	**95.9**	**95.2**	**89.7**	**63.8**	**61.1**	**54.4**	**51.5**	**51.3**	**50.9**	**50.6**
1 Solid fuel transformation	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.5	1.4	1.2	1.1	1.1	1.1	1.1
2 Oil and natural gas	97.4	97.3	96.3	95.5	94.4	93.7	88.2	62.3	59.7	53.2	50.4	50.2	49.9	49.5
N_2O														
All Energy (combustion & fugitive)	**1.7**	**1.8**	**2.0**	**2.1**	**2.2**	**2.3**	**2.4**	**2.4**	**2.5**	**2.4**	**2.4**	**2.5**	**2.5**	**2.5**
A. Fuel combustion total	**1.7**	**1.8**	**2.0**	**2.1**	**2.2**	**2.3**	**2.4**	**2.4**	**2.5**	**2.4**	**2.4**	**2.5**	**2.5**	**2.5**
1 Energy	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.7	0.7	0.7
2 Industry	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
3 Transport	0.9	1.0	1.2	1.3	1.4	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.6	1.5
4a Commercial/Institutional	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
4b Residential	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
4c 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
5 Other	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
B Fugitive fuel emissions	**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**
1 Solid fuel transformation	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
2 Crude oil and natural gas	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

Between 2002 and 2003, total Energy sector emissions increased by 1.8% mainly as a result of increased emissions for space heating (1A4) due to the relatively mild winter in 2002 and the more normal winter in 2003 (see *Table 3.2*), and further increases in the electricity production and transport sectors. The uncertainty in *annual* CO_2 emission estimates from fossil fuel combustion, which is related to uncertainty in activity data (energy statistics) and emission factors for CO_2 (basically, the carbon content of the fuels), is currently estimated at about 4% (with an order of magnitude factor of 1.5). This uncertainty has been based on a set of assumptions in sectoral activity data and emission factors. The uncertainty in annual CO_2 emissions of most stationary fuel combustion subsectors and road transport is also estimated to be about 3 to 4%, except for the other sectors and waste combustion where the uncertainty is assumed to be about 10%. The uncertainty for other mobile sources is not well known (see S*ection 1.7* for more details on individual assumptions). However, due to the minor share of these other sources, the uncertainty in the overall *annual* total is estimated to be about 4%; the Tier 1 *trend* uncertainty in total CO_2 emissions (excl. LUCF) has been calculated at ±3% points.

For CH_4 and N_2O emissions from fuel combustion the uncertainty in *annual* emissions is estimated approximately 50%, except for other mobile combustion (i.e. non-road) for which the uncertainty is estimated to be about a factor of 2.

3.2.1 Recalculations of emissions from fossil fuel combustion

As part of a comprehensive programme to improve greenhouse gas emissions a major change has been made in the methods for calculating emissions from fossil fuel use, in particular for CO_2 emissions from large stationary combustion sources and industrial process emissions. The objective of this change was to improve (a) the intransparant emission reporting by industries, both energy consumption and the applied emission factors (ERI/MJV), (b) inconsistencies in individual company emissions in the distinction between combustion and other non-combustion process emissions of CO_2 (amongst others related tot non-energy/feedstock uses of fuels) and the missing corrections of previous years when emission calculation methods or data sources were changed for recent years, (c) the supplemental estimate of CO_2 emissions of product use that was based on (petro)chemical products manufactured in the Netherlands (made from naphtha, aromatics etc. as feedstock), but of which the largest fraction is actually exported, (d) the distinction between national and international shipping and aviation that did not comply with the UNFCCC/IPCC reporting guidelines.

To meet the international calculation and reporting guidelines, all fossil energy-related emissions have been recalculated based on sectoral energy consumption statistics of Statistics Netherlands (CBS) for combustion and non-energy uses of fuels instead of base don individual reports by utilities, refineries and other large industrial companies. For the CO_2 emission factors a list was complied of new national default values consisting of documented country-specific factors or IPCC defaults (for details see *Annex 2.1*). These emission factors are used for all fossil fuel emission calculations, including recalculations back to 1990, except where documented plant-specific factors were available.

When applying sectoral energy consumption data from national energy statistics, in addition to the control activities performed earlier to the fuel consumption data as part of the quality assessment in view of apparent statistical differences (see previous NIRs), the internal consistency of statistics were once again checked and statistics were modified where the need was apparent (Huurman, 2005). In addition, for transport a separate estimate has been made for fuel use by inland shipping, for fisheries and for domestic aviation in conformity with UNFCCC/IPCC definitions, resulting in a modification of the original division between national and international (bunker) fuel use in the national energy statistics.

The largest changes in the 1A sector occur in the emissions of the categories 1A1 and 1A2 (see *Table 3.5*). These are partly due to methodological changes:

- *CO_2 from the use of (petro)chemical products:* change in method, now based on domestic use instead of based on the amount produced in the Netherlands (decreasing emissions by about 3 to 4 Tg CO_2, mainly in the industry 1A2 (Neelis and Patel, 2003);
- *CO_2 from fossil fuel combustion:* change in fuel consumption data, now based on national nergy statistics, thus complete and consistent over time, instead of individual company data, thereby avoiding possible double counting in supplemental emission estimates of these industrial sectors caused by too aggregated – i.e. intransparant – company reports;

- *CO_2 from fossil carbon in waste incineration:* 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) have been reassessed and revised (decreasing fossil emissions from 0.3 Tg in 1990);
- *CO_2 from so-called industrial process emissions:* change in method, now also based on national energy statistics and carbon balance calculations, instead of individual company data (possibly changing CO_2 emissions up to a few Tg);

However, also changes in *allocation* have been made, that affect all 1A subsectors and the international bunker emissions memo items:

- *joint-ventures in cogeneration* (combined heat and power generation, CHP): now allocated to the central electricity and heat production sector (1A1a) instead of to other sectors based on other definitions used in the ERI/MJV datasets (impact: a shift towards the energy sector from 1.3 Tg in 1993 to 2 to 2.5 Tg in 1995-2001, except for 1998-1999 where about 5 Tg was moved;
- *fossil fuel related CO_2 from so-called industrial process emissions:* according to IPCC Guidelines, the (net) CO_2 emissions from the inputs of coke and coal into blast furnaces and from the feedstock use of natural gas for the production of ammonia should be allocated to CRF sector 2; previously these were all reported in the fuel combustion sector 1A (impact: now about 2.5 to 1.5 and 3 Tg CO_2 from iron and steel industry and the chemical industry, respectively, is moved to industrial processes, CRF sector 2). The carbon contained in the blast furnace gas produced is subtracted from the process emissions in the iron and steel industry, since this gas is combusted in both the steel industry and in the public power generation category and thus allocated to the fuel combustion sector 1A.
  Also the CO_2 process emissions from non-energy use in the production of soda ash (from coke) (2A4), carbon electrodes (from petroleum coke), other chemicals (i.e. industrial gases hydrogen and carbon monoxide) (from natural gas) (2B), which account for less than 0.5 Tg CO_2, are now separately calculated and reported in CRF sector 2. Remaining non-energy uses of fuels with CO_2 process emissions are found in the food and drink industry (from coke) and in other economic sectors (from lubricants and waxes) are reported under 2D and 2G, respectively, amounting about 0.5 Tg CO_2.
  However, when in manufacturing processes the oxidation of fuels used as feedstock is accounted for in the energy statistics as production and combustion of residual gases (in the chemical industry and in refineries), then the CO_2 emissions are reported under fuel combustion (CRF 1A), not as industrial processes. This applies to the production of silicon carbide, carbon black, ethylene and methanol. From 1998 onwards this also applies to the combustion of phosphorous oven gas, instead as a coke consuming industrial process.
- *CO_2 from coke production:* related to transformation losses now based on national energy statistics of coal inputs and coke and coke oven gas produced and a carbon balance calculation of the losses.
- *CO_2 from off-road machinery:* tractors in agriculture are now reported as part of 1A4c ‘Agriculture and forestry’ (this is the liquid fuel part); machinery used for building construction and for other purposes (e.g. construction of roads and waterways, fork trucks etc.) are now reported under 1A2f ‘Other industry’ (part of the liquid fuels); previously these emissions were reported under 1A3e ‘Other transport’ (impact: about 1.5 Tg CO_2 in agriculture and about 1 Tg for the other sources).
- *CO_2 from inland shipping*: increased due to the addition of national fisheries and a revision based on re-evaluation of inland shipping activity data (impact: about 0.5 Tg CO_2 for most years (1995-1998 about 1 Tg) higher inland shipping and the inverse impact on international bunker shipping emissions).
- *CO_2 from domestic aviation*: decreased based on re-evaluation of domestic flight data (impact: decrease of about 0.5 to 0.2 Tg CO_2 with inverse effect on international aviation emissions).
- *CO_2 from domestic mobile military activities*: the related fuel consumption is assumed to be included in the national energy statistics as bunker fuel consumption and is now moved to

domestic fuel combustion and reported under CRF 1A5 (impact: increase of about 0.5 Tg CO_2 with inverse effect on international bunkers emissions).

Effectively, about 4 to 5 Tg CO_2 emissions that were previously reported under the fuel combustion (1A) have been moved to the industrial processes (CRF sector 2); another 0.4 and 0.2 to 0.3 Tg CO_2 has been moved to fugitive emissions from coke production (1B2) and solvents/product use (CRF 3), respectively (see *Table 3.5*). The largest shifts have occurred in the iron and steel industry an the chemicals industry, where about 1.2 to 2.5 Tg was moved to net inputs in blast furnaces and 2.6 to 3.6 Tg to ammonia production (*Table 3.5.b*). The changes in the division of national and international transport have reduced international bunker emissions of CO_2 by about 1 Tg.

Table 3.5.a. Recalculation of CO_2 emissions from fuel combustion (sector 1A) and related non-combustion emissions (sector 1B and 2): changes in fuel combustion and fugitive emissions.

IPCC Sector	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
1A. Fuel combustion total: CHANGES													
1a Electricity and heat production [a)]	-0.5	-1.3	-2.5	-1.2	0.3	3.6	3.2	4.3	3.2	3.6	0.3	1.2	2.2
1b Refineries	1.4	11.1	10.4	11.5	11.3	1.2	0.7	1.5	2.0	1.1	1.5	1.4	0.6
1c Other transformation	-0.5	-9.6	-9.7	-9.4	-10.1	-0.2	0.0	0.0	0.0	0.1	0.1	0.1	0.1
2 a Iron and Steel Industry [a)]	-2.3	3.7	4.2	4.6	4.4	-1.9	-1.0	-1.1	-2.2	-2.6	-2.3	-1.9	-1.4
2 c Chemicals Industry [b)]	-7.1	16.6	16.3	15.3	14.3	-12.3	-13.1	-8.0	-9.5	-8.7	-7.3	-8.1	-7.3
2 bdef Other Industries	-0.1	-30.7	-30.2	-27.8	-29.2	-0.6	-0.4	0.7	-0.2	0.2	0.0	-0.5	-0.4
3 b Road Transport	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.1
3 e Off-road Transport	-2.6	-2.5	-2.5	-2.5	-2.4	-2.3	-2.3	-2.3	-2.6	-2.6	-2.3	-2.2	-2.2
3 acd Other Transport	-0.9	-0.7	-0.7	-0.7	-0.5	-0.8	-0.7	-0.7	-0.7	-0.6	-0.7	-0.6	-0.5
4a Commercial/Institutional	0.8	-0.9	-1.0	-1.3	-1.9	0.2	1.0	1.3	1.0	0.6	0.0	0.1	0.2
4b Residential	-0.6	0.1	0.1	0.1	0.1	-0.6	-0.8	-0.7	-0.3	-0.3	-0.6	-0.7	-1.5
4c Agriculture/Forestry/Fisheries	2.3	2.6	2.6	2.8	2.6	3.2	2.6	2.7	2.6	2.8	3.0	3.0	2.9
5 Other	0.6	-0.5	0.6	-1.1	-0.1	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.5
Total 1A changes (NIR2005 – NIR2004):	**-9.4**	**-12.2**	**-12.3**	**-9.5**	**-11.0**	**-9.8**	**-10.0**	**-1.6**	**-6.0**	**-5.6**	**-7.5**	**-7.5**	**-6.9**
1B Fugitive fuel emissions													
1B1b Solid Fuel Transformation [c)]	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
1B2 Oil and gas	0.5	0.4	0.2	0.0	-0.2	-0.4	-0.5	-0.7	-1.3	-1.1	-1.2	-1.3	-1.2

a) Including combustion of blast furnace/oxygen furnace gas and coke oven gas.
b) Including combustion of residual gases for the manufacture of ethylene, methanol, silicon carbide and carbon black.
c) Previously included elsewhere (1A2a).

Table 3.5.b. Recalculation of CO_2 emissions from fuel combustion (sector 1A) and related non-combustion emissions (sector 1B and 2): changes in industrial process emissions and indirect CO_2 from product use.

IPCC Sector	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
2 Industrial processes (fossil fuel related)													
NEW IN NIR 2005:													
2A4a 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
2B1. Ammonia production	3.1	3.4	3.5	3.4	3.6	3.5	3.3	3.5	3.6	3.5	3.6	3.0	2.9
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
2B5. Production other chemicals	0.4	0.3	0.3	0.3	0.3	0.4	0.5	0.4	0.1	0.1	0.1	0.1	0.1
2B5. Activated carbon	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
2C1. Coke and coal inputs in blast furnaces (net: minus BF gas and OF gas)	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
2D2 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
2G4. Processes in other economic sectors [ab]	0.3	0.2	0.3	0.2	0.2	0.5	0.5	0.5	0.4	0.5	0.6	0.4	0.4
Total 2 'fossil fuel' changes, NIR2005:	**32.8**	**32.2**	**32.8**	**32.1**	**30.5**	**27.9**	**28.6**	**27.1**	**27.3**	**27.1**	**26.6**	**25.9**	**26.7**
3. Paints and other solvents: indirect CO_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
OLD IN NIR 2004:													
2G. Other industrial processes, excl. FGD	0.5	0.8	0.5	0.2	0.4	0.3	0.5	0.3	0.3	0.3	0.4	0.4	0.4
Total changes (NIR2005 – NIR2004):	**-15.5**	**-16.0**	**-15.8**	**-13.3**	**-14.3**	**-16.0**	**-16.4**	**-8.8**	**-12.5**	**-11.5**	**-9.6**	**-9.8**	**-9.1**

a) Coke (100% oxidation assumed)
b) Lubricants and mineral waxes (50% and 100% oxidation assumed, respectively)

Please note no adjustments are made in any reported sectoral CO_2 emissions for capture of CO_2 from flue gases that may have occurred (e.g. by power plants, refineries or chemical industries), which was subsequently sold and transported to other enterprises for further use (e.g. food and drink industries or in greenhouse horticulture).

3.2.2 Energy industries (CRF category 1A1)

3.2.2.1 Source category description

This source category consists of the sub-sources '*Public electricity and heat production*' (including emissions from waste incineration), '*Petroleum Refining*' and '*Other energy industries*' – all excluding CO_2 from organic sources, i.e. from biomass combustion – which together form a key source for CO_2 emissions. All emissions from waste incineration are included here, since (almost) all incineration facilities also produce heat and/or electricity that is sold to other energy consumers. The other energy industries comprise own fuel use emissions by the production industry of gas and oil and the distribution companies of gas, oil and electricity plus the combustion emissions for one independent coke production facility (Sluiskil). However, the fuel combustion emissions for coke production by the one iron and steel manufacturer in the Netherlands (Corus) are included in Manufacturing Industries (1A1a) since this is an integrated coke, iron and steel plant. Within the three subcategories, natural gas and coal combustion by public electricity production and oil combustion by refineries are the dominating key sources. The share of CO_2 emission from the energy industries in the national total was 33% in 1990 and 38% in 2003. For CH_4 and N_2O emissions from the energy subsector the share is relatively small and not considered a key source (*Table 3.6*).

Table 3.6. Trend in emissions from the energy industry (1A1) (CO_2 in Tg; others in Gg)

Gas/subsource	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2														
a. Public Electricity & Heat Production	39.8	40.3	40.8	42.0	45.1	48.1	49.0	49.6	51.4	48.4	49.6	53.1	54.3	54.9
b. Petroleum Refining	11.0	11.1	10.4	11.5	11.3	11.0	10.7	11.3	11.6	10.9	11.4	12.0	10.9	11.2
c. Manufacture of Solid Fuels/Other	0.8	1.0	1.2	1.2	1.1	1.3	1.7	1.7	2.0	1.8	1.8	1.9	1.7	1.6
CH_4														
a. Public Electricity & Heat Production	2.2	2.5	2.5	2.7	2.7	2.8	3.2	3.5	3.6	3.7	3.7	4.0	4.2	4.2
b. Petroleum Refining	0.4	0.5	0.5	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
c. Manufacture of Solid Fuels/Other	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
N_2O														
a. Public Electricity & Heat Production	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.6	0.6	0.6	0.7
b. Petroleum Refining	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c. Manufacture of Solid Fuels/Other	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

3.2.2.2 Methodological issues

A country-specific bottom-up (Tier2) method is used for calculating the emissions for fuel combustion in the '*Energy industry*' (1A1). As of this year fuel combustion emissions of greenhouse gases in this sector were calculated using fuel consumption data from national sectoral energy statistics and IPCC default emission factors for CO_2 and N_2O, except for CO_2 for natural gas, residual chemical gas and coal, for which country-specific emission factors were used. When available, company-specific or sector-specific emission factors have been used.

Public Electricity and Heat Production includes by definition the cogeneration (Combined Heat and Power, CHP) (and steam boiler) facilities that are operated as *joint-venture*. Since CHP has a substantial and increasing share in fuel consumption, this has a significant impact on emissions trend in both the energy sector and the manufacturing industry. Also included are all emissions from large-scale waste incineration.

For ***refineries*** the amount of CO_2 from fuel combustion based on the sectoral energy statistics, which include the combustion of residual refinery gases. However, since for the refinery subsector the energy and carbon balance between oil products produced does not match with total crude oil input and of fuel used for combustion, we conclude that not all residual refinery gases and other residual fuels are accounted for in the national energy statistics. Therefore, the calculation of the carbon difference, which always has a positive sign, is assumed unaccounted for residual refinery gases and other residual fuels that are all combusted but not monitored by the industry. This assumption is confirmed by the comparison of the calculated emission data to the data submitted by refineries in their Annual Environmental Reports (MJVs). These variable fuel consumption and CO_2 emissions is reported as part of 'Liquids fuels'. From *Table 3.7* and *Figure 3.4* it shows that this amounts to about 10% (5-20%) of the total fuel consumption accounted for in the statistics.

The emissions from ***coke production*** refer to one independent coke producer, of which the operation was discontinued in 1999. The on-site coke production by the iron and steel company (Corus) is included in 1A2a instead of here in 1A1c, since the fuel combustion emissions are reported in an integrated and aggregated way (see *Section 3.2.2.2*). The combustion emissions from oil and gas production refer to the so-called 'own use' of the gas and oil production industry, which is the difference between the amounts of fuel produced and sold, after subtraction of the amounts of associated gas which is either flared or vented or otherwise lost by leakage etc. Production and sales data are based on the national energy statistics; amounts flared and vented are based on reports from the sector.

More details on methodologies, data sources used and country-specific source allocation issues are provided in *Annex 2* and in the monitoring protocol (Ruyssenaars, 2005). The Netherlands intends to use in the future also plant-specific CO_2 emission factors, e.g. provided by the annual environmental reports of large companies, if it improves the accuracy of the emissions while maintaining consistency and transparency.

3.2.2.3 Uncertainty and time-series consistency

The uncertainty of this category is estimated to be 4% in annual emissions (see *Section 1.7* for more details). The trends in emissions of CO_2 from the energy sector are summarised in *Table 3.7*. Between 1990 and 2003 total CO_2 emissions increased by 30%, from 51.6 to 67.3 Tg. This increase can be attributed almost completely to the increase in emissions from electricity production following an increasing demand of electricity.

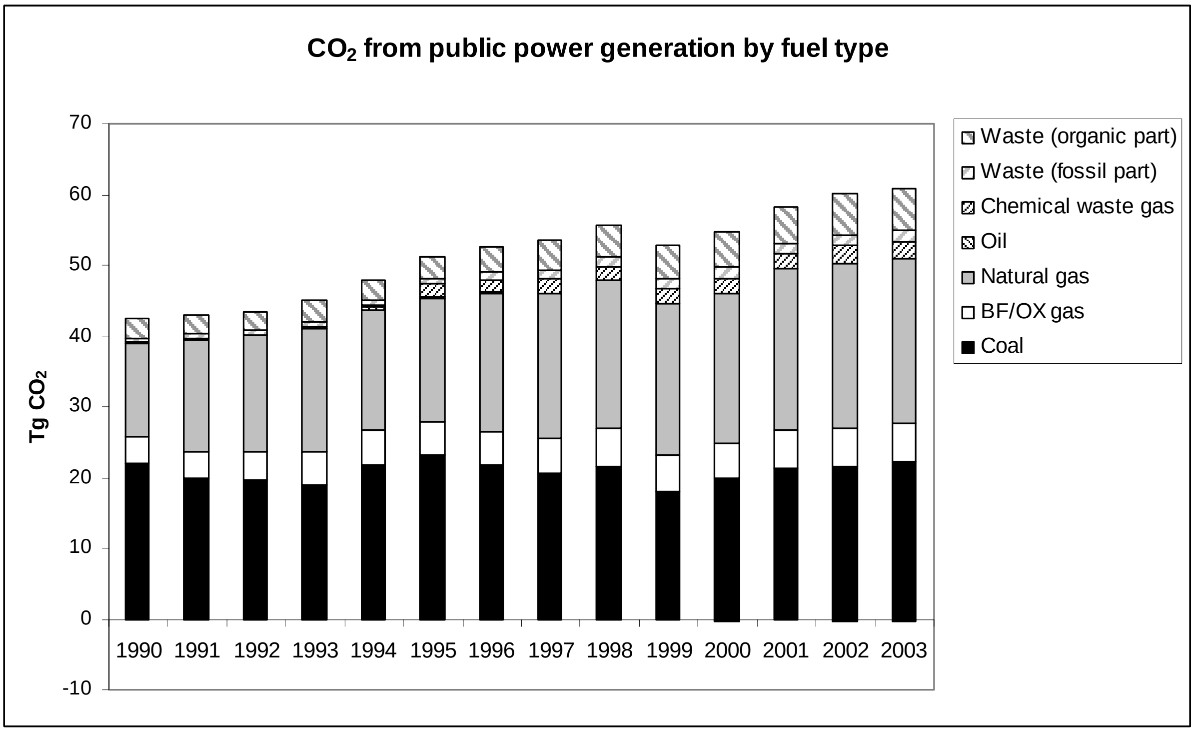


Figure 3.2. Trend in sources of CO_2 from fuel use in power plants. Note that CO_2 from organic waste (waste organic part) does not contribute to net CO_2 emissions (source: CBS)

Public Electricity and Heat Production

The increasing electric power production corresponds to a large increase in the use of fossil fuel by power plants, partly compensated by a shift from coal to natural gas and an increase in the efficiency of power plants. However, half of the marked increase of almost 30% between 1990 and 1998 was mainly 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). As illustrated in *Figure 3.3*, the corresponding CO_2 emissions allocated to the energy sector increased from virtually zero in 1990 to 8 Tg in 1998.

The use of residual chemical gas by utilities as shown in *Table 3.6* and *Figures 3.2* below and *Table 3.12b* in *Section 3.2.2*, which increases sharply in 1995, is almost all used in joint-venture electricity and heat production facilities. This also explains the somewhat lower IEF for CO_2 from liquids since 1997. Utilities also use significant amounts of blast furnace and oxygen furnace gas (BF/OX gas) purchased from the steel plant and residual chemical gas (*Table 3.7* and *Figure 3.1*). The emission factors of residual chemical gas and to a lesser extent of BF/OX gas are more uncertain than of other fuels used by utilities. However, consistency between sectors is now achieved by using the same factors for combustion in both the manufacturing industries and by utilities.

Table 3.7. Trend in CO_2 emissions from the energy industry (Tg)

Source	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Public electricity and heat production	39.8	40.3	40.8	42.0	45.1	48.1	49.0	49.4	51.1	48.1	49.3	52.9	54.0	54.6
o.w. Liquid fuels	*0.2*	*0.3*	*0.2*	*0.2*	*0.8*	*2.1*	*2.0*	*2.0*	*1.9*	*2.1*	*1.9*	*1.9*	*2.2*	*2.1*
o.w. residual chemical gas [1])	*0.0*	*0.0*	*0.0*	*0.0*	*0.3*	*1.8*	*1.7*	*2.0*	*1.9*	*2.1*	*1.9*	*1.9*	*2.2*	*2.1*
o.w. Solid fuels	*25.8*	*23.7*	*23.7*	*23.7*	*26.7*	*27.8*	*26.5*	*25.6*	*26.9*	*23.3*	*24.9*	*26.7*	*26.8*	*27.7*
o.w. BF/OX gas [2)]	*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*
o.w. Gaseous fuels	*13.2*	*15.6*	*16.3*	*17.5*	*17.0*	*17.4*	*19.4*	*20.4*	*20.9*	*21.3*	*21.1*	*23.4*	*23.4*	*23.3*
o.w. Other fuels (fossil waste)	*3.4*	*3.4*	*3.4*	*3.7*	*3.5*	*3.8*	*4.7*	*5.5*	*5.8*	*6.2*	*6.6*	*7.4*	*7.4*	*7.4*
Petroleum refining	11.0	11.1	10.4	11.5	11.3	11.6	11.6	12.0	12.2	11.5	12.1	10.9	10.9	11.2
o.w. Liquid fuels	*10.0*	*9.9*	*9.3*	*10.2*	*10.0*	*10.4*	*10.1*	*10.0*	*10.4*	*9.7*	*10.2*	*8.8*	*8.8*	*9.1*
o.w. refinery gas	*3.8*	*3.9*	*4.0*	*4.2*	*4.4*	*4.2*	*3.9*	*5.0*	*4.9*	*4.7*	*5.2*	*5.1*	*4.7*	*5.0*
o.w. unaccounted for liquids	*4.6*	*4.3*	*3.8*	*1.4*	*1.1*	*1.7*	*1.4*	*0.7*	*1.5*	*1.5*	*1.9*	*2.6*	*1.4*	*1.3*
Other energy industries [3)]	0.8	1.0	1.2	1.2	1.1	1.3	1.7	1.7	2.0	1.8	1.8	1.7	1.7	1.6
Total	**51.6**	**52.3**	**52.4**	**54.7**	**57.5**	**61.1**	**62.2**	**63.0**	**65.3**	**61.5**	**63.2**	**65.5**	**66.6**	**67.3**

1) Mainly used in cogeneration facilities operated as joint-venture with chemical industries.
2) Blast furnace and oxygen furnace gas purchased from the nearby steel plant.
3) Mainly oil and gas production industries; until 1999 including emissions from a small coke manufacture company in Sluiskil (about 15-20% of total coke production); fuel combustion emissions from the one steel manufacture company, including combustion emissions from the on-site coke plant, are reported in 1A2a due to the integrated nature of this iron and steel plant (Corus).

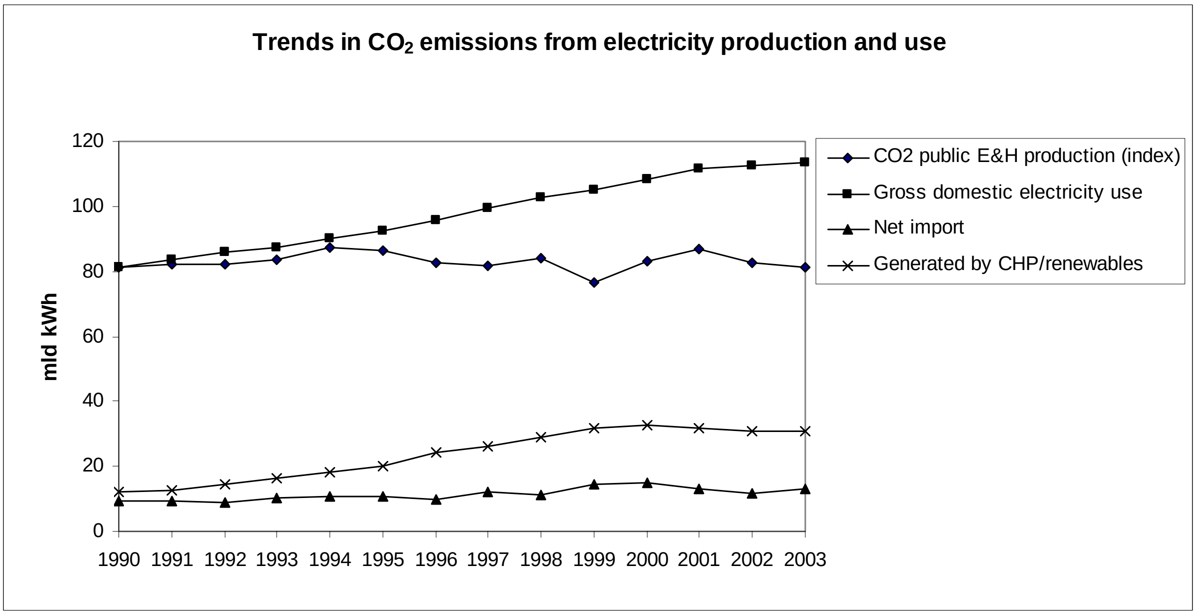


Figure 3.3. Trends in CO_2 emissions from electric power generation

Although CO_2 emissions from waste incineration of fossil carbon increased from 0.6 to 1.6 Tg CO_2, due to the increasing amounts of municipal waste being combusted instead of landfilled, their share in the total 1A1a category is only a few per cent.

Also noticeable in *Table 3.6* is that after an increase of CO_2 emissions from power generation up to 1998, in 1999 the emissions due too electricity and heat production suddenly drop 6% compared to 1998, while the electricity consumption in the Netherlands in 1999 is 2% higher than in 1998 (*Table 3.7*). This is caused by a large increase in imported electricity, which was almost double to that of 1998, and to a relatively large shift from coal to oil and natural gas in 1999 (see *Figure 3.2*). The higher import corresponds to an emission of about 4 Tg CO_2, while the shift from coal to natural gas and oil corresponds to about 1 Tg CO_2 in 1999. In 2001, the net import of electricity decreased, but this was compensated by the increased production of electricity from the public electricity sector.

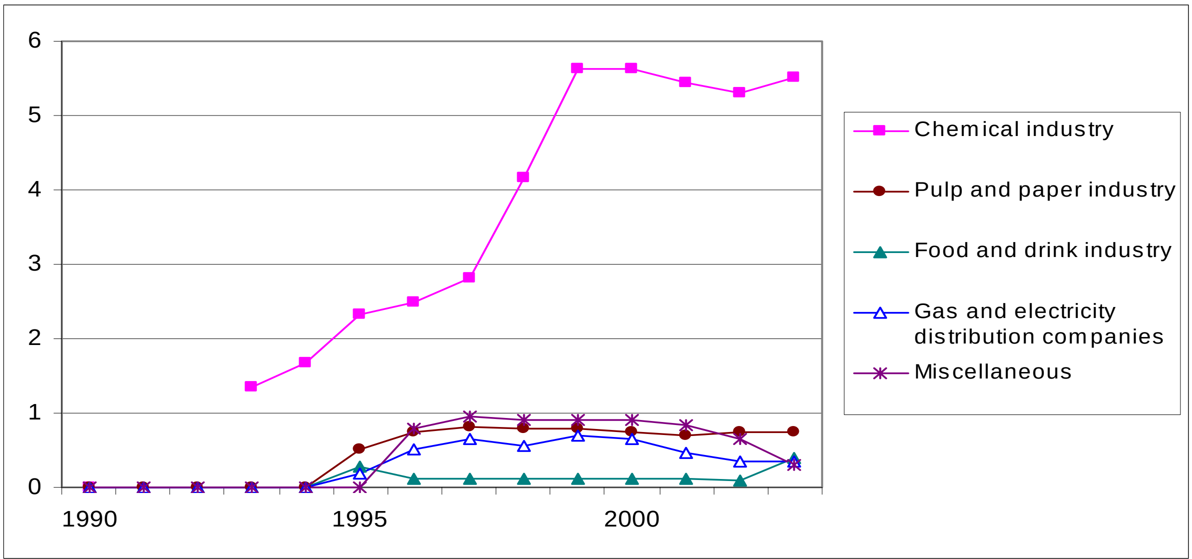


Figure 3.4. Trends in CO2 emissions from natural gas use in cogeneration joint –ventures (including steam boilers)

Table 3.8. Trends in gross production, import, export, and gross consumption of electricity (1000 mln kWh) Source: CBS, 2001a and www.statline.cbs.nl.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Gross production	71.9	74.4	77.2	76.9	79.7	81.0	85.2	86.7	91.0	86.7	89.4	94.2	96.3	96.7
Fossil fuel, public	56.1	58.3	59	56.8	57.7	56.8	56.7	58.2	58.4	51.3	52.6	62.4	65.4	66.5
Nuclear	3.5	3.3	3.8	3.9	4.0	4.0	4.2	2.4	3.8	3.8	3.9	ND	ND	ND
Private CHP&renewable	12.3	12.8	14.4	16.2	18	20.3	24.4	25.9	28.7	31.5	32.9	31.9	30.9	30.2
Import	9.7	9.8	8.9	10.6	10.9	12	11.3	13.1	12.2	22.4	23.0	17.3*	16.4*	17.0*
Export	0.5	0.6	0.2	0.3	0.3	0.6	0.7	0.5	0.4	4.0	4.0	ND	ND	ND
Gross domestic use	81.1	83.5	85.9	87.3	90.2	92.4	95.8	99.2	102.8	105.1	108.3	111.5	112.7	113.7

* For 2001 and subsequent years only the net import of electricity and the total production of power plants (fossil and nuclear together) have been published by Statistics Netherlands.

ND = No Data available.

Refineries

Liquid fuel combustion emissions from refineries comprise about 90% of total CO_2 emissions. *Table 3.6* shows the total liquid combustion and the part of unaccounted for fuel use, i.e. the calculated missing term from the mass balance that could not be associated with reported fossil fuel consumption. Apparently, the statistics for 1990-1992 did not capture a major part of the liquid fuel combustion by refineries (about 40% of liquid fuel combustion), but the addition of the unaccounted for part provides the correction here (see *Figure 3.5*). The carbon content of the unaccounted for liquids was determined from a carbon balance analysis for each year. For other years the correction term is still about 1 Tg CO_2 or 10% of total refinery CO_2 emissions (in 1993-2003 period ranging between 0 and 20%)

(see *Table 3.8b*). The interannual variation in the IEF for CO_2 from liquid fuels is due to the high but variable shares (between 40 and 55%) of refinery gas in total liquid fuel, which also has a relatively low emission factor compared to most other oil products, and to variable addition of unaccounted for liquids.

Table 3.8b. Trends in CO_2 emissions by refineries by fuel type (Tg).

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid: total	10.0	9.9	9.3	10.2	10.0	9.8	9.2	9.3	9.8	9.1	9.6	10.2	8.8	9.1
o.w. oil products	*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*
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*	*4.7*	*5.0*
o.w. unaccounted for liquid fuel	*4.6*	*4.3*	*3.8*	*1.4*	*1.1*	*1.7*	*1.4*	*0.7*	*1.5*	*1.5*	*1.9*	*2.6*	*1.4*	*1.3*
Gaseous fuels: total	1.0	1.1	1.1	1.3	1.3	1.2	1.5	2.0	1.8	1.8	1.8	1.8	2.1	2.1
Total CO_2 from refineries	**11.0**	**11.1**	**10.4**	**11.5**	**11.3**	**11.0**	**10.7**	**11.3**	**11.6**	**10.9**	**11.4**	**12.0**	**10.9**	**11.2**
Ref. act data: throughput	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
CO_2/PJ throughput	5.0	4.4	4.0	4.1	4.1	4.1	3.9	4.1	4.2	4.5	4.7	4.9	4.9	4.8

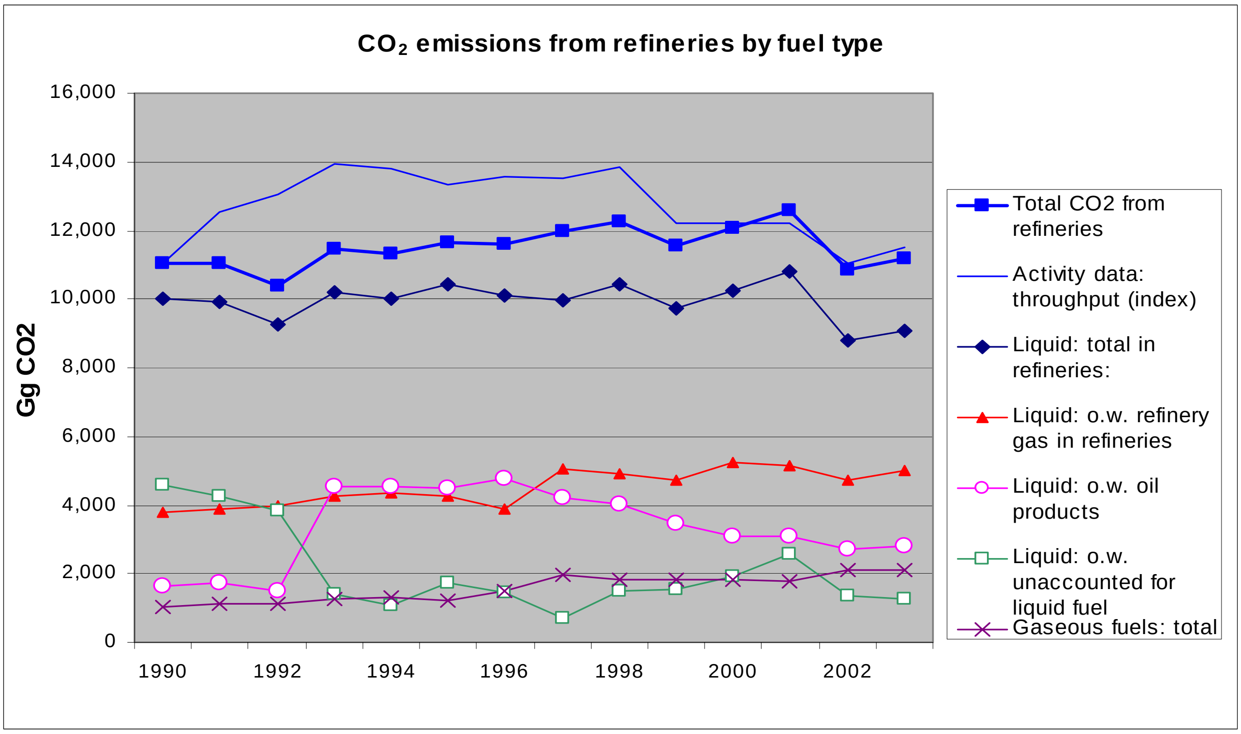


Figure 3.5. Trends in CO_2 emissions from refineries by fuel type.

Manufacture of Solid Fuels (coke) and Other Energy Industries (fuels production)

This category comprises mainly CO_2 emissions from natural gas, mainly the 'own use' for energy purposes by the oil and gas production and transmission industry that increased from 0.8 Tg in 1990 to 1.8 Tg CO_2 at present due to less favourable production sites than in the past, and some emissions from one coke production facility, of which the operation was discontinued in 1999.
The small amounts of solid fuel combustion by the coke plant in 1990-1994 are not separately recorded in the energy statistics, but included in the iron and steel industry (category 1A2a).

3.2.2.4 Source-specific recalculations

Major recalculations and allocation improvements were made: (a) for stationary fuel combustion emissions of greenhouse gases in subcategories 1A1, 1A2 and 1B2, which are now based on fuel consumption data from national sectoral energy statistics and national default emission factors for CO_2 and N_2O, and source-specific emission factors for CH_4, (b) 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) have been reassessed and revised (see *Table 3.3*), (c) CO_2 emissions from refineries were corrected for the missing carbon as calculated from the mass balance of inputs and outputs (see *Table 3.7*). Previously, the greenhouse gas emissions from these subcategories were based on individual company reports, the MJVs (the part of the national pollutant emission register called 'ER-I'), combined with an estimate for supplemental fuel consumption for non-reporting industries per category (see *Section 1.2*). However, these reports generally did not provide transparent and complete fuel use and emissions data at the required the level of detail (see *Section 1.2*). Consequently, consistency over time of emissions at subcategory level has been substantially improved, as well as transparency and the source allocation.

As shown in *Table 3.9a*, the largest changes in emissions are due to a change in CO_2 emissions from public electricity and heat production, mainly due to another allocation of fuel use in the national energy statistics than in the individual company reports. As of this year emissions from *all* joint-ventures of cogeneration facilities are all reported in the 1A1a subcategory, where previously this was only partly so (see also *Sections 3.2.1.3* and *3.2.2.5*). These changes were made as part of the inventory improvement programme and also in response to previous reviews requesting to report industrial process emissions in the correct IPCC subcategory (see *Section 3.2.7* and *Chapter 9*).

Table 3.9a. Recalculation of CO_2 emissions from 1A1a – 1A1c and 1A1 Total (Tg).

	Souce category		**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
1A1	Energy industries	new	52	52	52	55	57	60	61	63	65	61	63	67	67
1A1	Energy industries	old	51	52	54	54	56	57	58	57	60	57	61	65	64
1A1	*Energy industries*	***diff***	***0***	***0***	***-2***	***1***	***1***	***4***	***3***	***5***	***5***	***4***	***2***	***2***	***3***
1A1a	Public Electr .& Heat	new	40	40	41	42	45	48	49	50	51	48	50	53	54
1A1a	Public Electr. &Heat	old	40	42	43	43	45	45	46	45	48	45	49	52	52
1A1a	*Public Electr. & Heat*	***diff***	***-1***	***-1***	***-2***	***-1***	***0***	***4***	***3***	***5***	***3***	***4***	***1***	***1***	***2***
1A1b	Petroleum Refining	new	11	11	10	11	11	11	11	11	12	11	11	12	11
1A1b	Petroleum Refining	old	10	0	0	0	0	10	11	10	10	10	11	11	10
1A1b	*Petroleum Refining*	***diff***	***1***	***11***	***10***	***11***	***11***	***1***	***0***	***1***	***1***	***1***	***1***	***1***	***1***
1A1c	Manuf. of Solids	new	0.8	1.0	1.2	1.2	1.1	1.3	1.7	1.7	2.0	1.8	1.8	1.9	1.7
1A1c	Manuf. of Solids	old	1.3	10.6	10.9	10.6	11.2	1.6	1.7	1.7	2.0	1.7	1.7	1.8	1.7
1A1c	*Manuf. of Solids*	***diff***	***-0.5***	***-9.6***	***-9.7***	***-9.4***	***- 10.1***	***-0.2***	***0.0***	***0.0***	***0.0***	***0.1***	***0.1***	***0.1***	***0.1***

Table 3.9b. Recalculation of CH_4 and N_2O emissions from 1A1a – 1A1c and 1A1 Total (Gg) [shown if > 0.0].

	Souce category		**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
	CH_4														
1A1	Energy industries	new	2.8	3.1	3.1	3.5	3.4	3.5	3.9	4.3	4.4	4.4	4.5	4.7	5.0
1A1	Energy industries	old	3.3	3.2	3.8	3.4	3.7	4.9	5.7	3.0	4.4	6.0	6.0	5.5	4.9
1A1	*Energy industries*	***diff***	***-0.6***	***-0.1***	***-0.7***	***0.1***	***-0.3***	***-1.3***	***-1.8***	***1.3***	***0.0***	***-1.6***	***-1.4***	***-0.7***	***0.1***
1A1a	Public Electr. & Heat	new	2.2	2.5	2.5	2.7	2.7	2.8	3.2	3.5	3.6	3.7	3.7	4.0	4.2
1A1a	Public Electr & Heat	old	0.5	2.9	3.4	3.0	3.4	0.7	1.2	1.2	0.9	3.1	3.0	0.8	0.8
1A1a	*Public Electr. & Heat*	***diff***	***1.7***	***-0.4***	***-0.9***	***-0.3***	***-0.7***	***2.1***	***2.0***	***2.2***	***2.7***	***0.6***	***0.8***	***3.2***	***3.4***
1A1b	Petroleum Refining	new	0.4	0.5	0.5	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
1A1b	Petroleum Refining	old	0.3	0.0	0.0	0.0	0.0	0.6	0.8	0.3	0.1	0.1	0.3	0.0	0.0
1A1b	*Petroleum Refining*	***diff***	***0.1***	***0.5***	***0.5***	***0.7***	***0.7***	***0.0***	***-0.2***	***0.4***	***0.5***	***0.5***	***0.3***	***0.6***	***0.6***
1A1c	Manuf. of Solids	new	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2
1A1c	Manuf. of Solids	old	2.5	0.3	0.4	0.4	0.3	3.6	3.7	1.4	3.4	2.8	2.7	4.7	4.1
1A1c	*Manuf. of Solids*	***diff***	***-2.4***	***-0.2***	***-0.3***	***-0.3***	***-0.2***	***-3.5***	***-3.5***	***-1.3***	***-3.2***	***-2.6***	***-2.5***	***-4.5***	***-3.9***
	N_2O														
1A1	Energy industries	new	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.7	0.7
1A1	Energy industries	old	0.5	0.5	0.5	0.5	0.2	0.5	0.0	0.0	0.5	0.5	0.5	0.4	0.5
1A1	*Energy industries*	***diff***	***0.0***	***0.0***	***0.0***	***0.0***	***0.3***	***0.1***	***0.6***	***0.6***	***0.2***	***0.1***	***0.1***	***0.3***	***0.2***
1A1a	Public Electr. & Heat	new	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.5	0.6	0.6	0.6
1A1a	Public Electr. & Heat	old	0.4	0.4	0.4	0.4	0.1	0.4	0.0	0.0	0.4	0.4	0.4	0.3	0.4
1A1a	*Public Electr.& Heat*	***diff***	***0.1***	***0.1***	***0.1***	***0.1***	***0.4***	***0.1***	***0.5***	***0.5***	***0.2***	***0.1***	***0.2***	***0.3***	***0.2***
1A1b	Petroleum Refining	new	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1A1b	Petroleum Refining	old	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1	0.1	0.1	0.1
1A1b	*Petroleum Refining*	***diff***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.1***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***

3.2.3 Manufacturing industries and construction (CRF category 1A2)

3.2.3.1 Source category description

Source category 1A2 consists of the combustion emissions from six sub-sources: iron and steel, non-ferrous metals, chemicals, pulp and paper, food processing and the category '*Other*'. The latter includes the emissions of mobile machinery for building construction and for other purposes (e.g. construction of roads and waterways, fork trucks etc.). Iron and steel production, by the Netherlands integrated steel plant Corus, includes fuel combustion for the on-site coke production, since this is an integrated plant. It also includes the emissions the combustion of blast furnace gas and oxygen furnace gas in the steel industry and of residual chemical gas in the chemical industry as accounted for in the sectoral energy statistics.

This source category does not include most so-called industry process emissions of CO_2, which are now 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 production and combustion of residual gases (e.g. in the chemical industry) – as is often the case in the Netherlands – the corresponding CO_2 emissions are reported as combustion in 1A2 and not as industrial process in CRF sector 2. Furthermore, CO_2 emissions of non-energy uses of coke are reported under 2D and of lubricants and mineral waxes under 2G.

The share of the emissions from manufacturing industries and construction in the national CO_2 emission (excl. LUCF) was 21% in 1990 and 15% in 2003. The share of the other greenhouse gas emissions of this category is very small (*Table 3.4*). CO_2 emissions from manufacturing industries (1A2) are level and trend key source emissions (see *Box 3.1*). Within this category, natural gas, liquids and solid fuels are the dominating key sources: natural gas is mostly used in the chemical, food and drinks and other industry; liquids mostly in the chemical industry and also in the other industry; solids (i.e. coal and coke derived fuels such as blast furnace/oxygen furnace gas) are mostly used in the iron and steel industry (see *Table 3.9*).

Table 3.10.Trends in combustion emissions from manufacturing industries and construction (1A2) (CO_2 in Tg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2														
a. Iron and steel [1)]	4.0	3.7	4.2	4.6	4.4	4.7	4.7	4.4	4.2	3.9	3.9	4.2	4.2	4.4
o.w. blast furnace/oxygen furnace 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
b. Non-ferrous metals	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2	0.2
c. Chemicals [1)]	17.0	16.6	16.3	15.3	14.3	12.4	12.3	11.8	11.7	11.4	11.3	11.2	11.7	11.9
o.w. chemical residual gas	5.0	4.8	4.9	4.9	4.8	3.6	3.8	3.7	3.8	4.1	3.9	4.3	5.1	5.5
d. Pulp, paper and print	1.7	1.7	1.7	1.7	1.7	1.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.4
e. Food processing, beverages & tobacco	4.0	4.1	4.5	4.4	4.4	4.1	4.3	4.1	4.3	4.5	4.3	4.1	4.2	4.0
f. Other	5.8	5.9	5.9	5.8	5.5	5.1	5.5	4.9	5.4	5.4	5.3	4.8	4.9	5.0
Total (1A2)	**32.8**	**32.2**	**32.8**	**32.1**	**30.5**	**27.9**	**28.6**	**27.1**	**27.3**	**27.1**	**26.6**	**25.9**	**26.7**	**27.1**

[1)] Excluding non-energy use of fuels e.g. as chemical feedstock, but including emissions from combustion of secondary fuels produced as by-product from these uses (e.g. blast furnace gas, chemical residual gas).

3.2.3.2 Methodological issues

A country-specific bottom-up (Tier2) method is used for calculating the emissions for fuel combustion in the '*Manufacturing industry'* (1A2). As of this year fuel combustion emissions of greenhouse gases in this sector were calculated using fuel consumption data from national sectoral energy statistics and IPCC default emission factors for CO_2 and N_2O, except for CO_2 from gas and coal combustion and for CH_4, for which country-specific emission factors were used. Since the CO_2 combustion emissions from manufacturing industries are considered key sources (see *Section 3.1*), the present Tier 2 methodology complies with the *IPCC Good Practice Guidance* (IPCC, 2000).

In the ***iron and steel industry*** a substantial large fraction of total CO_2 emissions are 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 (BF) gas produced. Since the fraction of BF/OF gas captured and used for energy varies over time, the trend of the combustion emissions of CO_2 accounted for this source category should be viewed in connection with the reported process emissions. We note that 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 way. The *fugitive* emissions, however, from all coke production sites are reported separately (see *Section 3.3.2*).

However, in the ***chemicals industry***, CO_2 emissions from manufacturing carbon black, methanol and ethylene from the combustion of residual gas produced as by-product from the non-energy use of fuels are still reported under fuel combustion in the chemical industry (CRF 1A2c) based on the combustion of residual gases. Also, CO_2 emissions from silicon carbide production resulting from non-energy use of coke – without production of residual gases – are still included in fuel combustion in 'Chemical industry' (CRF 1A2c). Reporting of these cases of 'IPCC process' CO_2 emissions under fuel combustion 1A2 was done lacking further IPCC guidance how to report these under CRF 2.
More details on methodologies, data sources used and country-specific source allocation issues are provided in *Annex 2* and in the monitoring protocol (Ruyssenaars, 2005). The Netherlands intends to use in the future also plant-specific CO_2 emission factors, e.g. provided by the annual environmental reports of large companies, if improves the accuracy of the emissions while maintaining the consistency and transparency.

3.2.3.3 Uncertainty and time-series consistency

The uncertainty of this category is estimated to be 3% in annual CO_2 emissions from combustion (see *Section 1.7* for more details).

Between 1990 and 2003 the emission of CO_2 due to fossil fuel combustion by industry decreased from 32.8 to 27.1 Tg (-17%) (*Table 3.10*), and is dominated by the chemical industry, in 1990 accounting for about half of total manufacturing industry emissions. This includes emissions of CO_2 from the combustion of residual chemical gas as reported in the national energy statistics. As shown in *Table 3.9* and *Table 3.11* the combustion emissions, also here in other sectors, remained fairly constant in this period except for the chemicals industry. However, in the Netherlands any trends in the source categories within the industry may be significantly influenced by the use of cogeneration facilities (i.e. combined heat and power, CHP), where part of the electricity or heat produced may be sold to other users. As illustrated in *Figure 3.7* the use of CHP generally shows, firstly, an increasing trend and, secondly, a reallocation to the energy sector (due to changing many operations into joint-ventures with utilities).

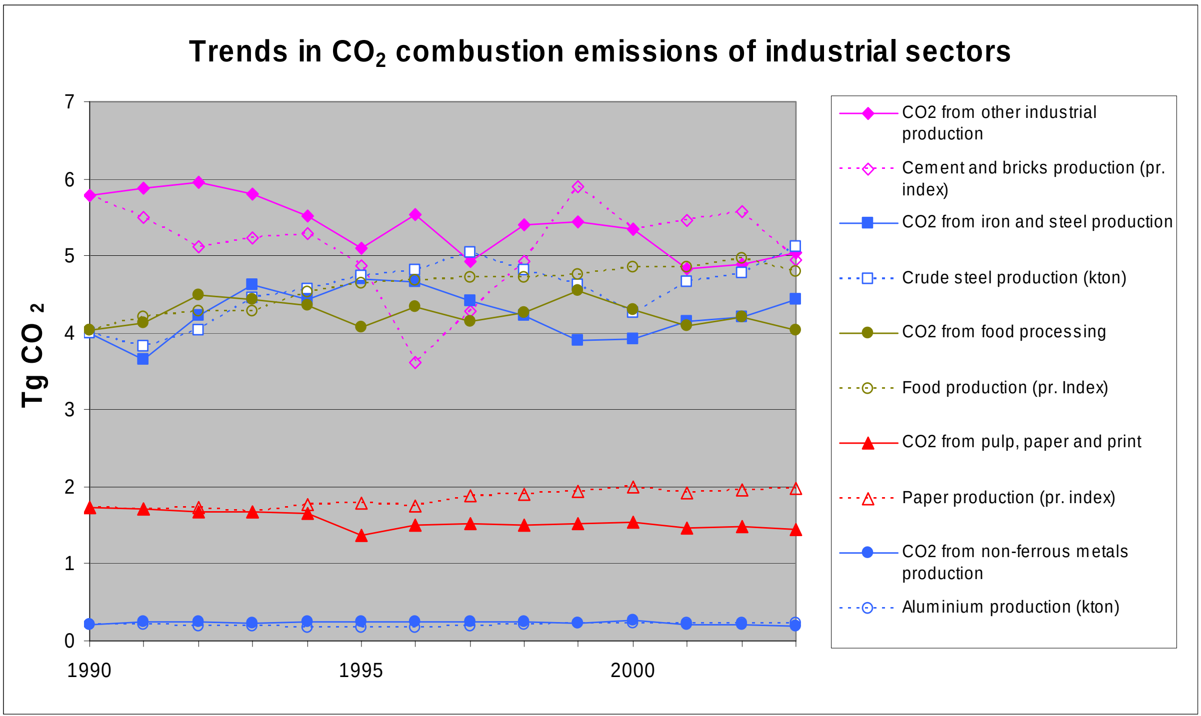


Figure 3.6. Trend analysis of CO_2 emissions in industrial subsectors.

Although total industrial production *increased* since 1990 by 22% (in monetary units), the combustion emissions of CO_2 *decreased* by 17% or about 6 Tg, to which the shift of ownership through CHP joint-ventures contributed more than 7 Tg (*Table 3.4*). The largest change was in the chemical industry, which CO_2 emissions decreased by 30% or 5 Tg (with about the same amount of CHP reallocated to the energy sector). Nevertheless, it can be concluded that apart from the CHP reallocation by and large in most industry source categories the CO_2 emissions from combustion remained almost constant, while their production significantly. The remaining differences can be explained mainly by energy conservation. Between 1989 and 1999, Netherlands' industry saw an improvement in its energy efficiency of about 20%, which is equivalent with an energy conservation of 142 PJ (EZ, 2000) or about 8.5 Tg CO_2 emissions or more (depending on the fuel mix assumed). The fuel data reported for biomass combustion are incomplete and not consistent over time (see *Section 3.12*). However, since these emissions contribute only very minor to national greenhouse gas emissions total and it is planned to improve this in the next NIR, these will not be further discussed here.

Trends in subsectors are presented in *Figure 3.6;* here CO_2 emissions trends are compared to trends in underlying production data. Both trends are closely. In *Table 3.11* the industrial CO_2 emissions are presented by fuel type, of which the fraction of natural gas is about 60%.

Table 3.11. Trend in CO_2 emissions by fuel type in the manufacturing industries and construction (1A2) (in Tg)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Total industrial combustion	32.8	32.2	32.8	32.1	30.5	42.6	28.6	27.1	27.3	27.1	26.6	36.4	35.8	27.1
o.w. Liquid fuels	8.9	8.8	8.8	8.5	8.3	7.4	6.6	5.9	6.1	6.5	5.9	5.8	0.5	7.4
o.w. Solid fuels	5.0	4.4	4.9	5.3	4.2	5.2	4.2	4.1	4.1	3.8	3.8	4.0	0.5	4.2
o.w. Gaseous fuels	18.8	19.1	19.2	18.2	17.9	18.5	17.8	17.1	17.1	16.7	16.9	16.1	16.8	15.5
o.w. Other fuels [1)]	0.0	0.0	0.0	0.0	0.0	11.5	0.0	0.0	0.0	0.0	0.0	0.0	17.9	0.0

[1)] Including unspecified emissions and incompatible fuel/emission datasets.

Notes: To reflect the degree of completeness, only emissions reported in the CRF files have been included here:
Note: IE = Included Elsewhere (for 1991-1994 no breakdown into fossil-fuel types in the CRF files).

The Netherlands' industry has a relative large number of petrochemical plants, which shows up in actual combustion CO_2 emissions associated with the manufacture of oil products and non-energy use of natural gas.

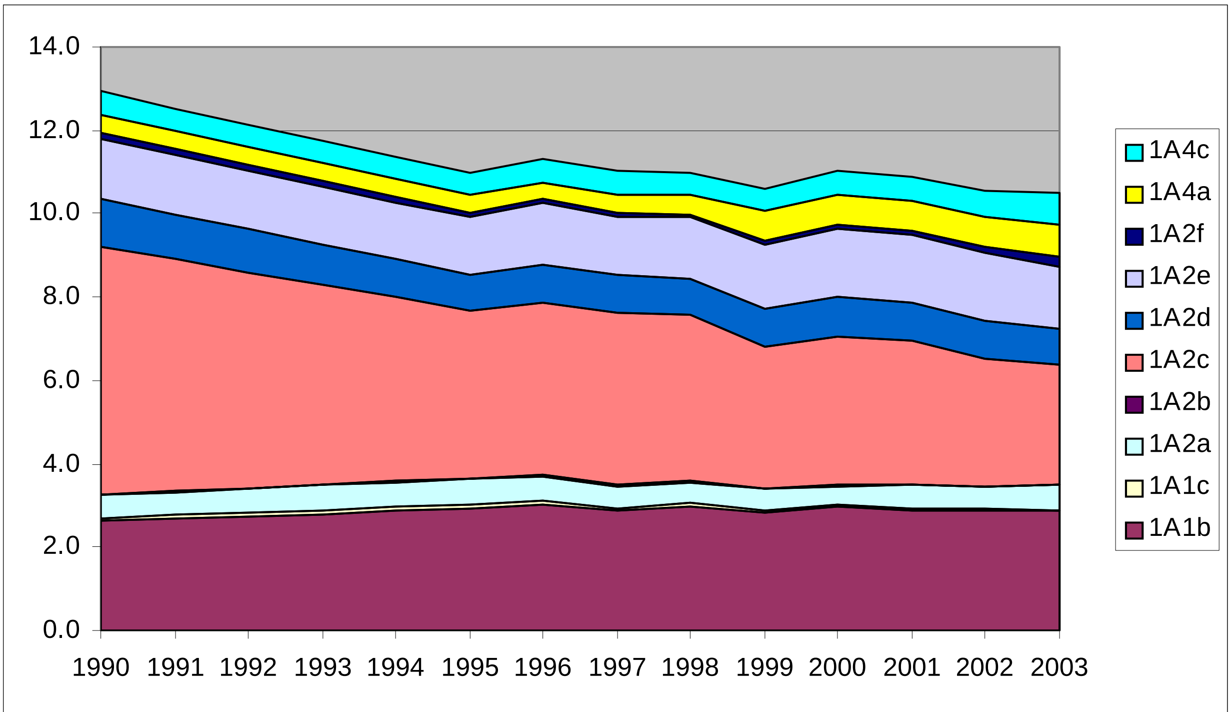


Figure 3.7. Trends in CO_2 emissions from privately owned CHP plants per source category.

Iron and Steel (1A2a)

The iron and steel industry shows interannual variations of fuel combustion CO_2 emissions that are mainly due to varying amounts of solid fuels used in the sector (*Table 3.12a*). However, when all CO_2 emissions from the sector are combined, i.e. including the net process emissions reported under category 2C1, total emissions closely follow the interannual variation in crude steel production, as shown in *Figure 3.8*. This figure also shows that total CO_2 emissions have remained rather constant in the 1990-2003 period although the production increased by more than 25%, indicating a substantial energy efficiency improvement. This deceasing trend of CO_2 losses from the coke and coal inputs in the blast furnaces, actually reducing from about 25% in 1990 to 12% presently (see *Table 4.6*), and corresponding increase of the capture and energetic use blast furnace gas (and oxygen furnace gas) of about 40% supports this conclusion.

Table 3.12a. Trends in CO_2 emissions from the iron and steel industry (excl. CO_2 losses in coke ovens) (Tg).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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
o.w. BF/OF 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
N.B. BF/OF gas in power gen.	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
Total BF/OF 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
o.w. CO gas in steel	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.1	0.0
o.w. other than BF/OF or CO gas	0.8	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.7	0.6	0.6	0.6	0.6	0.6
Gaseous fuels	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	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
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
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**	**5.5**	**5.9**
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
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

The interannual variation in the IEF for CO_2 from solid fuels is due to variable shares of BF/OF gas and coke ovens gas, which have much higher and lower emission factors, respectively, than hard coal. 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 accounted for in the energy statistics separately since 1995 and thus reported since then in the 1A1c sector (*Manufacturing of solid fuels*) (see *Section 3.2.2*).

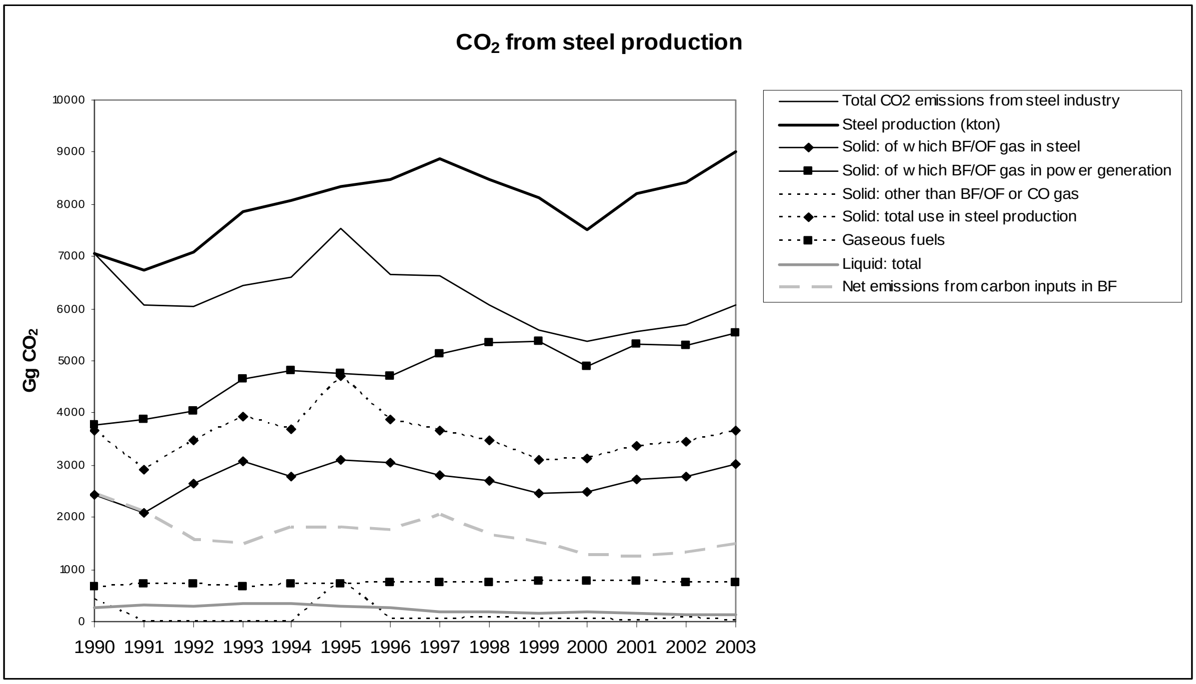


Figure 3.8. Trends in CO_2 emissions from the iron and steel industry (including on-site coke production).

Non-ferrous metals (1A2b)

This small source category of about 0.2 Tg CO_2, predominantly from natural gas combustion, consists mainly of two aluminium smelters. The combustion of liquid and solid fuels varies considerably between years, but is almost negligible. In contrast with previous years CO_2 from anode consumption is now reported under 2C.

Chemicals (1A2c)

The steady decreasing combustion of natural gas by the chemical industry, which is also in contrast with the use of other fuels, can be explained largely by decreasing use or ownership of cogeneration facilities by the industry.

The second large fuel combustion is liquid fuel combustion, which is predominantly chemical residual gas. The marked decrease in liquid fuel consumption since 1995 (see *Figure 3.9*) is not due to a decrease in chemical production or data errors, but mainly a large shift of ownership of a large cogeneration plant – using residual chemical gas – into a joint-venture and thus reallocated to public utilities (see *Figure 3.4* and *Section 3.2.1*). Also the interannual variation in the IEF for CO_2 from liquid fuels is due to the high but variable shares (between 70 and 90%) of residual chemical gas in total liquid fuel combustion, which also has a relatively low emission factor compared to most other oil products. The marked increase of the IEF for CO_2 from solid fuels in 1998 and 2000 are due to the combustion of phosphorus furnace gas since then, which has a very high emission factor of about 150 kg/GJ.

When all CO_2 emissions from the sector are combined, i.e. including the net process emissions reported under category 2B, and taking into account the shift to *joint-ventures* as shown in *Figure 3.4*, it shows that total CO_2 emissions have remained rather constant in the 1990-2003 period. Since 1990 the production increased by more than 45%, indicating a substantial energy efficiency improvement and or structural changes within the chemicals industry. *Table 3.12c* shows that the increase of oil feedstocks of about 60% since 1990 is composed of different mixture of input: naphtha use increased by one-third, whereas the feedstock use of Natural Gas Liquids (NLG) increased by half. On average, it has been calculated for the CO_2 Reference Approach 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). A more comprehensive discussion of all non-energy and feedstock uses of fuels is provided in *Section 3.2.7*.

Table 3.12b. Trends in CO_2 emissions from the chemical industry (Tg).

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Liquid: total used in chem. ind.	6.6	6.6	6.7	6.4	6.5	4.9	4.8	4.7	4.6	4.9	4.5	4.9	5.7	6.0
o.w. chem.residual gas	5.0	4.8	4.9	4.9	4.8	3.6	3.8	3.7	3.8	4.1	3.9	4.3	5.1	5.5
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*	*2.0*
Total chem. residual gas	*5.0*	*4.8*	*4.9*	*4.9*	*5.1*	*5.1*	*5.3*	*5.4*	*5.5*	*5.9*	*5.7*	*6.2*	*7.3*	*7.5*
o.w. other fuels	1.2	1.8	1.9	1.6	1.7	1.6	1.5	1.4	1.2	1.3	0.9	0.9	1.0	1.0
Natural gas	9.4	9.0	8.5	7.9	7.7	7.5	7.4	7.1	6.8	6.2	6.5	6.0	5.8	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	0.3	0.2	0.2
Ammonia production (a.o.) (2B)	3.5	3.8	3.8	3.7	3.9	3.9	3.8	3.9	3.7	3.6	3.7	3.1	3.0	2.8
Total CO_2 chemical industry	**17.0**	**16.6**	**16.3**	**15.3**	**14.3**	**12.4**	**12.3**	**11.8**	**11.7**	**11.4**	**11.3**	**11.2**	**11.7**	**11.9**

Table 3.12c. Chemical industry: feedstock uses of fuels (unit: PJ)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Oil products [1)]	303	337	346	314	329	321	299	318	317	350	387	411	430	489
o.w. Naphtha	136	*141*	*145*	*150*	*154*	159	176	171	117	111	74	77	94	181
o.w. Natural Gas Liquids	143	*151*	*159*	*167*	*174*	182	168	169	164	181	201	210	253	217
o.w. LPG	63	*62*	*60*	*58*	*56*	55	20	38	39	28	39	35	3	4
o.w. Gas/Diesel Oil	34	*29*	*24*	*20*	*15*	10	12	18	15	19	6	4	6	4
Natural Gas	101	109	107	102	109	110	105	113	107	107	113	100	97	91

[1)] Excluding lubricants, bitumen, coals, coal derived fuels, which are mainly or fully used elsewhere.
Figures in italics are interpolated data.

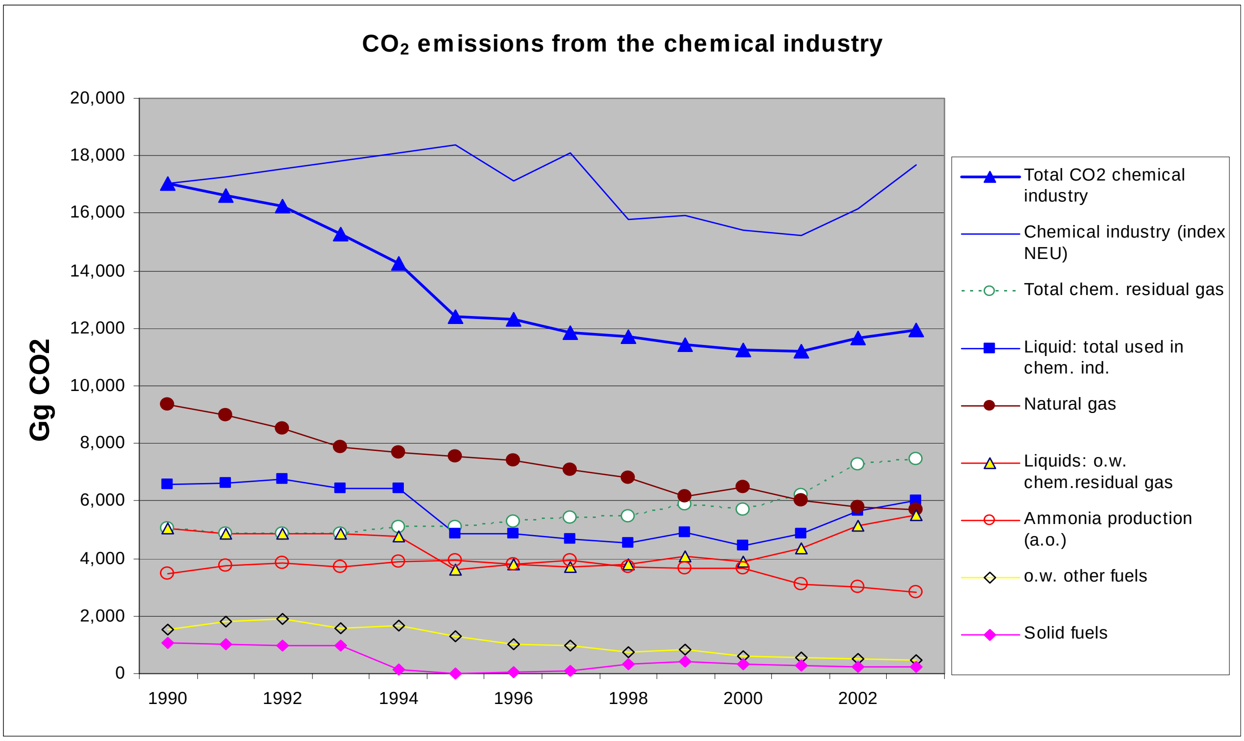


Figure 3.9. Trends in CO_2 emissions from the chemical industry.

Pulp, Paper and Print (1A2d)

CO_2 emissions of this source category decreased about 15% since 1990 following the consumption of natural gas, which is the single most used fuel for this subcategory. A very large fraction, almost 1 Tg of a total of about 1.5 Tg CO_2 is used for cogeneration (*Figure 3.6*). The notable decrease in CO_2 emissions in 1995 is due to the shift of joint-venture cogeneration to the energy sector of about 1 Tg CO_2 (see *Figure 3.3*).

Food Processing, Beverages and Tobacco (1A2e)

The CO_2 emissions of the food, beverages and tobacco industry (1A2e), almost all stemming from natural gas combustion, remained almost constant over time: the 10% increase of gas consumption since 1990 was compensated by decreases in the small uses of other fuels. About 1.5 Tg of a total of about 4 Tg CO_2 is emitted by cogeneration plants owned by the food industry (*Figure 3.6*).

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

The 'other' manufacturing industry (1A2f) includes all other industry braches, e.g. the mineral products (e.g. cement, bricks, other building materials, glass), textiles, wood and wood products. Also included is the building construction industry. The use of off-road machinery used for building construction and for other purposes (except agriculture) are also reported here (previously this was reported under 'Other transport', category 1A3e).

Most of the present 5 Tg CO_2 emissions from this source category stem from gas combustion (about 3.5 Tg) and almost all of the remainder relates to combustion of liquid fuels. A very small part, (0.2 Tg) is emitted by cogeneration plants (*Figure 3.7*). The varying amounts from liquid fuel are due to the relatively large inaccuracy of fuel consumption data in the energy statistics for off-road machinery, which account for 0.7 to 1.2 Tg CO_2 of the total from liquid fuels of 1-2 Tg CO_2 (see *Table 3.13*).

Table 3.13. CO_2 emissions from off-road machinery included in other industry (1A2f).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Building construction	0.36	0.35	0.34	0.36	0.32	0.25	0.26	0.27	0.39	0.34	0.26	0.23	0.23	0.23
Miscelleneous off-road [1)]	0.72	0.70	0.67	0.71	0.65	0.50	0.53	0.53	0.78	0.67	0.52	0.46	0.46	0.46
Total off-road in 1A2f	**1.08**	**1.05**	**1.01**	**1.07**	**0.97**	**0.75**	**0.79**	**0.80**	**1.18**	**1.01**	**0.77**	**0.68**	**0.69**	**0.69**

[1)] Road and waterways construction, other non-agricultural off-road sources.

3.2.3.4 Source-specific recalculations

Major recalculations and allocation improvements were made for stationary fuel combustion emissions of greenhouse gases in subcategories 1A1, 1A2 and 1B2, which are now based on fuel consumption data from national sectoral energy statistics and national default emission factors for CO_2 and N_2O, and source-specific emission factors for CH_4. The emissions include the combustion of blast furnace and oxygen furnace gas by the iron and steel plant and chemical waste gas by the chemical industry, which were produced in industrial processes (see source categories 2B and 2C). Previously, the greenhouse gas emissions from these subcategories were based on individual company reports, the MJVs (the part of the national pollutant emission register called ‘ER-I’) (see *Section 1.2*). However, these reports generally did not provide transparent and complete fuel use and emissions data at the required the level of detail, in particular not for the distinction in fuel use for combustion and non-combustion purposes (see *Section 1.2*). As a consequence, consistency over time of CO_2 and CH_4 emissions at subcategory level has now been substantially improved, as well as transparency and the source allocation.

Another major change was the reallocation of feedstock i.e. non-combustion CO_2 emissions of fuel use in the chemical industry to the industry processes sector, notably ammonia production (2B1). In addition, emissions from off-road machinery used for road and building construction were moved from ‘other transport’ (1A3e) to other industry (1A2f, liquid fuels). Both reallocations were done to comply with IPCC reporting guidelines.

As shown in *Table 3.14a*, the largest changes in emissions are due to a change in allocation of CO_2 emissions from the chemical industry and the iron and steel industry, mainly due to another allocation of fuel use in the national energy statistics than in the individual company reports (both fuel and non-fuel use and ownership of cogeneration facilities). As of this year emissions from all joint-ventures of cogeneration facilities are all reported in the 1A1a subcategory (see also *Sections 3.2.1.3* and *3.2.2.5*). These changes were made as part of the inventory improvement programme and also in response to previous reviews requesting to report industrial process emissions in the correct IPCC subcategory (see *Section 3.2.7* and *Chapter 9*).

3.2.3.5 Source-specific planned improvements

For biomass combustion, it is planned for the next NIR to replace the fuel data by a new consistent time series since 1990 reported in CBS (2004), which was compiled within the new project for collecting annually national statistics on renewable energy use by sector according to the Protocol for Monitoring of Renewable Energy (Abeelen and Bosselaar, 2004). This will remove the very large interannual variations that can be observed now in the subcategories 1A2d-e-f. However, this will have only a very small impact to national greenhouse gas emissions total. The Netherlands intends to use in the future also plant-specific CO_2 emission factors, e.g. provided by the annual environmental reports of large companies, if it improves the accuracy of the emissions while maintaining consistency and transparency.

Table 3.14a. Effects of recalculation of CO_2 emissions from Manufacturing industries 1990-2002 (in Tg)

	Souce category		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1A2	**Total Manuf. Industries**	**new**	**32.8**	32.2	32.8	32.1	30.5	**27.9**	**28.6**	**27.1**	**27.3**	**27.1**	**26.6**	**25.9**	**26.7**
1A2	**Total Manuf. Industries**	**old**	**42.2**	42.7	42.5	39.9	41.0	**42.6**	**43.0**	**35.5**	**39.2**	**38.2**	**36.3**	**36.4**	**35.8**
1A2	Total Manuf. Industries	***diff***	***-9.4***	***-10***	***-9.7***	***-7.9***	***-11***	***-14.7***	***-14.5***	***-8.4***	***-11.8***	***-11.1***	***-9.7***	***-10.5***	***-9.1***
1A2a	Iron and Steel	new	4.0	3.7	4.2	4.6	4.4	4.7	4.7	4.4	4.2	3.9	3.9	4.2	4.2
1A2a	Iron and Steel	old	6.3	0.0	0.0	0.0	0.0	6.5	5.6	5.5	6.4	6.5	6.2	6.1	5.6
1A2a	Iron and Steel	***diff***	***-2.3***	***3.7***	***4.2***	***4.6***	***4.4***	***-1.9***	***-1.0***	***-1.1***	***-2.2***	***-2.6***	***-2.3***	***-1.9***	***-1.4***
1A2b	Non-Ferrous Metals	new	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2
1A2b	Non-Ferrous Metals	old	0.2	0.0	0.0	0.0	0.0	0.3	0.3	0.2	0.3	0.3	0.2	0.2	0.6
1A2b	Non-Ferrous Metals	***diff***	***0.0***	***0.2***	***0.2***	***0.2***	***0.2***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.1***	***0.0***	***-0.4***
1A2c	Chemicals	new	17.0	16.6	16.3	15.3	14.3	12.4	12.3	11.8	11.7	11.4	11.3	11.2	11.7
1A2c	Chemicals	old	24.1	0.0	0.0	0.0	0.0	24.7	25.4	19.8	21.1	20.2	18.6	19.3	18.9
1A2c	Chemicals	***diff***	***-7.1***	***16.6***	***16.3***	***15.3***	***14.3***	***-12.3***	***-13.1***	***-8.0***	***-9.5***	***-8.7***	***-7.3***	***-8.1***	***-7.3***
1A2d	Pulp, Paper and Print	new	1.7	1.7	1.7	1.7	1.7	1.4	1.5	1.5	1.5	1.5	1.5	1.5	1.5
1A2d	Pulp, Paper and Print	old	1.6	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.0	1.6	2.1	2.0	2.0
1A2d	Pulp, Paper and Print	***diff***	***0.2***	***1.7***	***1.7***	***1.7***	***1.7***	***-0.6***	***-0.5***	***-0.5***	***-0.5***	***0.0***	***-0.6***	***-0.5***	***-0.5***
1A2e	Food, Beverages & Tobacco	new	4.0	4.1	4.5	4.4	4.4	4.1	4.3	4.1	4.3	4.5	4.3	4.1	4.2
1A2e	Food, Beverages & Tobacco	old	4.2	0.0	0.0	0.0	0.0	4.5	4.8	3.2	4.4	4.6	4.2	4.2	4.2
1A2e	Food, Beverages & Tobacco	***diff***	***-0.1***	***4.1***	***4.5***	***4.4***	***4.4***	***-0.4***	***-0.5***	***0.9***	***-0.1***	***-0.1***	***0.1***	***-0.1***	***0.0***
1A2f	Other	new	5.8	5.9	5.9	5.8	5.5	5.1	5.5	4.9	5.4	5.4	5.3	4.8	4.9
1A2f	Other	old	5.9	42.7	42.5	39.9	41.0	4.7	4.9	4.7	5.0	5.0	4.9	4.7	4.5
1A2f	Other	***diff***	***-0.1***	***-37***	***-37***	***-34***	***-35***	***0.4***	***0.6***	***0.2***	***0.4***	***0.4***	***0.4***	***0.1***	***0.4***

Table 3.14b: Effect of recalculations of CH_4 and N_2O from manufacturing industries (1A2) (in Gg)
[not shown are subcategories where old and new rounded emissions are 0.0 for all years]

	Souce category		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
	CH_4														
1A2	**Total Manuf. Industries**	**new**	**2.7**	**2.6**	**2.6**	**2.5**	**2.5**	**2.3**	**2.4**	**2.3**	**2.3**	**2.3**	**2.3**	**2.2**	**2.2**
1A2	**Total Manuf. Industries**	**old**	**2.9**	**3.5**	**4.9**	**3.2**	**2.6**	**5.1**	**1.8**	**1.0**	**1.7**	**2.9**	**3.2**	**2.2**	**2.3**
1A2	Total Manuf. Industries	***diff***	***-0.2***	***-0.9***	***-2.3***	***-0.7***	***-0.1***	***-2.8***	***0.5***	***1.3***	***0.6***	***-0.6***	***-0.8***	***0.0***	***0.0***
1A2a	Iron and Steel	new	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1
1A2a	Iron and Steel	old	0.6	0.0	0.0	0.0	0.0	0.7	0.4	0.1	0.1	0.6	0.8	0.7	0.7
1A2a	Iron and Steel	***diff***	***-0.4***	***0.1***	***0.1***	***0.1***	***0.1***	***-0.6***	***-0.3***	***0.1***	***0.1***	***-0.5***	***-0.7***	***-0.6***	***-0.6***
1A2c	Chemicals	new	1.4	1.3	1.3	1.2	1.2	1.1	1.1	1.0	1.0	0.9	0.9	0.9	1.0
1A2c	Chemicals	old	1.0	0.0	0.0	0.0	0.0	3.0	0.2	0.1	0.9	0.9	1.0	0.6	0.6
1A2c	Chemicals	***diff***	***0.3***	***1.3***	***1.3***	***1.2***	***1.2***	***-1.9***	***0.9***	***0.9***	***0.0***	***0.0***	***0.0***	***0.3***	***0.4***
1A2d	Pulp, Paper and Print	new	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.2	0.2
1A2d	Pulp, Paper and Print	old	0.1	0.0	0.0	0.0	0.0	0.3	0.2	0.1	0.0	0.2	0.2	0.1	0.1
1A2d	Pulp, Paper and Print	***diff***	***0.1***	***0.2***	***0.2***	***0.2***	***0.2***	***-0.2***	***0.0***	***0.1***	***0.1***	***0.0***	***0.0***	***0.1***	***0.1***
1A2e	Food, Beverages & Tobacco	new	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.4	0.4
1A2e	Food, Beverages & Tobacco	old	0.5	0.0	0.0	0.0	0.0	0.5	0.5	0.2	0.3	0.6	0.5	0.3	0.3
1A2e	Food, Beverages & Tobacco	***diff***	***-0.2***	***0.4***	***0.4***	***0.4***	***0.4***	***-0.1***	***0.0***	***0.2***	***0.2***	***-0.1***	***-0.1***	***0.1***	***0.1***
1A2f	Other	new	0.5	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.6	0.5	0.5	0.5
1A2f	Other	old	0.7	3.5	4.9	3.2	2.6	0.5	0.4	0.4	0.4	0.6	0.6	0.5	0.5
1A2f	Other	***diff***	***-0.1***	***-2.9***	***-4.3***	***-2.6***	***-2.1***	***0.0***	***0.1***	***0.0***	***0.2***	***0.0***	***0.0***	***0.0***	***0.0***
	N_2O														
1A2	**Total Manuf. Industries**	**new**	**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**
1A2	**Total Manuf. Industries**	**old**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.3**	**0.5**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
1A2	Total Manuf. Industries	***diff***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***-0.1***	***-0.2***	***-0.4***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
1A2c	Chemicals	new	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1A2c	Chemicals	old	0.1	0.0	0.0	0.0	0.0	0.1	0.3	0.5	0.1	0.0	0.1	0.1	0.0
1A2c	Chemicals	***diff***	***0.0***	***0.1***	***0.1***	***0.0***	***0.0***	***-0.1***	***-0.2***	***-0.4***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***

3.2.4 Transport (CRF category 1A3)

3.2.4.1 Source category description

The transport sector 1A3 comprises road traffic; rail transport; ships (excluding national fisheries, which are reported under 1A4c) and aircraft. The latter two can be separated into domestic (inland) transport and international transport (bunkers). As of this year, national fisheries emissions have been separately estimated and included in ‘*Agriculture, Forestry and Fisheries*’, CRF category 1A4c. Pipeline transport (excluding natural gas) is by definition also included in this sector, but are reported elsewhere as no separate statistics exist for this activity. According to the IPCC guidelines mobile off-road equipment such as tractors, and road and building construction equipment are reported elsewhere as are military mobile activities. The transportation sector, dominated by road transport, has some particular features that warrant special attention:

- Allocation differences in national energy statistics and IPCC/UNFCCC reporting guidelines. This refers in particular to off-road mobile equipment and national fisheries;
- Allocation to domestic or international transport. This concerns shipping and aviation (civil and military);
- Differences that may occur in road transport between fuel delivery statistics and fuel consumption estimated from vehicle-km statistics (top-down vs. bottom-up).

The first two issues will be discussed here, whereas the comparison of road transport statistics will be discussed in *Section 3.2.3.4* on ‘V*erification*’.

General trend

The greenhouse gas emissions from the transport sector are summarised in Table *3.15*. Obviously, CO_2 emissions from road transport are the dominant source category here, whereas most N_2O emissions also belong in this subcategory. In *Box 3.2* all CO_2 emissions as well as the N_2O emissions from road transport are identified as key sources.

Table 3.15. Trends of greenhouse gas emissions from the transport sector (unit: CO_2 in Tg; others in Gg)

Gas/sub-source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2														
a. Civil aviation	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
b. Road transport	25.5	25.7	27.0	27.6	28.1	28.6	29.4	29.7	30.5	31.3	31.7	32.2	32.9	33.4
c. Railways	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
d. Navigation	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.6	0.6	0.6	0.6	0.6
e. Other transport	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
CH_4														
a. Civil aviation	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
b. Road transport	7.5	6.5	6.0	5.8	5.6	5.2	4.9	4.7	4.5	4.0	3.8	3.8	3.7	3.4
c. Railways	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
d. Navigation	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
e. Other transport	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
N_2O														
a. Civil aviation	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
b. Road transport	0.9	1.0	1.2	1.3	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.5	1.5
c. Railways	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
d. Navigation	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
e. Other transport	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

By far the largest contributor to this sector is road transport, which accounted for 98% in 1990 (*Table 3.16*). In the period 1990-2003 total CO_2 emissions from transport ‘1A3’ have increased by 31%. This increase is predominantly caused by an increase in energy consumption by road transport were fuel consumption increased by 30% in this period. Navigation emissions (domestic shipping) do now include fisheries, which are the largest contributor to this subcategory. We note that CO_2 emissions from off-road machinery, which are used in agriculture and for building and road construction, are reported elsewhere. *Table 3.18* presents fuel consumption by road transport, both for the IPCC approach, which is based on fuel deliveries, and for the national approach, which is based on transport statistics in terms of vehicle-km travelled. While the share of petrol has remained rather constant over the whole period, there has been a shift from LPG to diesel fuel, effectively increasing the share of diesel in road transport fuel consumption from 45% in 1990 to 56% in 2003.

Table 3.16. CO_2 emissions from transport in 1990 and 2003 by transport mode (Tg)

	1990	Share in 1990	2003	Share in 2003	Increase 2003/1990 (Tg)	Increase 2003/1990 %
b. Road Transportation	25.5	98	33.4	98	8.0	31.3
e. Other Transportation (off-road)	0.0	0	0.0	0	0.0	
d. Domestic shipping	0.4	2	0.6	2	0.2	43.8
a. Domestic aviation	0.0	0	0.0	0	0.0	0.0
c. Railways	0.1	0	0.1	0	0.0	13.7
Total	**26.0**		**34.2**		**8.1**	**31.3**

We recall from *Section 3.1* that the Netherlands has a relatively very large bunker fuel consumption due to its strategic position at the mouth of the Rhine and housing Schiphol Airport as Western Europe's largest supply of aviation bunker fuels. To put this share into perspective, the CO_2 emissions from international bunkers form about 150% of total domestic transport emissions of CO_2. This is equivalent to about 18% of total national greenhouse gas emissions in 1990 and increases to around 25% for the current year. The information presented in the CRF on the shares of international and domestic emissions in total shipping and aviation is presented as a trend table in *Table 3.38* (see also *Table 2.3* in *Chapter 2*). *Box 3.2* presents the key and non-key sources of the transport sector based on level, trend or both. All CO_2 sources are key ones. Of the non-CO_2 sources, only N_2O from road transport is a key source.

Box 3.2. Key source identification in the transport sector using the IPCC Tier 1 and 2 approach (L = Level, T = Trend.

1A3b	**CO_2**	**Mobile combustion: road vehicles**	**Key (L,T)**
1A3d	**CO_2**	**Mobile combustion: domestic shipping**	**Key (L2)**
1A3a	CO_2	Mobile combustion: domestic aircraft	Non-key
1A3e	*CO_2*	*Mobile combustion: other (off-road now included elsewhere; see 1A2f and 1A4c)*	**-**
1A3b	CH_4	Mobile combustion: road vehicles	Non-key
1A3e	CH_4	Mobile combustion: other	Non-key
1A3b	N_2O	Mobile combustion: road vehicles	Non-key
1A3e	N_2O	Mobile combustion: other	Non-key

Allocation of emissions

Road transport

For national policy purposes, air pollution from road transport is, in general, calculated bottom-up from statistics on vehicle-km. However, the fuel consumption figure that is based on vehicle-km is lower than the fuel consumption included in the energy sales statistics of the Netherlands. The *Revised IPCC Guidelines* (IPCC, 1997) ask countries to report greenhouse gas emissions from combustion on the basis of fuel consumption within the national territory. Thus, road traffic emissions of the direct greenhouse gases CO_2, CH_4 and N_2O are calculated and reported according to these guidelines. 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-km data (i.e. with fuel consumption figures that are somewhat different from energy supply statistics; see *Section 3.2.3.4* for more details).

Inland navigation and Fisheries

This year it is the first time that greenhouse gas emissions from inland navigation are reported according to IPCC guidelines. These state that all fuel used in *domestic* navigation (between Dutch ports) should be reported. Fuel used for *international* navigation (from a Dutch to a foreign port) should not be reported. The distinction between domestic and international navigation can now be made using the

Emission Monitor Shipping (EMS) (AVV, 2003), which uses a bottom-up approach based on ton-kilometres travelled. Formerly, fuel consumption by inland navigation was based on the Netherlands Energy Statistics that does not correctly distinguish between domestic and international shipping. In previous submissions of the NIR all fuel sales to inland navigation (domestic sales and bunker sales) were reported under inland navigation resulting in an overestimation of activity levels and, consequently, also of the emissions.

International bunker statistics include activities from fisheries, which this year are no longer allocated under '*International bunkers'* but under domestic source category 1A4c '*Commercial/Institutional/ Fisheries' as required by the IPCC reporting guidelines.* A study has been carried out to identify fuel used by fishing ships, which is used to decrease the international bunker figures accordingly (Hulskotte, 2004).

Domestic air traffic

For this very small source, fuel consumption by aircraft for domestic flights in the Netherlands used to calculate greenhouse gas emissions from domestic air traffic is based on a study by RLD (Space and Aviation Department of the Ministry of Transport). Data included in the national energy statistics are not used since they have proven to be highly inaccurate. Default IPCC emission factors for kerosene and aviation gasoline (avgas) were used to calculate greenhouse gas emissions.

This is different from the non-greenhouse gas emissions recorded in the national Pollutant Emissions Register (PER), which accounts only for aircraft emissions associated with the Landing and Take-Off (LTO) cycles of Schiphol Airport (other airports are ignored). By far the most aircraft activities (>90%) are related to Schiphol Airport in the Netherlands. Non-greenhouse gas emissions reported in the NIR under domestic air traffic are the uncorrected PER values referring to LTO cycles only, for domestic and international flights. No attempt has been made to estimate non-greenhouse gas emissions related to only *domestic* flights (including *cruise* emissions of these flights), since these are almost negligible anyway.

Military shipping and aviation

This year greenhouse gas emissions from military aircraft and shipping activities have been estimated for the first time (Hulskotte, 2004). Following the IPCC reporting guidelines these emissions are reported under category 1A5 (see *Section 3.2.5*).

Off-road mobile sources

This category comprises agricultural machinery such as tractors, and road construction and building construction machinery. These emissions were previously reported under category *1A3e: 'Other Transport'* which did not comply with the IPCC reporting guidelines. Emissions from off-road machinery in agriculture are now reported under subcategory 1A4c '*Agriculture'*. Emissions from off-road machinery in construction and other areas are now reported under subcategory 1A2f '*Other' of 'Manufacturing industries and Construction'*.

Description of road transport (CRF 1A3b)

CO_2 emissions

The share of road transport in national CO_2 emissions was 16% in 1990 and 19% in 2003. By far the largest contributor to this source category are passenger cars, which accounted for 62% in 1990. Next are trucks, contributing about 22% in 1990. CO_2 emissions from road transport increased by 8 Tg or 31% in the period 1990-2003. This increase is predominantly caused by an increase by passenger cars of 21% and vans of about 130%, respectively (see *Table 3.17*). The share of CO_2 emissions of freight transport in total road transport increased from 36% in 1990 to 41% in 2003.

Table 3.17. Trend in CO_2 emissions from road transport by type.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Passenger transport	16.4	16.5	16.9	17.4	17.8	18.2	18.5	18.6	18.9	19.1	19.0	19.3	19.7	19.8
Freight transport	9.1	9.3	10.1	10.2	10.2	10.4	10.9	11.1	11.6	12.2	12.7	12.9	13.2	13.6
o.w. Freight vans	2.4	2.4	2.7	3.0	3.0	3.1	3.3	3.6	4.0	4.4	4.8	5.0	5.2	5.5
o.w. Freight trucks	6.7	6.9	7.4	7.2	7.2	7.3	7.5	7.5	7.6	7.8	7.8	7.9	7.9	8.1
Total road transport	25.5	25.7	27.0	27.6	28.1	28.6	29.4	29.7	30.5	31.3	31.7	32.2	32.9	33.4

While the share of petrol in fuel sales to road vehicles has remained rather constant over the whole period, there has been a shift from LPG to diesel fuel, effectively increasing the share of diesel in road transport fuel sales from 45% in 1990 to 56% in 2003 (*Figure 3.10*).

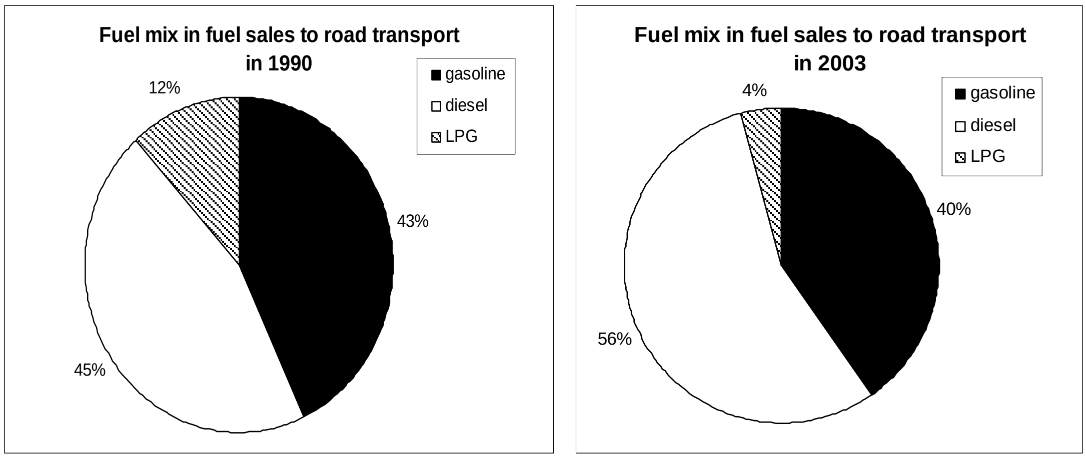


Figure 3.10. Shares of petrol, diesel and LPG in fuel sales to road transport 1990 and 2003.

Methane emissions

CH_4 emissions from road transport were calculated using mass fractions of total VOC from Veldt and Van der Most (1993). The mass fraction is dependent on 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. Diesel-fuelled vehicles emit less CH_4 per unit of total VOC than petrol-fuelled vehicles without a catalyst.

Total CH_4 emissions by road transport dropped by almost 50% between 1990 and 2003: 7.3 to 3.7 Gg (*Table 3.15*). In 2003 passenger cars were accountable for 65 to 70% of these CH_4 emissions. This reduction is related to the reduction in total VOC emissions, which was the result of European emission legislation for new road vehicles: total combustion and fugitive VOC emissions by road transport decreased by approximately 50% in the 1990-2003 period. This reduction was mainly the result of the penetration of catalyst-equipped cars into the passenger car fleet.

Nitrous oxide emissions

N_2O emissions from road transport increased from 0.9 Tg in 1990 to 1.6 Tg in 1999 and remained more or less constant between 1999 and 2003. The increasing trend up to 1999 could be expected from the increase in vehicles kilometres and from the increasing share of petrol cars equipped with a catalytic converter, which have a higher emission factor than cars without this emission control technology (*Table 3.18*). The fact that N_2O emissions from transport remained constant between 1999 and 2003, despite the increase in vehicle kilometres, can be explained from a mix of developments:

- 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 over the last few years.

These trends have been summarised in *Table 3.17*. Both the decreasing emission factor for catalyst-equipped cars as well as the increasing share of diesel cars with relatively low N_2O emission factors lead to the overall emission factor for N_2O from road transport to remain constant between 1999 and 2003. This has been visualised in *Figures 3.11* and *3.12.*

Table 3.18. Trends in N_2O emission factors for passenger cars.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
A. N_2O emission factors (mg/km)														
Gasoline total	9	11	13	14	15	17	16	16	16	15	14	13	13	12
o.w. gasoline without cat.	5	5	5	5	5	5	5	5	5	5	5	5	5	5
o.w. gasoline with cat.	26	25	25	25	25	25	23	21	20	18	17	15	14	13
Share of cars kms with cat.	14%	20%	27%	32%	36%	40%	43%	47%	49%	52%	54%	55%	57%	58%
Diesel	5	5	5	5	5	5	6	6	7	8	8	9	9	9
LPG	10	13	15	16	18	19	20	19	18	19	18	17	15	14
ALL FUELS	9	10	12	13	14	15	15	14	14	14	13	12	12	12
B. Share of fuels in passenger car km														
Gasoline	64%	64%	66%	68%	67%	68%	68%	68%	68%	68%	67%	67%	67%	67%
Diesel	20%	20%	19%	19%	19%	20%	20%	21%	22%	23%	25%	25%	26%	27%
LPG	16%	16%	15%	14%	13%	12%	12%	11%	10%	9%	8%	8%	7%	6%

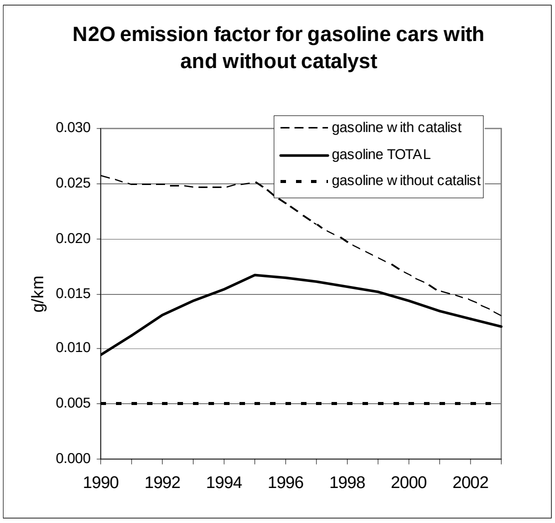


Figure 3.11. Trends in emission factors for N_2O from petrol passenger cars in the Netherlands due to increasing numbers of cars equipped with a catalytic converter.

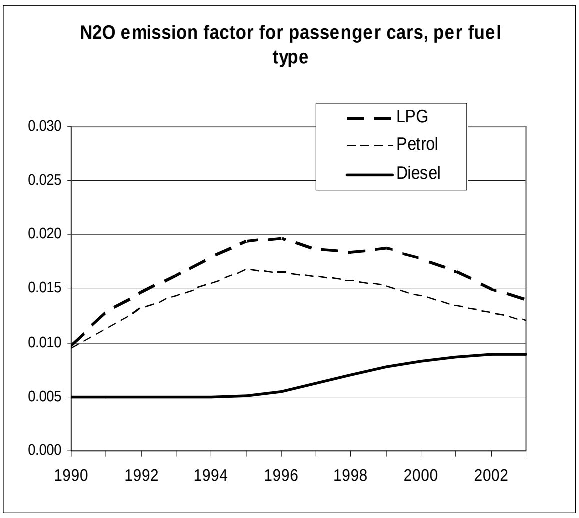


Figure 3.12 Trends in emission factors for N_2O from passenger cars in the Netherlands by fuel type.

Description of domestic shipping (waterborne navigation) (CRF 1A3d)

The share of domestic waterborne in national CO2 emissions was almost 2% in both 1990 and 2003. Emissions in 2003 were about 0.6 Tg and 0.4 Tg in 1990.

Description of domestic aviation (CRF 1A3a)

The share of domestic aviation in national CO_2 emissions was less than 1% in both 1990 and 2003. Domestic aviation consists of domestic civil aviation between Dutch airports, civil aviation from and to the same airport, and military aviation from Dutch military airports. Domestic aviation in the Netherlands emitted 0.4 Tg CO_2 in 1990 and 2003.

3.2.4.2 Methodological issues

A detailed description of the methodology and data sources used to calculate transport emissions can be found in Klein *et al.* (2002).

Road transport (CRF 1A3b)

IPCC Tier 2 methodologies are used for CO_2 emissions from road transport. CO_2 emissions are calculated using Netherlands data on fuel sales to road transport from Statistics Netherlands (CBS) and country-specific emission factors, reported in Klein *et al.* (2004).
IPCC Tier 3 methodologies are used for CH_4 emissions from road transport. VOC emissions from road transport are calculated using data on vehicle kilometres from *Statistics Netherlands* and VOC emission factors from the *Netherlands Organisation for Applied Scientific Research* (TNO). For every road transport subcategory the calculation methodology distinguishes between several vehicle characteristics like age, fuel type and weight. In addition, the methodology also distinguishes between three road types and takes into account cold starts.

A country-specific methodology is used for N_2O emissions from road transport. This is equivalent to the IPCC Tier 3 methodology. N_2O emissions are calculated combining fuel deliveries with energy-specific emission factors. 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 new heavy-duty diesel engines will need exhaust after-treatment systems like SCR-deNO$_x$ (Selective Catalytic Converters) or EGR (Exhaust Gas Recirculation) 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 and N_2O emissions from road transport are considered key sources (see *Section 3.1*), the present Tier 2 and Tier 3 methodologies comply with the *IPCC Good Practice Guidance* (IPCC, 2000). CH_4 emissions from road transport are not a key source.

Domestic shipping (waterborne navigation) (CRF 1A3d)

CO_2 emissions from domestic shipping are based on fuel deliveries to waterborne navigation in the Netherlands and country-specific emission factors, reported in Klein *et al.* (2004). In the Netherlands domestic commercial inland ships are allowed to use bunker fuels (i.e. sold without VAT). The sum of bunker fuel sales and domestic fuel sales to waterborne navigation (reported in the national Energy Statistics) includes fuel used for *international* navigation that should not be reported according to *IPCC Good Practice*. The EMS method (see paragraph on allocation in *Section 3.2.3.1*) however makes it possible to distinguish between national and international navigation based on ton-kilometres travelled by ships. 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 should be reported under 1A3d. Since the CO_2 emissions are considered a key source (see *Section 3.1*), the present Tier 2 methodology level does comply with the *IPCC Good Practice Guidance* (IPCC, 2000).

Domestic aviation (CRF 1A3a)

CO_2 emissions of domestic aviation are based on fuel deliveries to domestic aviation in the Netherlands (RLD, 2003) and country-specific emission factors, reported in Klein *et al*. (2004).. Deliveries of bunkers to international aviation are excluded from this calculation. Fuel use by domestic civil aviation in the Netherlands comes to around 0.6 PJ in 2003 (fuel deliveries to military aviation are 4.4 PJ). It is unknown to what extent fuel sold for domestic purposes is used for international aviation and vice versa. Besides, it is uncertain whether the fuel deliveries to the military air force are included in the fuel deliveries to domestic aviation. See *Section 3.2.8* for more information on the international transport (bunker) emissions. Since the CO_2 emissions are considered a key source (see *Section 3.1*), the present Tier 2 methodology level complies with the *IPCC Good Practice Guidance* (IPCC, 2000).

Rail transportation (CRF 1A3c)

Information on fuel use by diesel trains is obtained via the Dutch Railways (NS). Country-specific emission factors for CO_2 are used based on Olivier (2004). (For CH_4 and N_2O IPCC default emission factors have been used. Emissions from mobile machinery in the Netherlands were previously reported under CRF 1A3e but are now reported under 1A4c (agriculture) and 1A2f (construction and other). See these subsectors for a description of the emission calculation methodology of off-road machinery.

3.2.4.3 Uncertainty and time-series consistency

Road transport (CRF 1A3b)

The uncertainty in CO_2 emissions from road transport is estimated to be 3% in annual emissions. The trend shows an increase of 26%, which is mainly caused by the increase in passenger car use and the use of vans and the fact that both passenger cars and vans did not become significantly more energy efficient between 1990 and 1999. The commitment of the European, Korean and Japanese car manufacturers is to sell new cars in de European Union in 2008 emitting on average 25% less CO_2 per kilometre than in 1995. This has probably led to a slight decrease in average fuel use per kilometre driven in the last years. However, this 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 uncertainty in CH_4 emissions from road transport is estimated to be about 50% in annual emissions. Data on the share of CH_4 in VOC are based on information in Veldt and Van der Most (1993) and have not been validated since. Possibly, the mass fraction of CH_4 has changed due, for example, to recent changes in the aromatic content of road transport fuels or due to improvements in exhaust after-treatment technology.

The uncertainty in N_2O emissions from road transport is estimated to be 50% in annual emissions. Current emissions from heavy-duty diesel vehicles are probably overestimated, but for the whole period of 1990-2001 the overestimation only slightly affects the emission trend.

Other modes of transport (shipping, aviation, other) (CRF 1A3d, a and e)

The uncertainty in CO_2 emissions from domestic aviation and from other transport is presently estimated to be about 50% in annual emissions from aviation and 20% in shipping emissions. The uncertainty in CH_4 and N_2O emissions from non-road transport is estimated to be about 100% in annual emissions. Data on the share of CH_4 in total VOC are based on information in Veldt and Van der Most (1993) and have not been validated since.

Table 3.19. Fuel consumption due to road transport 1990-2003: fuel deliveries versus fuel consumption based on road transport statistics (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2003/1990
A. Deliveries															
Gasoline	151.6	152.1	158.1	166.7	171.9	177.0	179.4	177.8	179.7	182.1	177.3	181.3	183.4	184.2	22%
Diesel	159.0	163.4	175.3	176.7	179.5	182.9	191.8	197.3	205.9	218.7	231.3	236.1	244.6	254.0	60%
LPG	41.1	39.8	39.0	37.2	35.3	34.1	33.1	34.0	33.2	29.1	25.6	23.5	22.1	19.6	-52%
Total	**351.7**	**355.3**	**372.3**	**380.6**	**386.7**	**394.0**	**404.4**	**409.1**	**418.8**	**429.9**	**434.2**	**441.0**	**450.1**	**457.7**	30%
B. Consumption															
Gasoline	150.7	153.2	161.3	165.8	174.7	177.5	180.6	178.7	182.4	189.8	190.5	189.2	189.9	194.6	29%
Diesel	138.8	145.3	152.4	149.4	153.7	159.5	165.1	170.6	183.4	196.9	206.0	212.9	221.6	227.9	64%
LPG	37.0	37.4	35.4	31.8	30.9	27.7	26.7	26.5	25.5	23.5	21.3	20.9	19.3	18.1	-51%
Total	**326.4**	**336.0**	**349.1**	**347.1**	**359.3**	**364.6**	**372.4**	**375.8**	**391.3**	**410.2**	**417.8**	**422.9**	**430.7**	**440.6**	35%
Diff. [B-A)/A]															
Gasoline	-1%	1%	2%	-1%	2%	0%	1%	1%	1%	4%	7%	4%	3%	5%	
Diesel	-15%	-12%	-15%	-18%	-17%	-15%	-16%	-16%	-12%	-11%	-12%	-11%	-10%	-11%	
LPG	-11%	-6%	-10%	-17%	-14%	-23%	-24%	-28%	-30%	-24%	-20%	-12%	-15%	-8%	
Total	-8%	-6%	-7%	-10%	-8%	-8%	-9%	-9%	-7%	-5%	-4%	-4%	-5%	-4%	

3.2.4.4 Verification of road transport: vehicle-km approach versus IPCC approach

Table 3.19 presents fuel consumption by road transport, both for the IPCC approach, which is based on fuel deliveries, and for the national approach, which is based on transport statistics in terms of vehicle-km travelled. From this table it can be concluded that there is a difference in fuel consumption inferred from transport statistics and from supply statistics of deliveries to fuelling stations of about 4-9% (bottom line of the table). 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 up to -23%, with an average of about -12 and -14% for diesel and LPG, respectively (*Figure 3.13*). These differences can be explained to some extent, but not completely, e.g. by fuel bought on both sides of the Dutch borders but consumed at 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, resulting in an underestimation of kilometres travelled by passenger cars. As illustrated in *Figure 3.13*, the annual differences per fuel type have more or less the same sign for the whole period. The discrepancy between total road fuel consumption and fuel deliveries tends to decrease in the last five years. It can be concluded that roughly both methods show similar trends in fuel consumption by fuel type over the last 10 years.

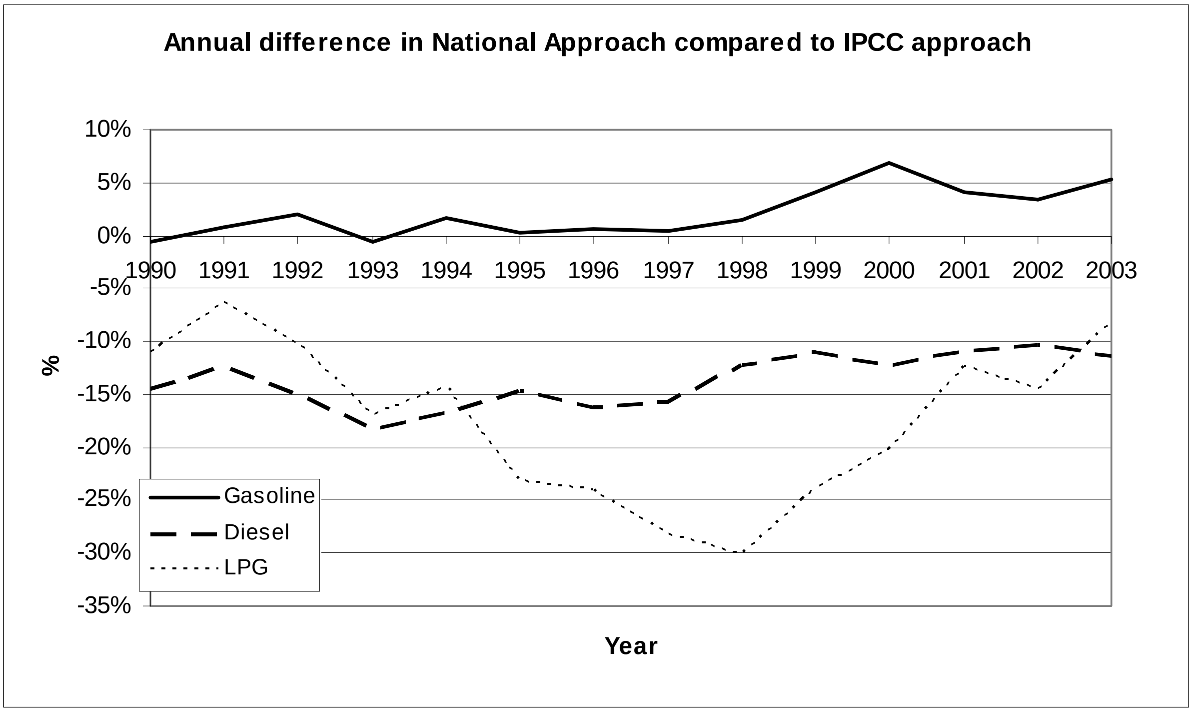


Figure 3.13. Annual differences per fuel type between fuel consumption (PJ) according to the national approach (based on v-km statistics) and the IPCC approach (based on fuel deliveries to fuelling stations).

3.2.4.5 Source-specific recalculations

Road transport (CRF 1A3b)

The CO_2 emission factors of petrol, diesel and LPG have been altered this year, based on country-specific information on the carbon content of these fuel types (measurements for petrol and diesel and fuel composition of LPG) (Olivier, 2004). See *Annex 2* for more details. *Table 3.20* provides an overview of the differences between the NIR 2004 and the NIR 2005.

Inland navigation and rail (CRF 1A3d and 1A4c)

The CH_4 and N_2O emission factors for the non-road categories rail and inland navigation have been altered. In the previous NIR, country-specific emission factors were used for N_2O that were not sufficiently well-founded in literature. Therefore, IPCC default emission factors were adopted. Emission factors of N_2O and CH_4 used in the previous NIR were 1.87 g/GJ and 4.9 g/GJ respectively, and have now been changed to 0.60 g/GJ and 5.0 g/GJ respectively. *Table 3.20* shows the difference in emission factors and the impact on emissions between the NIR 2004 and the NIR 2005.

Table 3.20. Effect of recalculation of CO_2 emissions (Tg) and N_2O emissions (Gg) from road transport (category 1A3b) due to correction in N_2O emission factors of heavy duty vehicles

Gas		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CO_2	NIR 2005	25.5	25.7	27.0	27.6	28.1	28.6	29.4	29.7	30.5	31.3	31.7	32.2	32.9
	NIR 2004	25.4	25.6	26.9	27.5	27.8	28.4	29.2	29.5	30.2	31.1	31.5	32.0	32.7
	Difference	***0.1***	***0.1***	***0.2***	***0.1***	***0.2***	***0.2***	***0.2***	***0.2***	***0.2***	***0.2***	***0.2***	***0.2***	***0.1***
N_2O	NIR 2005	0.9	1.0	1.2	1.3	1.4	1.5	1.6	1.6	1.6	1.6	1.5	1.5	1.6
	NIR 2004	0.9	1.0	1.2	1.4	1.5	1.6	1.6	1.6	1.6	1.6	1.6	1.5	1.5
	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***	***0.0***

Domestic aviation (CRF 1A3a)

A different approach to calculate emissions from domestic aviation has been adopted. Fuel *used* has now been taken to calculate emissions instead of fuel *sold*. The amount of fuel used is based on a report by the Space and Aviation Department (RLD, 2000), which makes a distinction between aviation gasoline (avgas) and kerosene used. Default IPCC emission factors were used to calculate CO_2, N_2O and CH_4 emissions.

Other transport (CRF 1A2e)

In the previous NIR all emissions from off-road machinery were reported under *'Transport other'* (1A3e), which does not comply with IPCC reporting guidelines. This year emissions from off-road machinery for construction and other non-agricultural activities are reported under *'Other industry'* (1A2f), and emissions from off-road machinery in agriculture are reported under *Agriculture, Forestry, Fisheries'* (1A4c). Consequently this year no emissions are reported under category 1A3e.

Off-road machinery (CRF 1A2f and 1A4c)

Information on fuel use by mobile machinery used in agriculture is obtained via the Agricultural Economics Institute (LEI). For other off-road machinery used for building construction and other purposes activity data on fuel deliveries from Statistics Netherlands (CBS) were used. These fuel use data are combined with country-specific emission factors for CO_2, reported in (Olivier (2004). Since the CO_2 emissions are not considered a key source (see *Section 3.1*), the present Tier 1 methodology level complies with the *IPCC Good Practice Guidance* (IPCC, 2000). IPCC Tier 1 methodologies and IPCC defaults emission factors are used for CH_4 and N_2O emissions from other mobile combustion (i.e. non-road machinery).

Military marine and aviation (CRF 1A5)

Emissions from military aviation and shipping haven been obtained from the Ministry of Defense (Hulskotte, 2004), using country-specific emission factors, and are now separately reported.

Table 3.21. Effect of recalculation of CO_2 emissions (Tg) from other transport (category 1A3e) due to correction in fuel consumption by off-road machinery.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
NIR 2005	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
NIR 2004	2.6	2.5	2.5	2.5	2.4	2.3	2.3	2.3	2.6	2.6	2.3	2.2	2.2
Difference	***-2.6***	***-2.5***	***-2.5***	***-2.5***	***-2.4***	***-2.3***	***-2.3***	***-2.3***	***-2.6***	***-2.6***	***-2.3***	***-2.2***	***-2.2***

3.2.4.6 Source-specific planned improvements

New emission factors for passenger cars will become available in 2005 from research by TNO. VOC emissions for passenger cars will become significantly higher due to the inclusion of cold-start effect on emissions. Since CH_4 is calculated as a fixed share of VOC, the CH_4 emissions will also become higher, but remain very small.

3.2.5 Other sectors (CRF category 1A4)

3.2.5.1 Source category description

Source category 1A4 '*Other sectors'* comprises the following sub-sources:

- energy use by commercial and institutional services (1A4a);
- residential energy use (1A4b);
- energy use by agriculture (mainly greenhouse horticulture), forestry and fisheries (1A4c). Now off-road machinery in agriculture & national fisheries are also reported here.

The service sector (1A4a) comprises commercial and public services such as banks, schools and hospitals; 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. Residential fuel use (1A4b) refers to space heating, water heating and cooking. Fuel use by the agricultural sector includes agriculture, horticulture, greenhouse horticulture, cattle breeding and forestry. Tractors and other diesel machinery used in agriculture are also included here. The source category 1A4c *'Agriculture, Forestry and Fisheries'* also comprises fuel consumption and related emissions by fisheries.

Most of the energy in this category 1A3 *'Other sectors'* is used for space and water heating; some energy is used for cooling. The major fuel used in these sectors is natural gas, accounting for 90% of the CO_2 emissions; much less liquid fuel is used by off-road machinery and by fisheries. Almost no solid fuels are used in these sectors. Since this year, to comply with IPCC reporting guidelines the source category *mobile machinery in agriculture* is also reported here (1A4c), instead of under the transport category '*Other transportation'* (off-road machinery, 1A3e). Also as of this year, emissions by national fisheries are reported here (under 1A4c), instead of under '*International bunkers*'.

Table 3.22. Trends of greenhouse gas emissions from the 'Other sectors' (unit: CO_2 in Tg; others in Gg)

Gas/sub-source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2														
a. Commercial/Institutional	7.5	10.3	9.4	10.6	0.0	10.5	11.4	10.0	10.1	7.8	8.8	10.5	11.1	11.5
b. Residential	19.3	21.6	19.5	20.6	19.6	20.7	24.1	20.2	19.2	19.0	19.0	19.7	18.7	19.1
c. Agriculture/Forestry/Fishery	10.7	11.1	11.1	11.5	11.6	10.5	11.4	9.9	9.9	10.2	9.8	9.6	9.0	9.5
CH_4														
a. Commercial/Institutional	0.7	1.1	1.0	0.9	0.1	1.0	1.1	1.0	1.0	0.8	1.0	1.2	1.2	1.2
b. Residential	16.9	16.1	15.0	17.0	15.2	17.7	20.2	17.4	16.4	16.1	16.6	17.1	16.4	16.5
c. Agriculture/Forestry/Fishery	1.0	2.9	2.9	3.0	3.0	1.0	1.1	1.0	0.9	0.9	0.9	0.9	0.8	0.9
N_2O														
a. Commercial/Institutional	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
b. Residential	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
c. Agriculture/Forestry/Fishery	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

The greenhouse gas emissions from the '*Other sectors'* are summarised in *Table 3.21*. Obviously, CO_2 emissions from fuel combustion form the dominant source here, whereas most methane emissions stem from the residential sector. The residential sector is also the largest subcategory of the three for CO_2 emissions. As can be observed from the temperature correction data presented in *Section 3.1.1*, this source category, in particular, is quite sensitive to weather conditions since the largest part of the fuel use in these sectors is for space heating. From *Table 3.21* we can also observe that the emissions from the '*Other sectors*' tend to vary considerably across years due to the variation of the winter weather over time, requiring more or less space heating.

Table 3.21 also shows that CO_2 emissions from the service sectors increased substantially over time, more than 50% since 1990, while emissions from agriculture/fisheries decreased by 10% since 1990. Residential CO_2 emissions remain fairly constant over time, apart from weather influences. Looking at the trend of methane and nitrous oxide emissions, which primarily originate from the residential sector, we see that these emissions are also rather constant over time. About 70% of the methane emissions from this source category stem from residential gas combustion; the second largest source is biofuel combustion in the residential sector.

In *Box 3.3* the key and non-key sources of the '*Other sectors'* are presented on the basis of level, trend or both. Total CO_2 emissions from the '*Other sectors'* form a key source and since CO_2 sources larger than 1.5 Mton are key-level sources (see *Section 1.7*), all three subcategories are key sources. In addition, *total* CH_4 emissions from all combustion sources collectively are a key source. Since methane from fuel combustion predominantly stems from gas losses from cooking in the residential sector (1A4b, these emissions are also higher in this source category due to biofuel combustion), this key source should actually be attributed to the residential sector only (1A4b).

The share of CO_2 emissions from the 'Other sectors' in the national CO_2-eq. total was about 16% in 1990 and 17% in 2003, with the residential sector alone having a share of about 9%; the shares of CH_4 and N_2O in the national total is very small (both about 0.5%).

Box 3.3. Sub-sources of 'Other sectors' and identification as key source or non-key source (IPCC tier 2) (L = Level, T = Trend)

1A4	**CO_2**	**Emissions from stationary combustion: Other Sectors**	**Key (L,T1)**
1A	**CH_4**	**Emissions from stationary combustion: non-CO_2**	**Key (L2)**
1A	N_2O	Emissions from stationary combustion: non-CO_2	Non-key

3.2.5.2 Methodological issues

Stationary combustion

For calculation of greenhouse gas emissions from the stationary sources IPCC Tier 2 methodologies are used. The emission factors for CO_2 from natural gas and from diesel fuel are based on country-specific data; also for the CH_4 emission factors country-specific values are used; for other factors IPCC defaults were used. Since the CO_2 emissions are considered a key source (see *Section 3.1*), the present methodology complies with the *IPCC Good Practice Guidance* (IPCC, 2000). For a brief description of the methodology and data sources used see *Annex 2.1*. A full description of the methodology is provided in the monitoring protocols (Ruyssenaars, 2005).

Off-road machinery in agriculture (CRF 1A4c-ii)

Information on fuel use by off-road machinery (mostly tractors) is obtained via the Agricultural Economics Institute (LEI). These fuel use data are combined with country-specific emission factors for CO_2 (Olivier, 2004). Since the CO_2 emissions are considered a key source (see *Section 3.1*), the present Tier 2 methodology level complies with the *IPCC Good Practice Guidance* (IPCC, 2000).

Fisheries (CRF 1A4c-ii)

This year emissions from fisheries have been explicitly calculated for the first time. The methodology for the calculation of these emissions is described in Hulskotte (2004b). The fuel use, which is included in the national energy statistics as bunker fuel consumption, is now moved to domestic fuel combustion and reported under CRF 1A4c. *Table 3.23* shows the emission factors used to calculate emissions from this newly identified source.

Table 3.23. Emission factors used for fisheries.

Subcategory		**CO_2**	**CH_4**	**N_2O**
Fisheries	Emission factor	74.3 kg/GJ	5 g/GJ	0.6 g/GJ
	Emissions in 2003 (Gg)	1.1	0.01	0.00

Source: Hulskotte (2004b).

3.2.5.3 Uncertainty and time-series consistency

Please note that the energy consumption data for the total category, *1A4 'Other sectors'* is much more accurate than the data for the subsectors. In particular, energy consumption by the commercial and - to a lesser extent - the agricultural subsectors is less accurately monitored than for the residential sector. So trend conclusions for these subcategories should be treated with some caution. The uncertainty of this category is estimated to be 10% in annual emissions of CO_2, the uncertainty in CH_4 and N_2O emissions is estimated to be much higher (about 50% and 100%, respectively) (see *Section 1.7* and Annex 1 for more details). The uncertainty in gas consumption data is estimated at 5% for the residential sector and 10% for agriculture and the commercial sector; for off-road machinery in agriculture also 10% uncertainty is assumed. However, the uncertainty of fuel statistics for the total '*Other sectors'* is somewhat smaller than the data for the subsectors: 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 by using a trend analysis of sectoral data (the so-called BAK and BEK datasets of annual surveys of the residential sector and LEI data for agriculture). Again, the remainder of total consumption in the '*Other sectors*' is by definition the energy consumption in the service sectors.

If the changes made in earlier years would be indeed indicative for the data quality (see Table 3.22 in the previous NIR), 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 indeed confirms the general conclusion that the uncertainty for this source category is higher than currently used in the overall uncertainty assessment; the uncertainty in particular for the service sector could be quite high, up to 20% or so. This should be taken into account when drawing conclusions about the emission trends in this source category.

Time series consistency

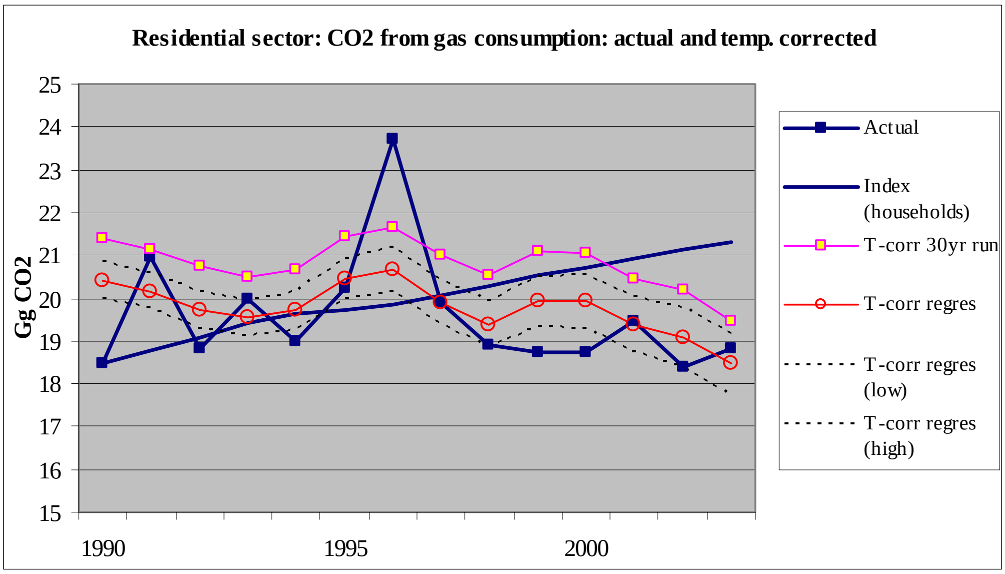
Keeping the qualification of the uncertainty in emissions in mind, we will look at the consistency of the emission trends. The 1990-2003 trend of CO_2 emissions shows an increase of 2.7 Tg or 7%. The main contributor to this increase was the service sector, with an increase of about 4 Tg or about 50%, partially compensated by the 10% decrease in the agricultural sector. CO_2 emissions from the residential sector did remain almost constant in this period, as did the CH_4 and N_2O emissions of the total sector. Most of these CH_4 emissions stem from the residential sector, in particular from cooking losses.

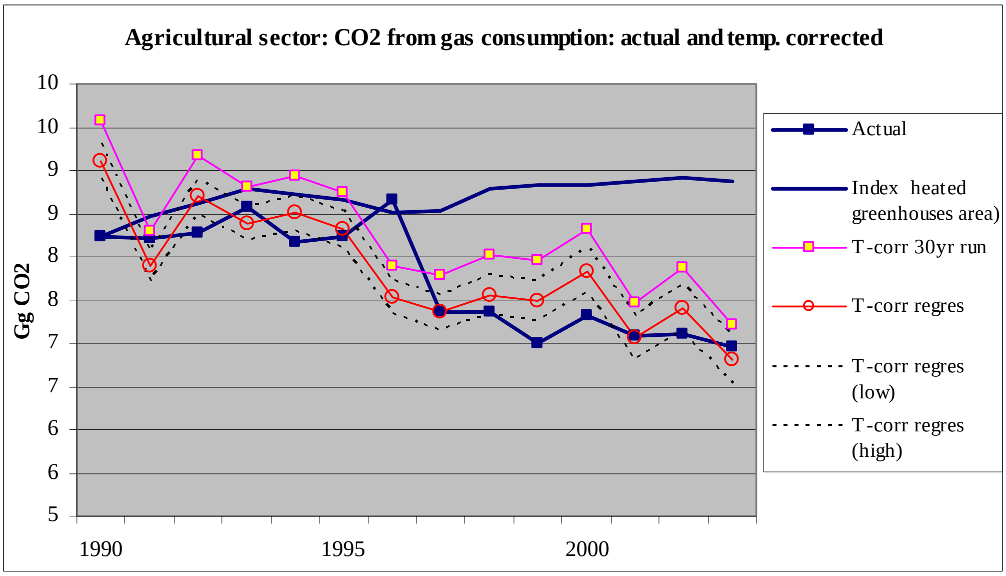
To analyse the effect over time of implemented policies on the trend in *anthropogenic* emissions, a temperature correction term has been calculated for all CO_2 emissions from gas combustion. This correction aims at filtering out the interannual changes due to variation of weather. Resulting emissions trends for the '*Other sectors'* with this correction incorporated are presented in *Table 3.22*. This method is discussed in more detail in *Section 3.1.1*, where also the time series with the CO_2 correction terms is presented. The temperature correction method aims at compensating for anomalous mild or cold years by using heating-degree days as input for the calculation. However, the correction should be considered as a *proxy* for the weather influence, since it is a simple method and space heating behaviour of the public is influenced by more factors than only the average outside temperature.

Table 3.24. Temperature-corrected CO_2 emissions for the other sectors (in Tg).

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Commercial/Institutional	8.5	9.4	9.2	9.6	9.0	10.3	10.3	10.3	10.8	9.2	9.6	10.8	11.5	11.8
Residential sector	22.2	21.9	21.5	21.2	21.3	21.9	22.0	21.3	20.8	21.4	21.4	20.8	20.5	19.8
Agricultural and forestry	12.1	11.1	12.0	11.8	12.1	11.8	10.7	10.6	10.8	10.9	11.2	10.3	10.5	9.9
Total	**42.8**	**42.4**	**42.7**	**42.6**	**42.3**	**44.0**	**43.0**	**42.2**	**42.4**	**41.5**	**42.2**	**41.9**	**42.4**	**41.5**

Figure 3.14 compares the actual trend data for CO_2 of the three stationary subsectors with temperature-corrected emissions and basic activity indicator trends of the residential, service and agricultural sectors. The figures also show the result of another implementation of the temperature correction, which uses another 'normal' level. The year 1996 clearly shows as a particular cold year, whereas other years are relatively warm (see *Section 3.1.1* for details). From these graphs we can draw the conclusion that the temperature correction is indeed a *proxy* for the weather influence, since for it removes the largest interannual variations, but the resulting time series is still not a completely smooth line. This is of particular interest in the residential sector, where the data quality of gas consumption is assumed to be quite good.





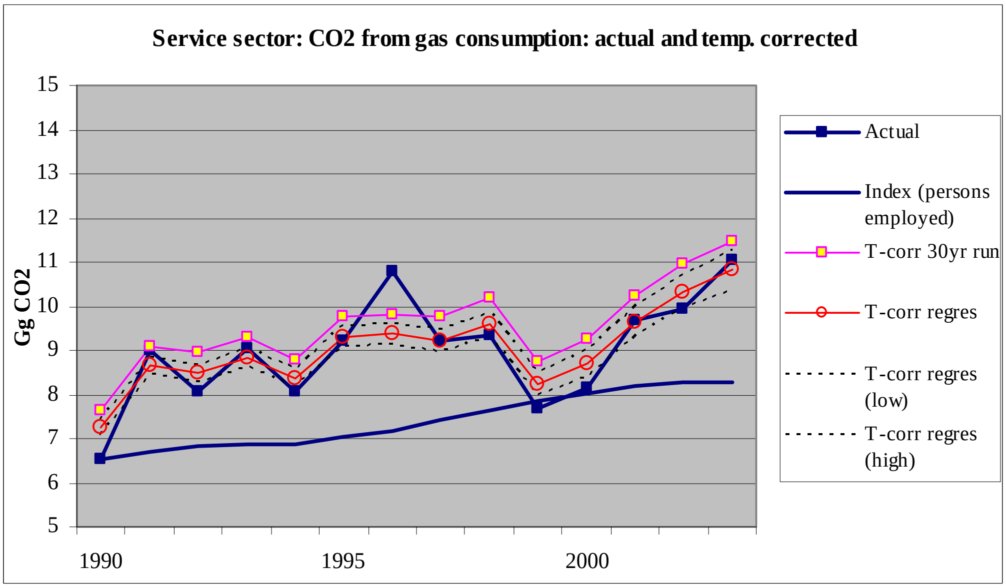


Figure 3.14. Trend analysis of CO_2 emissions from the 'Other sectors' (1A4): residential (top); agriculture (middle); commercial/institutional services (bottom).

Residential sector

In the residential sector CO_2 emissions remained almost constant since 1990, but when accounting of a temperature correction, the structural, anthropogenic trend including temperature correction shows a decrease of 7% in this period. This can be compared with the increase in households of 15% since 1990. The number of residential dwellings increased similarly by 16% in this period, but their temperature corrected energy use has decreased by 7% over this period. This decrease is mainly due to improved insulation of dwellings and increased efficiency of heating apparatus (increased use of high-efficient boilers for central heating).

Commercial and institutional sector

In the commercial and institutional service sector CO_2 emissions increased by about 50% since 1990, but taking a temperature correction into account, the structural, anthropogenic trend shows a somewhat lower increase of 44% in this period. Still, the emission trend presented here should be considered as not very robust. The commercial and institutional sector has grown strongly during this period: the amount of manpower (in man-years) increased by 32% in the period 1990-2000, while their energy consumption increased by 28%. This increase is roughly compatible with the structural increase of about 45% of the emissions. We note that about 0.4 Tg in 1990 increasing to 0.8 Tg in 2003 of the CO_2 emissions from the service sectors are emissions from cogeneration facilities, which may also provide electricity to the public grid.

Agriculture (stationary)

In the stationary agricultural sector CO_2 emissions decreased by about 10% since 1990, but taking into account a temperature correction; the structural, anthropogenic trends show a decrease of even 15% in this period. This is mainly due to energy conservation measures in the greenhouse horticulture, which account for approximately 85% of the primary energy use of the agricultural sector. Space heating and artificial lighting are the dominant uses here. The sector has improved its energy efficiency in the past decade significantly (Van Harmelen *et al.*, 2002). The total area of heated greenhouses increased by 8% after 1990 and now occupies over 95% of the total area of greenhouses. In particular, cultivation of flowers and plants showed a large aerial increase of 15%. Thus we may conclude that heated greenhouses have reduced their energy consumption, although their surface area increased by 8%, and physical production only decreased by 5% over this period (LEI/CBS, 2002). We note that about 0.6-0.8 Tg of the CO_2 emissions from the agricultural sector are emissions from cogeneration facilities, which may also provide electricity to the public grid.

Agricultural machinery and fisheries

In *Table 3.25* the CO_2 emissions from off-road machinery used in agriculture and from fisheries are presented. Both sources emit a little over 1 Tg of CO_2.The CO_2 emissions from agricultural machinery (mainly tractors) increased by 5% since 1990, whereas the emissions from fisheries decreased by 9%.

Table 3.25. Trend in CO_2 emissions from agricultural machinery and fisheries.

Subcategory	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Agricultural machinery	1.48	1.48	1.48	1.39	1.45	1.60	1.48	1.47	1.46	1.56	1.57	1.56	1.55	1.55
Fisheries	1.24	1.26	1.22	1.30	1.35	1.35	1.25	1.26	1.21	1.26	1.26	1.23	1.13	1.13
Total mobile in 1A4c	**2.73**	**2.75**	**2.70**	**2.69**	**2.80**	**2.95**	**2.73**	**2.73**	**2.67**	**2.82**	**2.83**	**2.79**	**2.68**	**2.68**

3.2.5.4 Source specific recalculations

Firstly, accidentally a small part of gas consumption of 10 to 15 PJ was misallocated to the residential sector instead of to the commercial sector, which has been corrected in the present emissions of the 1A4b and 1A4a subcategories, respectively. Secondly, statistics of gas consumption – and diesel fuel statistics of off-road vehicles – in agriculture maintained by LEI were updated. Since the total gas consumption of the 1A4 sector did not change, consequently also gas consumption in the commercial sector was inversely adjusted. Furthermore, emissions from off-road machinery used in agriculture were moved from ‘other transport’ (1A3e) to the mobile sources part of subcategory 1A4c, liquid fuels) to comply with IPCC reporting guidelines. In addition to these changes of activity data, this year the emissions from fisheries have been explicitly calculated for the first time. These are also reported as part of category 1A4c in compliance with the IPCC reporting guidelines (previously these were included in international bunker emissions).

In addition to these reallocations and updates of fuel data, recalculations were made for CH_4 and N_2O emissions from these sources, using the IPCC default emissions factors more consistently. In the previous NIR, country-specific emission factors were used for N_2O and CH_4 that were not sufficiently well-founded in literature. Therefore, IPCC default emission factors for diesel fuel were adopted. Emission factors of N_2O and CH_4 used in the previous NIR were 1.87 g/GJ and 4.9 g/GJ respectively, and have now been changed to 0.6 g/GJ and 5 g/GJ, respectively. These changes made as part of the inventory improvement programme and in response to previous reviews requesting to report emissions from off-road vehicle and fisheries in the correct IPCC subcategory (see *Section 3.2.7* and *Chapter 9*). The results of these changes are presented in *Tables 3.26 a. and b*, showing the largest changes in the 1Ac subsector due to the reallocation of mobile sources.

Table 3.26a: Effects of recalculation of CO_2 for the Other sectors (in Tg)

	Source		**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
1A4	Total Other	new	37.4	42.1	39.0	41.7	39.3	41.6	46.9	40.1	39.2	37.0	37.6	39.9	38.8
		old	34.9	40.4	37.3	40.1	38.5	38.8	44.1	36.8	35.9	33.9	35.2	37.4	37.2
		diff.	***2.5***	***1.7***	***1.7***	***1.6***	***0.8***	***2.8***	***2.8***	***3.3***	***3.3***	***3.0***	***2.4***	***2.5***	***1.6***
1A4a	Commerica/	new	7.4	9.4	8.4	9.4	8.3	9.7	11.3	9.8	9.9	8.1	8.5	10.2	10.4
	Institutional	old	6.6	10.3	9.4	10.6	10.1	9.5	10.4	8.5	8.9	7.5	8.5	10.1	10.2
		diff.	***0.8***	***-0.9***	***-1.0***	***-1.3***	***-1.9***	***0.2***	***1.0***	***1.3***	***1.0***	***0.6***	***0.0***	***0.1***	***0.2***
1A4b	Residential	new	19.3	21.7	19.5	20.7	19.7	20.7	24.1	20.2	19.2	19.0	19.0	19.7	18.7
		old	19.9	21.6	19.5	20.6	19.6	21.3	24.9	20.8	19.5	19.3	19.6	20.4	20.2
		diff.	***-0.6***	***0.1***	***0.1***	***0.1***	***0.1***	***-0.6***	***-0.8***	***-0.7***	***-0.3***	***-0.3***	***-0.6***	***-0.7***	***-1.5***
1A4c	Agriculture/	new	10.7	11.0	11.1	11.6	11.3	11.2	11.5	10.2	10.1	9.9	10.1	9.9	9.7
	Forestry/	old	8.4	8.5	8.5	8.8	8.8	8.1	8.9	7.5	7.5	7.1	7.1	6.9	6.8
	Fisheries	***diff.***	***2.3***	***2.6***	***2.6***	***2.8***	***2.6***	***3.2***	***2.6***	***2.7***	***2.6***	***2.8***	***3.0***	***3.0***	***2.9***

Table 3.26b: Effects of recalculation of CH_4 and N_2O for the Other sectors (1A4) (in Gg)

	Souce category		**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
	CH_4														
1A4	Other Sectors	new	18.7	20.2	18.8	19.7	19.0	19.7	22.4	19.3	18.4	17.9	18.4	19.2	18.3
		old	20.4	22.2	20.5	21.1	20.8	20.5	24.0	20.2	19.8	19.1	19.9	20.5	20.4
		diff	***-1.7***	***-2.0***	***-1.6***	***-1.4***	***-1.8***	***-0.8***	***-1.6***	***-0.9***	***-1.4***	***-1.3***	***-1.5***	***-1.3***	***-2.1***
1A4a	Commercial/	new	0.7	1.0	0.9	1.0	0.9	1.0	1.1	1.0	1.0	0.8	1.0	1.2	1.2
	Institutional	old	0.9	1.1	1.0	0.9	1.4	0.6	1.3	0.6	1.1	1.0	1.1	1.3	1.3
		diff	***-0.2***	***-0.1***	***-0.1***	***0.1***	***-0.5***	***0.5***	***-0.1***	***0.4***	***-0.1***	***-0.1***	***-0.1***	***-0.1***	***-0.1***
1A4b	Residential	new	16.9	18.2	16.9	17.7	17.1	17.7	20.2	17.4	16.4	16.1	16.6	17.1	16.4
		old	16.8	18.3	16.8	17.4	16.6	17.4	19.9	17.3	16.3	15.9	16.5	17.1	16.9
		diff	***0.2***	***-0.1***	***0.2***	***0.3***	***0.5***	***0.2***	***0.3***	***0.1***	***0.1***	***0.2***	***0.0***	***0.0***	***-0.6***
1A4c	Agriculture/	new	1.0	1.0	1.0	1.1	1.0	1.0	1.1	1.0	0.9	0.9	0.9	0.9	0.8
	Forestry/	old	2.6	2.7	2.7	2.8	2.8	2.5	2.8	2.4	2.4	2.2	2.2	2.2	2.2
	Fisheries	***diff***	***-1.6***	***-1.7***	***-1.7***	***-1.7***	***-1.8***	***-1.5***	***-1.7***	***-1.4***	***-1.4***	***-1.3***	***-1.4***	***-1.3***	***-1.3***
	N_2O [1)]														
1A4	Other Sectors	new	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1
		old	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
		diff	***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***
1A4b	Residential	new	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
		old	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1
		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***	***0.0***

[1)] Commercial and agricultural emissions of N_2O are all 0.0 Gg.

3.2.5.5 Source-specific planned improvements

For biomass combustion, it is planned for the next NIR to replace the fuel data by a new consistent time series since 1990 reported in CBS (2004), which was compiled within the new project for collecting annually national statistics on renewable energy use by sector according to the Protocol for Monitoring of Renewable Energy (Abeelen and Bosselaar, 2004). This will remove the very large interannual variations that can be observed now in the commercial and residential categories. However, this will have only a very small impact to national greenhouse gas emissions total.

3.2.6 Others (CRF category 1A5)

3.2.6.1 Source category description

In this 'Others' category for the first time emissions from military ships and aircraft are now reported (category 1A5b). Emissions from military activities (aviation and shipping) haven been obtained from the Ministry of Defense (Hulskotte, 2004a). These emissions are reported under category 1A5b. For CO_2, CH_4 and N_2O sector-specific emission factors are used (Hulskotte, 2004a).

3.2.6.2 Methodological issues

Emissions from military activities haven been calculated from fuel consumption data for aviation, which is a mixture of jet kerosene, F65 and SFC, and for shipping and source-specific emission factors reported by the Ministry of Defense. The methodology and data sources for the calculation of these emissions can be found in (Hulskotte, 2004a).

Table 3.27. Emission factors used for military marine and aviation activities.

Subcategory		**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

source: Hulskotte (2004b).

The assumption was made that the related fuel consumption is included in the national energy statistics as bunker fuel consumption and is now moved to domestic fuel combustion and reported under CRF 1A5. No distinction was made between domestic military activities and so-called multi-lateral operations. *Table 3.27* shows the emission factors and the emissions from this newly identified source.

3.2.6.3 Uncertainty and time-series consistency

The uncertainty in CO_2 emissions from is tentatively estimated to be about 20% in annual emissions. For CH_4 and N_2O emissions is estimated to be about 100%.
The CO_2 emissions from this source category are about 0.5 Tg with interannual variation caused by different levels of operations (*Table 3.28*). The emissions of CH_4 and N_2O are negligible.

Table 3.28. Trend in CO_2 emissions from military ships and aviation.

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Military ships	0.25	0.23	0.24	0.23	0.21	0.23	0.20	0.20	0.22	0.23	0.21	0.18	0.22	0.17
Military aviation	0.32	0.31	0.32	0.31	0.28	0.28	0.30	0.30	0.30	0.42	0.37	0.29	0.28	0.27
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**

3.2.6.4 Source-specific recalculations

Last year this source category consisted of a few Tg of CO_2 emissions (+ or -) calculated from statistical differences in energy statistics for 1991-1994, which were not removed in the energy statistics improvement project. Also some very small CH_4 and N_2O emissions were reported as miscellaneous emissions by individual waste handling companies. As part of the inventory improvement programme, the energy statistics for 1991-1994 used for the greenhouse gas inventory have been improved by ECN under supervision of Statistics Netherlands (CBS), which included the effective removal of the statistical differences for these years. The other emissions have now been set to zero and all specific fuel combustion and process emissions have been estimated and reported under the corresponding sectors (1A, 2), thereby achieving consistent times series for the complete 1990-2003 period in this and other source categories.

These emissions have now been replaced by the new estimate of the military mobile sources described above. The effect of this recalculation for CO_2 is shown in *Table 3.29*. The impact on 1990 and present emissions is an increase of about 0.5 Tg CO_2 (with inverse effect on international bunkers emissions).

Table 3.29. Effect of recalculation of CO_2, Other - Stationary and Mobile (1A5) (in Tg).

	Source		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1A5	Other	New	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
		old	0.00	1.07	0.00	1.65	0.56	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
		Diff	***0.56***	***-0.53***	***0.55***	***-1.11***	***-0.07***	***0.51***	***0.50***	***0.48***	***0.51***	***0.65***	***0.58***	***0.47***	***0.50***
1A5a	Stationary	New	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		old	0.00	1.07	0.00	1.65	0.56	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00
		Diff	***0.00***	***-1.07***	***0.00***	***-1.65***	***-0.56***	***0.00***	***-0.01***	***0.00***	***-0.01***	***0.00***	***0.00***	***0.00***	***0.00***
1A5b	Mobile	New	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
		odl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		Diff	***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***

3.2.7 Comparison of Sectoral Approach with the 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, 2000). More details on the calculation and the recalculation differences can be found in *Annex 4*.

There are three main reasons for differences in the two approaches, some are country-specific and others are inherent to the comparison method itself (see *Annex 4*):

- The CO_2 from incineration of waste that contains fossil carbon is not included in the Reference Approach;
- 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);
- The country-specific 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.

In addition, the liquids and other fuel component in the RA is different from SA, in that the LPG in transport is in the National Approach reported under ‘other fuel’ versus in ‘liquid fuel’ in the Reference Approach.

In *Table 3.30* the results of the *Reference Approach* calculation are presented for 1990-2003 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 1.4% for 2002 and +4.9% for 1991, with an average of 3.0%. The largest differences are seen for the early 1990’s. However, if we correct for the fossil waste included in the RA and the sector 1B and sector 2 emissions that should be added to the 1A total before the comparison is made, then the remaining differences are much smaller and all below 2% (see *Table 3.31*): between –1.0% in 1992 and +0.8% in 1998 and 1999, with an average of 0.2%. Also, the largest differences do not concentrate in a particular corner of the period. The corrected 1990-2003 trends also differ only slightly: 11.6% for the *National Approach* (NA) (= sum of sectoral emissions in source category 1A plus selected 1B and 2) and 11.3% for the *Reference Approach* (= minus fossil waste). The corrected *Reference Approach* (based on national energy balance data) shows differences in emissions from liquid fuels up to 3% vs. 8% for uncorrected comparisons; up to 3% vs. 11% for solid fuels and 1% vs. 6% for gaseous fuels, if only corrections are made for LPG (in road transport) in RA-liquids, 1B (coke production) and 2C1 (blast furnaces) in NA-solids, and 2B1 (ammonia) in NA-gases (*Table 3.31*).

Table 3.30. Comparison of CO_2 emissions: Reference Approach (RA) versus National Approach (in %)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Liquid Fuels	6	7	8	4	5	3	4	4	2	1	2	1	0	1
Solid Fuels	10	11	9	8	9	7	8	9	7	7	6	5	6	7
Gaseous Fuels	6	6	6	5	6	6	5	5	5	5	5	5	5	4
Total (NA-RA)/RA	**4.3**	**4.9**	**4.8**	**3.4**	**4.1**	**3.0**	**3.0**	**3.1**	**2.1**	**2.0**	**2.5**	**1.6**	**1.4**	**1.8**

Table 3.31. Comparison of CO_2 emissions: differences between corrected Reference Approach (RA) versus corrected National Approach [(NA-RA)/RA)] (in %)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Liquids incl. LPG(road)	-0.1	1.5	2.1	-0.6	0.2	-1.8	-0.8	-1.0	-2.4	-2.3	-0.8	-1.6	-2.8	-1.5
Solid incl. 1B, 2C1	1.2	2.5	3.0	2.2	1.9	0.7	1.1	1.1	0.6	0.7	0.9	0.0	0.9	1.5
Gas, incl. 2B1	1.2	1.1	0.9	0.7	0.8	0.9	0.8	0.9	0.5	0.5	0.7	0.8	0.9	0.8
Total (RA excl. waste)	*0.1*	*0.6*	*0.5*	*-0.6*	*0.0*	*-0.9*	*-0.7*	*-0.7*	*-1.7*	*-1.7*	*-1.0*	*-1.3*	*-1.5*	*-0.8*
With full NA correction	**0.0**	**-0.8**	**-1.0**	**0.0**	**-0.3**	**0.7**	**0.2**	**0.2**	**0.9**	**0.9**	**0.3**	**0.6**	**0.8**	**0.3**

3.2.8 Feedstocks and other non-energy use of fossil fuels

3.2.8.1 Source category description

Energy statistics contain a section referring to the use of fossil fuels for non-combustion purposes, mostly in industry but also in other sectors. During these uses CO_2 emissions may occur or carbon can be stored in manufactured products. Subsequently, CO_2 emissions may occur during domestic use of these petrochemical products, often in the form of NMVOC emissions. Finally, in the waste phase fossil CO_2 emissions will occur if the wasted products are incinerated. At present all of these emissions are accounted for (source categories between brackets):

- CO_2 emissions from the use of feedstock and other non-energy uses of fuels: feedstocks natural gas and oil products in the chemical industry (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).

Not all process emissions are now allocated in sector 2: an exception is the combustion of by-products produced in these processes (e.g. blast furnace gas, residual chemical gas and refinery gas), if these are accounted for in the sectoral energy statistics as fuel combustion. In those cases the associated CO_2 emissions are reported in the energy sector under *'Electricity and heat production'* and *'Manufacturing Industry and Construction'*.

Table 3.32 presents the allocation of CO_2 emissions related to the sources mentioned, including those reporting in sector 1A. About 1/3 in 1990 decreasing to 1/5 in 2003 of the group total is reported as industrial process emissions (sector 2), only 1% under product use and 3 to 7% (1990 and 2003, respectively) are emissions from waste incineration (sector 6, but allocated under 1A1a). The largest part, about 2/3 is reported under fuel combustion (1), about half of which is blast furnace gas, largely used for power generation and the other half is residual chemical gas, predominantly used in the chemical industry. Most 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).

The share of total feedstock-related emissions, including combustion of residual chemical gas and waste combustion, in national total CO_2 emissions (excluding LUCF) is about 12%: the share of combustion of the by-product gases and waste incineration reported under sector 1A increased from 8% to 10% since 1990 while the share of industrial process emissions in sector 2 remained about 3%.

3.2.8.2 Methodological issues

Country-specific methodologies are used for the emissions from feedstocks use and feedstock-product use with country-specific or default IPCC emission factors (see *Annex 2.1*). A full description of the methodology is provided in Ruyssenaars (2005). In the sectoral approach the Netherlands uses the following data sources to estimate these emissions:

- national sectoral energy consumption statistics, including by-products produced from feedstock uses of fuels;
- plant-specific fuel consumption data, if needed to identify a particular industrial process, e.g. soda ash production;

- production data, if needed to estimate the net oxidation fractions, e.g. urea production;
- NMVOC emissions from solvents and other products from the PER on an as-is basis;
- the amount waste incinerated (and composition to calculate fraction and amount of fossil carbon).

Not all CO_2 emissions from the use of feedstock and other non-energy uses of fuels are allocated under sector 2. This is because the Netherlands accounts in the energy statistics a large part of the residual chemical gas produced. Also substantial parts of residual chemical gas and blast furnace gas are combusted in another sector (i.e. public power generation) than where they were produced, making it logical to allocate these combustion emissions under the energy sector (CRF 1) rather than allocating these all under industrial processes (CRF 2). This applies to the production of silicon carbide, carbon black, ethylene and methanol.

Table 3.32. CO_2 emissions from non-energy and feedstock uses of fossil fuels (production and product use) in sectors 1, 2 and 3 (in Tg)

IPCC no. / category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
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
Chemical residual gas	0.0	0.0	0.0	0.0	0.3	1.8	1.7	2.0	1.9	2.1	2.2	2.2	2.5	2.4
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	1.6
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
1A2c Chemicals														
Chemical residual gas	5.0	4.8	4.9	4.9	4.8	3.6	3.8	3.7	3.8	4.1	3.9	4.3	5.1	5.5
TOTAL ENERGY (2)	**11.8**	**11.4**	**12.1**	**13.3**	**13.4**	**13.8**	**14.1**	**14.6**	**14.9**	**15.2**	**14.6**	**15.8**	**16.9**	**17.6**
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
2B Chemical industry														
1 Ammonia Production	3.1	3.4	3.5	3.4	3.6	3.5	3.3	3.5	3.6	3.5	3.6	3.0	2.9	2.7
5 Prod. other chemicals	0.4	0.3	0.3	0.3	0.3	0.4	0.5	0.4	0.1	0.1	0.1	0.1	0.1	0.1
5 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
5 Prod. activated carbon [1)]	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														
1 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
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
2G Other														
4 Other economic sectors	0.3	0.2	0.3	0.2	0.2	0.5	0.5	0.5	0.4	0.5	0.6	0.4	0.4	0.4
TOTAL IND. PROC. (2)	**6.2**	**6.1**	**5.6**	**5.4**	**5.9**	**6.2**	**6.0**	**6.4**	**5.7**	**5.6**	**5.5**	**4.7**	**4.7**	**4.6**
3 Solvents / Product use														
A Paint Application	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
B Degreasing & Dry Clean	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
D Other	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
TOTAL PROD. USE (3)	**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 Feedstock/NEU CO_2	**18.4**	**17.8**	**18.0**	**18.9**	**19.5**	**20.2**	**20.2**	**21.2**	**20.9**	**21.1**	**20.3**	**20.7**	**21.8**	**22.4**

N.B. 0.0 means a non-zero emission, less than 0.05.

[1)] Peat consumption; is not included in Netherlands Energy Statistics (NEH) but taken from other sources.

As clearly indicated in this table, a major part of the process emissions is reported as combustion of residual chemical gas and of blast furnace gas (including some oxygen furnace gas), which amount to about 5 Tg CO_2 each. The very small indirect CO_2 emissions from product use (domestic solvent evaporation in sector 3) are calculated from the carbon content in the NMVOC emissions calculated for this source. Because it is assumed that this includes the use of mineral turpentine, to avoid double counting these are not accounted for in the emissions from other economic sector (2G4).

Table 3.33. Feedstock/NEU fuels used per source category and allocation of CO_2 emissions in sectors 2, 3 and 6 versus sector 1 (emissions for 1990, in Tg).

Source category	**Reported in sector 2, 3 or 6**			**If "IE"**		**Remark**
	Primary NEU	**Other NEU**	**CO_2**	**Subcategory**	**CO_2**	**no.**
2 INDUSTRIAL PROCESSES						
2A: Mineral Industry						
2A4a: Soda Ash Production	coke		0.1			
2A5: Asphalt Roofing	bitumen		NE			1
2A6: Road Paving with Asphalt	bitumen		NE			1
2B: Chemical Industry						
2B1: Ammonia Production	natural gas		3.1			
2B4a: Silicon Carbide Production	petroleum coke		IE	1A2c	see below	
2B4b: Calcium Carbide Production	NO		NO			
2B5: Other production						
Carbon black	heavy fuel oil	natural gas	IE	1A2c	see below	
Ethylene	naphtha	gas oil, LPG, ..	IE	1A2c	see below	
Methanol	natural gas	coal, oil	IE	1A2c	see below	
Production other chemicals	natural gas	petcoke, coke	0.4			(H_2, CO)
Carbon electrode production	petroleum coke	coal	0.05			
Production activated carbon	peat		0.03			2
2C: Metal Industry						
2C1: Iron & Steel Production						
Coke production	coal		IE	1B1b	0.4	3
Coke inputs in blast furnaces	coke	coal	2.2	1A1a, 1A2a	see below	4
2C3: Aluminium Production	(carbon electrode)		0.4			5
2D: Other						
2D1: Pulp and Paper			NO			
2D2: Food and Drink	coke		0.1			
2G: Other						
2G1: Fireworks and candles			0.0002			6
2G4: Process em. other econ. sectors	lubricants	waxes	0.3			7
Other non-energy uses of fuels	coke		NO			8
3: Solvents / Product Use						
3A: Paint Application		(min. turpentine)	0.2			9
3B: Degreasing and Dry Cleaning		(min. turpentine)	0.004			9
3C: Chem. Products, Manuf.& Proc.			NO			
3D: Other product use			0.1			
1A FUEL COMBUSTION		**subtotal 2+3+6:**	**6.9**			
1A1a: Public electricity and heat	BF gas	OF gas, CO gas	-		3.8	10
	residual chem.gas		-		0.0	11
	fossil waste	(plastics, ..)	-		0.6	12
1A1b. Petroleum Refining	(refinery gas)	(not accounted)	-		4.6	13
1A2a: Iron and Steel	BF gas	OF gas, CO gas	-		2.4	10
1A2c: Chemicals	residual chem.gas		-		5.0	
1A2f: Other manufacture						
Cement production	(plastics)	(lubricants)	-		NE	14
1B FUGITIVE-SOLID,OIL&GAS				**subtotal 1:**	**16.8**	
1B1b: Solid Fuel Transformation						
Coke production (losses)	coal		-		0.4	15
1B2a: Oil						
iv. Refining/Storage	(crude oil, NGL)		-	1A1b - part liquid	IE	15
6 WASTE						
6C: Waste incineration						
Fossil waste	(plastics)	(textile, rubber)	IE	1A1a - Other fuels	see above	16

Notes to Table 3.33:
a) Same emissions as in Sectoral Background Tables (also for emissions notation keys NE, NO, IE, where applicable).
1) Negligible.
2) Peat use not in energy statistics; data taken from annual environmental reports.
3) Transformation losses are reported under Fugitive emissions (1B) cf. the guidelines.
4) Net losses, i.e. minus blast furnace gas and oxygen furnace gas produced, which is partly uses outside the steel industry.
5) Not estimated from non-energy use of petcoke etc. for producing the anodes, since part of the national production occurs outside the aluminium industry.
6) Not related to non-energy use
7) Mostly lubricants
8) No emissions from production of coal tar.
9) CO_2 emissions from mineral turpentine are included in the indirect emissions from NMVOC.
10) Blast furnace gas, oxygen furnace gas and coke oven gas.
11) Increasing to 2.4 Tg in 2003.
12) Increasing to 1.6 Tg in 2003.
13) In years after 1992, the unaccounted part falls to about 1 Tg.
14) Presently not explicitly accounted for in waste statistics.
15) Transformation losses, not otherwise accounted for.
16) Based on accounting of total waste incinerated in large-scale incinerators (AVI's) and waste composition.

The Netherlands reports waste combustion emissions under fuel combustion by the energy sector (1A1a) since most of these facilities (so-called 'AVIs') also produce commercial energy (heat and/or electricity). Total CO_2 emissions related to the fossil-carbon content in waste combusted in these facilities have increased since 1990 from 0.5 Tg to 1.5 Tg CO_2 (see also *Section 8.5* on *Other waste*).

3.2.8.3 Completeness and allocation

All major sources reported under industrial processes (ammonia production, other chemical product manufacture and carbon inputs in the iron and steel's blast furnace) and fossil waste incineration reported under 1A1a are identified as key source (most level and trend). The analysis of the feedstock and other non-energy uses in the energy statistics ensures that all relevant sources are taken into account. Also, by coupling each of these uses – when applicable – to industrial process sources identified by the IPCC, double counting has been avoided.

To summarise both method and allocation of these emissions, in *Table 3.33* per source category the fuels used as feedstock and for other non-energy product uses are listed including the allocation of corresponding CO_2 emissions, either in sectors 2, 3 and 6 or in sector 1.

The main question that could be raised is about completeness: whether or not is the accounting of residual chemical gas and the blast furnace gas production in energy statistics complete? However, for blast furnace gas this is not relevant, since the not-captured gas is by definition included in the net carbon loss calculation used for the process emissions. For residual chemical gas, however, this may be an issue to be elaborated further. This mainly refers to oxidation losses in the production of ethylene, methanol and carbon black; it does not apply to ammonia production, for which a carbon balance is used since no residual gases are accounted in this chemical subsector.

3.2.8.4 Uncertainty and time-series consistency

The uncertainty in the newly estimated feedstock/non-energy use emissions in sector 2 is estimated as at about to be about 5% for production of soda ash and ammonia. 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, e.g. 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 total activity data and the underlying composition and fossil carbon fraction of the various waste types. Total CO_2 emissions of this group *increased* by about 20% or 3.6 Tg since 1990 (*Table 3.32*):

- industrial process emissions (sector 2), with a share decreasing from 1/3 to 1/5, *decreased* by 25% (by 1.6 Tg CO_2);

- combustion emissions of blast furnace gas and residual chemical gas (sector 1A), which share increased to about 70%, *increased* about 45% (by 4.3 Tg CO_2);
- fossil waste incineration (in 1A1a), which share increased from 3 to 7%, *increased* well over 100% (by 1 Tg CO_2);
- product used emissions (sector 3) decreased about 50% (by 0.2 Tg CO_2).

The reduction of industrial process emissions is largely due to the increasing fraction of blast furnace gas captured and use as fuel, in particular in the 90's (see *Section 4.4.3*). This also explains half of the increase of the combustion emissions in the 1A sector. The environmental policy that encourages waste being incinerated rather then landfilled resulted in the increase of 1 Tg in fossil waste emissions. Although CH_4 emissions from landfills are avoided, from a climate change perspective one may question their contribution to reducing fossil CO_2 emissions from electricity and heat production: the CO_2 saved compared to a gas-fired power station that has a much higher efficiency appears to be very limited or even negative (CBS, 2004). Due to 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 little.

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 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 (see *Annex 4* for more details). In *Table 3.34* the total CO_2 calculated as emitted from the oxidation of these non-energy uses are presented per fuel type.

Table 3.34. 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)

Fuel type	Oxidation Factors *	1990	…	1995	1996	1997	1998	1999	2000	2001	2002	2003	Trend
Liquids **	22.3%	5.0		5.2	4.9	5.1	5.3	5.8	6.2	6.6	6.8	7.8	2.8
Solids***	42.5%	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	3.6	3.9	3.7	3.7	3.9	3.4	3.3	3.1	-0.3
Total		**8.9**		**9.3**	**8.9**	**9.4**	**9.4**	**9.8**	**10.5**	**10.4**	**10.6**	**11.4**	**2.5**

* Using country-specific carbon fuel type averaged Oxidation Factors, calculated from all processes for which emissions are calculated in the sectoral approach, either by assuming a fraction oxidised, e.g. ammonia, or by accounting for by-product gases.

** Excluding refinery gas.

*** Coal oils and tars (from coking coal), coke and other bituminous coal only; no coal derived gases.

Table 3.35. Trends in CO_2 emitted by feedstock use of energy carriers by fuel type, based on sources listed in Table 3.34 (in Tg)

Fuel type	Sources	1990	…	1995	1996	1997	1998	1999	2000	2001	2002	2003	Trend
Liquids	Chemical residual gas in 1A + 2G4 lubr./wax	5.6		5.5	5.5	5.7	5.8	6.2	6.3	6.6	7.5	7.7	2.1
Solids *	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	0.0
Gaseous	2B1 ammonia + 2B5 other chemicals **	3.5		3.9	3.8	3.9	3.7	3.6	3.7	3.1	3.0	2.8	-0.6
Total		**9.3**		**9.6**	**9.5**	**9.8**	**9.6**	**10.1**	**10.1**	**9.9**	**10.7**	**10.7**	**1.4**

* Excluding coke used a reducing agent in blast furnaces, since that is not labelled as feedstock in the energy statistics. Also excluding coal and coke derived gases such as coke oven gas, blast furnace gas and oxygen furnace gas.
** Including some emissions from coke use (or combustion of phosphorus oven gas).
Not included is 2B5 electrode production since this very small and refers to a mixture of liquid and solids used as input.

According to the Reference Approach dataset, the CO_2 emissions of this group of sources increased by almost 30% or 2.5 Tg CO_2, of which most are due to changes in emissions from liquid fuels (*Table 3.34*). This should be compared to sector 2 emissions and selected by-product emissions in sector 1A, but excluding waste incineration and blast furnace gas in 1A1a and product use in sector 3. For the comparison we summed the most relevant sources from *Table 3.34* in *Table 3.35*, without trying to be completely accurate and complete (However, we see similar trends for the three fuels types.

In particular 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 per cent points can be observed.

3.2.8.5 Source-specific recalculations

As mentioned before, the emissions from all fossil fuel use, both combustion and non-combustion uses, have been recalculated to achieve a much better transparency, consistency and accuracy. In previous submissions the feedstock and other non-energy use emissions were all reported as part of the fuel combustion sector 1A, including supplemental estimates that took account of oxidation during the use of petrochemical products manufactured in the Netherlands (see *Table 3.27* in NIR 2004).

- *Main fossil-fuel related CO_2 from so-called industrial processes:* according to IPCC Guidelines, the (net) CO_2 emissions from the inputs of coke and coal into blast furnaces and from the feedstock use of natural gas for the production of ammonia should be allocated to CRF sector 2; previously these were all reported in the fuel combustion sector 1A (impact: now about 2.5 to 1.5 and 3 Tg CO_2 from iron and steel industry and the chemical industry, respectively, is moved to industrial processes, CRF sector 2). The carbon contained in the blast furnace gas produced is subtracted from the process emissions in the iron and steel industry, since this gas is combusted in both the steel industry and in the public power generation category and thus allocated to the fuel combustion sector 1A.
- *Other CO_2 process emissions from non-energy use:* in the production of soda ash (from coke) (2A4), carbon electrodes (from petroleum coke), other chemicals (i.e. industrial gases hydrogen and carbon monoxide) (from natural gas) (2B), which account for less than 0.5 Tg CO_2, are now separately calculated and reported in CRF sector 2. Remaining non-energy uses of fuels with CO_2 process emissions are found in the food and drink industry (from coke) and in other economic sectors (from lubricants and waxes) are reported under 2D and 2G, respectively, amounting about 0.5 Tg CO_2.

The effects of the recalculation are indicated in *Table 3.36*

Table 3.36. Effect of recalculations of CO_2 emissions from fossil fuel use (Tg).

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
NIR2005													
1A	148.4	153.5	152.3	157.1	156.3	160.3	168.1	161.0	163.5	158.2	160.4	166.5	166.1
1B1b	0.4	0.4	0.4	0.4	0.5	0.5	0.7	0.5	0.5	0.4	0.4	0.4	0.4
2	6.2	6.1	5.6	5.4	5.9	6.2	6.0	6.4	5.7	5.6	5.5	4.7	4.7
3	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
Total	**155.3**	**160.3**	**158.6**	**163.1**	**162.9**	**167.2**	**174.9**	**168.0**	**169.9**	**164.5**	**166.5**	**171.8**	**171.4**
NIR2004													
1A	157.8	165.7	164.6	166.6	167.3	170.1	178.1	162.5	169.4	163.8	167.9	174.0	173.0
1B2-iv	0.2	0.3	0.4	0.5	0.6	0.7	0.7	0.7	1.3	1.4	1.4	1.5	1.3
2	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
3	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
7	0.2	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.4	0.4	0.5
Total	**158.2**	**166.2**	**165.3**	**167.4**	**168.2**	**171.1**	**179.2**	**163.7**	**171.2**	**165.7**	**169.7**	**175.9**	**174.8**
Difference	***-2.9***	***-6.0***	***-6.7***	***-4.3***	***-5.3***	***-3.9***	***-4.3***	***4.3***	***-1.3***	***-1.3***	***-3.2***	***-4.1***	***-3.4***

It compares sector 1A and selected sector 1B, 2 and 3 emissions of CO_2 reported in the NIR 2004 with new sector 1A and selected sector 1B, 2 and 3 emissions. Its shows that excluding the 1997 data, of which the sectoral CO_2 emissions in the NIR2004 are known to be in error, the new totals are on average 3.9 Tg CO_2 lower than the totals reported previously (with annual variations having a standard deviation of 1.7 Tg). The size of this correction is as expected for the change to estimating only actual

CO_2 emissions from *domestic* uses of petrochemical products as instead of estimating supplementary emissions from the use of products manufactured in the Netherlands. Neelis *et al.* (2003) and the size of the estimates made in the previous reports to supplement the CO_2 emissions reported by the individual industries(ER-I) already indicated changes between 3 and 7 Tg.

3.2.9 International bunker fuels

3.2.9.1 Source category description

In *Table 3.37* both energy consumption and CO_2 emissions from international air transport and international shipping are presented per fuel type. In 2003, bunker emissions of CO_2 were about 15.1 Tg or 40% higher than in 1990. In particular, international aviation showed a very high growth of about 140%, whereas international shipping increased by 28%. Due to the much higher growth of international air traffic, its share in international bunker emissions increased from about 11% in 1990 to about 20% in 2003.

Table 3.37. International bunkers: energy consumption (PJ) and related CO_2 emissions (Tg) 1990-2003

Source	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Energy consumption														
Marine bunkers	**445**	**460**	**464**	**480**	**455**	**461**	**471**	**499**	**505**	**522**	**555**	**611**	**604**	**564**
- heavy fuel oil	368	378	382	410	384	375	391	427	427	446	473	522	521	491
- petrol	73	78	78	66	66	82	75	68	73	71	76	82	77	68
- lubricant	4	3883	3620	4003	4606	4	5	5	5	5	6	7	5	5
Aviation bunkers	**64**	**68**	**79**	**87**	**91**	**106**	**113**	**122**	**134**	**138**	**136**	**133**	**140**	**137**
- jet fuel (kerosene)	64	68	79	87	91	106	113	122	134	138	136	133	140	137
- aviation petrol	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 bunkers	509	528	543	567	546	567	584	622	639	660	692	745	743	702
Emissions														
Marine bunkers	**34.2**	**35.3**	**35.6**	**36.9**	**35.0**	**35.4**	**36.2**	**38.4**	**38.9**	**40.2**	**42.7**	**47.0**	**46.5**	**43.4**
- heavy fuel oil	28.5	29.2	29.5	31.7	29.7	29.0	30.3	33.0	33.0	34.5	36.6	40.4	40.3	38.0
- petrol	5.4	5.8	5.8	4.9	4.9	6.1	5.6	5.0	5.4	5.3	5.6	6.1	5.8	5.1
- lubricant	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.4	0.3
Aviation bunkers	**4.5**	**4.8**	**5.6**	**6.2**	**6.5**	**7.6**	**8.1**	**8.7**	**9.6**	**9.8**	**9.7**	**9.5**	**10.0**	**9.8**
- jet fuel (kerosene)	4.5	4.8	5.6	6.2	6.5	7.6	8.1	8.7	9.6	9.8	9.7	9.5	10.0	9.8
- aviation petrol	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total bunkers	**38.8**	**40.2**	**41.3**	**43.1**	**41.5**	**43.0**	**44.3**	**47.2**	**48.4**	**50.0**	**52.5**	**56.6**	**56.4**	**53.3**

Source: CBS, 1990-2003 (NEH/Energy Monitor, Table 1.1; revised data); with a few corrections for definition differences.
N.B. Aviation petrol is included under jet fuel; ND = No data; lubricants used as bunker fuel are 100% oxidised (instead of 50% in the National Approach).

3.2.9.2 Methodological issues

Marine bunker sales include fuel deliveries to professional domestic inland shipping. In addition, bunker sales include fuel deliveries to deep-sea fishing boats whereas according to the *Revised IPCC Guidelines* emissions from combustion of fuels delivered to both domestic inland shipping and fishing boats should be considered as national emissions. In the previous NIR, only a few per cent of total marine and aviation emissions of CO_2 were reported as domestic and included in national total greenhouse gas emissions. This year it is the first time that this non-compliance has been eliminated since emissions from national fisheries and military activities can be calculated (see *Table 3.25* in *Section 3.2.3.1* and Section *3.2.6*, respectively). In addition, as explained in *Section 3.2.3.1* it is now possible to distinguish between fuel use by *domestic* navigation and *international* navigation. The latter was previously included in the fuel use and emissions from inland navigation (1A3d), but has this year been shifted to the international bunkers as IPCC guidelines prescribe. However, the share of domestic shipping and aviation fuels is still only a per cent or so (*Table 3.38*).

Table 3.39 presents the trend in greenhouse gas emissions from international bunkers for CO_2, CH_4 and N_2O. Although a recent study on CH_4 and N_2O emission factors showed that the IPCC defaults (IPCC, 1996) may be outdated (Denier van der Gon *et al.*, 2002), these factors were still used for the calculation of N_2O and CH_4 emission estimates, since no better data are currently available.

Table 3.38. Allocation of marine and aviation fuel consumption: domestic vs. international (%).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Marine fuel consumption:														
- Domestic	1.2	1.2	1.2	1.1	1.2	1.2	1.1	1.1	1.2	1.4	1.3	1.2	1.3	1.4
- International	98.8	98.8	98.8	98.9	98.8	98.8	98.9	98.9	98.8	98.6	98.7	98.8	98.7	98.6
Aviation fuel consumption:														
- Domestic	1.0	0.8	0.7	0.7	0.6	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4
- International	99.0	99.2	99.3	99.3	99.4	99.5	99.5	99.5	99.6	99.6	99.6	99.6	99.6	99.6

3.2.9.3 Uncertainty and time-series consistency

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

Table 3.39. Trend in greenhouse gas emissions (Tg; Others in Gg) from international bunkers 1990-2003

	Implied EF [1)]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2		**34.2**	**35.3**	**35.6**	**36.9**	**35.0**	**35.4**	**36.2**	**38.4**	**38.9**	**40.2**	**42.7**	**47.0**	**46.5**	**43.4**
Marine	74.30	5.4	5.8	5.8	4.9	4.9	6.1	5.6	5.0	5.4	5.3	5.6	6.1	5.8	5.1
Gas/Diesel Oil	77.40	28.5	29.2	29.5	31.7	29.7	29.0	30.3	33.0	33.0	34.5	36.6	40.4	40.3	38.0
Residual Fuel Oil	73.30	0.3	284.7	265.3	293.4	337.7	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.4	0.3
Lubricants		**4.5**	**4.8**	**5.6**	**6.2**	**6.5**	**7.6**	**8.1**	**8.7**	**9.6**	**9.8**	**9.7**	**9.5**	**10.0**	**9.8**
Aviation		4.5	4.8	5.6	6.2	6.5	7.6	8.1	8.7	9.6	9.8	9.7	9.5	10.0	9.8
Jet Kerosene	7150	4.5	4.8	5.6	6.2	6.5	7.6	8.1	8.7	9.6	9.8	9.7	9.5	10.0	9.8
Total bunkers		**38.8**	**40.2**	**41.3**	**43.1**	**41.5**	**43.0**	**44.3**	**47.2**	**48.4**	**50.0**	**52.5**	**56.6**	**56.4**	**53.3**
CH_4															
Marine		**0.84**	**0.87**	**0.88**	**0.88**	**0.84**	**0.88**	**0.89**	**0.92**	**0.94**	**0.96**	**1.02**	**1.12**	**1.10**	**1.02**
Gas/Diesel Oil	3.40	0.25	0.27	0.27	0.23	0.23	0.28	0.25	0.23	0.25	0.24	0.26	0.28	0.26	0.23
Residual Fuel Oil	1.60	0.59	0.60	0.61	0.66	0.61	0.60	0.63	0.68	0.68	0.71	0.76	0.84	0.83	0.79
Lubricants	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.00
Aviation		**0.22**	**0.23**	**0.27**	**0.30**	**0.31**	**0.36**	**0.38**	**0.42**	**0.45**	**0.47**	**0.46**	**0.45**	**0.47**	**0.47**
Jet Kerosene	3.40	0.22	0.23	0.27	0.30	0.31	0.36	0.38	0.42	0.45	0.47	0.46	0.45	0.47	0.47
Total bunkers		**1.06**	**1.11**	**1.15**	**1.18**	**1.16**	**1.24**	**1.27**	**1.33**	**1.39**	**1.43**	**1.49**	**1.58**	**1.58**	**1.49**
N_2O															
Marine		**0.27**	**0.28**	**0.28**	**0.29**	**0.27**	**0.28**	**0.28**	**0.30**	**0.30**	**0.31**	**0.33**	**0.37**	**0.36**	**0.34**
Gas/Diesel Oil	0.60	0.04	0.05	0.05	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.05	0.05	0.05	0.04
Residual Fuel Oil	0.60	0.22	0.23	0.23	0.25	0.23	0.22	0.23	0.26	0.26	0.27	0.28	0.31	0.31	0.29
Lubricants	1.00	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Aviation		**0.04**	**0.04**	**0.05**	**0.05**	**0.05**	**0.06**	**0.07**	**0.07**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**
Jet Kerosene	0.60	0.04	0.04	0.05	0.05	0.05	0.06	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08
Total bunkers		**0.31**	**0.32**	**0.33**	**0.34**	**0.33**	**0.34**	**0.35**	**0.37**	**0.38**	**0.40**	**0.42**	**0.45**	**0.45**	**0.42**

[1)] Implied emission factors: CO_2 in kg/GJ, CH_4 and N_2O in kg/TJ.

3.2.9.4 Source-specific recalculations

These emissions have now been replaced by the new estimate of the military mobile sources described above. The effect of this recalculation for CO_2 is shown in *Table 8.11*. The impact on 1990 and present emissions is an increase of about 0.5 Tg CO_2 (with inverse effect on international bunkers emissions).

Table 3.40. Recalculation of CO_2, CH_4, N_2O emissions for Marine, Aviation and Total bunkers

	Souce category		1990	1995	1996	1997	1998	1999	2000	2001	2002
	CO_2										
Memo Items (1):	International Bunkers	new	38.8	43.0	44.3	47.2	48.4	50.0	52.5	56.6	56.4
	International Bunkers	old	39.8	44.3	45.4	48.4	49.5	51.2	53.5	57.6	57.4
	International Bunkers	***diff***	***-1.0***	***-1.3***	***-1.2***	***-1.3***	***-1.1***	***-1.2***	***-1.0***	***-1.0***	***-1.0***
	Aviation	new	4.5	7.6	8.1	8.7	9.6	9.8	9.7	9.5	10.0
	Aviation	old	4.5	7.7	8.2	8.9	9.7	10.1	10.1	9.9	10.3
	Aviation	***diff***	***0.0***	***-0.1***	***-0.2***	***-0.2***	***-0.1***	***-0.2***	***-0.3***	***-0.3***	***-0.3***
	Marine	new	34.2	35.4	36.2	38.4	38.9	40.2	42.7	47.0	46.5
	Marine	old	35.3	36.6	37.2	39.5	39.8	41.1	43.4	47.7	47.1
	Marine	***diff***	***-1.0***	***-1.2***	***-1.0***	***-1.1***	***-1.0***	***-0.9***	***-0.7***	***-0.7***	***-0.7***
	CH_4										
Memo Items (1):	International Bunkers	new	1.1	1.2	1.3	1.3	1.4	1.4	1.5	1.6	1.6
	International Bunkers	old	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
	International Bunkers	***diff***	***0.9***	***1.1***	***1.1***	***1.2***	***1.2***	***1.3***	***1.3***	***1.4***	***1.4***
	Aviation	new	0.2	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5
	Aviation	old	NE	NE	NE	NE	NE	NE	NE	NE	NE
	Aviation	***diff***									
	Marine	new	0.8	0.9	0.9	0.9	0.9	1.0	1.0	1.1	1.1
	Marine	old	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2
	Marine	***diff***	***0.7***	***0.7***	***0.7***	***0.8***	***0.8***	***0.8***	***0.9***	***0.9***	***0.9***
	N_2O										
Memo Items(1):	International Bunkers	new	NE	NE	NE	NE	NE	NE	NE	NE	NE
	International Bunkers	old	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	International Bunkers	***diff***	-	-	-	-	-	-	-	-	-
	Aviation	new	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	Aviation	old	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Aviation	***diff***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***
	Marine	new	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4
	Marine	old	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0
	Marine	***diff***	***0.2***	***0.2***	***0.2***	***0.3***	***0.3***	***0.3***	***0.3***	***0.3***	***0.3***

3.3 Fugitive emissions from solid fuels, oil and natural gas [CRF sector 1B]

3.3.1 Source category description

Fugitive emissions in this source category primary originate from oil and gas (1B2):

- exploration, production (venting and flaring), on-site gas processing; onshore and offshore);
- gas transmission (including emissions of compressor stations);
- gas distribution (pipelines for local transport);
- oil refining (non-fuel combustion emissions).

Other non-combustion solid fuel-related emissions, mainly CO_2, stem from coke manufacture (1B1). In *Table 3.41* the emissions from this category are summarised. Methane emissions from gas production and from gas distribution are key sources according to *Box 3.4*. As of this year, also CO_2 from gas flaring (including venting of gas with a high carbon dioxide content) and CO_2 from coke production are also identified as key sources. Emissions from oil production and refineries have been identified as non-key sources.

In the Netherlands there are no fugitive emissions from coal mining and handling activities (1B1); they take no longer place anymore since the last mine closed in the early 1970s. We note that *fugitive* emissions from all coke production sites are included here; this is in contrast with fuel *combustion* emissions from on-site coke production by the iron and steel industry with are included in 1A2a instead of 1A1c, since these are reported in an integrated and aggregated way (see *Section 3.2.2*).

Table 3.41. Fugitive emissions from production, processing and transmission/distribution of solids, oil and gas (in Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2														
1B1b. Solid fuel transf.	403	430	431	446	559	517	651	505	492	446	422	412	430	464
1B2a. Oil refining	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1B2b. Gas process.	179	206	199	150	130	178	166	1	2	138	138	138	138	138
1B2c. Venting	331	296	260	225	189	154	167	138	174	176	176	176	176	176
1B2c. Flaring	329	310	266	188	237	121	146	132	115	90	90	96	95	91
CH_4														
1B1b. Solid fuel transf.	1.4	1.4	1.4	1.4	1.4	1.4	1.5	1.5	1.4	1.2	1.1	1.1	1.1	1.1
1B2a. Oil refining	1	1	1	1	1	0	0	0	0	0	0	0	0	0
1B2b. Gas transmission	6	7	7	7	6	6	7	5	4	4	3	4	4	4
1B2b. Gas distribution	31	30	29	28	28	27	27	26	26	26	26	25	25	25
1B2c. Venting	59	59	59	59	59	59	54	30	29	23	21	21	21	21
1B2c. Flaring	1	1	0	0	1	0	0	0	0	0	0	0	0	0
N_2O														
1B2c. Flaring	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Box 3.4. Key source identification in the fugitive emissions sector using the IPCC Tier 1 and 2 approach (L = Level, T = Trend)

1B1	CH_4	Coal mining	Not occurring
1B1	***All***	***Coke production: CO_2***	***Key (L2) ****
1B2	***CO_2***	***Fugitive emissions from venting/flaring***	***Key (L,T1) ****
1B2	**CH_4**	**Fugitive emissions from oil and gas: gas production**	**Key (T1)**
1B2	**CH_4**	**Fugitive emissions from oil and gas: gas distribution**	**Key (L2)**
1B2	CH_4	Fugitive emissions from oil and gas operations: other	Non-key

** Changed compared to previous NIR.*

3.3.2 Solid fuels (coke manufacture) (CRF category 1B1)

Presently the Netherlands 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.

3.3.2.1 Methodological issues

The CO_2 emissions related to transformation losses now based on national energy statistics of coal inputs and coke and coke oven gas produced and a carbon balance calculation of the losses. Completeness of 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 reported here.

3.3.2.2 Uncertainty and time-series consistency of fugitive emissions

Table 3.42 presents the trend of CO_2 emissions from transformation losses in coke production as well as the amount of coke produced and the implied emission (loss) factor. The decrease of production and emissions in 1999 is caused by the discontinuation of the activities in Sluiskil. The CH_4 emissions are very minor (about 1 Gg), based on the IPCC default emission factor of 0.5 kg per ton of coke produced.

Table 3.42. 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
CO_2 emissions (Gg)	403	430	431	446	559	517	651	505	492	446	422	412	430	464
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
CO_2 losses/coke prod. (kg/GJ)	5.2	5.1	5.2	5.4	6.3	6.3	7.8	6.1	6.1	6.7	7.0	6.6	7.1	7.6

3.3.2.3 Source-specific recalculations

This source category was previously included elsewhere (in 1A2a).

3.3.3 Fugitive emissions from oil and natural gas (CRF category 1B2)

The CO_2 emissions 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. Fugitive CO_2 emissions from refineries are included in the combustion emissions reported in category 1A1b.

The fugitive emissions are mostly CH_4 emissions that originate from production, transmission and distribution of natural gas. Production and distribution of gas are specified as key sources for the emission of CH_4. The decreasing trend of CH_4 from venting and of CO_2 emissions from venting and flaring is mainly due to measures taken to increase the of utilisation of this gas for energy purposes. In addition, methane emissions from gas distribution decrease over time, due to the replacement of the leakiest materials as part of the maintenance programme. The share of these sources in national total CH_4 emissions decreased from 8% to 6% at present and the share in the total greenhouse gas emissions decreased from 1% to 0.5% in 2003. For the other emissions these categories have a small share in the national total and are no key-sources. Insignificant N_2O emissions reported here stem from gas flaring.

3.3.3.1 Methodological issues

Country-specific methods comparable with the IPCC Tier 3 method are used for the emission estimation of fugitive CH_4 and CO_2 emissions from oil and gas production and processing (NOGEPA, 2003). The emission factors for CH_4 from gas flaring and venting are plant-specific. The emissions from exploration activities data are small compared to production emissions and have not been reported separately but included in oil and gas production emissions. A full description of the methodology is provided in the monitoring protocols (Ruyssenaars, 2005). 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.

The new Tier 2 method for gas distribution is based on emissions per km pipeline per type of material due to leakages, for which the country-specific emission factors determined for the Western part of Germany were used. Since CH_4 emissions from gas production and gas distribution are considered key sources (see *Box 3.4*), the present methodology complies with the *IPCC Good Practice Guidance* (IPCC, 2000). Note that CO_2 emissions from fugitive sources and CH_4 from refineries are no key sources. Fugitive CH_4 emissions from refineries are calculated as 4% from total VOC emissions reported by the individual companies (Spakman *et al*., 2003).

3.3.3.2 Uncertainty and time-series consistency of fugitive emissions

The uncertainty in annual CO_2 emissions from this source category is estimated to be about 50%. The uncertainty in methane emissions from gas production and gas distribution is estimated to be 25% and 50% in annual emissions, respectively (see *Section 1.7* for more details).

The emission trends are summarised in *Table 3.43*. As discussed above, the decrease in flaring and venting emissions is due to measures to reduce these emissions, whereas gas distribution emissions decrease over time due the gradual phase-out of the most leaky grey cast iron part of the distribution network. For recalculation purposes of historical data, the total length of the distribution network for 1990-2002 was provided by Gastec (Gastec, 2003) (*Table 3.44*). In the period 1990-2002 the estimated emission of CH_4 decreased from 138 to 89 Gg per year (-35%); total CO_2 emissions of category 1B2 decreased be almost 50% to 0.2 Tg.

Table 3.43. Trends in CH_4 emissions from production of oil and gas, and transmission and distribution of gas (Gg)

Source category	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Production/processing	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Transmission	6	7	7	7	6	6	7	5	4	4	3	4	4	4
Distribution	31	30	29	28	28	27	27	26	26	26	26	25	25	25
Total	37	37	36	35	34	33	33	31	30	29	29	29	29	28

Table 3.44. Development of the natural gas distribution pipeline network (in 1000 km) (source: Gastec, 2003)

Material	**1990**	**1991**	**1992**	***1993***	**1994**	**1995**	**1996**	**1997**	***1998***	**1999**	**2000**	**2001**	**2002**	**2003**
Grey cast iron	10.4	10.0	9.6	9.2	8.9	8.7	8.5	8.2	8.0	7.8	7.6	7.5	7.3	7.2
Nodular cast iron	4.3	4.2	4.2	4.1	3.9	3.7	3.5	3.3	3.1	3.1	3.1	3.1	3.1	3.0
Steel	18.9	18.9	19.0	19.0	19.2	19.3	19.4	19.6	19.7	19.8	20.0	20.1	20.2	20.4
PVC	52.5	53.8	55.2	56.5	57.4	58.3	59.2	60.1	61.1	62.7	64.2	65.8	67.4	69.0
PE	10.4	10.8	11.3	11.8	12.2	12.5	12.9	13.3	14.2	14.6	15.0	15.4	15.8	16.2
Other	2.3	2.2	2.1	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.9	1.9
Length of network:	**98.7**	**100.0**	**101.3**	**102.6**	**103.6**	**104.5**	**105.5**	**106.5**	**108.0**	**109.9**	**111.9**	**113.8**	**115.7**	**117.6**

Note: years in italics (for 1988, 1993, 1996 and 2004) are monitored network data; intermediate years are interpolated values. CI = Cast Iron; PVC = Poly Vinyl Chloride; PE = Poly Ethylene.

Table 3.45. Trend in CH_4 emissions from gas distribution and emission factors per type of pipeline material.

Material	**Gg CH_4/ km/yr**	**m^3 CH_4/ Mm/yr**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Grey cast iron	2.18	3818	22.7	21.8	20.9	20.0	19.5	19.0	18.5	17.9	17.4	17.1	16.7	16.3	16.0	15.6
Nodular CI	0.20	348	0.8	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6
Steel	0.23	399	4.3	4.3	4.3	4.3	4.4	4.4	4.4	4.5	4.5	4.5	4.6	4.6	4.6	4.6
PVC	0.05	84	2.5	2.6	2.6	2.7	2.8	2.8	2.8	2.9	2.9	3.0	3.1	3.2	3.2	3.3
PE	0.03	54	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5
Other	0.06	100	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
Total CH_4			**30.8**	**30.0**	**29.2**	**28.4**	**27.9**	**27.4**	**26.9**	**26.5**	**26.0**	**25.8**	**25.5**	**25.3**	**25.0**	**24.8**

Table 3.46. Trends in activity data of production, transmission and distribution of oil and natural gas (source: EZ, 2002; Gasunie, 2001 and 2002)

Activity	**Unit**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Oil production	mln m^3	3.99	3.67	3.21	3.01	4.02	3.21	2.65	1.48	2.03	1.89	1.71	1.63	2.68	2.76
Gas production	PJ	2292	2608	2628	2659	2482	2478	2839	2590	2529	2280	2144	2287	2255	2171
Gas transmission	PJ	2292	2608	2652	2738	2598	2630	2968	2660	2527	2385	2311	2554	2513	2437
Gas distribution	PJ	99	100	101	103	104	105	106	107	108	110	112	114	116	118

This substantial emission reduction is not the result of a decrease in activity data: both amounts of gas distributed and gas transported have increased, while gas production decreased only slightly, although there was a movement towards more offshore production of gas and less onshore production (*Table 3.46*). Emission reductions are mainly the result of the implementation of cost-effective measures to prevent venting of natural gas during production (NOGEPA, 1996, 1999, 2003; NAM, 1999a, 1999b; Oonk and Vosbeek, 1995). These measures have been applied in accordance with the *Netherlands Emission Directives* for the production of natural gas and oil (Infomil, 2000).

The gas leakage from distribution networks decreases because of the gradual replacement of old cast iron pipes by modern materials (*Tables 3.44* and *3.45*). *Figure 3.10* shows the trends of the production and transmission of natural gas and related CH_4 emissions (including emissions from oil).

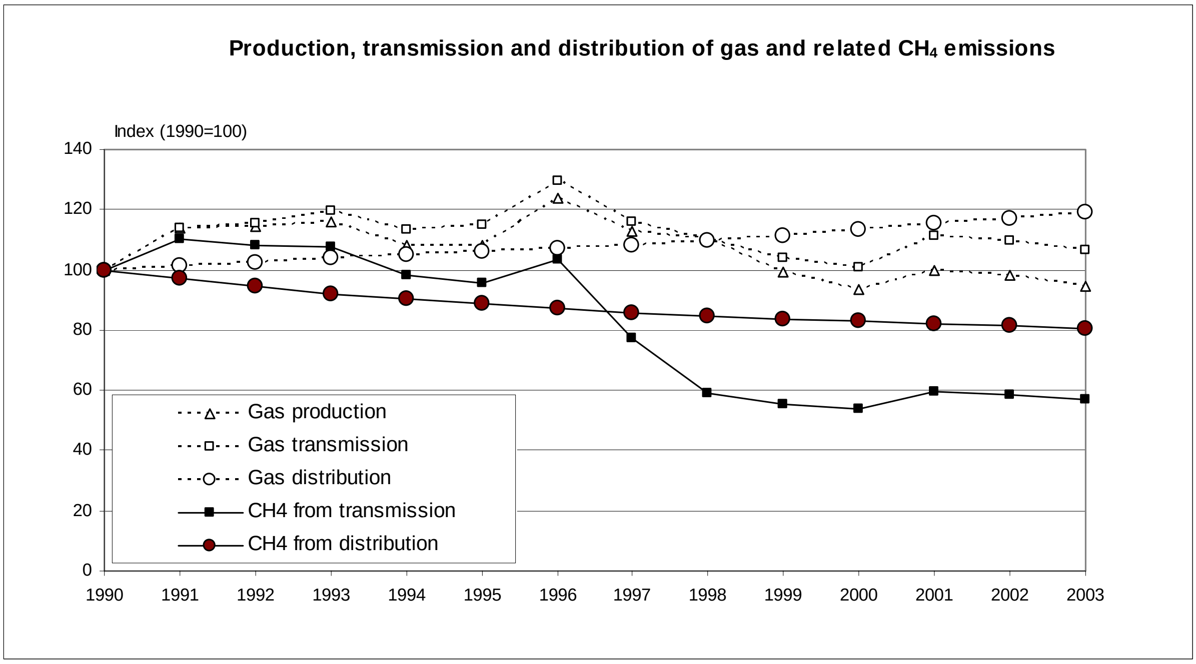


Figure 3.15. Trends in production, transmission and distribution of natural gas and oil and related CH_4 emissions.

3.3.3.3 Source-specific recalculations

The emissions from this category have been complete recalculated in order to comply with IPCC good practice, i.e. to achieve both consistency over time and transparency for the oil and gas production and processing and oil refineries and to use the required higher tier methodology for gas distribution. This has substantially changed CH_4 emissions from venting and gas distribution and CO_2 from flaring and from venting of high CO_2 gas (see *Table 3.47*). The very low gas processing emissions in 1997 and 1998 are due to apparent discontinuities on the platform.

Table 3.47.a Effect of recalculation on CO_2 emissions from fugitive oil and gas sources (Gg).

Source category		**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
1B2b. Gas processing	new	178	205	198	149	129	177	165	0	1	137	137	137	137
	old	99	110	122	133	145	156	296	279	275	93	196	236	299
	diff	*79*	*94*	*76*	*16*	*-16*	*21*	*-131*	*-279*	*-274*	*44*	*-59*	*-100*	*-162*
1B2c. Venting	new	331	296	260	225	189	154	167	138	174	176	176	176	176
	old	0	0	0	0	0	0	0	0	0	0	0	0	0
	diff	*331*	*296*	*260*	*225*	*189*	*154*	*167*	*138*	*174*	*176*	*176*	*176*	*176*
1Bc. Flaring	new	329	310	266	188	237	121	146	132	115	90	90	96	95
	old	0	0	0	0	0	0	0	0	0	0	0	0	0
	diff	*329*	*310*	*266*	*188*	*237*	*121*	*146*	*132*	*115*	*90*	*90*	*96*	*95*

Table 3.47.b Effect of recalculation on CH_4 emissions from fugitive oil and gas sources (Tg)

Source category		**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
1B2a. Oil refining	new	0.6	0.6	0.6	0.6	0.5	0.5	0.4	0.4	0.4	0.3	0.3	0.3	0.3
	old	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.0	0.0	0.0
	diff	***0.3***	***0.4***	***0.4***	***0.4***	***0.3***	***0.2***	***0.2***	***0.1***	***0.1***	***0.0***	***0.3***	***0.3***	***0.3***
1B2b. Gas transmission	new	6.3	7.0	6.8	6.8	6.2	6.1	6.6	4.9	3.7	3.5	3.4	3.8	3.7
	old	6.3	7.0	7.0	7.0	6.0	3.9	6.6	4.9	2.4	3.5	2.6	3.0	3.7
	diff	***0.0***	***0.0***	***-0.2***	***-0.2***	***0.2***	***2.2***	***0.0***	***0.0***	***1.4***	***0.0***	***0.9***	***0.8***	***0.0***
1B2b. Gas distribution	new	30.8	30.0	29.2	28.4	27.9	27.4	26.9	26.5	26.0	25.8	25.5	25.3	25.0
	old	72.6	81.0	75.0	78.0	69.0	69.7	77.7	64.6	61.8	58.7	58.0	61.3	58.3
	diff	***-41.8***	***-51.0***	***-45.8***	***-49.6***	***-41.1***	***-42.3***	***-50.8***	***-38.1***	***-35.8***	***-33.0***	***-32.5***	***-36.0***	***-33.3***
1B2c. Venting	new	58.8	59.0	59.2	59.3	59.3	59.4	53.8	30.1	29.2	23.3	20.9	20.5	20.5
	old	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
	diff	***58.8***	***59.0***	***59.2***	***59.3***	***59.3***	***59.4***	***53.8***	***30.1***	***29.2***	***23.3***	***20.9***	***20.5***	***20.5***
1B2c. Flaring	new	0.8	0.7	0.5	0.5	0.5	0.4	0.5	0.4	0.4	0.3	0.3	0.3	0.3
	old	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
	diff	***0.8***	***0.7***	***0.5***	***0.5***	***0.5***	***0.4***	***0.5***	***0.4***	***0.4***	***0.3***	***0.3***	***0.3***	***0.3***

3.3.3.4 Source-specific planned improvements

As of 2003, all oil and gas production companies operating in the Netherlands were to submit an *annual environmental report* (MJV) with a detailed format for reporting of greenhouse gas emissions. The rationale of this new inventory structure of company data is to collect enough detailed information to be able to produce a transparent greenhouse gas emission inventory of this source category for recent years. Results are not yet available for years after 2002 for use in this submission.

Although for distribution of natural gas the present method complies with the tier 2 method recommended by IPCC Good Practice, country-specific emission factors are still missing. Measurements of the Dutch situation are not available and costly to perform. For future years the association of energy distribution companies, EnergieNed, will annually collect data on the length of distribution network and the amount of leaks of each material. However, EnergieNed questions the applicability of the now used German data for Dutch circumstances of gas distribution. Therefore, in 2005 EnergieNed will measure data on the number of leaks per type of material, from which country-specific emission factors can be determined. This should enable the use of country-specific emission factors for the next submission.

4. INDUSTRIAL PROCESSES [CRF sector 2]

Major changes in Industrial Processes sector compared to previous National Inventory Report

Emissions: From now on the CO_2 process emissions from the iron and steel industry, primary aluminium production and the chemical industry are reported in this sector using a consistent methodology (previously in 1A2). Therefore, the Standard Data Tables in the CRF spreadsheets are now complete, transparent and consistent over time. This is now also the case for the CO_2 emissions from minerals production. Furthermore, because a complete new time series of production data became available, the emissions of PFCs from primary aluminium production have been recalculated from 1990 onwards.

Key sources: CO_2 from ammonia manufacture (2B1), iron and steel production (2C1), and other chemicals (2B5), recalculated and reported separately, and indirect N_2O from deposition of NO_x from non-agricultural sources, previously included elsewhere, are now *key sources*. SF_6 is now a *non-key source*.

Methodologies: CO_2 emissions from the production of minerals (and use of minerals, excluding cement), steel, aluminium, ammonia, and other minor sources were now estimated based on national statistics of feedstock/non-energy use and on production statistics and national emission factors instead of individual company data. And CO_2 emissions are now reported in this sector instead of in the energy sector, when these emissions are not fully captured by chemical waste gas combustion (and thus reported elsewhere, i.e. in 1A).

4.1 Overview of sector

This sector comprises all *non-combustion* emissions from manufacturing industry activities including construction and *all* emissions from the use of the F-gases HFCs, PFCs and SF_6 (i.e. including use in other sectors). Non-combustion emissions from the energy sector are reported under IPCC category 1B 'Fugitive emissions' with the exception of CO_2 from limestone use in flue gas desulphurisation which we report under category 2A3. The sector *'Industrial Processes'* consists of the following subsectors:

- Mineral products (2A), CO_2, mainly from limestone and dolomite uses;
- Chemical industry (2B), with a variety of sources of CO_2, CH_4 and N_2O;
- Metal production (2C), CO_2 from Iron & Steel and Aluminium, and PFCs as by-product;
- Other production (i.e. Pulp & paper and Food & drinks) (2D), some CO_2;
- Production of halocarbons and SF_6 (2E), mainly HFC-23 as by-product;
- Consumption of halocarbons and SF_6 (2F), so-called F-gas uses and emissions;
- Other industrial (2G), a great mix of some CO_2 but mainly indirect N_2O.

Type of sources

The Netherlands sources of this sector can be characterised as follows:

- CO_2 from three types: feedstock uses of fossil fuels (in 2B,C,D,G); carbonates in limestone and dolomite (in 2A and 2C1); and other non-fossil fuel carbon, e.g. soda ash (2A, 2G);
- N_2O from three sources: nitric acid production, caprolactam production, and indirect N_2O from non-agricultural sources;
- CH_4 in negligible amounts from six sources.

In addition, CO_2 emissions from the use of peat in the production of active carbon ('norit') (2B5) and from the use of carbon electrodes ('anodes' in primary aluminium production) (2C2) are included.

Please note that indirect CO_2 emissions stemming from oxidation of NMVOC emitted from uses of *solvents and other product use* are reported in CRF sector 3, as the IPCC guidelines require.

Completeness

Some sources have not been estimated, notably CO_2 from lime production and from miscellaneous limestone uses, while others are only partly estimated (CO_2 from soda ash use). Also no CO_2 emissions are reported for asphalt use, since methodologies and default factors are not available, but these are believed to be negligible. However, also the Netherlands reports a number of sources that are often not identified by other countries:

- N_2O from caprolactam production (2B) and indirect N_2O from atmospheric deposition of $NO_{x,}$ and $NH_{3,}$ from non-agricultural sources (2G4), which are significant sources;
- CH_4 from degassing of drinking water made from groundwater that contains some methane (2G);
- CO_2 and CH_4 from candles and fireworks (2G), tiny, negligible sources that 'peaked' in 1999 due to the millennium celebration.

Please note the because of competitiveness, if the number of companies within a source category is three or less, generally the activity data and sometimes also emission factors are considered confidential. In those cases the notation key 'C' is used in the CRF tables.

Allocation of fossil fuel feedstock emissions

No CO_2 emissions are reported for the production of silicon carbide, carbon black, ethylene and methanol in the chemical industry (2B) because all feedstock emissions are accounted for in the residual chemical gas resulting from these processes. CO_2 emissions resulting from the combustion of these residual gases, of which production and consumption are all included in the national energy statistics are reported under the energy sector (1A) following the principle that all emissions from fuel combustion should be reported under the energy sector 1A, these emissions have indeed been allocated there (1A1a and 1A2c, see *Sections 3.2.1 and 3.2.2* for more details).

However, CO_2 emissions from carbon *losses* from coke and coal input as reducing agent in blast and oxygen furnaces in the iron and steel industry are reported under CRF subcategory 2C1: the difference between the carbon input and the carbon contained in the blast furnace and oxygen furnace gas produced as by-products (and subsequently used as fuels for energy purposes in the steel industry and by electrical utilities). The carbon contained in the blast furnace and oxygen furnace gas produced is not reported in category 2C but subtracted from the carbon balance calculation for the steel industry, since the production and consumption of these gases are all included in the national energy statistics and since their combustion emissions occur partly outside the steel industry. These latter combustion emissions are therefore reported in the energy sector (1A1a and 1A2a, see *Sections 3.2.2 and 3.2.3*), again following the principle that emissions from all fuel combustion should be reported under the energy sector 1A.

Please note no adjustments are made in any reported sectoral CO_2 emissions for capture of CO_2 from flue gases that may have occurred (e.g. by power plants, refineries or chemical industries), which was subsequently sold and transported to other enterprises for further use (e.g. food and drink industries or in greenhouse horticulture).

Trends and shares

The trends in greenhouse gas emissions from industrial processes are summarised in Table *4.1*. In 2003 emissions from the Industrial Processes sector contributed 8% of total national emissions (without LUCF), the same proportion as in 2002, compared with 11% in 1990. Emissions of CO_2 and N_2O accounted each for 40% per cent of CO_2 equivalent emissions from the sector, and CH_4, HFCs, PFCs and SF_6 for 2%, 9%, 8% and 2% of the sector emissions, respectively, in 2003. F-gas emissions had a share of almost 33% in total source category emissions in 1995. Emissions of N_2O from industrial processes accounted for 39% of national total N_2O emissions. Thus, at present, CO_2 and N_2O emissions cover each about 40% of the sector total, the rest mainly stemming from HFCs and PFCs.

From 1990 to 2003, emissions of the sector declined by 28%, and from 2002 to 2003 they decreased by 3.0%. The strong decreasing trend in HFC emissions of 2/3 reduction since 1990 and 3/4 reduction since 1995, notably of HFC-23 from HCFC-22 manufacture, is primarily responsible for the decreasing trend in this source category.

Total CO_2 emissions from the sector decreased by 17% from 1990 to 2003, mainly due to decreasing emissions from the iron and steel and chemical industries, and by 1.3% from 2002 to 2003. N_2O emissions fell by 21% from 1990 to 2003, mainly due to a decrease of 20% in emissions from nitric acid production but also other sources decreased by a similar percentage, and decreased by 3.7% from 2002 to 2003. CH_4 emissions, although trivial, decreased by 5% from 1990 to 2003.

HFC emissions decreased by 76% from 1995 to 2003 and decreased by 7% from 2002 to 2003; PFC emissions decreased by 23% from 1995 to 2003 and by 1.4% from 2002 to 2003; and SF_6 emissions increased by 11% from 1995 to 2003 and decreased by 7% from 2002 to 2003. The decreases of HFC and PFC emissions are mainly due to decreases in by-product emissions from HCFC-22 and aluminium manufacture, respectively. HFC and PFC emissions from the *use* of these compounds have increased substantially over time, as a result of substitution for traditional (H)CFCs and halons. The Netherlands has a few manufacturing industries where F-gases are used or produced as by-product:

- HFC-23 is emitted at one HCFC-22 production facility;
- PFCs are emitted by two primary aluminium smelters;
- PFCs (and SF_6) are used at one semiconductor manufacture location
- SF_6 was used at one production facility of Gas Insulated Switchgear (GIS) until 2003.

In addition, there are other, more diffuse, industries and service sectors where F-gases are used. Total F-gas emissions have been strongly reduced due to a substantial reduction of by-product emissions: an afterburner was installed at the HCFC-23 production plant in 1998 and the switch from side feed to point feed technology at one of the two aluminium smelters in 1998.

In *Box 4.1* specific sources in this category are listed and characterised as key or non-key source. The N_2O emissions from nitric acid production are a major key source, both in terms of level and trend. Its share of N_2O emissions in the national greenhouse gas total is presently 2.8% (and 4.0% in the base year 1990). Other large key sources are CO_2 emissions from ammonia manufacture and from iron and steel production, having a share of 16% and 9% in the sector total emissions in 2003. Of the F-gases, both by-product sources and the use of HFCs are identified as key sources.

Box 4.1 Key source identification for category 2 (industrial processes) using the IPCC Tier 1 and 2 approach (L = Level, T = Trend)

2A	CO_2	Cement production	Non-key
2G	CO_2	Limestone and dolomite consumption	Non-key
2A	CO_2	Emissions from lime consumption	Non-key
2A	CO_2	Other minerals (glass manuf., other soda ash use/production)	Non-key
2B	***CO_2***	***Ammonia production***	***Key (L1,T1) ****
2B	CO_2	Silicon carbide production	Included in 1A2
2B	***CO_2***	***Chemical industry: other chemicals (but mostly IE, in 1A2)***	***Key (L2) ****
2C	***CO_2***	***Iron and steel production (net carbon inputs)***	***Key (L1,T1) ****
2C	CO_2	Aluminium production: CO2	Non-key
2G	CO_2	Other industrial: CO_2	Non-key
2G	CH_4	Other industrial: CH_4	Non-key
2B	**N_2O**	**Emissions from nitric acid production**	**Key (L,T1)**
2B	**N_2O**	**Emissions from caprolactam production**	**Key (L)**
2G	***N_2O***	***Indirect N_2O from NO_x deposition by non-agric. sources***	***Key (L2) ****
2G	N_2O	Indirect N_2O from NH_3 deposition by non-agric. sources	Non-key
2C	**F-gas**	**PFC emissions from aluminium production**	**Key (L,T1)**
2E	**F-gas**	**HFC-23 emissions from HCFC-22 manufacture**	**Key (T)**
2E	F-gas	HFC by-product emissions from HFC manufacture	Non-key
2F	**F-gas**	**Emissions from ODS substitutes: HFC**	**Key (L,T1)**
2F	F-gas	PFC emissions from PFC use	Non-key
2F	*F-gas*	*SF_6 emissions from SF_6 use*	*Non-key **

** Changed compared to previous NIR.*

Major recalculations and allocation improvements were made for the CO_2 sources for the minor CH_4 sources that were previously based on individual company reports, the MJVs (the part of the national pollutant emission register called 'ER-I') (see *Section 1.2*), with the exception of cement clinker production and related CO_2 emissions where data from the MJV were used. As a consequence, consistency over time of CO_2 and CH_4 emissions at subcategory level has been substantially improved, as well as transparency and the source allocation.

In the next sections a description of these subcategories and their source categories will be given, per main category, except for the minor CH_4 sources listed in *Table 4.1* of which the emissions are all based on IPCC default Tier 1 methodologies and IPCC default emission factors.

Table 4.1. Trend in greenhouse gas emissions from industrial processes (category 2) (CO_2 in Tg; CH_4 and N_2O in Gg; F-gases in 1000 kg)

Gas/Subcategory	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
CO_2														
2A. Mineral products	1.2	1.3	1.2	1.3	1.5	1.4	1.3	1.3	1.3	1.4	1.4	1.5	1.4	1.3
2B. Chemical industry	3.5	3.9	3.9	3.8	4.0	4.0	3.9	4.0	3.8	3.7	3.8	3.2	3.1	2.9
2C. Metal production	2.9	2.5	2.0	1.9	2.2	2.2	2.1	2.4	2.1	2.0	1.8	1.7	1.8	2.0
2D. Other production [1]	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
2G. Other	0.3	0.2	0.3	0.2	0.2	0.5	0.5	0.5	0.4	0.5	0.6	0.4	0.4	0.4
CH_4														
2A. Mineral products	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
2B. Chemical industry	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.3	12.4	12.4	12.9	13.0
2C. Metal production	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
2D. Other production	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2G. Other	2.0	2.0	2.0	1.9	2.0	2.0	2.0	2.0	1.9	1.9	1.9	1.8	1.8	1.8
N_2O														
2B. Chemical industry	24.4	24.7	24.9	26.7	25.5	24.3	24.2	24.2	24.1	23.2	23.0	21.2	20.2	19.4
B2. Nitric acid production	20.4	20.7	20.9	22.7	21.5	20.3	20.2	20.2	20.1	19.2	19.0	17.2	16.2	16.3
B3. Adipic acid production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B5. Other	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.1
G. Other N_2O.	3.0	3.0	3.0	2.8	2.7	2.7	2.6	2.4	2.4	2.4	2.3	2.3	2.3	2.3
G1. Indirect N_2O from NO_x	2.8	2.8	2.8	2.7	2.5	2.5	2.4	2.2	2.2	2.2	2.1	2.1	2.1	2.1
G2. Indirect N_2O from NH_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	0.2
G3. Candles and fireworks	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
HFCs														
2E. By-product HCFC prod.	379	295	378	423	537	492	589	573	666	294	207	38	59	39
HFC-23														
2F. From HFC use														
HFC-23	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
HFC-32	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
HFC-125	0.0	0.0	0.0	0.0	0.0	2.5	9.0	15.5	20.3	21.4	31.1	42.4	53.3	62.5
HFC-134a	NO	NO	18	12	31	3	46	85	14	37	NO	1	3	5
HFC-152a	NO	NO	10	29	24	18	25	NO	NO	NO	22	7	2	4
HFC-143a	NO	NO	NO	3	6	NO	28	NO	18	17	50	8	5	6
HFC unspecified	NO	NO	NO	7	20	NO	18	198	129	68	46	17	15	11
PFCs														
2C. By-product aluminium prod														
CF_4	281	278	252	254	244	237	261	278	217	154	180	172	168	162
C_2F_6	29	29	26	27	26	25	28	29	22	35	18	17	17	16
2F. From PFC use														
PFC unspecified	2	3	3	3	4	4	6	12	13	17	22	17	20	23
SF_6														
2F. From SF_6 use	9	6	6	6	8	13	13	14	14	13	14	15	15	14

[1] Pulp & paper and Food & drinks. NO = Not Occurring.

4.1.1 Recalculation of CO_2 and CH_4 emissions

As part of a comprehensive programme to improve greenhouse gas emissions a major change has been made in the methods for calculating CO_2 emissions from feedstock and other non-energy uses of fossil fuels and other CO_2 emissions from industrial processes, including the allocation to either industrial processes (CRF sector 3) or fuel combustion (CRF sector 1A). The objective of this change was to improve (a) the intransparant emission reporting by industries, both energy consumption and the applied emission factors (ERI/MJV), (b) inconsistencies in individual company emissions in the distinction between combustion and other non-combustion process emissions of CO_2 (amongst others related tot non-energy/feedstock uses of fuels) and the missing corrections of previous years when emission calculation methods or data sources were changed for recent years, (c) the supplemental estimate of CO_2 emissions of product use that was based on (petro)chemical products manufactured in the Netherlands (made from naphtha, aromatics etc. as feedstock), but of which the largest fraction is actually exported, (d) the distinction between national and international shipping and aviation that did not comply with the UNFCCC/IPCC reporting guidelines.

To meet the international calculation and reporting guidelines, all fossil energy-related emissions have been recalculated based on sectoral energy consumption statistics of Statistics Netherlands (CBS) for combustion and non-energy uses of fuels instead of base don individual reports by utilities, refineries and other large industrial companies. For the CO_2 emission factors a list has been compiled of new national default values consisting of documented country-specific factors or IPCC defaults (for details see *Annex 2.1*). These emission factors are used for all fossil fuel emission calculations, including recalculations back to 1990, except where documented plant-specific factors were available.

4.2 Mineral products [2A]

4.2.1 Source category description

This source category consists of the non-key CO_2 sources *'cement clinker production', 'lime production', 'limestone and dolomite use', 'soda ash production'* and *'soda ash use'*, and *'Other'*. Its share of CO_2 emissions in the national greenhouse gas total was 0.5% in 1990 and in the last reported year. Limestone and dolomite used in the production of cement clinker, lime, glass (also soda ash use) and iron and steel are reported separately; the remainder is reported in the '*limestone and dolomite use'* subcategory (2A3). However, CO_2 emissions from lime production, at four locations, have not been estimated due to lack of activity data. Also no CO_2 emissions are reported for asphalt use but these are believed to be negligible.

4.2.2 Methodological issues

For all source categories country-specific methodologies are used. The CO_2 emissions from the source category '*Cement clinker production'* (2A1) are based on (measured) data reported by the one producing company, resulting in a plant-specific emission factor of 0.54 kg/kg clinker. We note that CO_2 emissions from cement production are correlated to clinker production, not cement production. The Netherlands imports a large fraction of the cement clinker used for cement production, so comparison with emission factors based on cement production would give a wrong picture. The clinker ovens also burn some other carbon sources such as anode waste, slate and sludge, of which the carbon oxidation should be reported. Although presently not done, this should be reported under 1A2.

The CO_2 emissions from the source category *Limestone and dolomite use* (2A3) are based on consumption figures for *limestone* use for Flue Gas Desulphurisation (FGD) with a wet process by coal-fired power plants plus apparent *dolomite* consumption which is mostly used for road construction (excluding the amount reported elsewhere, i.e. for liming of agricultural soils, reported under 5C). There are no data for other sources.

The minor emissions from *soda ash production* (2A4), which is produced by one manufacturer in the Netherlands using the Solvay process, are calculated from the non-energy use of coke and assuming 100% oxidation. For *soda use* (2A4) consumption of soda ash could only be calculated from apparent consumption, based on estimated domestic production of 400 Gg/year and reported import and export data from 2001 onwards. These import/export statistics may well be incomplete. Since for prior years these statistics are missing at all, glass production statistics were used to estimate the activity trend in these years.

The CO_2 emissions from the *'Other'* subcategory refer to *glass production*, for which gross glass production data are made available by the industry and a country-specific emission factor was used of 0.16 kg CO_2/ kg glass (uncertainty 20%), which is defined as total non-fossil CO_2 per unit of gross glass production from the use of limestone, dolomite and soda ash and was based on the average calculated from reported emissions for 1990 and 1995-1998 reported by almost all glass industries (ER-I data).

Some sources have not been estimated, notably CO_2 from lime production and from miscellaneous limestone uses, while others are only partly estimated (CO_2 from soda ash use). Also no CO_2 emissions are reported for asphalt use, since methodologies and default factors are not available, but these are believed to be negligible.

Apart from CO_2 emissions from lime production some smaller sources of CO_2 from limestone use may be missing since the available national import statistics are incomplete since the calculated apparent domestic consumption level (= production + import - export) is lower than the already identified uses. However, since older data reported by individual companies suggest that these emissions are very small, these sources are assumed to be negligible. CO_2 emissions from road paving with asphalt and asphalt roofing, not estimated since methodologies and default factors are not available (IPCC, 1997), are assumed to be negligible (i.e. oxidation factor 0%).

Since the emissions are considered to be no key source for CO_2, the present level of methodology does comply with the *IPCC Good Practice Guidance* (IPCC, 2000). A full description of methodology and data sources is provided in the monitoring protocols (Ruyssenaars, 2005).

4.2.3 Uncertainties and time-series consistency

The uncertainty in CO_2 emissions from cement production is estimated to be about 10% in annual emissions; for limestone/dolomite use and other sources an uncertainty of 25% is used, based on the relatively high uncertainty in activity data (see *Section 1.7* for more details). *Table 4.2* provides an overview of the trend in CO_2 emissions from the subcategories cement clinker production, limestone and dolomite use (i.e. FGD and dolomite use not reported elsewhere), soda ash production and use, and other (i.e. glass production). The emissions remained rather constant in this period, because no large structural changes occurred in the activities of these industries.

Table 4.2. Emissions of CO_2 *from mineral products (2A) 1990-2003 (Tg)*

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
2A1. Cement clinker production	0.5	0.5	0.4	0.5	0.5	0.4	0.3	0.4	0.4	0.5	0.5	0.5	0.5	0.4
2A3. Limestone (FGD) and Dolomite Use	0.4	0.5	0.5	0.5	0.7	0.7	0.7	0.6	0.6	0.5	0.6	0.6	0.6	0.6
2A4 Soda Ash production and use	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.1	0.2	0.2	0.2
2A7. Other: Glass production	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total	**1.2**	**1.3**	**1.2**	**1.3**	**1.5**	**1.4**	**1.3**	**1.3**	**1.3**	**1.4**	**1.4**	**1.5**	**1.4**	**1.3**

4.2.4 Source-specific recalculations

Changes were made in reported emissions in 1990 and 1991 for CO_2 for *cement production* (see *Table 4.3*) due to error correction, also in response to the in-country review of the NIR 2004. Other recalculations were made for all years for all other sources except CO_2 from limestone use in FGD (the limestone part of 2A3) (see *Table 4.3*) as part of the inventory improvement programme and in response to previous reviews, which recommended disaggregating the CO_2 sources previously all lumped together under 2D 'Other'. The largest changes in emissions are due to changes in activity data and using well referenced emission factors to comply with IPCC Good Practice, thereby improving the transparency and consistency over time of the emissions.

Table 4.3. Effect of recalculation of emissions of CO_2 *(Tg) from mineral products (2A) due to error correction in clinker production and method/data changes and disaggregation of other sources.*

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
2.A NIR2004	1.1	0.7	0.8	1.1	1.0	1.1	0.9	1.1	1.0	1.0	0.9	1.0	1.4
2.A NIR2005	1.2	1.3	1.2	1.3	1.5	1.4	1.3	1.3	1.3	1.4	1.4	1.5	1.4
Difference	**-0.1**	**-0.6**	**-0.5**	**-0.2**	**-0.4**	**-0.3**	**-0.4**	**-0.2**	**-0.3**	**-0.4**	**-0.5**	**-0.5**	**0.0**

4.2.5 Source-specific planned improvements

Possible future improvement may be adding CO_2 from lime production, if lime production data or capacity estimates become available. Also, if the glass industry starts to report disaggregated data on the use of limestone, dolomite and soda ash, CO_2 estimates can be made more accurately and possible double counting with other source categories (1A3, 1A4) can be avoided.

4.3 Chemical industry [2B]

4.3.1 Source category description

The source category '*Chemical industry'* (2B) consists of four key sources and other non-key sources (see *Box 4.1*). As of this year the category's share of its CO_2 emissions in the national CO_2 total was 2% in 1990 and at present (almost the same in the national greenhouse gas total), primarily stemming from ammonia production (2B1). Other, minor reported CO_2 sources reported under 'Other' (2B5) are the production of so-called industrial gases (e.g., hydrogen, carbon monoxide), carbon electrodes and activated carbon ('norit'). Calcium carbide is not manufactured in the Netherlands. CO_2 from other sources production of silicon carbide, carbon black, ethylene and methanol) are reported elsewhere, in fuel combustion category 1A2c because all feedstock emissions are accounted for in the residual chemical gas resulting from these processes, which are included in the national energy statistics, and thus reported under the energy sector (1A) (see *Section 3.2.3*).

The share the chemical industries' N_2O emissions in the national N_2O total was 46% in 1990 and 42% at present (2.7% in the national greenhouse gas total). The most important industrial non-combustion process in the Netherlands with associated N_2O emissions is nitric acid production; no adipic acid manufacture occurs in the Netherlands. However, in the Netherlands another industrial process source of N_2O was identified and included in this subsector: caprolactam production.

Finally, some negligible CH_4 emissions are calculated for the production of carbides, carbon black, ethylene, dichloro-ethene, styrene and methanol.

4.3.2 Methodological issues

For the CO_2 process emissions from the chemical industry country-specific methodologies are used. Firstly, for the key source CO_2 from ***ammonia production*** (2B1) the emissions are estimated from the amount of natural gas used as feedstock (equivalent to IPCC Tier 1b) and a country-specific emission factor based on a 17% fraction of carbon in the gas-feedstock oxidised during the ammonia manufacture, which was calculated from the carbon not contained in the urea produced (Neelis *et al.*, 2003). The remainder is stored in the urea produced, of which the largest part is exported. Therefore, the Netherlands reports here only the prompt process emissions from the ammonia/urea production process, while the emissions from the use of urea in domestic agricultural activities are reported separately (under category 5C, see *Chapter 7*). It is known that a part of the CO_2 emissions from ammonia production is captured and sold to other industries; however, this has not been taken into account since no sales and purchase figures are publicly available.

Other CO_2 emissions are reported for subcategory **2B5 *Other***, a key source for which country-specific methods and emission factors were used and no IPCC methodologies exist. These refer to the production of:

- ***industrial gases:*** hydrogen and carbon monoxide is produced mainly from natural gas used as chemical feedstock and also from petroleum coke and coke, for which an oxidation fraction of 20% is used based on reported data in MJVs;
- ***carbon electrodes***: mainly produced from petroleum coke and also coke, with a small fraction of 5% oxidised, based on reported data in MJVs;
- ***activated carbon***: Norit is one of world's largest manufacturers of activated carbon, for which peat is used as carbon source. Since peat consumption is not included in national energy statistics, the related CO_2 emissions are calculated from the production of norit and an emission factor derived from the carbon losses from peat uses as reported in MJVs of 1 kg CO_2/kg Norit. Missing production data since 1990 is estimated by used the 2002 production level of 33 Tg. Since the CO_2 emissions are well below 0.1 Tg, the error made will be very small.

A full description of methodology and data sources for all sources in the chemical industry is provided in the monitoring protocol for non-combustion emissions from the chemical industry (Ruyssenaars, 2005).

For N_2O from ***nitric acid production*** (2B2) the IPCC Tier 2 method is used. 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 ER-I part of the Netherlands' *Pollutant Emission Register* (PER). The N_2O emissions from the "Other chemical industry" (mainly ***caprolactam production*** (2B5)) are also based on data reported by the manufacturing industry. These data are also included in PER.
Since for the four key sources for CO_2 and N_2O higher tier (ammonia, nitric acid, caprolactam) or country-specific (industrial gases) methodologies are used, the present methodologies used for the subcategory do comply with the *IPCC Good Practice Guidance* (IPCC, 2000).
For the minor sources of ***CH_4 emissions*** IPCC Tier 1 methodologies and IPCC default emission factors were used.

No CO_2 emissions are reported here for ***silicon carbide production*** (2B4) because all feedstock emissions arise from the combustion of residual chemical gas resulting from these process, of which production and consumption are included in the national energy statistics. The combustion may also be partly outside the chemical industry. Therefore, these CO_2 emissions are calculated as emissions of the combustion of this residual chemical gas. In those cases, following the rule that emissions from all fuel combustion should be reported under the energy sector 1A, these emissions have indeed been allocated there (1A2c, see *Section 3.2.2* for more details). The same holds for the production of ***carbon black, ethylene and methanol*** in the chemical industry, which are not reported under subcategory 2B5, but in the energy sector under fuel combustion (1A1a and 1A2c, see *Sections 3.2.1* and *3.2.2* for more details).

4.3.3 Uncertainties and time-series consistency

In *Table 4.4* an overview is presented of the trend in CO_2 emissions from the chemical industry in the period 1990-2003. The uncertainty in CO_2 emissions from ammonia and other chemicals production is estimated to be about 2% and 70% in annual emissions (see *Section 1.7* for more details).

Table 4.4. Trend in CO_2 emissions from chemical industry processes (2B) (Gg CO_2)

Source	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
2B1. Ammonia production	3058	3446	3503	3407	3561	3527	3339	3511	3567	3543	3566	2996	2871	2686
2B5. Other chemicals	480	413	412	380	415	520	560	517	234	206	218	221	255	248
o.w. Industrial gases	*393*	*322*	*325*	*297*	*325*	*407*	*450*	*435*	*119*	*93*	*92*	*116*	*142*	*141*
o.w. Carbon electrodes	*55*	*58*	*54*	*50*	*58*	*79*	*77*	*49*	*81*	*80*	*93*	*72*	*79*	*74*
o.w. Activated carbon	*33*	*33*	*33*	*33*	*33*	*33*	*33*	*33*	*33*	*33*	*33*	*33*	*33*	*33*
Total	**3538**	**3858**	**3915**	**3787**	**3976**	**4047**	**3899**	**4029**	**3801**	**3749**	**3784**	**3217**	**3126**	**2935**

The trend in CO_2 emissions is generally rather smooth, with a few exceptions. Most interannual variations are likely due to conjunctural changes. For ***ammonia*** production the relative low emissions in 1990 and in 2001-2003 reflect the national energy statistics on non-energy use of natural reported for these activities; in contrast the amount of residual chemical gas combustion is higher in these years, suggesting a compensating effect (see tables in *Section 3.2.3.3*). For ***industrial gases*** production the increase in 1995 and the decrease in 1998 can be explained by the accounting of the combustion of phosphorous oven gas as fuel since 1998, which has an emission factor of 149.5 kg CO_2/GJ. This decreases process emissions and increases the combustion emissions of solids reported in 1A2c with a similar amount. The increase since 2001 is due to the start of using petroleum coke.

In *Table 4.5* an overview is presented of the trend in N_2O emissions from the chemical industry in the period 1990-2003. The uncertainty in N_2O emissions from nitric acid is estimated to be about 50% and caprolactam production is estimated to be about 70% annual emissions (see *Section 1.7* for more details).

Table 4.5. Trend in N_2O emissions from chemical industry processes (2B) (Gg CO_2)

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
B2. Nitric acid production	20.4	20.7	20.9	22.7	21.5	20.3	20.2	20.2	20.1	19.2	19.0	17.2	16.2	16.3
B3. Adipic acid production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
B5. Other	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	3.1
Total	24.4	24.7	24.9	26.7	25.5	24.3	24.2	24.2	24.1	23.2	23.0	21.2	20.2	19.4

NO = Not Occurring.

N_2O emissions from the chemical industry remained rather constant in the 1990-2000 period because no measures were taken to control these emissions. The reduction of 8% in 2001 compared to 2000 was realised by a technical measure applied at one of the ***nitric acid*** plants. Because of a lower production level of the nitric acid plants the emissions in 2002 decreased with 6% compared to 2001. In 2003 the emission kept stable. In 2003 the N_2O emissions from ***caprolactam*** production were 25% lower than in earlier years due to more accurate measurements. The measurements made in the mid '90s are believed to be more representative for the years before 2003 than the new measurement data.

4.3.4 Source-specific recalculations

Major recalculations and allocation improvements were made for the CO_2 sources (and for the minor CH_4 sources) now based on national energy statistics of non-energy uses of fuels and on production and combustion of chemical waste gas, that were previously based on individual company reports, the MJVs (the part of the national pollutant emission register called 'ER-I') *and* where were previously all reported as fuel combustion under the energy sector (see *Section 1.2*). As a consequence, consistency over time of CO_2 and CH_4 emissions at subcategory level has been substantially improved, as well as transparency and the source allocation. The largest changes in emissions are due to:

- a change in CO_2 emissions from ammonia production (change in method by using activity data (non-energy use of natural gas) from national energy statistics);
- reporting of (mostly indirect) CO_2 emissions from the use of fossil-fuel containing products such as solvents separately (in Sector 3). In previous submissions the indirect emissions were based on non-energy use statistics and a fuel-specific oxidation factor and reported under fuel combustion (sector 1A).

These changes were made as part of the inventory improvement programme and also in response to previous reviews requesting to report industrial process emissions in the correct IPCC subcategory (see *Section 3.2.7* and *Chapter 9*).

4.4 Metal production [2C]

4.4.1 Source category description

The category '*Metal production'* (2C) consists of three source categories all specified as key sources in *Box 4.1*: the net CO_2 process emissions from the iron and steel industry (i.e. from carbon inputs in blast furnaces and oxygen furnaces) and both CO_2 and PFCs from primary aluminium production (i.e. CO_2 consumption of anodes and by-product emissions of CF_4 and C_2F_6). The Netherlands has one integrated iron and steel plant (Corus-IJmuiden, previously named Hoogovens) and two primary aluminium smelters (Pechiney and Aldel); the Netherlands has no ferroalloys production nor magnesium foundries (or aluminium foundries, that could use SF_6 as cover gas). Corus sells part its coke oven gas and blast/oxygen furnace gas produced to a nearby power plant.

The share of CO_2 emission from the iron and steel industry and the primary aluminium production in the national total of CO_2 was 1.8% in 1990 and 1.1% (0.9% in the national total greenhouse gas emissions) in the last reported year. The share of PFC emissions from primary aluminium production in the national total of F-gases was 34% in 1990 and 33% (0.5% in the national total greenhouse gas emissions) in the last reported year.

4.4.2 Methodological issues

CO_2 from iron and steel production (2C1)

CO_2 emissions are calculated for the carbon losses from coke and coal input used as reducing agent in blast and oxygen furnaces are calculated using a Tier 2 IPCC method and country-specific carbon contents of the fuels, thus also 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):

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

$$CO_2 \text{ from additional carbon inputs} = [\text{C inputs (in ton)} * \text{MF (limestone)}] * EF_{limestone} \quad (1b)$$

$$CO_2 \text{ from iron ore} = (Frac_{C,iron\ ore} * \text{ore consumption} - Frac_{C,crude\ steel} * \text{crude steel production}) * 44/12 \quad (1c)$$

Please note the CO_2 emissions from the production of coke is reported in sector 1B; the amount of coke and coal inputs here only relate to iron and steel making. The Netherlands uses the same emission factors for blast furnace (BF) gas and oxygen furnace (OF) gas (see *Annex 2.1*). Since Corus does not report the specific materials used as additional carbon (limestone and others), a multiplication factor (MF) was used to convert this C into amounts of pure limestone-eq. (MF = Molecular weight of limestone/Mol weight of C). In the calculation for CO_2 from the C fractions in ore and crude steel, both the C content in the amount of pig iron purchased (i.e. not on-site produced) and produced is very small or nil, respectively, it therefore it could be neglected in the overall calculation. Thus, this higher tier method essentially complies with IPCC Good Practice (IPCC, 2000).

Only the net carbon losses are reported in subcategory 2C1, i.e. not the carbon contained in the blast furnace gas and oxygen furnace gas produced as by-products and subsequently used as fuels for energy purposes (in the Netherlands in the steel industry and by electrical utilities). The carbon contained in the blast furnace and oxygen furnace gas produced is subtracted from the carbon balance calculation since the production and consumption of these gases are all included in the national energy statistics and since they are partly used outside the steel industry. These combustion emissions are therefore reported in the energy sector (1A1a and 1A2a, see *Sections 3.2.2 and 3.2.3*), following the rule that emissions from all fuel combustion are reported in the energy sector 1A.

For years prior to 2000 the latter two contributions are calculated from the data reported in the annual environmental reports by Corus for 2000 to 2002. The amount of additional carbon was calculated from the average consumption in 2000-2002 of these other C inputs per ton of crude steel produced. A similar calculation was made for the CO_2 from the C fractions in ore and crude steel (see *Table 4.6*).

Table 4.6. Factors used for calculating CO_2 emissions from iron and steel production.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Data for 2000-2002 1)														
- C in iron ore(% m)											*0.12%*	*0.18%*	*0.19%*	
- C in pig iron purchased (%m)											*5.9%*	*4.7%*	*4.7%*	
- C in steel scrap (%m)											*0.10%*	*0.10%*	*0.10%*	
- C in steel produced (%m)											*0.55%*	*0.58%*	*0.54%*	
- C inputs/crude steel (%m)											*1.5%*	*1.4%*	*1.5%*	
C losses/crude steel (inputs – products) (kg/Mg) 2)	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	2.3	1.6	2.2	3.0	2.3
Additional C inputs/crude steel (kg C /Mg) 3)	13.1	13.1	12.8	12.9	12.6	12.4	12.4	12.3	12.3	12.3	12.2	12.3	12.3	12.4

1) Data from Corus MJVs, 2000-2002. Used for calculation calculating the terms in equations (1b) and (1c) for 1990-1999.
2) Carbon in iron ore (plus steel scrap and purchased pig iron) minus carbon in net crude steel produced; figures vary due to rounding.
3) Limestone and other additional non-fossil carbon inputs; figures vary due to rounding.

CO_2 from aluminium production (2C3)

For the CO_2 emissions from the anodes used for primary aluminium production, the Tier 1a IPCC method is now used, which is based on aluminium production as activity data. From the reaction $Al_2O_3 + 3/2C \rightarrow 2Al + 3/2\ CO_2$, the stoichiometric ratio of carbon needed to reduce the aluminium ore to pure aluminium can be used to calculate the IPCC default emission factor. This factor was corrected to include the additional CO_2 produced in practice by the reaction of the carbon anode with oxygen in the air. The emission factor used of 1.45 kg CO_2/ton aluminium (uncertainty 5%) was picked from the range of the IPCC factor of 1.5 and the factor of 1.43 calculated by the *World Business Council for Sustainable Development (*WBCSD) (WBCSD/WRI, 2004). The Tier 1b method based on the amount of carbon consumed in the anodes, which are produced from petcoke, could not be applied since this data is not publicly available. Also non-energy use of petcoke is not a good choice for activity data since one anode manufacturer exports part of its products (CO_2 from anode production is reported in category 2B5 (see *Section 4.3*).

PFCs from aluminium production (2C3)

For reporting key source PFC emissions from primary aluminium the two producers used the IPCC Tier 2 method for the complete period 1990-2003 with emission factors from measured data. The largest producer produces about 2/3 of the national total. Both producers used the Side Work Prebake (SWPB) technology, but one of them switched from side feed to point feed technology (PFPB) in 1998 and the other in 2003 (see *Table 4.7*). Since the emissions are considered to be a key source for PFCs, the present higher tier methodologies do comply with the *IPCC Good Practice Guidance* (IPCC, 2000). A full description of the methodology is provided in the monitoring procotol for this source category (Ruyssenaars, 2005).

Table 4.7. Implied CF_4 and C_2F_6 emission factors for aluminium production (kg/Tg) (2C3)

Gas	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
CF_4	1.03	1.05	1.07	1.10	1.11	1.10	1.15	1.20	0.82	0.53	0.60	0.59	0.59	0.57
C_2F_6	0.11	0.11	0.11	0.12	0.12	0.12	0.12	0.13	0.08	0.12	0.06	0.06	0.06	0.06
Ratio	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%	10.6%	10.6%	10.3%	23.0%	10.0%	10.0%	10.0%	10.0%

4.4.3 Uncertainties and time-series consistency

In *Table 4.8* an overview is presented of the trend in CO_2 emissions from the iron and steel industry and the primary aluminium production in the period 1990-2003. The interannual variation of CO_2 emissions from steel production is influenced by the accuracy of accounting the blast furnace and oxygen furnace gas produced, of which the carbon contents is subtracted from the process emissions reported here. The net carbon losses calculated here vary inversely with amounts of by-product gases captured.

Table 4.8. Emissions of CO_2 from metal production (2C) (Tg)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
2C1. Iron and Steel Production	2.5	2.2	1.6	1.6	1.9	1.9	1.8	2.1	1.7	1.6	1.3	1.3	1.4	1.6
2C3. Aluminium production	0.4	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4
Total	**2.9**	**2.5**	**2.0**	**1.9**	**2.2**	**2.2**	**2.1**	**2.4**	**2.1**	**2.0**	**1.8**	**1.7**	**1.8**	**2.0**

Therefore, to show the consistency of total CO_2 emissions from iron and steel production, in *Table 4.9* total CO_2 emissions from steel production (including combustion emissions from on-site coke production) is presented as well as the total CO_2/kton steel index. The trend of total emissions follows the production index quite closely, the interannual variation being affected by efficiency improvements and stock changes.

Table 4.9. Total CO_2 emissions from iron and steel production (process and combustion) (excl. CO_2 losses in coke ovens) (Tg) and total CO_2/kton steel produced.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Fuel combustion (1A1a) [1)]	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
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
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*
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*
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*
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**	**5.5**	**5.9**
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
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

1) Including fuel combustion for on-site coke production.
2) Excluding carbon contained in blast furnace gas and oxygen furnace gas.

In *Table 4.10* an overview of the trend in PFC emissions from primary aluminium industry during the period 1990-2003 is given. These emissions decreased by about 30% during the period 1995-2001. Switching from side feed to point feed in 1998 at one of the producing companies is the main cause. Interannual changes of about 10% can be observed, which relate to variations in annual production levels.

The uncertainty of annual CO_2 emissions is estimated at about 5% for iron and steel production and for aluminium production, whereas the uncertainty in PFC emissions from aluminium production is estimated to be about 25% (see *Section 1.7* for more details.

Table 4.10. Actual PFC emissions per compound from aluminium production (2C3) 1990-2003 (Gg CO_2-eq.)

Compound	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CF_4 (PFC-14)	1826	1805	1638	1652	1585	1540	1698	1807	1412	998	1170	1118	1093	1054
C_2F_6 (PFC-116)	271	268	244	247	237	230	254	271	206	326	166	159	155	150
PFC total	2097	2074	1881	1899	1822	1769	1952	2078	1618	1323	1336	1276	1249	1204

4.4.4 Source-specific recalculations

This year the CO_2 process emissions from the iron and steel industry (i.e. from carbon inputs in blast furnaces and oxygen furnaces) and from primary aluminium production (consumption of anodes (= carbon electrodes)) have been recalculated and are now reported separately in this source category. Previously, these emissions were based on data by the individual companies and reported in their MJVs (the part of the national pollutant emission register called 'ER-I') *and* where were previously included in the fuel combustion emissions reported in the energy sector, except for all emissions from solid fuels in steel production which were reported as proxy for the process emissions (see *Section 1.2*). As a consequence, consistency over time of CO_2 and CH_4 emissions at subcategory level has been substantially improved, as well as transparency and the source allocation. Thus, the changes in CO_2 emissions are to a change in methodology and allocation for iron and steel aluminium production. These changes were made as part of the inventory improvement programme and also in response to previous reviews requesting to report industrial process emissions in the correct IPCC subcategory (see *Section 3.2.7* and *Chapter 9*).

In addition, because a complete new time series of plant-specific activity data became available via MJVs, the emissions of PFCs from the primary aluminium production from 1990 onwards have been recalculated (see *Table 4.11*).

Table 4.11. Effects of recalculation of PFCs from the primary aluminium production (2C) 1990-2002 (in Gg).

		1990	1991	1992	1993	1994	1995 *	1996	1997	1998	1999	2000	2001	2002
PFCs	NIR2005	2097	2074	1881	1899	1822	1769	1952	2078	1618	1323	1336	1276	1249
	NIR2004	2398	2398	2054	2067	1832	1799	1964	2065	1625	1326	1390	1322	1041
	Difference	**-301**	**-324**	**-173**	**-168**	**-10**	**-30**	**-12**	**13**	**-7**	**-3**	**54**	**-46**	**208**

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

4.5 Food and drink production [2D]

4.5.1 Source category description

The category '*Food and drink production'* (2D) consists only of one non-key source of CO_2 (see *Box 4.1*). This very small source of CO_2 (less than 0.1 Gg CO_2, see *Table 4.1*) refers to the non-energy use of fuels, i.e.coke for whitening of sugar, of which the carbon is oxidised.

4.5.2 Methodological issues

These CO_2 emissions are now calculated from non-energy use of fuels by the food and drink industry as included in the national energy statistics and the emission factor is based on the national default carbon contents of the fuels (see *Annex 2.1*) and assuming that the carbon is fully oxidised to CO_2.

4.5.3 Uncertainties and time-series consistency

In *Table 4.1* the trend in the very minor CO_2 emissions from the food and drink industry is presented for the period 1990-2003 in rounded figures. Since the emissions are varying around 0.05 Gg, the rounded values are either 0.1 or 0.0 Gg. The uncertainty is estimated at about 5%.

4.5.4 Source-specific recalculations

Previously, these emissions were based on data by the individual companies and reported elsewhere, either as part of the fuel combustion emissions or as miscellaneous industrial process emissions (2G), but these non-combustion emissions were often not well identified nor described, i.e. lacking transparency and consistency. The present method complies with *IPCC Good Practice*.

4.6 Production of halocarbons and SF6 [2E]

4.6.1 Source category description

The subsector '*Production of halocarbons and SF_6*' (2E) consists of two sources, by-product HFC-23 emissions from HCFC-22 manufacture, identified as key source in *Box 4.1* and *handling* emissions of HFCs. The share of HFC emissions from production of halocarbons and SF_6 (2E) in total F-gas emissions was 70% in the base year 1995 and 19% (0.2% in the national total greenhouse gas emissions) in 2003.

4.6.2 Methodological issues

For source category '*HFC-23 emissions from HCFC-22 manufacture'* the IPCC Tier 2 method is used. Since these emissions are a key source for F-gases, the present methodology complies with the *IPCC Good Practice Guidance* (IPCC, 2000). For the *handling* emissions of HFCs country-specific methodologies are used, based on emissions data reported by the manufacturing and sales companies. A full description of the methodology is provided in Spakman *et al.* (2003).

4.6.3 Uncertainties and time-series consistency

The uncertainty in HFC emissions from HCFC-22 production is estimated to be about 22% in annual emissions (see *Section 1.7* for more details). *Table 4.12* provides an overview of the trend in HFC emissions from the subcategories HCFC-22 production and HFCs from handling for the 1990-2003 period. Due to an increase of production in the 1995-1998 period, the emissions of HFC-23 from the HCFC-22 manufacture increased by 35% However, in the 1998-2000 period, the emission of HFC-23 from the HCFC-22 manufacture decreased by 69% because a thermal afterburner was installed.

Table 4.12. Trend in HFC-23 by-product emissions from HCFC-22 manufacture and HFC emissions from handling (2E) (Gg CO_2-eq.).

Compound	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
HFC-23	4432	3452	4423	4947	6278	5759	6887	6709	7791	3440	2421	450	685	460
E.3.Other HFCs	0	0	24	51	129	12	223	707	519	385	417	191	97	100
HFC total	4432	3452	4447	4998	6407	5771	7110	7416	8310	3825	2838	641	782	560

A reduction of 80% in 2001 compared to 2000 was realised by an increase of the operation time of the thermal afterburner (95% in 2001 compared to 84% in 2000). Because of a lower operation time of the thermal after-burner (93.6% in 2002 compared to 95% in 2001) the emission increased by 52% in 2002. The decrease of emission by 33% in 2003 was mainly caused by a lower production level. The large inter-annual variation of handling emissions can be explained by variation in handling activities.

4.7 Consumption of halocarbons and SF6 [2F]

4.7.1 Source category description

The subsector consumption of halocarbons and SF_6 (2F) consists of the source categories specified as key or non-key source in *Box 4.2.* The share of HFC emissions from consumption of HFCs, PFCs and SF_6 (subcategory 2F) in the national total F-gas emissions was 7% in the base year 1995 and presently 45% (0.7% in the national total greenhouse gas emissions). The subsources of the consumption source categories are presented in *Box 4.2.*

Box 4.2. Subsources of HFCs, PFCs and SF_6 emissions and calculation methods

Source category	**Subsource**	**Calculation method**
HFC emissions from substitutes for ODS-substitutes	2F1 Stationary refrigeration	country-specific
	2F1 Mobile air conditioning	country-specific
	2F4 Aerosols	IPCC Tier 2
PFC emissions from PFC use	2F6 Semiconductor manufacturing	IPCC Tier 2c
SF_6 emissions from SF_6 use	2F7 Semiconductor manufacturing	IPCC Tier 2c
	2F6 Electrical equipment	country-specific
	2F8 Sound-proof windows	country-specific
	2F8 Electron microscopes	country-specific

4.7.2 Methodological issues

The type of methods used to calculate the emissions from HFC, PFC and SF_6 consumption are presented in *Box 4.2*. The country-specific methods for HFC and SF_6 emissions are equivalent to IPCC Tier 2. A full description of the country-specific methods is provided in Spakman *et al.* (2003) and in the monitoring protocol (Ruyssenaars, 2005). Since HFC emissions from the use of these substances are considered to be key sources (see Box *4.1*), the use of higher tier methodologies does comply with the *IPCC Good Practice Guidance* (IPCC, 2000).

4.7.3 Uncertainties and time-series consistency

The uncertainty in HFC emissions from HFC consumption is estimated to be about 50% in annual emissions (see *Section 1.7* for more details).

Trends in *actual* emissions from 1990 onwards are presented in *Table 4.13,* whereas *potential emissions* (or so-called *apparent consumption*) are shown in *Table 4.14.* It shows that HFC emissions are a factor of 3 higher in 2002 than in 1995, largely because of an increase in HFC consumption – in particular of HFC-134a – as a substitute for (H)CFC use (see *Table 4.13*). The sometimes large inter-annual variation of consumption and emissions of some sources can be explained by the variation in production levels of specific industries and service sectors. In the period 1995-2003 the actual emissions of SF_6 remained almost constant.

Table 4.13. Actual emission trends per compound from the use of HFCs, PFCs and SF6 (2F) (Gg CO2-eq.).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
HFC-134a	0	0	0	0	111	224	494	771	892	893	783	556	420	421
HFC-143a	0	0	0	0	0	6	26	48	68	73	106	143	179	255
HFC-125	0	0	0	0	0	7	25	43	57	60	87	119	149	175
HFC-152a	0	0	0	0	0	0	0	0	0	0	0	0	0	0
HFC-32	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other HFC's [1)]	0	0	0	0	0	2	9	16	21	18	25	32	36	38
HFC Total	0	0	0	0	111	240	554	879	1038	1044	1001	851	784	890
PFC use [2)]	18	21	24	28	32	37	49	99	111	142	185	141	167	192
SF_6 use	217	134	143	150	191	301	312	345	329	317	335	357	359	334
Total HFC/PFC/SF_6	**236**	**155**	**167**	**178**	**334**	**578**	**916**	**1323**	**1478**	**1503**	**1521**	**1348**	**1310**	**1417**

[1)] Average GWP of other HFCs: 3000.
[2)] Average GWP of other PFCs: 8400.

Table 4.14. Potential emission trends per compound from the use of HFCs, PFCs and SF_6 (Gg CO_2-eq.).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
HFC-134a	0	0	0	0	289	590	1187	1398	1365	1386	1011	702	689	689
HFC-143a	0	0	0	0	0	129	315	350	456	642	828	828	828	828
HFC-125	0	0	0	0	0	140	286	274	333	543	655	753	840	840
HFC (unspecified)	0	0	0	0	0	69	168	96	123	45	249	99	99	99
HFC total	0	0	0	0	289	928	1956	2118	2277	2616	2744	2383	2456	2456
PFC use	C	C	C	C	C	C	C	C	C	C	C	C	C	C
SF_6 use	C	C	C	C	C	C	C	C	C	C	C	C	C	C
Total HFC/PFC/SF_6 [1)]	**0**	**0**	**0**	**0**	**289**	**928**	**1956**	**2118**	**2277**	**2616**	**2744**	**2383**	**2456**	**2456**

Note: C = Confidential Business Information.
1) Only HFCs are included in the F-gas total of potential emissions due to confidentiality of PFC and SF_6 use.

4.7.4 Source-specific recalculations

Actual emissions of PFCs for 1996 onwards have been recalculated due to more detailed information on the use of PFCs in semiconductor manufacturing (see *Table 4.15*). Also actual emissions of HFCs for 1994 onwards have been slightly revised as more detailed information on the use of HFCs in stationary refrigeration and mobile air-conditioning became available.

Table 4.15. Effects of recalculation of HFC and PFC emissions (2F) 1990-2002 (in Gg).

		1990	1991	1992	1993	1994	1995 *	1996	1997	1998	1999	2000	2001	2002
HFCs	NIR2005	0	0	0	0	111	240	554	879	1,038	1,044	1,001	851	784
	NIR2004					80	248	565	891	1051	1097	1040	865	790
	Difference	**0**	**0**	**0**	**0**	**31**	**-8**	**-11**	**-12**	**-13**	**-53**	**-39**	**-14**	**-6**
PFCs	NIR2005	18	21	24	28	32	37	49	99	111	142	185	141	167
	NIR2004	18	21	24	28	32	37	50	100	113	145	187	160	160
	Difference	**0**	**0**	**0**	**0**	**0**	**0**	**-1**	**-1**	**-2**	**-3**	**-2**	**-19**	**7**
SF6	NIR2005	217	134	143	150	191	301	312	345	329	317	335	357	359
	NIR2004	217	134	143	150	191	301	312	345	329	317	335	356	344
	Difference	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**15**

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

4.8 Other industrial processes [2G]

4.8.1 Source category description

This miscellaneous category now consists of the following sources, of which the N_2O source is identified as key source (see *Box 4.1)*:

- CO_2 emissions from miscellaneous non-energy fossil fuel product uses, mainly lubricants and waxes (about 0.2 Tg);
- CH_4 emissions from degassing of drinking water that contains some methane;
- Indirect N_2O emissions from deposition of NO_x and NH_3 emitted by domestic non-agricultural sources;
- Candles and fireworks, two tiny sources of CO_2, CH_4, N_2O, which showed a 'peak' in 1999 because of the millennium celebrations, also reported here.

Feedstock uses of fuels that cause CO_2 emissions are included in categories 2B (chemical industry) and 2C (metal production), whereas indirect CO_2 emissions from the use of fossil-fuel containing products such as solvents are reported in sector 3. The only part of CO_2 emissions from non-energy/feedstock uses of fuels that is not covered is reported here: the direct use of specific fuels for non-energy purposes, which results in partial or full *Oxidation During Use* (ODU) of the carbon contained, i.e. lubricants, waxes and other fuels.

The main non-agricultural source of NO_x emissions in the Netherlands is transport, with a share of 2/3, with minor sources being combustion for power generation and by the manufacturing industry; presently the largest source of non-agricultural NH_3 is the residential sector (mainly humans and their pets); in 1990 the chemical industry of similar size as the residential sector.

4.8.2 Methodological issues

For CO_2 from ***lubricants*** we assume an ODU factor of 50% (the IPCC default value in the Reference Approach), for ***waxes*** we assume 100% oxidation. No other fuels are included here, since we assume 0% oxidation for bitumen (IPCC default), coal derivatives used by 'other consumers', coal tars (no emissions occurring) and 100% for mineral turpentine, but these included elsewhere (indirect CO_2 of solvent use in sector 3).

The CH_4 sources consist mainly of ***degassing of drinking water***, for which a country-specific methodology and emission factor is used. In addition, the very small sector 3 sources of methane, which cannot be reported there in the CRF, are reported here (candles and fireworks). For this reason, also the negligible N_2O emissions from the latter source are reported here.

The Netherlands uses the Tier 1b method for estimating ***indirect N_2O emissions*** from deposition of nitrogen from domestic anthropogenic sources of N_2O, NO_x and NH_3, including emissions from other source sectors than agriculture. Here we report the indirect N_2O emissions from non-agricultural sources of NO_x and NH_3 (non-agri sources of N_2O were neglected because of their negligible size), using the same IPCC methodology as described for indirect N_2O emissions from soils (category 4D, see *Section 6.5*). The activity data are the emissions as reported for the Netherlands in RIVM's annual *Environmental Balance* (see *Annex 7.4*), mainly combustion emissions of NO_x and combustion and process emissions of NH_3.

A full description of the methodology for all sources is provided in the monitoring protocols (Ruyssenaars, 2005).

4.8.3 Uncertainties and time-series consistency

The uncertainty of CO_2 emissions is this sector is estimated at about 50%, 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 often is the result of the subtraction of two or three very large numbers (production, import and export). The uncertainty in the CH_4 emissions is also estimated at about 50%. The indirect N_2O emissions are by the nature of the methodology and default IPCC emission factors used very uncertain, currently estimated to be more than a factor of 2 in annual emissions.

The very small CO_2 and CH_4 emissions remained rather constant in the 1990-2003 period, whereas the indirect N_2O from deposition of NO_x decreased by almost 30% in this period, mainly due to a decrease in NO_x emissions from combustion in road transport, power generation and the manufacturing industry (see *Table 4.16* and *Table A7.35* in *Annex 7.4*).

Table 4.16. Trend in emissions from'Other industrial processes' (2G) 1990-2003 (CO_2 *in Tg; others in Gg)*

Gas/Subcategory	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2 – 2G	0.3	0.2	0.3	0.2	0.2	0.5	0.5	0.5	0.4	0.5	0.6	0.4	0.4	0.4
CH_4 – 2G [1)]	2.0	2.0	2.0	1.9	2.0	2.0	2.0	2.0	1.9	1.9	1.9	1.8	1.8	1.8
N_2O – 2G	3.0	3.0	3.0	2.8	2.7	2.7	2.6	2.4	2.4	2.4	2.3	2.3	2.3	2.3
G1. Indirect N_2O from NO_x	*2.8*	*2.8*	*2.8*	*2.7*	*2.5*	*2.5*	*2.4*	*2.2*	*2.2*	*2.2*	*2.1*	*2.1*	*2.1*	*2.1*
o.w. from transport	*1.8*	*1.8*	*1.7*	*1.7*	*1.6*	*1.6*	*1.5*	*1.5*	*1.5*	*1.5*	*1.5*	*1.4*	*1.4*	*1.4*
G2. Indirect N_2O from NH_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*	*0.2*
G3. Candles and fireworks	*0.01*	*0.01*	*0.02*	*0.01*	*0.02*	*0.02*	*0.02*	*0.02*	*0.02*	*0.03*	*0.02*	*0.02*	*0.02*	*0.02*

[1)] From ground water (degassing of drinking water).

The CO_2 emissions refer to the remaining non-energy use of fuels recorded in the national energy statistics that have not been accounted for in other source categories 2A to 2D nor incorporated in combustion emissions of by-product fuel gases reported in category 1A. From *Table 4.17*, which lists these uses, it shows that lubricants, waxes and mineral turpentine are indeed the largest contributors. The very small uses of other fuels comprise incidental uses in particular years of e.g. additives for lubricants, LPG, coal tar and heavy fuel oil. Since the latter use cannot be associated with specific activities of which the nature is clear, no specific ODU factor could be determined and thus 0% oxidation was assumed.

Table 4.17. Sources of non-energy use CO_2 emissions in 'Other industrial processes' (2G)

Fuel type / unit	ODU factor	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Non-energy use (PJ)															
Lubricants and greases	0.5	5.4	6.8	7.5	5.8	6.2	7.7	7.5	7.0	7.6	7.7	7.2	7.1	7.5	6.8
Paraffin waxes	1.0	1.5	ND	ND	ND	ND	2.6	2.7	2.8	2.1	3.2	4.2	2.0	1.8	1.8
Mineral turpentine	1.0	4.0	ND	ND	ND	ND	3.4	3.9	4.4	3.8	3.4	2.8	2.3	3.0	3.4
Other fuels	1.0	4.0	ND	ND	ND	ND	0.0	1.4	1.1	1.7	0.7	0.0	0.1	1.0	0.1
CO_2 emissions (Tg)	**C content (kgC/GJ)**														
Lubricants and greases	20.0	0.20	0.25	0.27	0.21	0.23	0.28	0.27	0.26	0.28	0.28	0.27	0.26	0.27	0.25
Paraffin waxes	20.0	0.11	ND	ND	ND	ND	0.19	0.20	0.20	0.16	0.24	0.31	0.15	0.13	0.13
Mineral turpentine [1)]	20.0	0.29	ND	ND	ND	ND	0.25	0.28	0.32	0.28	0.25	0.21	0.17	0.22	0.25
Other fuels	20.0	0.29	ND	ND	ND	ND	0.00	0.10	0.08	0.12	0.05	0.00	0.01	0.07	0.01

ND = No detailed Data
[1)] Included elsewhere (Sector 3).

4.8.4 Source-specific recalculations

In the previous NIR 2004 this source category comprised CO_2 from 'Flue gas desulphurisation', now reallocated to category 2A as requested by the IPCC reporting guidelines, and miscellaneous industrial process emissions CO_2 emissions based on data provided by the individual companies in their annual environmental report. However, these latter non-combustion emissions were often not well identified nor described, i.e. lacking transparency and consistency. The present method for these non-key sources complies with *IPCC Good Practice*.

The CH_4 source categories '*degassing of drinking water*' and '*candles and fireworks*' were previously reported under sector 7, since the CRF does not allow reporting non-industrial non-combustion sources of methane there. However, in response to the last in-country review, we have reallocated these emissions to this category 2G.

Major changes were made in the methodology for estimating indirect N_2O emissions to comply with *IPCC Good Practice* for the IPCC source definition and methodology for N_2O from atmospheric deposition. These changes included splitting indirect N_2O from agricultural sources – reported in sector 4 – and from non-agricultural sources. The latter were previously calculation by a much different, country-specific method and reported as '*N_2O from polluted surface water*' in sector 7. Both methodological and allocation changes were made as part of the inventory improvement programme and in response to previous UNFCCC reviews (see *Table 4.18*). The emissions data used for the calculation are those reported previously. Presently, the NO_x emissions have been recalculated (see Chapter 2), and are now about 10% lower than the emissions now used as activity data.

Table 4.18. Non-agricultural emissions of NO_x and NH_3 used to calculate indirect N_2O emissions from these sources (in Gg)

Gas/Subcategory	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
NO_x (in Gg)	**595**	**586**	**579**	**554**	**530**	**515**	**500**	**469**	**461**	**463**	**447**	**436**	**430**	**430**
o.w. 2G1. Energy	99	97	97	93	82	82	72	64	59	69	65	58	59	59
o.w. 2G1. Industry	80	74	74	68	65	57	64	53	50	40	35	37	36	36
o.w. 2G1. Transport	375	371	365	347	341	329	319	314	313	310	303	294	288	288
o.w. 2G1. Other sectors	41	45	42	46	42	48	46	38	38	44	44	47	47	47
NH_3 (in Gg)	**13**	**13**	**13**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**	**14**
o.w. 2G2. Energy/Industry	5					4					3		3	3
o.w. 2G2. Transport	7					8					8		8	8
o.w. 2G2. Other sectors	13	13	13	14	14	14	14	14	14	14	14	14	14	14

5. SOLVENT AND OTHER PRODUCT USE [CRF sector 3]

Major changes in Solvents sector compared to previous National Inventory Report

Emissions: Indirect CO_2 emissions from solvents and other product use (0.3 to 0.2 Tg in 1990-2003), have now been calculated from NMVOC emissions and the carbon contents of the NMVOC.

Methodologies: The methodology of calculating indirect CO_2 emissions related to NMVOC emissions from solvents and other product use, as *Oxidation During Use* (ODU) of fossil-carbon containing products is part of the complete revision of the methodology for estimating and reporting CO_2 emissions from feedstock and non-energy use of fossil fuels, of which actual, prompt emissions during manufacture are estimated in sector 2 and the emissions from domestic use of these chemical products are estimated in sector 3.

5.1 Overview of sector

In this sector the minor indirect emissions of CO_2 related to NMVOC from the use of solvents and other fossil-carbon containing products are reported. The use of these (petro)chemical product are now based on domestic use of these products instead of based on the amounts produced in the Netherlands. In addition, some N_2O emissions are reported originating from the use of N_2O as anaesthesia and as a propelling agent in aerosol tins, such as those used for whipped cream.

Please note that this sector comprises all *non-combustion* emissions from other sectors than the manufacturing and energy industry. There is, however, one exception. Emissions from the use of the F-gases, HFCs, PFCs and SF_6 are all reported under source category 2 '*Industrial processes'*, according to the IPCC reporting guidelines (thus including use in the residential and commercial sectors).

The trends in greenhouse gas emissions from this sector are summarised in Table *5.1*. In 2003 emissions from the Solvent and Other Product Use sector contributed only 0.1% of total national emissions (without LUCF), compared with 0.3% in 1990. Indirect emissions of CO_2 and N_2O for dispersive uses accounted for 64% and 36% of CO_2 equivalent emissions from the sector, respectively. We note that direct non-energy use of fuels (e.g. lubricants, waxes, etc.) are not reported in this category but are included in the industrial process emissions reported under the other subcategory (2G).

Table 5.1. Trends in greenhouse gas emissions from solvents and other product use (category 3) (CO_2 in Tg; others in Gg)

Gas/sub-source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2	**0.32**	**0.24**	**0.22**	**0.21**	**0.21**	**0.24**	**0.19**	**0.17**	**0.19**	**0.20**	**0.17**	**0.16**	**0.16**	**0.16**
3A. Paint application	0.21	0.14	0.12	0.12	0.13	0.16	0.12	0.10	0.11	0.12	0.10	0.09	0.09	0.09
3B. Degreasing and dry cleaning	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3C. Chemical products, manuf. & proc.	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3D. Other	0.10	0.10	0.09	0.09	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07
CH_4														
Included in category 2G [1)]	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
N_2O														
3A. Paint application	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3B. Degreasing and dry cleaning	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3D. Other	**0.7**	**0.7**	**0.7**	**0.7**	**0.7**	**0.6**	**0.6**	**0.6**	**0.5**	**0.5**	**0.4**	**0.4**	**0.3**	**0.3**
- Use of N_2O for anaesthesia	0.65	0.65	0.65	0.60	0.56	0.51	0.47	0.42	0.37	0.36	0.33	0.26	0.20	0.20
- N_2O from aerosol cans	0.08	0.08	0.08	0.10	0.10	0.13	0.15	0.14	0.15	0.14	0.12	0.09	0.09	0.09

[1)] Methane emissions from solvents and other products, although very small, have been reported under IPCC sector 2G ('*Other'*), since CRF emission tables for category 3 erroneously do not allow for methane to be reported here.

From 1990 to 2003, emissions of the sector declined by 54%, and from 2002 to 2003 they decreased by 0.6%. CO_2 emissions from the sector decreased by almost 50% from 1990 to 2003, mainly due to decreasing indirect emissions, in particular from paints, due to the emission reduction programme for NMVOC. N_2O emissions fell by 60% from 1990 to 2003 due to better dosing of anaesthesia and decreasing use of N_2O in spray tins.

The emissions from '*Solvent and other product use*' (category 3) should also be discussed in conjunction with (very small) methane emissions reported under category 2G, since the IPCC tables do not allow for methane emissions under category 3.

Box 5.1 lists the sub-sources in this category, which are characterised as non-key sources. The share of CO_2 and N_2O emissions in the national total is negligible (about 0.1%). The most important sub-sources in category 3 are, relatively speaking, indirect CO_2 from paints and the use of N_2O as an anaesthetic gas in hospitals.

Box 5.1. Key source identification for solvent and other product use using the IPCC Tier 1 and 2 approach (L = Level, T = Trend)

3.	CO_2	Indirect CO_2 from solvents/product use	Non-Key
3.	*CH_4*	*Solvents and other product use (IE, reported under 2G)*	*Non-key*
3D.	N_2O	Misc. N_2O; component in category 3:	Non-Key

5.1.1 Source category description

IPCC Sector 3 '*Solvents and other product use'* consists of the following subsources:

- Indirect CO_2 from solvents and other product use (related to NMVOC emissions) (3A, 3B, 3D);
- Use of N_2O for anaesthesia (3D);
- N_2O from aerosol tins (3D).

In addition, some minor sources of CH_4 emissions from non-industrial, non-combustion sources have been included in the Netherlands' inventory, but these are reported under category 2G '*Other*'. This is because CRF emission tables for category 3 erroneously do not allow for methane to be reported here.

5.1.2 Methodological issues

Country-specific carbon contents of the NMVOC emissions from ***Paints*** (3A), ***Degreasing and Dry Cleaning*** (3B) and ***Other product use*** (3D) have been used as well as country-specific methods for estimating NMVOC emissions from these sources. The indirect CO_2 emissions from NMVOC of the use of petrochemical products are calculated from the average carbon contents of NMVOC emissions per subcategory 3A, 3B and 3D the 85-95% most important contributing compounds included in total NMVOC. Lacking data for 3C, the weigthed average of the other three was used. These fractions were calculated for the 1990 and 2000 emissions. However, since the trends were not robust and the 2000 emissions are only a small part of the total, the following fixed carbon fractions are used:

- 3A: 0.64
- 3B: 0.16
- 3C: 0.63
- 3D: 0.69

The emissions are then calculated as follows:

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

We assume that the fraction of organic carbon in the NMVOC emissions is negligible. By estimating the CO_2 emissions from product use based on reported NMVOC emissions, the changes in the '90 in the type of paints (containing less oil-based solvents) are automatically incorporated.

Also for the N_2O sources in this sector country-specific methodologies are used. The major supplier of the gas reports the use of anaesthetic gas every year and the Dutch Association of Aerosol

Producers reports the annual sales of N_2O containing spray tins. Since the emissions in this source category are considered to be from non-key sources for CO_2 and N_2O (see *Section 1.5*), the present methodology level does comply with the *IPCC Good Practice Guidance* (IPCC, 2000). For a brief description of the methodology and data sources used see *Annex 2/3*. A full description of the methodology is provided in the monitoring protocols (Ruyssenaars, 2005) and for N_2O also in Spakman *et al.* (2003).

5.1.3 Uncertainties and time-series consistency

The trend in emissions of this category is summarised in *Table 5.1,* where it is shown that the CO_2 emissions show a continuously decreasing trend, in particular for paints. This is due to emission reduction programme for NMVOC. The use of N_2O for anaesthesia in hospitals and other medical institutions has decreased over time due to better dosing. The use of N_2O in spray tins has also decreased over the last five years.

The uncertainty of CO_2 and N_2O emissions is not explicitly estimated for this category but is expected to be fairly low. For indirect CO_2 emissions the uncertainty in the NMVOC emissions are estimated at about 25% and the uncertainty in the carbon contents about 10%, resulting in an uncertainty in CO_2 emissions of about 25%. For N_2O emissions the uncertainty will be in the order of 50% due to an uncertainty in the activity data of N_2O use of about 50% and 0% in the emission factor (since all gas will be released).

5.1.4 Source-specific recalculations

The CO_2 emissions from the use of petrochemical products is part of the major recalculation of fossil-fuel related emissions from feedstock and other non-energy uses as described in *Section 3.2.1*, previously not estimated and reported in sector 3, but calculated as supplementary estimate based on country-specific oxidation (i.e. non-storage) fractions which were also used in the Reference Approach and reported under fuel combustion in the chemical industry (1A2c).

Smaller changes are found in the removal of the negligible CO_2 emissions reported as non-combustion emissions by some individual companies, thereby ensuring that the Standard Data Tables in the CRF spreadsheets are transparent and consistent over time.

6. AGRICULTURE [CRF sector 4]

Major changes in the agriculture sector compared to the previous National Inventory Report

Emissions: The 1990-2002 CH_4 emission trend has been adjusted from -23% to -17%. Total CH_4 emissions decreased in 1990 (-3%) and total CH_4 emissions increased in 2002 (+6%). CH_4 emissions by manure management increased for the complete time series (+37% in 1990 and + 45%) in 2002, and enteric fermentation decreased (-13% in 1990 and -4% in 2002).
The 1990-2002 N_2O emission trend was adjusted from +1% to -16%. Total N_2O emissions increased for the complete time series (+70% in 1990 and +42% in 2002), mainly because of new calculations of indirect emissions. In addition, the Sectoral Background Data Tables in the CRF spreadsheets are now complete, transparent and consistent over time.

Key sources: New key sources are CH_4 from enteric fermentation from swine, N_2O from manure management and N_2O from animal production (manure produced in meadow during grazing).

Methodologies: Major methodological changes due to the use of higher tier methods were seen in:
- CH_4 emission factors for *enteric fermentation by cattle* (dairy and non-dairy);
- CH_4 emission factors for *manure management systems* (for all animal categories).
  Moreover, in manure management *three waste management systems* are now distinguished for the CH_4 emission calculation, namely, liquid and solid manure management systems (in stable and storage) and manure produced in the meadow during grazing. [Only the first two systems calculate N_2O emissions by manure management. The same categorisation as in previous NIRs is used for N_2O emissions of manure produced in the meadow (animal production, part of 4D).]
- *Indirect agricultural N_2O soil emissions*. Now calculated using the IPCC Tier 1 method with activity data now estimated for every year and using country-specific nitrogen input data for calculating nitrogen leaching and run-off as well as nitrogen deposition from agriculture.
- *Direct N_2O emissions.* Crop residues and histosols are now also included. Minor adjustments were made in methods used for calculating N_2O emissions from N-fixing crops and from animal production, and in emission factors used for synthetic fertilisers.

6.1 Overview of the sector

The agricultural sector in the Netherlands comprises three source categories:

- enteric fermentation: CH_4 emissions only (4A);
- manure management: CH_4 and N_2O emissions (4B);
- agricultural soils: N_2O emissions only (4D).

The other IPCC subcategories – rice cultivation (4C), prescribed burning of savannas (4E), field burning of agricultural residues (4F) and 'other' (4G) – do not occur in the Netherlands. Burning in the field, prohibited by law, is negligible in practice. Manure management (4B) refers to all emissions from confined animal waste management systems (AWMS). It includes also CH_4 emissions from animal waste produced in the meadow during grazing. So the Netherlands does not report these CH4 emissions under 4D category animal production (but under 4B instead).

N_2O emissions from animal waste produced in the meadow during grazing are actually reported under subcategory 4D (animal production). Methane emissions from agricultural soils are regarded as 'natural' (non anthropogenic) – as far as direct emissions are concerned – and therefore are not estimated. CO_2 emissions from agricultural soils are not reported under category 4D but under 5D (see *Section 7.5*).

The trends in greenhouse gas emissions from the agricultural sector are summarised in *Table 6.1*, which clearly shows methane emissions from enteric fermentation to be the largest source of methane and agricultural N_2O soil emissions (4D), the largest source of nitrous oxide reported under the IPCC 'Agriculture' sector. In 2003 emissions from the Agriculture sector contributed 8% of total national emissions (without LUCF), compared with 10% in 1990. Emissions of N_2O accounted for 54% per cent of CO_2 equivalent emissions from the sector in 2003, and CH_4 for the remainder. Emissions of N_2O from agriculture, mainly from animal wastes applied to soils and indirect emissions from nitrogen leaching and run-off (LRO) of agricultural soils, accounted for (accidentally also) 54% of national total N_2O emissions. CH_4 emissions from agriculture, for ¾ from enteric fermentation and ¼ from animal waste management systems, accounted for 49% of the national total CH_4 emissions in 2003.

From 1990 to 2003, emissions of the sector declined by 18%, and from 2002 to 2003 they decreased by 2.8%. Total CH_4 emissions from the sector decreased by 18% from 1990 to 2003, mainly due to decreasing numbers of dairy cattle (-26%) and also decreasing livestock numbers of non-dairy cattle and swine (of about 20%). Total N_2O emissions from the sector decreased by 19% from 1990 to 2003, largely due to a decrease in emissions from LRO, synthetic fertilisers and cattle on grasslands. These changes are mainly due to decreasing use of synthetic fertilisers (-29%) and less cattle on grasslands (-45%) and less animal waste applied to soils (-25%) [although the change in method of injecting manure into the soils instead of surface spreading increased the related emissions]. Subsequently, also the indirect N_2O emissions from LRO and from atmospheric deposition also decreased by 30% and 40%, respectively. From 2002 to 2003 N_2O and CH_4 emissions from the sector decreased by 4% and 0.3%.

Looking at *Box 6.1*, in which key and non key sources in the agricultural sector are identified according to level, trend or both, we can conclude that methane emissions from manure management of cattle and swine are also key sources. Furthermore, compared to previous NIRs three new (level) key sources can be distinguished: CH_4 from enteric fermentation by swine, N_2O from manure management and N_2O from animal production.

Table 6.1 Trends in greenhouse gas emissions from agriculture (category 4) (CO_2 in Tg; other emissions in Gg)

Source category	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
CH_4														
4A Enteric fermentation	349	354	347	340	336	334	328	318	314	311	307	307	293	289
4B Manure management	141	142	141	141	135	145	143	142	132	130	127	126	120	115
N_2O														
4B Manure management	2.2	2.2	2.4	2.4	2.3	2.4	2.3	2.3	2.5	2.5	2.4	2.4	2.4	1.9
4D Agricultural soils	35.1	35.9	37.6	38.1	36.7	38.4	37.8	37.3	36.3	34.9	32.0	30.7	28.8	28.3
4D1 Direct soil emissions	14.9	14.9	17.7	18.4	18.3	19.8	19.2	19.1	19.3	18.8	17.3	16.6	15.9	15.5
a. Synthetic fertilisers	6.9	6.7	6.6	6.5	6.2	6.7	6.5	6.7	6.7	6.4	5.7	4.9	4.7	4.6
b. Animal wastes to soils	5.5	5.8	8.8	9.5	9.8	10.7	10.4	10.2	10.3	10.1	9.3	9.4	8.9	8.7
c. N-fixing crops	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
d. Crop residue	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.6	0.5	0.5	0.6	0.5
e. Cultivation of histosols	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7
4D2 Animal production	4.2	4.7	4.4	4.1	3.8	3.8	4.0	3.7	3.2	2.9	2.7	2.7	2.2	2.2
4D3 Indirect emissions	16.1	16.3	15.5	15.7	14.7	14.9	14.6	14.5	13.9	13.2	12.0	11.4	10.7	10.5
a. Atmospheric deposition	3.5	3.6	3.1	3.2	2.9	2.6	2.6	2.6	2.4	2.3	2.1	1.9	1.8	1.7
b. N leaching &run-off	12.6	12.7	12.4	12.5	11.8	12.2	12.0	11.9	11.5	11.0	10.0	9.5	8.9	8.8
4D4 Other	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

Note: CO_2 from 4D Agricultural soils are “IE” (in category 5D); CH_4 and N_2O from 4G Other are “NO”.

Box 6.1. Key sources identified in the agriculture using the IPCC Tier 1 and 2 approach (L = Level, T = Trend)

4A	**CH_4**	**CH_4 emissions from enteric fermentation: cattle**	**Key (L,T1)**
4A	***CH_4***	***CH_4 emissions from enteric fermentation: swine***	***Key (L) ****
4A	CH_4	CH_4 emissions from enteric fermentation: other	Non key
4B	**CH_4**	**Emissions from manure management: cattle**	**Key (L)**
4B	**CH_4**	**Emissions from manure management: swine**	**Key (L,T1)**
4B	CH_4	Emissions from manure management: other	Non key
4B	***N_2O***	***Emissions from manure management***	***Key (L2) ****
4C	CH_4	Rice cultivation	Not Occurring
4D	**N_2O**	**Direct soil emissions from agricultural soils**	**Key (L)**
4D	***N_2O***	***Animal production (manure produced in meadow during grazing)***	***Key (L,T1) ****
4D	**N_2O**	**Indirect N_2O emissions from nitrogen used in agriculture**	**Key (L,T1)**
4E	All	Prescribed burning of savannas	Not occurring
4F	n-CO_2	Emissions from agricultural residue burning	Not occurring

** Changed compared to previous NIR.*

6.2 Enteric fermentation [4A]

6.2.1 Source category description

Source category enteric fermentation consists of the sources specified in *Box 6.1*. The category other (sources) consists of sheep, goats and horses. Buffalo, camels and llamas, and mules and donkeys do not occur in the Netherlands. Enteric fermentation emission from poultry is not estimated because of lack of data on CH_4 emissions from this animal category. Moreover, the *IPCC Guidelines* do not provide a default emission factor for this animal category; the Netherlands has noticed that other countries do not estimate emissions from poultry either. A major level and trend key source is enteric fermentation by cattle. Its share of CH_4 in the national total was 26% in 1990 and is currently 31%. Its share in the agricultural total is in both years is 64%. Enteric fermentation by swine is also a level key source now, with a share in the national total of 2% in 1990 and 2003.

6.2.2 Methodological issues

IPCC methodologies are used for estimating methane emissions from source category enteric fermentation. For key source cattle, the emission factors are based on a country-specific IPCC Tier 2 analysis. These emission factors are calculated periodically for several subcategories of dairy and non dairy cattle, respectively, by multiplying the gross energy uptake with a methane conversion factor. Changes are based on changes in gross energy uptake that depend on such factors as feed intake, weight gain, milk production and activity (time spent in the meadow). The present methodology used for cattle fully complies with the *IPCC Good Practice Guidance* (IPCC, 2000). A full description of the methodology is provided in the monitoring protocols (Ruyssenaars, 2005). A specific description with more details on data and data sources is found in Smink *et al*. (2004).

The emission factors for the sources swine, sheep, horses and goats are based on default IPCC Tier 1 emission factors, which are taken from an OECD publication in 1991 as documented in Van Amstel *et al*. (1993). This is in compliance with *IPCC GPG* for non key sources. The Netherlands uses the same emission factor for enteric fermentation of goats as for sheep, i.e. 8 kg CH_4 per animal. The *Revised 1996 IPCC Guidelines*, published in 1997, mention different default emission factors for sheep and goats. The Netherlands, however, uses the same emission factor for both animal categories because sheep and goats consume roughly the same amount of dry matter per animal. In the Netherlands goats are kept for milking, and with an annual milk production of about 800 kg, the feed intake is at the same level as for sheep.

6.2.3 Uncertainty and time-series consistency

The uncertainty of CH_4 emissions from enteric fermentation from cattle sources is estimated to be about 20% in annual emissions (see *Section 1.7* for more details). The trend in CH_4 emissions due to enteric fermentation is summarised in *Table 6.2.* In the 1990-2003 period, the total agricultural emission of CH_4 decreased from 348.7 to 288.7 Gg (-17%). For key source cattle (with a share of 90%), the decrease in emission is also 17%. For new key source swine the decrease in emission is 20%.

Table 6.2. CH_4 emissions due to enteric fermentation (4A) 1990-2003 (Gg)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Cattle	312.4	316.9	308.1	302.5	297.7	297.0	290.2	280.9	279.6	276.5	273.3	273.7	261.7	258.0
- Dairy cattle	*266.1*	*265.2*	*256.5*	*250.8*	*246.9*	*249.1*	*246.3*	*238.3*	*238.9*	*236.2*	*232.2*	*234.4*	*224.6*	*221.8*
- Non dairy cattle	*46.4*	*51.7*	*51.6*	*51.7*	*50.8*	*47.8*	*44.0*	*42.6*	*40.7*	*40.3*	*41.1*	*39.3*	*37.1*	*36.2*
Sheep	13.6	15.1	15.6	13.3	14.1	13.4	13.0	11.7	11.2	11.2	10.5	10.3	9.5	9.5
Goats	0.5	0.6	0.5	0.5	0.5	0.6	0.8	1.0	1.1	1.2	1.4	1.8	2.0	2.2
Horses	1.3	1.4	1.6	1.7	1.8	1.8	1.9	2.0	2.0	2.1	2.1	2.2	2.2	2.3
Swine	20.9	19.8	21.2	22.5	21.9	21.6	21.6	22.8	20.2	20.4	19.7	19.6	17.5	16.8
Poultry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total	**348.7**	**353.7**	**347.0**	**340.3**	**335.9**	**334.4**	**327.6**	**318.4**	**314.0**	**311.3**	**307.0**	**307.5**	**292.9**	**288.7**

Table 6.3. Number of animals from 1990-2003 (1000 head) (CBS/RIVM, 2003)

Animal type	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Cattle	4926	5062	4919	4796	4716	4654	4551	4411	4283	4206	4070	4047	3897	3759
- Dairy cattle	3607	3627	3490	3360	3277	3298	3276	3150	3061	2972	2840	2896	2754	2661
- Non dairy cattle	1319	1435	1429	1436	1439	1356	1275	1261	1222	1233	1231	1151	1144	1098
Sheep	1702	1882	1952	1916	1766	1674	1627	1465	1394	1401	1308	1296	1186	1185
Goats	61	70	63	57	64	76	102	119	132	153	179	221	255	274
Horses	70	77	86	92	97	100	107	112	114	115	118	120	121	126
Poultry	96242	97323	103128	99258	95016	92588	94511	96386	102179	108272	107498	103723	104348	74896
Pigs	13915	13217	14160	14964	14565	14397	14419	15189	13446	13567	13118	13073	11648	11169

The numbers of dairy and non dairy cattle in the Netherlands decrease from 1990 to 2003 from 3.61 to 2.66 million animals (-26%) and from 1.32 to 1.10 million animals (-17%), respectively. Dairy cattle include young cattle for breeding. Swine numbers decreased by 20% in the same period (*Table 6.3).* It is obvious that the decreasing numbers of cattle and swine are the main cause of the decrease in the CH_4 emissions. Livestock numbers in general are influenced by the Dutch manure policy and live-stock cattle numbers are (mainly) influenced by the EU policy on the milk quota. The Dutch manure policy regulates livestock numbers by regulating the amount of manure production and manure application. As a result, numbers of non dairy cattle and swine have been reduced by 17 and 20% respectively, and this is reflected in the decrease in methane emissions.

Milk production per cow has increased autonomously (more than 23% between 1990 and 2003) and as a consequence – when the national milk quota remained the same – dairy cattle numbers for females were reduced by the same order of magnitude. This is not entirely reflected in the 11% decrease in methane emission by adult female (milk-producing) cows between 1990 and 2003. The reason is that when milk production per cow increases, the methane production per cow also increases at the same time (when digestible energy (DE) of the feed remains the same). In the period, 1990-2003, the milk production efficiency increase of 23% resulted in an almost 13% increase of methane production per cow, as can be seen in *Table 6.4* in the emission factor trends.

Table 6.4. Subtypes of dairy and non dairy cattle and trends in emission factors 1990-2003 (kg/head.year)(Van der Hoek and Van Schijndel, 2005)

Animal type	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Dairy cattle														
Young females < 1 yr	34	34	34	34	34	34	34	34	34	34	35	35	35	34
Young males < 1 yr	29	29	29	29	29	29	29	29	29	29	37	37	37	37
Young females > 1yr	51	51	51	51	51	51	51	51	51	51	52	52	52	51
Young males 1-2 yr	55	55	55	55	55	55	55	55	55	55	55	55	55	55
Adult females	102	102	102	104	105	106	106	107	109	111	115	114	113	115
Adult males > 2yr	63	63	63	63	63	63	63	63	63	63	63	63	63	63
Non dairy cattle														
Veal calves, rosé	36	36	36	36	36	36	36	36	36	36	38	38	38	38
Veal calves, white meat	16	16	16	16	16	17	17	17	17	17	18	18	18	18
Young females < 1 yr	34	34	34	34	34	34	34	34	34	34	35	35	35	34
Young males < 1 yr	40	40	40	40	40	39	39	39	39	39	40	40	40	41
Young females >1 yr	49	49	49	49	49	49	49	49	49	49	49	49	49	48
Young males 1-2 yr	60	60	60	60	60	59	59	59	59	59	60	60	60	60
Adult females* > 2 yr	65	65	65	65	65	65	65	65	65	65	65	65	65	65

Figure 6.1 shows the trend of the number of cattle and their methane emission due to enteric fermentation. Here, it is also clear that for dairy cattle that the decrease in animal numbers is higher than the decrease in methane emissions. Therefore animal numbers cannot solely explain the emission trend; part of the explanation is found in the increase in the emission factor. For non dairy cattle the decrease in methane emissions is higher than the decrease in animal numbers. Here, the trend can be explained by the shift in shares of non dairy cattle subtypes considered in the emission calculation, each with a different emission factor (see also *Table 6.4*).

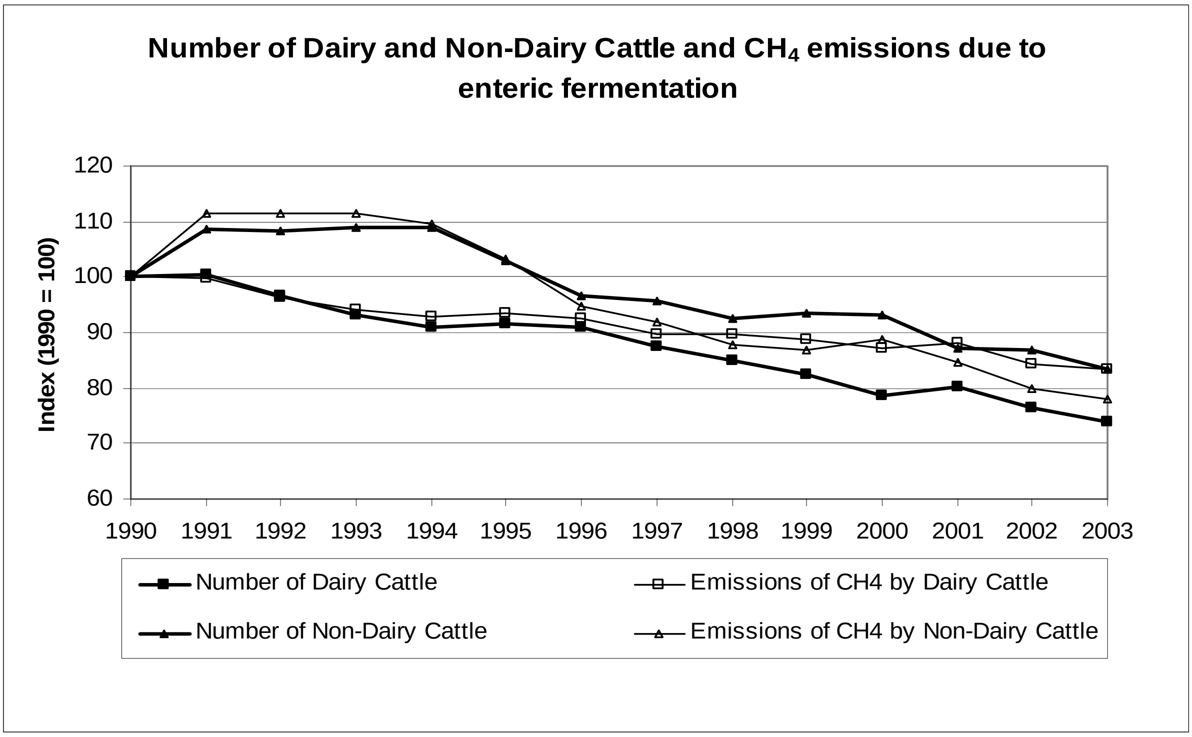


Figure 6.1. Number of cattle and CH_4 emissions due to enteric fermentation from cattle.

6.2.4 Source-specific recalculations

A recalculation was made for all years for CH_4 from cattle (see *Table 6.5*). The largest changes in emissions are due to a change in the calculation method for emission factors to a tier 2 level to comply with IPCC Good Practice. A full description of the methodology is provided in the monitoring protocols (Ruyssenaars, 2005). A specific description with more details on data and data sources is found in Smink *et al*. (2004). The emission factors are now calculated periodically using a country-specific method based on the IPCC tier 2 method thereby improving the accuracy of the level of emissions (see also *Section 6.2.2.*). These changes were made as part of the inventory improvement programme (also in response to previous reviews).

Table 6.5. Differences in enteric fermentation methane emission calculation between the NIR2004 and NIR2005

	Submission	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
4A Enteric	NIR2005	349	354	347	340	336	334	328	318	314	311	307	307	293
fermentation	NIR2004	402	412	401	393	382	377	366	353	341	334	319	322	306
	Difference	-53	-58	-54	-52	-46	-42	-38	-34	-27	-23	-12	-14	-13
Contribution from:														
Dairy cattle	NIR2005	266	265	256	251	247	249	246	238	239	236	232	234	225
	NIR2004	291	291	280	271	264	266	262	252	248	242	230	234	225
	Difference	-25	-26	-24	-20	-17	-16	-16	-14	-9	-5	2	0	0
Non dairy cattle	NIR2005	46	52	52	52	51	48	44	43	41	40	41	39	37
	NIR2004	75	84	82	82	80	74	66	63	59	57	55	54	50
	Difference	-29	-32	-31	-30	-29	-26	-22	-20	-19	-17	-14	-14	-13

6.2.4 Source-specific planned improvements

The IPCC default methane conversion factor (MCF) of 6% is used for most sub types of key source cattle. The change in feed ration (e.g. in share of feed types) since 1990 is not accounted for in this MCF. Since 1990 relatively more maize and concentrates are included in the feed. Enteric fermentation by swine is also a new key source. The Netherlands will investigate the need and possibility to revise and extend calculations on both issues to be in accordance with *IPCC Good Practice*.

6.3 Manure management [4B]

6.3.1 Source category description

Source category manure management consists of the sources specified in *Box 6.1*. The category other (sources) consists of sheep, goats, horses and poultry. Buffalo, camels and llamas, and mules and donkeys do not occur in the Netherlands. Three waste management systems are distinguished for both CH_4 and N_2O emission calculations: namely, liquid and solid manure management systems and manure produced in the meadow while grazing. However, N_2O emissions from manure produced in the meadow during grazing are not reported here, but under category 4D (agricultural soils: animal production).

The share of CH_4 in the national total was 12% in 1990 and is now 14%. Major level trend and key sources are cattle and swine manure management systems. The share of N_2O emissions by manure management in the national total is about 3% in 1990 and 2003. Manure management is now also a level key source of N_2O emissions.

6.3.2 Methodological issues

IPCC methodologies are used to calculate CH_4 and N_2O from manure management systems. There is, however, a difference in approach between the IPCC method and the method used by the Netherlands for CH_4 calculations. Instead of the total numbers of animal types, in the Netherlands, the produced amounts of manure are taken as the starting point for calculating CH_4 emissions. The produced amount of manure is calculated by multiplying manure production factors (in kg per head x year) by animal numbers. The country-specific emission factors are expressed as the amount of CH_4 (kg) per amount of manure (kg) instead of the amount of CH_4 (kg) per animal.

For CH_4 calculations on a tier 2 level, annually produced amounts of manure (in kg) are calculated for every manure management system for several animal categories. For N_2O calculations for the same manure management systems and animal categories, the N content of the manure produced (in kg N) is calculated by multiplying N-excretion factors (kg N per head x year) by animal numbers.

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 (volatile solids and maximum methane producing potential). Country-specific data on manure management system conditions (storage temperature and period) are also taken into account for liquid manure systems, which determine the methane conversion factor. For the other manure systems (solid manure and manure produced in the meadow), IPCC default based values for the methane conversion factor are used.

IPCC default values are used for N_2O emission factors for liquid and solid manure management systems. As already mentioned in *Section 6.3.1*, N_2O emissions from manure produced in the meadow during grazing are not taken into account in the source category, manure management, but in the source category agricultural soils (*Section 6.4*). Since the CH_4 emissions from manure management from cattle and swine are key sources (see *Box 6.1* the present country-specific Tier 2 methodology fully complies with the *IPCC Good Practice Guidance* (IPCC, 2000). The N_2O emission from manure management is also a key source. Activity data are collected on a tier 2 level. However, N_2O emission factors used are IPCC defaults. Because country specific data and higher tier methods for calculating N_2O emission factors for manure management are not available in the Netherlands, the method followed is in compliance with the *IPCC Good Practice Guidance* (IPCC, 2000).

A full description of the methodology for CH_4 from manure management from cattle and swine is provided in the monitoring protocols (Ruyssenaars, 2005). A full description of the methodology for N_2O from manure management and more details on data and data sources, used for both N_2O and CH_4 from manure management, are provided in Van der Hoek and Van Schijndel (2005).

6.3.3 Uncertainty and time-series consistency

The uncertainty of CH_4 and N2O emissions from manure management from cattle and swine is estimated at about 100% in annual emissions (see *Section 1.7* for more details).

The trend in emissions of CH_4 due to manure management is summarised in *Table 6.6.* Between 1990 and 2003, the emission of CH_4 decreased from 141.4 to 115,4 Gg (-18%). As can be seen from *Table 6.6*, the decrease in CH_4 is only partly due to the decrease in emissions from manure management of the key sources, *cattle* (-6.7 Gg) and *swine* (-10.6 Gg). In fact, a relatively high decrease in CH_4 emission was reached in emissions from manure management of the non key source, *poultry* (-8.8 Gg).

Table 6.6. Trend in CH_4 emissions from manure management (4B) 1990-2003 (Gg)

Animal type	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Cattle	74.9	75.6	72.9	70.9	69.0	75.6	73.4	70.4	69.4	67.7	67.7	68.7	69.7	68.2
- Dairy cattle	67.2	67.0	64.4	62.6	60.9	67.5	66.4	63.7	63.2	62.0	62.6	63.8	65.2	64.0
- Non dairy cattle	7.7	8.6	8.5	8.3	8.1	8.1	7.0	6.7	6.2	5.8	5.1	4.9	4.5	4.2
Sheep	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.2	0.2
Goats	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Horses	0.3	0.3	0.3	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.5	0.5	0.5	0.5
Swine	54.3	54.5	55.5	57.7	55.7	60.3	60.2	62.7	56.1	55.1	52.8	50.1	45.7	43.7
Poultry	11.5	11.6	11.7	11.2	9.4	8.2	8.4	8.5	5.7	5.9	6.0	5.9	4.3	2.7
Total	**141.4**	**142.3**	**140.8**	**140.6**	**134.8**	**144.8**	**142.8**	**142.4**	**132.0**	**129.5**	**127.3**	**125.5**	**120.4**	**115.4**

For ***poultry***, the decrease in CH_4 emissions cannot be explained by the decrease in animal numbers. While emissions decreased by 77% (*Table 6.6*), animal numbers showed a decline of 22% in the 1990 to 2003 period (*Table 6.3*). This decline in animal numbers was mainly caused by the avian flu in 2003. Comparing the decrease in emission in the period, 1990-2002 (-63%), with the *increase* of 8% in animal numbers in the same period, it is clear that animal numbers do not explain the trend. The reason for the decrease in CH4 emissions is a shift in the proportion of the two poultry manure management systems (solid and liquid manure). In the 1990-2002 period the amount of liquid poultry manure decreased by 80%, while the amount of solid poultry manure increased by approximately 46%. The lower CH_4 emission factor for solid manure systems explains the decrease in emissions.

The share of ***dairy cattle*** CH_4 emissions is more than 90% of the total ***cattle*** CH_4 manure management emissions. As described in the previous section on enteric fermentation, the number of dairy cattle in the Netherlands decreased by 26% since 1990 (*Table 6.3).*This decrease is hardly reflected by the 3% decrease in the dairy cattle CH_4 emissions (*Table 6.6*). The adult dairy cows form the main sub source for methane emissions from dairy cattle (75-80 %). These dairy cows show a small increase (1-2%) in methane emissions, while their numbers decreased by 23%. The reason for the decrease is discussed in *Section 6.2.3.* Milk production per cow has increased and as a consequence – when the national milk quota remains the same – dairy cattle numbers have been reduced.

There are three reasons that the decrease in dairy cattle numbers is not reflected in the amount of CH_4 emissions by dairy cattle manure management. Firstly, when reviewing manure production per dairy cow in the Netherlands in 2000 it appeared to be higher than in 1990 (+9%). The second reason is that in 2000 the CH_4 emission factor for all manure management systems increased by 6% compared to 1990 because the volatile solids content in the manure increased by 6%. These two factors led to an increase in the CH_4 emission factor per cow of almost 16%. The increase in milk production in the 1990-2000 period of approximately 20% is concluded to be accompanied by a 16% increase in methane emission factor per cow. A third reason can be found in the fact that since 2002 relatively more manure per cow has been produced in the stable than in the meadow. This is partly due to higher cost-effectiveness but partly also due to the effects of the Dutch manure policy. To increase the efficiency of manure application, the amount of manure produced in the meadow during grazing was decreased by keeping dairy cattle indoors more often. The share of the amount of stable manure increased from 70 to approximately 78% between 1990 and 2003. With stable manure showing a 17-fold higher emission factor for CH_4 emissions, the increase in methane emission per cow turns out to be 10%.

Between 1990 and 2003, the increase in manure production per cow (+9%) and volatile solids – content of manure (+6%) combined with a shift to more stable manure (+10%) – resulted in a 27% increase in the methane emission per cow. Combined with the decrease of 23% in adult dairy cow numbers since 1990, this explains the small increase of the total CH_4 emission of milk producing cows.

For ***swine*** the decrease of 18% (*Table 6.6*) is closely related to the decrease in animal numbers (-20%) as can be seen in *Table 6.3.* The increase in the number of swine in 1997 was due to the outbreak of classical swine fever in that year. In areas where this disease was present, transportation of finished pigs, sows and piglets to the slaughterhouse was not allowed so the animals had to stay on the pig farms. This is why the annual census of 1997 shows high numbers of pigs.

The trend in emissions of N_2O due to ***manure management*** decreased from 2.2 to 1.9 Gg (-11%) between 1990 and 2003 *(Table 6.7*). The shift to a higher proportion of solid manure produced by poultry, which was discussed to explain the decrease of CH_4 emissions from poultry manure management, also explains mainly the increase in N_2O emissions by manure management (*Table 6.7*) between 1990 and 2002. N_2O emissions of solid storage increase by 23% between 1990 and 2002 which is in line with the more than 20% increase in the total nitrogen of the solid manure (including manure from poultry, non dairy cattle, sheep and goats). Also here in 2003 there is a decrease in N_2O emissions of solid manure, which can be explained by the avian flu.

Table 6.7. Trend in N_2O emissions from manure management (4B) 1990-2003 (Gg)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Total N_20 from 4B	2.16	2.24	2.38	2.43	2.29	2.39	2.34	2.32	2.51	2.53	2.39	2.38	2.38	1.93
Liquid system	*0.57*	*0.57*	*0.56*	*0.60*	*0.58*	*0.57*	*0.55*	*0.54*	*0.52*	*0.49*	*0.45*	*0.46*	*0.43*	*0.43*
Solid storage and dry lot	*1.59*	*1.67*	*1.82*	*1.83*	*1.71*	*1.82*	*1.79*	*1.78*	*1.99*	*2.04*	*1.94*	*1.92*	*1.95*	*1.50*
Contribution from:														
Liquid system	*26%*	*25%*	*24%*	*25%*	*25%*	*24%*	*24%*	*23%*	*21%*	*19%*	*19%*	*19%*	*18%*	*22%*
Solid storage and dry lot	*74%*	*75%*	*76%*	*75%*	*75%*	*76%*	*76%*	*77%*	*79%*	*81%*	*81%*	*81%*	*82%*	*78%*
Nitrogen excretion per animal waste management system (mill. kg N per yr)														
Liquid system	*430*	*431*	*420*	*450*	*434*	*429*	*412*	*400*	*384*	*366*	*338*	*337*	*319*	*316*
Solid storage and dry lot	*60*	*63*	*69*	*69*	*64*	*68*	*67*	*66*	*74*	*77*	*73*	*71*	*72*	*55*
Total AMWS	*490*	*494*	*488*	*519*	*499*	*497*	*479*	*467*	*458*	*443*	*411*	*408*	*391*	*371*

6.3.4 Source-specific recalculations

A recalculation was made for CH_4 and N_2O from all sources for all years (*Table 6.8*). The largest changes in CH_4 emissions are due to a change in CH_4 emissions by cattle. Changes in CH_4 emissions are due to a change in the emission factors and to the distinction made between different manure management systems (liquid and solid manure management systems, and manure produced in the meadow). The CH_4 emission factors used in the recalculation are based on country-specific data on manure composition and manure management system.

The largest changes in N_2O emissions are due to the inclusion of solid manure management systems and the use of an IPCC default emission factor for solid manure (which is 20 times higher than for liquid manure). These actions have improved the accuracy of the level of emissions. The changes were made within the inventory improvement programme (also in response to previous reviews).

A full description of the methodology for calculating CH_4 emissions from manure management by cattle and swine is provided in the monitoring protocols (Ruyssenaars, 2005). A full description of the methodology for N_2O from manure management and of more details on data and data sources used for both N_2O and CH_4 from manure management is provided in Van der Hoek and Van Schijndel (2005).

Table 6.8 Differences in manure management for CH_4 and N_2O emissions between NIR2004 and NIR2005.

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
4B CH_4 manure	NIR2005	141	142	141	141	135	145	143	142	132	130	127	126	120
Management	NIR2004	103	105	105	105	101	100	98	93	93	91	91	88	83
	Difference	*38*	*37*	*36*	*35*	*33*	*45*	*45*	*49*	*39*	*38*	*36*	*37*	*37*
4B N_2O manure	NIR2005	2.2	2.2	2.4	2.4	2.3	2.4	2.3	2.3	2.5	2.5	2.4	2.4	2.4
Management	NIR2004	0.7	0.7	0.7	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.6	0.6	0.6
	Difference	*1.5*	*1.5*	*1.7*	*1.6*	*1.5*	*1.7*	*1.6*	*1.6*	*1.8*	*1.9*	*1.8*	*1.8*	*1.8*

6.3.5 Source-specific planned improvements

In order to prevent methane emissions from manure management one measure to be taken could be the treatment of manure in an anaerobic digester. The Netherlands will investigate the future need and possibilities for including anaerobic treatment in the methodology and extended calculations, and, in doing so, take 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 category consists of the N_2O subsources specified in *Table 6.1:*

- direct soil emissions from the application of synthetic fertilisers and animal wastes to soils, and from N-fixing crops, crop residues and 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).

Both direct and indirect N_2O soil emissions are major-level and/or trend key sources; N_2O from manure produced in the meadow during grazing now falls into this category (see *Box 6.1*). The share of N_2O emission by agricultural soils in the national total is shown to be 54% in 1990 and 2003. The share of direct N_2O emissions in the national total was about 22% in 1990 and is now about 28%. The share of indirect N_2O emissions in the national total was about 23 % in 1990 and is now about 19%.

Methane emissions from agricultural soils are regarded as ‘natural’ (non anthropogenic) and are estimated on the basis of the methane background document (Van Amstel *et al.*, 1993). Therefore these are not reported as anthropogenic emissions.

The most important subsources of agricultural soil emissions of N_2O are direct emissions due to application of synthetic fertilisers and animal wastes (manure) to soil, and indirect emissions caused by nitrogen leaching and run off.

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 methodology used for direct and animal production N_2O emission calculations is the same as the IPCC Tier 1b method. On application of synthetic fertiliser and manure, a distinction is made between organic and inorganic soils, between ammonium phosphate/sulphate and other synthetic fertiliser and between 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 present methodology fully complies with the *IPCC Good Practice Guidance* (IPCC, 2000).

The Netherlands uses the IPCC Tier 1 method to estimate *indirect* N_2O emissions. Indirect N_2O emissions resulting from atmospheric deposition are estimated using country-specific data on ammonia emissions. IPCC default values are used for N_2O emission factors because of lack of country-specific data. Indirect N_2O emissions resulting from leaching and run-off emissions are estimated using country-specific data on total N input to 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 N_2O emission factors because of lack of country-specific data that can be used in consistency with data used in estimation of direct soil emissions. The present methodology fully complies with the *IPCC Good Practice Guidance* (IPCC, 2000). For a description of the methodologies and data sources used, see the monitoring protocols (Ruyssenaars, 2005). A full description of the methodologies is provided in Van der Hoek *et al.* (2005), with more details in Kroeze (1994).

An overview of the emission factors used for calculation of agricultural soil N_2O emissions from different sources is presented in *Table 6.9*.

Table 6.9. Emission factors for different sources of N_2O emissions from agricultural soils.

DIRECT	Mineral soils	Organic soils	Other	Reference
Synthetic fertiliser				
Ammonium fertiliser	0.005	0.01		2
Other fertiliser	0.01	0.02		1
Manure (animal wastes applied to soils)				
Surface spreading	0.01	0.02		1
Incorporation into soil	0.02	0.02		1
N-fixing crops	0.01			1
Crop residues	0.01			2
Cultivation of histosols		0.02		2
ANIMAL PRODUCTION				
Faeces	0.01	0.01		1
Urine	0.02	0.02		1
INDIRECT EMISSIONS				
Atmospheric deposition	0.01	0.01		2*
Nitrogen leaching and run-off			0.025	2*

- References: 1= Kroeze (1994); 2= Van der Hoek *et al.* (2005); = IPCC default.

6.4.3 Uncertainty and time-series consistency

The uncertainty in direct N_2O emissions from agricultural soils is estimated to be about 60%. The uncertainty in indirect N_2O emissions from nitrogen used in agriculture is estimated to be more than a factor of 2.

The trend in N_2O emissions from agricultural soils is summarised in *Table 6.10*. Between 1990 and 2003 total N_2O emissions from agricultural soils decreased by 19%, direct N_2O emissions increased by 4% and indirect N_2O emissions decreased by 35%. More than 50% reduction was reached in the animal production emission.

Between 1990 and 1995 N_2O emissions increased by approximately 9%. This increase is almost completely due to the increase in the emissions related to the application of animal manure to agricultural soils. The application method has changed considerably from 1990 to 1995. Before 1990 manure was applied by surface spreading *on* grasslands and *on* agricultural soils. As a result of the Dutch policy for reduction of ammonia emissions, this practice has changed since 1990 to incorporate manure *into* the soil (sod injection and ploughing in). These new incorporation methods have increased the local concentration of nitrogen in the upper layer of the soil, which leads to changes in the microbial environment and the microbial processes, and, ultimately, to an increase of N_2O emissions per amount of manure applied. In 1995 (and following years) all manure was incorporated into the soil, explaining the increase in N_2O emissions between 1990 and 1995. On the other hand, indirect N_2O emissions by atmospheric deposition decreased in this period because the ammonia emissions were reduced.

Between 1995 and 2003 total N_2O emissions from agricultural soils decreased by 26%, direct N2O emissions by 23% and indirect N2O emissions by 32%. More than 40% reduction was reached in the animal production emission, which can be mainly explained by the tendency to keep dairy cattle for a longer period in the stable (and for a longer period in the meadow) (see also *Section 6.3.3*).

The N_2O emission since 1995 has decreased as a result of the Dutch manure policy aimed at reduction of N leaching and run-off. Application of synthetic fertilisers and animal wastes to soil was reduced as a consequence of this manure policy. Around 1999, N_2O emissions had returned to the 1990 level.

Table 6.10. N_2O Emissions from agricultural soils (4D) 1990-2003 (Gg N_2O).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
4D1 Direct soil emissions	14.9	14.9	17.7	18.4	18.3	19.8	19.2	19.1	19.3	18.8	17.3	16.6	15.9	15.5
a. Synthetic fertilisers	*6.9*	*6.7*	*6.6*	*6.5*	*6.2*	*6.7*	*6.5*	*6.7*	*6.7*	*6.4*	*5.7*	*4.9*	*4.7*	*4.6*
b. Animal wastes applied to soils	*5.5*	*5.8*	*8.8*	*9.5*	*9.8*	*10.7*	*10.4*	*10.2*	*10.3*	*10.1*	*9.3*	*9.4*	*8.9*	*8.7*
c. N-fixing crops	*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*
d. Crop Residue	*0.6*	*0.6*	*0.6*	*0.6*	*0.6*	*0.6*	*0.5*	*0.5*	*0.5*	*0.6*	*0.5*	*0.5*	*0.6*	*0.5*
e. Cultivation of Histosols	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*	*1.7*
4D2 Animal production	4.2	4.7	4.4	4.1	3.8	3.8	4.0	3.7	3.2	2.9	2.7	2.7	2.2	2.2
4D3 Indirect emissions	16.1	16.3	15.5	15.7	14.7	14.9	14.6	14.5	13.9	13.2	12.0	11.4	10.7	10.5
Atmospheric deposition	*3.5*	*3.6*	*3.1*	*3.2*	*2.9*	*2.6*	*2.6*	*2.6*	*2.4*	*2.3*	*2.1*	*1.9*	*1.8*	*1.7*
Nitrogen leaching and run-off	*12.6*	*12.7*	*12.4*	*12.5*	*11.8*	*12.2*	*12.0*	*11.9*	*11.5*	*11.0*	*10.0*	*9.5*	*8.9*	*8.8*
4D4 Background agricultural soils	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	**35.1**	**35.9**	**37.6**	**38.1**	**36.7**	**38.4**	**37.8**	**37.3**	**36.3**	**34.9**	**32.0**	**30.7**	**28.8**	**28.3**

Note: This table excludes emissions from animal housing included in category 4.B *Manure management (see Table 6.7).*

Table 6.11 presents the nitrogen flows from synthetic fertilisers and from animal waste management systems. About 80-85% of total collected manure is applied to Dutch soils. The remainder of about 15% is emitted as ammonia during manure application in the field, while a small portion of the manure is exported. It is shown that the amount of nitrogen in manure and fertiliser applied to agricultural soils is shown to have decreased, both by approximately 30%.

Table 6.11. Additional information on nitrogen flows related to N_2O emissions from soils.

Nitrogen flows (Gg N per year)	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Use of synthetic fertilisers	412	400	392	390	372	406	389	401	403	383	339	298	292	291
N input from manure applied to soils	410	411	401	425	401	400	394	386	382	362	334	335	318	309
As percentage of total in AWMS	84%	83%	82%	82%	80%	80%	82%	83%	84%	82%	81%	82%	81%	83%
N fixation by legumes	7.9	6.8	6.2	5.7	5.3	4.9	4.9	4.7	4.7	5	4.7	5.1	4.7	5.2

6.4.4 Source-specific recalculations

Changes were made in reported emissions for indirect N_2O due to the reallocation of sources for a better compliance with IPCC source definitions (N_2O from leaching and run off) and to the addition of a new source category, N_2O from deposition. A recalculation was also made for N_2O from leaching and run off for all years. Changes in emissions are due to a change in the method to comply with *IPCC Good Practice* (*Table 6.12*).

Changes were also made in reported emissions for direct N_2O mainly from the reallocation of sources for a better compliance with IPCC source definitions (N_2O from histosols and crop residues, which were formerly included in background agricultural soil emissions). A recalculation was also made for N_2O from histosols and crop residues for all years. Some minor adjustments are found in 1) methods used for calculating N2O emissions from N-fixing crops and from animal production and 2) in emission factors for chemical fertilisers.

Table 6.12.Differences in agricultural soil N_2O emission calculations between the NIR2004 and NIR2005

	Submission	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
4D Agricultural soils	NIR2005	35.1	35.9	37.6	38.1	36.7	38.4	37.8	37.3	36.3	34.9	32.0	30.7	28.8
	NIR2004	21.2	21.7	24.4	24.8	24.5	26.1	25.7	25.3	24.6	24.6	22.6	22.0	21.4
	Difference	*13.9*	*14.2*	*13.2*	*13.4*	*12.2*	*12.3*	*12.1*	*12.0*	*11.8*	*10.3*	*9.4*	*8.7*	*7.5*
Contribution from:														
1. Direct soil emissions	NIR2005	14.9	14.9	17.7	18.4	18.3	19.8	19.2	19.1	19.3	18.8	17.3	16.6	15.9
	NIR2004	12.8	13.1	16.0	16.4	16.5	18.0	17.4	17.1	16.8	17.2	15.4	14.8	14.1
	Difference	*2.1*	*1.8*	*1.7*	*2.0*	*1.9*	*1.8*	*1.8*	*2.1*	*2.5*	*1.6*	*1.9*	*1.8*	*1.8*
2. Animal production	NIR2005	4.2	4.7	4.4	4.1	3.8	3.8	4.0	3.7	3.2	2.9	2.7	2.7	2.2
	NIR2004	3.8	3.8	3.7	3.7	3.4	3.4	3.5	3.5	3.1	2.7	2.5	2.5	2.5
	Difference	*0.4*	*0.8*	*0.8*	*0.4*	*0.4*	*0.4*	*0.5*	*0.2*	*0.0*	*0.2*	*0.2*	*0.2*	*-0.3*
3. Indirect Emissions	NIR2005	16.1	11.4	15.5	15.7	14.7	14.9	14.6	14.5	13.9	13.2	12.0	11.4	10.7
	NIR2004	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
	Difference	*16.1*	*11.4*	*15.5*	*15.7*	*14.7*	*14.9*	*14.6*	*14.5*	*13.9*	*13.2*	*12.0*	*11.4*	*10.7*

These actions have improved the accuracy of the level of emissions, with changes made as part of the inventory improvement programme (also in response to previous reviews). A description of the methodology for N_2O from agricultural soils is provided in the monitoring protocols (Ruyssenaars, 2005). A full description of the methodology and of more details on data and data sources used is provided in Van der Hoek *et al.* (2005).

6.4.5 Source-specific planned improvements

IPCC default values are used for key source indirect N_2O emissions from agricultural soils for the fraction leached (fraction of N input to soil that leaches from the soil and ends up partly as N_2O emissions from groundwater and surface water) and for the N_2O emission factors. The main reason for this is lack of country-specific data that is consistent with data used in the estimation of direct soil emissions. The present methodology fully complies with the *IPCC Good Practice Guidance* (IPCC, 2000). However, because of the typical Dutch circumstances in agricultural soils (with relatively high water tables), there is a need for country-specific data on the fraction leached and the emission factors. For this reason the Netherlands will investigate the needs and possibilities to extend calculations in the future so as to take the specific Dutch circumstances into account.

7. LAND USE CHANGE AND FORESTRY [CRF sector 5]

Major changes in the LUCF sector compared to previous National Inventory Report

Emissions: A significant change in net emissions/removals from a net sink of about 1.5 Tg CO_2, based on only estimate for 5A, to a net source of about 2.8 Tg CO_2. This is mainly due to the addition of emissions now estimated for cultivation of organic soils in category 5D, partly compensated by a larger net sink in category 5A due to other biomass expansion factors and inclusion of dead wood.

Key sources: The LUCF sector as a whole is now a key source. Further analysis on carbon stock changes within the subcategories has yet to be made.

Methodologies: The method used to calculate the emissions and removals from forestry (5A) has been improved and includes all carbon pools. The methods for all other LUCF categories have not been addressed in previous NIR reports and are introduced for the first time.

7.1 Overview of sector

The policy on 'sinks' has evolved to cover emissions and removals of greenhouse gases resulting form land use, land-use change and forestry (LULUCF). Under the Kyoto Protocol, Parties decided that greenhouse gas removals and emissions through certain activities – namely, afforestation and reforestation since 1990 – are accounted for in meeting the Protocol's emission targets. Conversely, activities that deplete forests, namely deforestation, will be subtracted from the amount of emissions that an Annex I Party may emit over its commitment period. Also was decided that additional activities could be added to this list in the future. In the Kyoto protocol a number of issues remained unresolved. These included the elaboration of agreed definitions for 'forest' and for all the activities to be considered under Article 3.3 afforestation, reforestation and deforestation, and under Article 3.4, namely, forest management, revegetation, cropland management and grazing land management. Rules for the accounting and reporting of these activities were developed as part of the Marrakesh accords. After Marrakesh an inventory was made of present readiness of and omissions in the Dutch National System for greenhouse gas reporting (Nabuurs *et al*., 2003; Kuikman *et al.*, 2004). The report concludes on the main discrepancies between ongoing reporting and monitoring and the requirements of the Marrakesh accords and the Good Practice Guidance. The conclusion of the report was a start for further research in the field of land use change (including mapping), forestry and soil carbon inventory. The results of the executed studies supported to a large extent the reporting on LUCF in this NIR.

In the previous NIRs the Netherlands only reported data in category '*changes in forest and other woody biomass stocks'* (5A), and only for the subcategory '*temperate forests*', because the Netherlands has neither tropical or boreal forests nor tundra. The forest sector was reported in a way largely based on IPCC defaults methods (Nabuurs *et al.*, 2005). The earlier reported CO_2 sinks figures showed a sink of about 1.5 Tg CO_2, about 0.8% of the total emissions reported for 2000 (169.3 Tg CO_2). Because of the elaboration of the work done for the forest sector it was decided to report the forest carbon stock changes from now on at Tier 2 level. A major difference with the earlier approach is that at Tier 2 level emission factors and activity data are now defined by the country for the most important land uses/activities and also the stock change methodologies are based on country specific data (Nabuurs et al., 2005). The in this NIR presented results for forestry are based on the Protocol Forest Land (2005). Due to the research in the field of land use change and carbon stocks it was made possible to report for the first time in this NIR on the other LUCF categories: '*forest and grassland conversion*' (5B), '*abandonment of managed lands*' (5C), '*CO_2 emissions and removals from soils*' (5D) and '*other*' (5E). These categories are covered in one protocol: Protocol Total Land Use Categories (2005). With the recent elaboration of the work in the field of accounting and reporting the LUCF sector as a whole is now a key source. Nevertheless, some further analysis on the (sub)categories has yet to be made. In Sections 7.2 to 7.6 the results of the individual categories are discussed.

Table 7.1 shows the sources and sinks in land use change and forestry in 1990. In 1990 there is a total net emission of 2.9 Tg CO_2. This is the net result of emissions (8.1 Tg CO_2) and removals (-5.2

Tg CO_2). The major source is CO_2 emissions from the decrease in C-stored in organic soils and peatlands (4.2 Tg CO_2) as result of agricultural and water management. The major sink is the storage of carbon in forests (-2.5 Tg CO_2).

Table 7.1. Summary of sub-sources/sinks in Land-Use Change and Forestry (LUCF) in 1990 (IPCC category 5)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**CO_2 emissions**	**CO_2 removals**	**Net CO_2 emissions/ removals**
	(Gg)		
Total Land-Use Change and Forestry	**8,115.13**	**-5,220.93**	**2,894.20**
A. Changes in Forest and Other Woody Biomass Stocks	**2,110.17**	**-4,615.50**	**-2,505.33**
1. Tropical Forests	NO	NO	NO
2. Temperate Forests (1)	2,110.17	-4,615.50	-2,505.33
3. Boreal Forests	NO	NO	NO
4. Grasslands/Tundra	NO	NO	NO
5. Other	NE	NE	NE
B. Forest and Grassland Conversion (2)	**865.64**		
1. Tropical Forests	NO		
2. Temperate Forests *(Deforestation)*	865.64		
3. Boreal Forests	NO		
4. Grasslands/Tundra	NO		
5. Other	NE		
C. Abandonment of Managed Lands	**0.00**	**-21.07**	**-21.07**
1. Tropical Forests	NO	NO	NO
2. Temperate Forests *(Afforestation)*	NO	-21.07	-21.07
3. Boreal Forests	NO	NO	NO
4. Grasslands/Tundra	NO	NO	NO
5. Other	NE	NE	NE
D. CO_2 Emissions and Removals from Soil	**5139.31**	**-584.36**	**4,554,95**
1. Cultivation of Mineral Soils	NE	NE	NE
2. Cultivation of Organic Soils	4,246.00	NO	4,246.00
3. Liming of Agricultural Soils	183.15	NO	183.15
4. Forest Soils (3)	IE	IE	IE
5. Other (due to change in land use) (4)	710.16	-584.36	125.8
E. Other	**NE**	**NE**	**NE**

(1) Temperate Forests include: forest, trees outside forests and dead wood.

(2) Include only the emissions of CO_2 from Forest and Grassland Conversion. Associated removals are reported under section D.

(3) Forest soils 5D4 is reported under 5D5 Other

(4) Include all emissions from land use and soils carbon stocks not reported under sections A, B and C.

NE = Not Estimated
NO = Not Occurring

Share in 2003 and trends

In 2003 the Land Use Change and Forestry (LUCF) sector accounted for 1.3% per cent of gross total emissions (i.e. including LUCF). The subcategory '*CO_2 Emissions/Removals from Soils*' (5D) is the major emissions source category in the sector (4.5 Tg), accounting for about 2/3 of all emissions/removals from the LUCF sector, whereas the net removals of subcategory '*Changes in Forest and Other Woody Biomass Stocks*'(5A) accounts for about 1/3 (-2.3 Tg). In addition, emissions from '*Forest and Grassland Conversion*' (5B) contribute 0.9 Tg; removals from '*Abandonment of Managed Land*' (5C) are the smallest contribution to the sector total (-0.3 Tg) in 2003.

From 1990 to 2003, emissions from the LUCF sector decreased by 5% (-0.1 Tg CO_2) from 2.9 Tg CO_2 to 2.8 Tg CO_2, primarily due to increased removals from abandonment of managed land (-0.3 Tg) and a small decrease of emissions from CO_2 emissions from soils (-0.1 Tg), which were partly compensated by a less removals from changes in forest and other woody biomass stocks (+0.2 Tg). Between 2002 and 2003 no changes in emissions/removals by the LUCF sector are reported due to lack of new monitoring data.

Table 7.2 and *Figure 7.1* show the details of the trends in CO_2 sources and sinks from the land use change and forestry category. Most of the individual sinks and sources are based on a fixed figure for all years between 1990 and 2003. Therefore a rather stable development since 1990 occurs. The major sinks, changes in forest and other woody biomass stock, shows a small decrease (about 200 Gg CO_2), the result of a slightly increasing harvest and a slightly decreasing amount of carbon stored in living trees over the period 1990 to 2003. The major source, CO_2 emission and removals from soil, shows a small change over the period 1990 to 2003. This is only caused by the reduction in the emissions from liming of agricultural soils. The other subcategories are presented as a fixed figure. The contribution of this category is dominated by the emission from managed organic soils (more than 4 Tg CO_2).

Table 7.2. CO_2 sources/sinks from Land Use Change and Forestry(Gg CO_2)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
5. Land-Use Change and Forestry	**2 894**	**2 796**	**2 673**	**2 620**	**2 623**	**2 651**	**2 671**	**2 844**	**2 736**	**2 730**	**2 814**	**2 775**	**2 759**	**2 761**
Per category:														
A.Changes in Forest and Other Woody Biomass Stocks	-2 505	-2 546	-2 642	-2 653	-2 605	-2 558	-2 529	-2 335	-2 415	-2 381	-2 289	-2 289	-2 289	-2 289
B.Forest and Grassland Conversion	866	866	866	866	866	866	866	866	866	866	866	866	866	866
C.Abandonment of Managed Lands	-21	-42	-63	-84	-105	-126	-148	-169	-190	-211	-232	-253	-274	-274
D.CO2 Emissions and Removals from Soil	4 555	4 519	4 513	4 491	4 468	4 470	4 482	4 482	4 476	4 456	4 469	4 452	4 456	4 458
E.Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

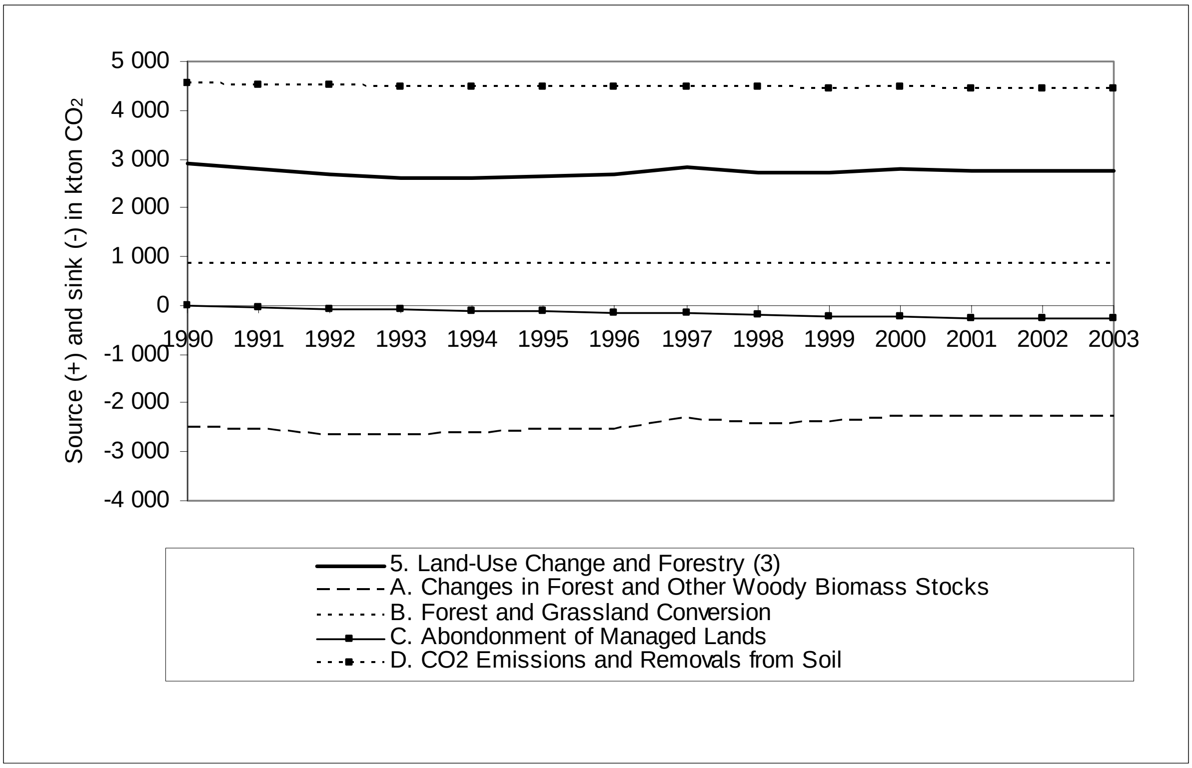


Figure 7.1. CO_2 sources/sinks from Land Use Change and Forestry (5D Other is not estimated)

7.2 Changes in forestry and other woody biomass stock [5A]

7.2.1 Source category description

The Netherlands has only temperate forests and grasslands, neither tropical or boreal forests nor tundra. As of this year this category also includes the dead wood parts of the forest.

7.2.2 Methodological issues

The approach chosen follows the IPCC 1996 Revised Guidelines and its updates in the Good Practice Guidance (IPCC, 2003); a carbon stock change approach based on inventory data subdivided to appropriate pools and land use types. The Dutch 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. Carbon stock changes 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 does not change in the period 1990-2000. An elaborate description of the methodology is presented in *Annex 3.2*.

7.2.3 Uncertainty and time-series consistency

The time-series shows a slight decrease in sink strength from 1990 to 2003 (*Table 7.3*). Although, different databases have been used the time-series shows a stable trend. The uncertainty in the estimates for forest growth is estimated at 10 to 20% (Nabuurs *et al.*, 2005).

Table 7.3. CO_2 emissions/removals from changes in forest and other woody biomass stocks (IPCC category 5A) showing the carbon uptake increment, dead wood, carbon release and the net CO_2 removals (carbon release minus carbon uptake increment and dead wood) (in Gg CO_2)

Category	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
Net CO_2 removal	-2505	-2546	-2642	-2653	-2605	-2558	-2529	-2335	-2415	-2381	-2289	-2289	-2289	-2289
Per subcategory														
Live trees (excl.harvest effect)	-4073	-4030	-3994	-3962	-3935	-3912	-3893	-3876	-3863	-3851	-3959	-3959	-3959	-3959
Trees outside forest	-209	-209	-209	-209	-209	-209	-209	-209	-209	-209	-209	-209	-209	-209
Dead wood	-334	-334	-334	-335	-336	-337	-338	-339	-339	-339	-339	-336	-336	-336
Total harvest	2110	2028	1895	1854	1876	1901	1911	2089	1995	2018	2214	2214	2214	2214

Note: 2001-2003 is identical to the 2000 data.

7.2.4 Source-specific recalculations

The previous NIR report the calculation of the contribution of forestry to emission and removals of CO_2, addressed only carbon stock change in living biomass. The previous calculation was based on one national average increment minus harvest at the national level and for the biomass expansion factors the IPCC defaults were used. For the recalculation in this report an elaborated methodology, based on a more complete carbon cycle, was used. In the recalculation the detailed inventory plot level data are used, new pools as dead wood are included and European specific biomass expansion factors are used. For soil organic carbon and litter, it was still assumed that the stock does not change.

The recalculation shows a sink that is higher than previously reported (*Table 7.4*). In the previous NIR the average sink was about -1.5 Tg CO_2. The current calculation ranges from -2.5 Tg CO_2 in 1990 to almost -2.3 Tg CO_2 in 2003. The difference with the previous NIR figures is due to new pools as dead wood (0.3 Tg CO_2), use of European specific biomass expansion factors and partly due to the use of new datasets.

Table 7.4. Effect of recalculation of CO_2 emissions and removals from Temperate Forests (in Tg CO_2)

Category	NIR	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
5A-CO_2 Emissions	2005	2.1	2.0	1.9	1.9	1.9	1.9	1.9	2.1	2.0	2.0	2.2	2.2	2.2
	2004	3.3	3.3	3.2	3.5	3.6	3.4	3.6	3.5	3.6	3.4	3.6	3.6	3.6
Difference		***-1.2***	***-1.3***	***-1.3***	***-1.7***	***-1.7***	***-1.5***	***-1.7***	***-1.4***	***-1.6***	***-1.4***	***-1.4***	***-1.4***	***-1.4***
5A-CO_2 Removals	2005	-4.6	-4.6	-4.5	-4.5	-4.5	-4.5	-4.4	-4.4	-4.4	-4.4	-4.5	-4.5	-4.5
	2004	-1.9	-1.8	-1.7	-1.7	-1.6	-2.2	-2.2	-2.3	-2.2	-2.2	-2.2	-2.2	-2.2
Difference		***-2.7***	***-2.8***	***-2.8***	***-2.8***	***-2.8***	***-2.3***	***-2.3***	***-2.1***	***-2.2***	***-2.2***	***-2.3***	***-2.3***	***-2.3***
5A-Net emissions/	2005	-2.5	-2.5	-2.6	-2.7	-2.6	-2.6	-2.5	-2.3	-2.4	-2.4	-2.3	-2.3	-2.3
removals	2004	-1.4	-1.5	-1.5	-1.8	-1.9	-1.2	-1.4	-1.2	-1.4	-1.2	-1.4	-1.4	-1.4
Difference		***-1.1***	***-1.0***	***-1.2***	***-0.8***	***-0.7***	***-1.3***	***-1.1***	***-1.2***	***-1.0***	***-1.1***	***-0.9***	***-0.9***	***-0.9***

7.3 Forest and grassland conversion [5B]

7.3.1 Source category description

The category '*Forest and Grassland Conversion'* includes only the *emissions* of CO_2 from the source category. Associated *removals*, e.g. such as in soils organic matter, are reported under 5D.

7.3.2 Methodological issues

Under 5B only deforestation is reported. Combining the deforested area with the standing biomass estimates leads to emissions as given in *Table 7.5*. The deforestation led in total over the thirteen years of 1990-2002 to an emission of 11.3 Tg CO_2. Average figure is 0.9 Tg CO_2 per year.

7.3.3 Uncertainty and time-series consistency

The time-series does not show any differentiation. This is due to the averaging of the emission from deforestation over the whole period concerned on the basis of two measurements. The uncertainty for this number is estimated at 10 to 20% (Nabuurs *et al*., 2005).

Table 7.5. CO_2 emissions from forest and grassland conversion (IPCC category 5B) (in Gg CO_2)

Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Forest and Grassland Conversion	866	866	866	866	866	866	866	866	866	866	866	866	866	866

7.3.4 Source-specific recalculations

The applied methodology was not addressed in previous reports

7.4 Abandonment of managed land [5C]

7.4.1 Source category description

The category 5C '*CO_2 from abandonment of managed land'* includes the sink due to afforestation.

7.4.2 Methodological issues

The sink due to afforestation gradually increases as the area of afforestation increases in the period 1990-2002 to a total sink of 0.6 Tg C. The sequence of sinks since 1990 ranges from 0.02 Tg CO_2 to 0.27 Tg CO_2 in 2003 (see *Table 7.6*).

7.4.3 Uncertainty and time-series consistency

The time-series shows a constant increase since 1990. The figure reflects the yearly growth and the yearly increase of the forested area. There is no inconsistency in the way the afforestation is calculated. The uncertainty for this number is estimated at 10 to 20% (Nabuurs *et al*., 2005).

Table 7.6. CO_2 emissions/removals from abandonment of managed lands (IPCC category 5C) (in Gg CO_2)

year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Abandonment of managed lands	-21	-42	-63	-84	-105	-126	-148	-169	-190	-211	-232	-253	-274	-274

Note: 2003 is identical to the 2002 data.

7.4.4 Source-specific recalculations

The applied methodology was not addressed in previous reports

7.5 Emissions and removals from soil [5D]

7.5.1 Source category description

The category 5D includes emissions and removals of carbon dioxide resulting from cultivation of organic soils, liming of agricultural soils and all land use changes including forest soils. The reporting is considered as Tier 2 level (see protocol on Land Use).

7.5.2 Methodological issues

An elaborate description of the methodology is presented in *Annex 3.2*.

7.5.3 Uncertainty and time-series consistency

The development of greenhouse gas sources en sinks which belong to category 5D is shown in *Table 7.7*. The emission level since 1990 shows a more or less steady horizontal line of about 4.5 Tg CO_2. This flat line is due to the linear interpolation of most of the underlying figures except for liming agricultural soils.

The methodology used to calculate the figures for the period 1990-2000 is time consistent and uses topographic maps to determine land use and most recent soil data for soil carbon stocks. The level of emission has an uncertainty in the order of 20 to 50%. The hold especially for the two major sources: cultivation of organic soils and the soil related sinks and sources. Information on carbon stock changes as direct result of agricultural management and land use change is not available yet. Further conceptual difficulties arise from the land change from any category to other land (most water) and conversion of (agricultural) land to settlement. In the latter case, the carbon stock is maintained under settlement (de Groot *et al.*, 2005).

Table 7.7. CO_2 emission and removals from soil (IPCC category 5D) (in Gg CO_2)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Net CO_2 Emissions and Removals from Soil	4,555	4,519	4,513	4,491	4,468	4,470	4,482	4,482	4,476	4,456	4,469	4,452	4,456	4,458
Per subcategory														
Cultivation of organic soils	4,246	4,246	4,246	4,246	4,246	4,246	4,246	4,246	4,246	4,246	4,246	4,246	4,246	4,246
Liming of agricultural soils	183	147	141	120	96	98	111	110	104	84	98	80	85	86
Emission CO_2	710	710	710	710	710	710	710	710	710	710	710	710	710	710
Removals CO_2	-584	-584	-584	-584	-584	-584	-584	-584	-584	-584	-584	-584	-584	-584

7.5.4 Source-specific recalculations

The applied methodology was not addressed in previous reports.

7.6 Other sources/sinks [5E]

In the Netherlands no estimate is made for other sources of sinks.

8. WASTE [CRF sector 6]

Major changes in Waste sector compared to previous National Inventory Report

Emissions: The ambiguous CO_2 emissions and some CH_4 and N_2O emissions previously reported in 6D have now been set to zero and all specific fuel combustion and process emissions have been estimated and reported under the corresponding sectors (1A, 2); Thus, there are no longer CO_2 emissions reported in the Waste sector. CH_4 emissions increased over the whole time series (7.3 Gg in 1990 and 13.8 Gg in 2002) mainly due the addition of new sources (see below). N_2O emissions increased due to a new method for the domestic wastewater handling for the total time series (0.4 Gg in 1990 and 0.2 Gg in 2002).

Key sources: CO_2 from waste incineration (IE, in 1A1a) and N_2O from wastewater handling.

Methodologies: Major methodological changes are found in the wastewater treatment (6B) and the category '*Other*' (6D) due to the addition in category 6B of new sources '*Industrial wastewater treatment*' and '*Septic tanks*' and indirect N_2O from the effluent from WWTPs and in category 6D of '*Industrial composting*'.

8.1 Overview of sector

The waste sector comprises four source categories:

- solid waste disposal (i.e. landfills) (6A);
- wastewater handling (6B);
- waste incineration (emissions reported under 1A1a) (6C);
- other waste (i.e. industrial composting) (6D).

The trends in greenhouse gas emissions from the waste sector are summarised in Table *8.1*, which clearly shows that methane emissions from solid waste disposal sites (landfills) are the largest source category within this sector. In fact, these emissions rank among the top 5 key-level and key-trend sources (see *Annex 1*).

In 2003 the waste sector accounted for 3% of total national emissions (without LUCF) compared with 6% in 1990. Emissions of CH_4 and N_2O accounted for 95% and 5% of CO_2 equivalent emissions from the sector, respectively. Emissions of CH_4 from waste, almost all (97%) from landfills (5A), accounted for 40% of national total CH_4 emissions in 2003. The small N_2O emissions from the waste sector are from domestic and commercial wastewater. Please note that 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.

Table 8.1. Trend in greenhouse gas emissions from waste handling (category 6) (CO_2 in Tg; others in Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2														
6A. Solid waste disposal	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
6C. Waste incineration [1)]	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
6D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
CH_4														
6A. Solid waste disposal	572	572	560	545	527	500	483	468	448	410	386	363	345	323
6B. Waste water handling	13.8	18.4	18.3	18.3	13.4	11.5	11.3	11.0	11.0	11.2	10.5	10.5	10.7	9.9
6C. Waste incineration [1)]	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
6D. Other	0.1	0.8	1.5	1.9	2.9	3.4	3.5	3.6	3.5	3.5	3.7	3.3	3.4	0.0
N_2O														
6B. Waste water handling	1.7	1.7	1.6	1.6	1.6	1.5	1.5	1.4	1.5	1.4	1.4	1.4	1.4	1.3
6C. Waste incineration [1)]	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
6D. Other	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0

[1)] Since most waste incineration facilities also produce electricity or heat used for energetic purposes, these are reported under category 1A1a (to comply with IPCC reporting guidelines).

From 1990 to 2003, emissions from the waste sector decreased by 42% and from 2002 to 2003 by 8%, mainly due to 44% reduction in CH_4 from landfills (6A1 Managed Waste Disposal on Land). This is the result of a) a reduction of 44% of municipal solid waste (MSW) disposal at landfills through increased recovery and recycling of waste for composting and/or incineration, b) decreasing the organic waste fraction of the waste disposed, and c) increased methane recovery from the landfills (from 5% in 1990 to 21% in 2003).

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. Therefore their emissions are reported under category 1A1a (to comply with IPCC reporting guidelines). However, methodological issues of this source category are briefly discussed in *Section 8.4*.

From *Box 8.1*, in which the key and non-key sources of the waste sector are presented on the basis of level, trend or both, we can conclude that both methane emissions from landfills and N_2O from wastewater handling are key sources. Methane from landfills is a large *level* key source.

Box 8.1. Key source identification in the waste sector using the IPCC Tier 1 and 2 approach (L = Level, T = Trend)

6A	**CH_4**	**CH_4 emissions from solid waste disposal sites**	**Key (L,T1)**
6B	CH_4	Emissions from wastewater handling	Non-Key
6B	*N_2O*	*Emissions from wastewater handling*	*Non-Key*
6C	***CO_2***	***Emissions from waste incineration (IE, included in 1A1a)***	***Key (L1,T1) ****
6D	*CH_4*	*Emissions from industrial composting*	*Non-Key **
6D	*N_2O*	*Emissions from industrial composting*	*Non-Key **

** Changed (addition) compared to the previous NIR.*

8.2 Solid waste disposal on land [6A]

8.2.1 Source category description

As mentioned above, methane from landfills is a major key source, both in terms of level and trend. At present, its share of CH_4 emissions in the national greenhouse gas total is 3% (and 6% in the base year, 1990). In the Netherlands, the policy aims to reduce landfilling. This means all efforts must be undertaken to enhance prevention and recycling of waste, followed by incineration. As early as in the 1990s the government introduced bans for landfilling of certain categories of waste, e.g. the organic fraction of household waste. Another method to reduce landfilling was raising the landfill tariff to comply with the incineration of waste. Depending on the capacity of incineration, the government can grant exemption from these ‘obligations’. *Figure 8.1* shows the landfilled waste categories in the Netherlands in 2003.

In 2003 there were 30 operating landfill sites. In addition, there are a few thousand old sites, which still are reactive. Methane recovery takes place at 51 sites. As a result of anaerobic degradation of the organic material within the landfill body, all these landfills produce methane and carbon dioxide. Landfill gas contains about 60%(vol) methane and 40%(vol) carbon dioxide. Due to a light overpressure the landfill gas migrates into the atmosphere. On several landfill sites the gas is extracted before it reaches the atmosphere. In these cases this gas will then be used as an energy source or be flared off; in both cases the methane in the extracted gas will not come into the atmosphere. When the landfill gas passes the cover of the landfill, the methane can more or less be degraded (oxidised) by bacteria resulting in a lower methane concentration.

The anaerobic degradation of the organic matter in a landfill is a time-dependent process, which can take many decades. Some influencing factors are known, some are not. Every landfill site has its own unique characteristics: concentration and type of organic matter, moisture, temperature etc. Major determining factors for the decrease in net CH_4 emissions were lower quantities of organic carbon deposited into landfills (organic carbon content * total amount of landfilled waste) and higher methane recovery rates from landfills (see *Sections 8.2.2 and 8.2.3*).

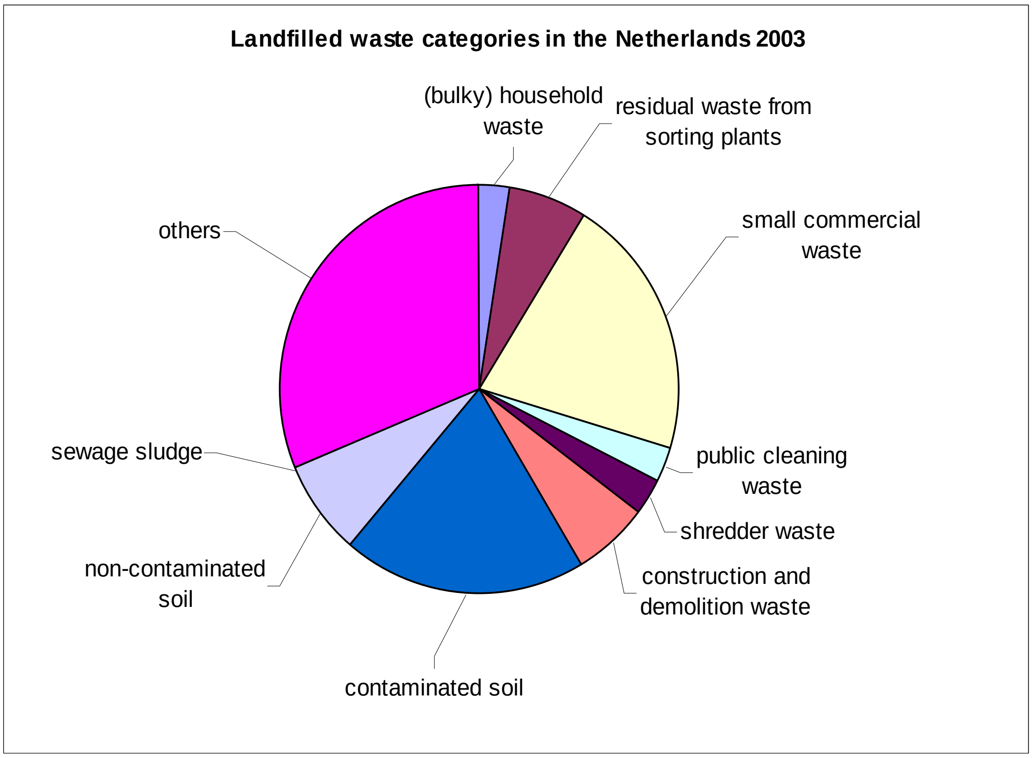


Figure 8.1. Landfilled waste categories in the Netherlands (2003).

8.2.2 Methodological issues

In order to calculate the methane 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. Methane 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 characteristics of the land-filled waste and the amount of landfill gas extracted. This is equivalent to an IPCC Tier 2 methodology. Since the methane emissions from landfills are a key source (see *Box 8.1*), the present methodology does comply with the *IPCC Good Practice Guidance* (IPCC, 2000). Parameters used in the landfill emissions model are[1]:

- total amount of landfilled waste;
- fraction of Degradable Organic Carbon (DOC) (see *Table 8.2* for a detailed time series);
- methane 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 year, respectively (see *Table 8.2* for a detailed time series);
- methane oxidation factor: 10%;
- fraction of DOC actually dissimilated (DOC_F): 0.58;
- methane conversion factor (IPCC parameter): 1.0.

Trend information on IPCC Tier 2 method parameters that change over time is provided in *Table 8.2* and additional information on the composition of landfilled waste for selected years is provided in *Table 8.3*. The change in DOC values is due to factors as the prohibition of landfilling combustible wastes whereas the change in k values 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.

1) Until 2001 the fraction of methane in landfill gas was set at 60%. From 2002 and further the average fraction of methane is yearly determined based on the composition of landfill gas at all sites with methane recovery.

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	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Waste generation rate[1] (kg/cap/day)	1.52	1.52	1.52	1.52	1.54	1.50	1.54	1.62	1.62	1.64	1.69	1.68	1.68	1.63
Fraction MSW disposed to SWDS	0.38	0.38	0.38	0.38	0.33	0.29	0.20	0.12	0.09	0.07	0.09	0.08	0.08	0.03
Fraction DOC in MSW	0.13	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.10	0.10	0.11	0.10	0.10	0.09
Fraction of waste incinerated	0.08	0.08	0.08	0.08	0.09	0.09	0.11	0.12	0.12	0.12	0.12	0.13	0.14	0.14
Fraction of waste recycled	0.63	0.67	0.68	0.69	0.72	0.75	0.76	0.77	0.76	0.76	0.79	0.79	0.79	0.80
CH_4 generation rate constant (k)	0.09	0.09	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Number of SWDS recovering CH_4	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	47	51	50
Waste incineration (Tg)	3.9	4.1	4.0	3.8	4.4	4.7	5.6	6.7	6.8	7.1	7.2	7.6	7.6	7.6

[1] Waste generation rate refers to MSW waste, excluding inorganic industrial waste such as construction or demolition waste. NE = Not Estimated.

The following primary data sources are used for the annual activity data applied to the emission calculations:

- waste production and handling: Working Group on Waste Registration (WAR), CBS, RIVM;
- methane recovery from landfills: VA.

8.2.3 Uncertainty and time-series consistency

The uncertainty in CH_4 emissions of solid waste disposal sites is estimated to be about 34% in annual emissions (see *Section 1.7* for more details). The CH_4 emission trend for landfills is summarised in *Table 8.4*. This table also shows that the amount of CH_4 has been recovered (mostly for energy use). In the period 1990-2003 the emissions of CH_4 have decreased from 572 to 345 Gg per year (-40%). This decrease is due to the fourfold increase in CH_4 recovered, from about 5% in 1990 to 20% in 2003 (*Table 8.4*), but also to the decrease in methane produced in solid waste disposal sites. The main factors influencing the quantity of CH_4 produced are the *amount* of waste disposed of on land (see *Table 8.5*) and the *concentration* of C (carbon) in that waste (see *Table 8.2*).

Table 8.3. Composition of landfilled waste (%) (additional information on solid waste handling, part 2)

Waste type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Paper and paperboard	NE	NE	NE	NE	NE	16.6	NE	NE	11.2	11.1	13.1	11.4	9.1	8.6
Food and garden waste	NE	NE	NE	NE	NE	21.6	NE	NE	19.0	18.2	19.8	20.2	19.1	13.8
Plastics	NE	NE	NE	NE	NE	6.9	NE	NE	8.5	8.5	9.4	8.6	7.2	7.8
Glass	NE	NE	NE	NE	NE	2.1	NE	NE	1.5	1.5	1.8	1.7	1.1	1.0
Textiles	NE	NE	NE	NE	NE	1.0	NE	NE	1.1	1.1	1.3	1.4	1.4	1.1
Other:														
- Metals	NE	NE	NE	NE	NE	2.5	NE	NE	3.0	2.9	3.6	2.9	3.2	3.0
- Building wastes and ashes	NE	NE	NE	NE	NE	32.5	NE	NE	36.0	37.7	32.5	35.0	42.1	46.7
- Wood	NE	NE	NE	NE	NE	6.5	NE	NE	4.6	4.8	5.3	5.2	6.3	5.2
- Other	NE	NE	NE	NE	NE	10.2	NE	NE	14.6	13.8	13.0	13.5	10.3	12.4

NE = Not Estimated

Table 8.4. Net methane emissions and methane recovered from solid waste disposal sites 1990-2003(unit: Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CH_4 emissions (net)	572	572	560	545	527	500	483	468	448	410	386	363	345	323
CH_4 recovered/flared	26	35	45	55	64	74	69	59	54	66	66	67	69	69
% of gross emissions	5%	6%	8%	10%	12%	15%	14%	13%	12%	16%	17%	18%	20%	21%

Table 8.5. Waste disposal (excluding discharge into surface water)(Tg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Incinerated	3.9	4.1	4.0	3.8	4.4	4.7	5.6	6.7	6.8	7.1	7.2	7.6	7.6	7.6
Reused/recycled	5.2	5.6	5.7	5.8	6.2	6.4	6.6	7.1	7.1	7.2	7.7	7.7	7.8	7.7
Landfilled	3.1	3.1	3.2	3.2	2.8	2.4	1.8	1.1	0.8	0.6	0.9	0.8	0.8	0.3

Since 1990, the amounts of waste disposed in landfills and the concentration of carbon (C) have decreased, resulting in a smaller production of CH_4. These decreases are the result of environmental policy in the Netherlands to minimise the disposal of waste in landfills, and to increase recycling and incineration of waste. *Table 8.5* shows the trend in waste handling in the Netherlands for 1990-2003, where the amount of waste disposed in landfills decreased substantially.

8.2.4 Source-specific recalculations

Compared to NIR 2004 the calculated formation of methane and the amount of methane recovered for the year 2002 have been updated. This because of a different fraction of methane in landfill gas, as described in *section 8.2.2*, and because of an update in the amounts of waste landfilled. In addition, the amounts recovered or flared in 1991-1994 were updated and, accordingly, the gross emissions too, thereby not changing the net emissions reported last year.

Table 8.6. Effect of recalculation of CH_4 (Gg) emissions from landfills (category 6A)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
NIR2005													
- Gross emissions	597.8	607.8	605.5	599.1	591.0	573.8	552.4	527.1	501.4	475.9	451.4	429.2	414.2
- Recovered/flared	25.9	35.5	45.0	54.6	64.2	73.8	69.1	59.3	53.7	66.2	65.7	66.5	68.8
- Net emissions	**571.9**	**572.3**	**560.5**	**544.5**	**526.8**	**500.1**	**483.3**	**467.8**	**447.8**	**409.6**	**385.7**	**362.7**	**345.4**
NIR2004													
- Gross emissions	597.8	607.8	605.5	599.1	591.0	573.8	552.4	527.1	501.4	477.5	454.7	434.0	414.2
- Recovered/flared	25.9	35.5	45.0	54.6	64.2	73.8	69.1	59.3	53.7	66.2	65.7	66.5	68.8
- Net emissions	**571.9**	**572.3**	**560.5**	**544.5**	**526.8**	**500.1**	**483.3**	**467.8**	**447.8**	**411.3**	**389.1**	**367.4**	**345.4**
Difference													
- Gross emissions	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-1.7	-3.4	-4.7	0.0
- Recovered/flared	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 emissions	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**-1.7**	**-3.4**	**-4.7**	**0.0**

8.3 Wastewater handling [6B]

8.3.1 Source category description

CH_4 emissions from wastewater handling (category 6B) are not identified as a key source in *Box 8.1*. This year the CH_4 emissions from industrial waste water treatment plants (WWTP) and from septic tanks have been added, but these are very small compared to domestic and commercial WWTP. Its present share of CH_4 emissions in the national total was 0.1% (0.5% in 1990). N_2O emissions from wastewater treatment are a (level) key source and have, at present, a share of 1.2% in total emissions (0.8% in 1990) and were estimated for domestic and commercial WWTP and the N in the effluent wastewater causing indirect N_2O emissions, which are now also calculated cf. the IPCC guidelines.

8.3.2 Methodological issues

Country-specific methodologies are used for CH_4 and N_2O emissions from wastewater handling (including sludge), which are both equivalent to the IPCC Tier 2 methods. Generally IPCC default emission factors are used. For anaerobic industrial WWTP, the CH_4 emission factor is defined as 0.056 kg/industry equivalent (i.e.) capacity and an utilisation rate of 80%. For septic tanks, the emission factor for CH_4 is expressed as 7.5 kg/year per person connected to a septic tank, assuming an MCF of 0.5 and B_o of 0.25.

A full description of the methodology is provided in the protocol (Ruyssenaars, 2005) and in the background document *Oonk et al.* (2004). Since the N_2O emissions from wastewater handling are a key source (see *Box 6.1*), the present Tier 2 methodology complies with the *IPCC Good Practice Guidance* (IPCC, 2000). The calculation of indirect N_2O from N in the effluent wastewater is an addition and change from the previous method and is part of the complete revision of the method for calculating indirect N_2O emissions (see Chapters 6 and 4).

8.3.3 Uncertainties and time-series consistency

Table 8.7 gives an overview of the trend in greenhouse gas emissions from the three sources of wastewater handling. Since 1990, CH_4 emissions from wastewater treatment plants have decreased due to the introduction of a new sludge stabilisation system in one of the largest wastewater treatment plants in 1990; the operation of the plant took a few years to become optimised. This caused larger venting emissions in the introductory period than during normal operating conditions. From *Table 8.8* it can be concluded that 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.

The newly added source '*Septic tanks*" shows a steady decrease from 1990 onwards which can be explained by the increase in the number of households which is connected to the sewer systems in the Netherlands and thus no longer make use of septic tanks.

Table 8.7. Wastewater handling emissions of methane (in Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Industrial Wastewater	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3
Domestic & Com.Wastewater	9.1	14.0	14.2	14.5	9.7	7.9	7.9	7.8	8.0	8.5	8.0	8.1	8.5	8.0
Septic tanks	4.5	4.1	3.8	3.5	3.4	3.3	3.1	2.9	2.6	2.4	2.2	2.0	1.8	1.5
Net CH_4 emissions (Gg)	13.8	18.4	18.3	18.3	13.4	11.5	11.3	11.0	11.0	11.2	10.5	10.5	10.7	9.9
CH_4 recovered and/or flared (Gg)	27.6	27.6	27.6	27.6	27.6	37.8	37.3	39.5	34.3	37.9	36.6	39.5	39.5	39.5
Recovery/flared (% gross emis.)	67%	60%	60%	60%	67%	77%	77%	78%	76%	77%	78%	79%	79%	80%

Table 8.8. Wastewater handling: composition (unit: Gg DOC/yr [1])

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Wastewater	933	933	933	933	933	921	921	916	930	915	921	937	937	937
Sludge	254	254	254	254	254	269	283	270	279	282	281	299	299	299
Total	**1 187**	**1 187**	**1 187**	**1 187**	**1 187**	**1 190**	**1 204**	**1 186**	**1 209**	**1 197**	**1 202**	**1 236**	**1 236**	**1 236**

1) DOC: Degradable Organic Component

Table 8.9. Indirect N_2O from wastewater handling (unit: Gg DOC/yr [1])

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
N in effluent (Gg)	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
N_2O (Gg)	0.8	0.8	0.8	0.8	0.7	0.7	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.4

1) DOC: Degradable Organic Component

8.3.4 Source-specific recalculations

This year two new sources have been added: CH_4 from industrial wastewater treatment and from septic tanks (see *Table 8.7).* Because of their insignificance compared to N_2O from domestic wastewater treatment, no N_2O emissions were estimated for these sources. However, N_2O emissions from domestic WWTP changed compared to last submission due to a new calculation method for domestic (urban) waste-water, which is fully described in *Oonk et al.* (2004). In addition to the direct emissions in the WWTP, the N in the effluent wastewater causes indirect N_2O emissions, which are now also calculated cf. the IPCC guidelines (*Table 8.9*). The latter is an addition/change in view of the total revision of the method for calculating indirect N_2O emissions (see Chapters 6 and 4). The effects of these recalculations are shown in *Table 8.*10.

Table 8.10. Effect of recalculations of CH_4 and N_2O (Tg) emissions from wastewater handling (category 6B)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CH_4 - NIR2005	**13.8**	**18.4**	**18.3**	**18.3**	**13.4**	**11.5**	**11.3**	**11.0**	**11.0**	**11.2**	**10.5**	**10.5**	**10.7**
o.w. Dom./Com.. WWTP	*9.1*	*14.0*	*14.2*	*14.5*	*9.7*	*7.9*	*7.9*	*7.8*	*8.0*	*8.5*	*8.0*	*8.1*	*8.5*
o.w. Industrial WWTP	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.3*	*0.4*
o.w. Septic tanks	*4.5*	*4.1*	*3.8*	*3.5*	*3.4*	*3.3*	*3.1*	*2.9*	*2.6*	*2.4*	*2.2*	*2.0*	*1.8*
CH_4 - NIR2004	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**1.3**	**0.8**	**3.8**	**1.8**	**0.8**	**0.7**	**0.7**
Difference	*12.5*	*17.1*	*17.1*	*17.0*	*12.1*	*10.2*	*10.0*	*10.2*	*7.2*	*9.4*	*9.7*	*9.8*	*10.0*
N_2O - NIR2005	**2.5**	**2.5**	**2.5**	**2.4**	**2.4**	**2.1**	**2.1**	**2.0**	**2.1**	**2.0**	**1.9**	**1.9**	**1.9**
o.w. Dom. & Ind. WWTP	*1.7*	*1.7*	*1.6*	*1.6*	*1.6*	*1.5*	*1.5*	*1.4*	*1.5*	*1.4*	*1.4*	*1.4*	*1.4*
o.w. Indirect emissions	*0.8*	*0.8*	*0.8*	*0.8*	*0.7*	*0.7*	*0.6*	*0.6*	*0.6*	*0.6*	*0.5*	*0.5*	*0.5*
N_2O - NIR2004	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.6**	**0.5**	**0.6**	**0.6**	**0.6**	**0.6**
Difference	***1.2***	***1.2***	***1.2***	***1.1***	***1.1***	***1.0***	***1.0***	***0.9***	***0.9***	***0.8***	***0.8***	***0.8***	***0.8***

8.4 Waste incineration [6C]

8.4.1 Source category description

The source category waste incineration is included in source category 1A1 '*Energy industries'* since most waste incineration facilities also produce electricity or heat used for energetic purposes and according to the *IPCC Guidelines* (IPCC, 1997), these should be reported under category 1A1a.

8.4.2 Methodological issues

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 included in the ER-I dataset. The fossil-based and organic CO_2 emissions from *waste incineration* (e.g. plastics) are calculated from the total amount of waste incinerated. Per waste stream (residential and several others) the composition of the waste (the six types as listed in *Table 8.10*) is determined. For each of these six types a specific carbon content and fractions of fossil C in total C is assumed, which will yield the CO_2 emissions. The method is described in detail in Joosen and De Jager (2003) and in the monitoring protocol (Ruyssenaars, 2005). CH_4 emissions from these sources are not estimated (neglected). For N_2O an emission factor of 20 g/ton waste is applied based on measurement data (Spoelstra, 1993).

8.4.3 Uncertainties and time-series consistency

The source category '*Waste incineration*' is included in category 1A1 (Energy industries) as part of the subsource '*Public Electricity and Heat Production'* (1A1a), see *Section 3.2.1*. As the emissions from this source are now reported under combustion of 'other fuels' in 1A1a, these are now specified separately. *Table 8.11* shows 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 total waste incinerated.

Table 8.11.Composition of incinerated waste: carbon fraction and fossil fraction (%)

Waste type	Carbon fraction	Fossil fraction
WIP: 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

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 8.12. Composition of incinerated waste.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Total waste incinerated (Gg)	2.8	2.7	2.7	2.9	2.7	2.9	3.6	4.1	4.6	4.6	4.9	4.7	5.0	5.1
o.w. residential waste (Gg):	2.3	2.2	2.2	2.2	2.0	2.1	2.6	3.0	2.9	3.1	3.1	3.4	3.6	3.6
Of which:														
WIP: paper/cardboard (%)	*25*	*25*	*25*	*25*	*28*	*29*	*30*	*30*	*29*	*29*	*27*	*28*	*27*	*26*
WIP: wood (%)	*2*	*2*	*3*	*3*	*3*	*4*	*4*	*5*	*5*	*5*	*6*	*5*	*5*	*5*
WIP: other organic (%)	*46*	*46*	*44*	*40*	*37*	*33*	*32*	*32*	*33*	*31*	*32*	*32*	*32*	*32*
WIP: plastics (%)	*9*	*9*	*9*	*9*	*9*	*10*	*11*	*12*	*13*	*13*	*13*	*13*	*13*	*15*
WIP: other combustible (%)	*8*	*9*	*9*	*11*	*11*	*11*	*10*	*9*	*10*	*10*	*10*	*10*	*10*	*10*
WIP: non-combustible (%)	*11*	*10*	*11*	*11*	*12*	*12*	*11*	*11*	*11*	*12*	*12*	*12*	*13*	*13.0*
Energy content (MJ/kg)	8.2	8.4	8.5	9	9.3	9.8	10.1	10.1	10.2	10.3	10.2	10.3	10.3	10.6
Fraction organic (%)	*58*	*57*	*57*	*56*	*55*	*54*	*53*	*52*	*52*	*51*	*51*	*50*	*49*	*47*
Amount of fossil carbon	162	161	161	191	189	221	294	352	380	404	405	408	435	477
Amount of organic carbon	530	517	508	554	510	563	709	836	891	920	929	897	932	924

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).

8.5 Other waste handling [6D]

8.5.1 Source category description

This source category consists of some CH_4 and negligible N_2O emissions from industrial composting (see *Table 8.1*). It is a new source, previously not reported. This source category is not considered as a key source. Please note that non-CO_2 emissions from combustion of biogas at wastewater treatment facilities are allocated under category 1A4 (*Fuel combustion - Other sectors)* because this combustion is partly used for heat or power generation at the plant.

8.5.2 Methodological issues

A country-specific methodology is used for industrial composting with activity data from WAR (2004) and emission factors from VROM (2002) (see monitoring protocol, Ruyssenaars, 2005). Emissions from small-scale composting of garden waste and food waste by households are not estimated as these are assumed to be negligible. Since this source is not considered as a key source (see *Box 8.1*), the present methodology level complies with the *IPCC Good Practice Guidance* (IPCC, 2000).

8.5.3 Uncertainties and time-series consistency

This activity has been increased over time as can be concluded from the trend in methane emissions from the 6D subcategory (*Table 8.1*). The emissions are calculated using an average emission factor from literature. Given the large scatter in reported emission factors the uncertainty is estimated more than 100%.

8.5.4 Source-specific recalculations

Last year this source category consisted of ambiguous CO_2 emissions and some CH_4 and N_2O emissions reported as miscellaneous emissions by individual waste handling companies. As part of the inventory improvement programme, these emissions have now been set to zero and all specific fuel combustion and process emissions have been estimated and reported under the corresponding sectors (1A, 2), thereby achieving consistent times series for the complete 1990-2003 period in this and other source categories. The effect of this recalculation for CO_2 is shown in *Table 8.13*.

Table 8.13. Effect of recalculation of CO_2 (Tg) emissions from 'Other waste' (category 6D).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
NIR2005	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
NIR2004	0.9	0.0	0.0	0.0	0.0	0.9	1.1	1.2	0.1	0.7	0.0	0.0	0.0
Difference	-0.9	0.0	0.0	0.0	0.0	-0.9	-1.1	-1.2	-0.1	-0.7	0.0	0.0	0.0

9. RECALCULATIONS AND IMPROVEMENTS

In this chapter, we outline the key differences compared with the previous NIR (i.e in 1990-2002 data) (*Klein Goldewijk et al.*, 2004). Most changes arise from major recalculations in the different sectors. Most recalculations are carried out for the whole time series. For more details, please refer to the recalculation sections in the sector chapters, *Chapters 3 to 8*.

9.1 Explanation and justification for recalculations

This section will elaborate the relevant changes in emission figures compared to the previous NIR. A distinction is made between:

1. *Methodological changes:* new data arising from revised, or new estimation methods; improved emission factors have also been included under methodological changes (including reallocations in international bunkers that affect the national total);
2. *Allocation:* changes in the allocation of emissions to different sectors (these only affect the totals for these sectors);
3. *Error corrections:* repairing incorrect data.

Because nearly all data were being recalculated and completely refreshed in the CRF, in the present CRF, errors in the previous submission have also been corrected. Apart from these changes, emissions for the last year reported in the NIR 2004, i.e. 2002, have also been recalculated and then updated as more detailed statistics and information on recent emission-factor trends became available.

As described in the sector chapters of this NIR, several methodological changes have been implemented for this submission. The methodologies are explained in the relevant chapters. These changes are justified, because they improve the inventory for greenhouse gas in terms of:

- transparency (mainly categories 1A, 2);
- completeness (mainly categories 4B, 4D/2G, 5, 6B, 6D);
- consistency (mainly categories 1A, 1B, 2, 4A), and;
- compliance with IPCC guidelines (higher tiers for key sources and source allocation) (mainly categories 1B, 3, 4A, 4B);
- accuracy (mainly categories 1A, 1B, 4A, 4B, 4D, 6B).

In particular, substantial improvements have been achieved in increasing the transparency and consistency of categories 1A and 2, the methodologies for gas distribution, enteric fermentation from cattle and indirect N_2O, in compliance with IPCC Good Practice, and in significantly increasing the completeness of ‘CO_2 from LUCF’. All the recalculations are part of the ongoing improvement plan, as described in *Section 9.4.7*.

9.1.1 Methodological changes

The following methodological changes were made for greenhouse gases:

- Fuel use and emissions (CO_2, CH_4, N_2O) from fossil fuels (stationary combustion, processes and feedstocks) have been recalculated, based on National energy statistics, country-specific emission factors, and on specific circumstances (Sectors 1A and 2). It was possible to carry out these recalculations in detail for the years 1990 and 1995 to 2003. For some sources, for the years 1991-1994, a more aggregated approach had to be used, because of a lack of detailed energy statistics;
- In the CO_2 Reference Approach we also used updated carbon storage factors for the non energy use of fossil fuels;
- Emissions from domestic and international transport (all gases, all years) have been recalculated, based on updated emission factors; gas/oil data for other mobile sources (category 1A3) have also been recalculated;

- Emissions from fisheries and from military shipping and aviation, have been recalculated, i.e. explicitly estimated now, and reported as domestic emissions instead of being included in international bunker emissions (categories 1A4a and 1A5, respectively);
- Emissions (CO_2, CH4, N_2O) from oil and natural gas production have been recalculated, based on detailed data from the industry (category 1B2). Emissions from venting and flaring have also been distinguished now for the total time series;
- CH_4 emissions from gas distribution have been recalculated, based on detailed data about network materials and emission factors gained from a German study (category 1B2b);
- CO_2 and CH_4 emissions from industrial processes have been recalculated from statistical information and default emission factors, rather than from emission data supplied by individual firms (all years, Sector 2); this also includes CO_2 from the use of fossil fuels for feedstock in the chemical industry, and the use of fuels for other purposes than for energy in other source categories (Sector 2);
- CO_2 from use of petrochemical products (indirect emissions from NMVOC) has been recalculated. This calculation was previously based on domestically manufactured chemical products, but now it is based on the products actually used in the Netherlands (Sector 3);
- CH_4 from enteric fermentation by cattle and manure management has been recalculated, based on country-specific Tier 2 emission factors, calculated for each year (Sector 4);
- N_2O (mostly indirect) from agricultural soils has been recalculated to comply with the IPCC Good Practice methods (category 4D). Indirect N_2O emissions from agricultural sources of NO_x and NH_3 not listed in Sector 4 have also been recalculated (category 2G);
- N_2O from manure management has been recalculated from more detailed activity data on manure systems (category 4B);
- The LUCF CO_2 data, as required in the Good Practice for LULUCF, have been recalculated and up-dated (Sector 5);
- New emission figures have been added for CH_4 and N_2O in waste-water handling (industrial WWTP, septic tanks, and human sewage) and large-scale waste composting (categories 6B and 6D);
- HFC and PFC emissions for the years 1990-2002 have been revised using improved data from that industrial branch (Sector 2).

These recalculations had little or no effect on the emissions of the precursor gases. However, in the previous submission, the emissions of precursors from international navigation were included in the national total by mistake; the largest changes in precursor emissions have come about because these emissions have now been excluded. However, these reallocations have not yet been made for 1991-1994, so there is a discontinuity in the domestic emissions of these gases for these years.

9.1.2 Source allocation

In this submission, the source allocation was improved in the following ways:

- Fossil-fuel-related non-combustion CO_2 emissions previously reported under 1A have now been reported as industrial processes, e.g. production of ammonia and other chemicals (category 2B) and coke/coal inputs in blast furnaces (category 2C) (net, i.e. combustion emissions of blast furnace gas are reported under 1A);
- CO_2 emissions from solvents and by using other products, previously estimated from domestically produced chemical products and reported under 1A2, are now allocated under Sector 3 (and recalculated with a completely different methodology, see *Section 9.1.1*);
- CO_2 emissions in category 6D are now identified as combustion emissions and are allocated in the 1A4 category;
- Emissions formerly reported under Sector 7 are now allocated under category 2G; indirect N_2O is also allocated under category 4D;
- Emissions from mobile off-road machinery are now reported under 1A2f (other industry) and 1A4c (agriculture, forestry and fisheries) (in last submission, they were reported under the transport category, 1A3);

- As mentioned under methodological changes, the source-specific calculation of emissions from fisheries and military ship and aircraft emissions effectively resulted in a shift from bunker emissions to emissions in the energy sector (1A4c and 1A5);
- The emissions from the combustion of biogas at waste disposal sites are no longer allocated in 1A5, but are now to be found in 1A4a.

9.1.3 Error correction

During the compilation of the CRF based on the PER inventory for 2003, and the in-country review of the NIR 2004, a few minor errors were detected in the emissions reported in the CRF. The most obvious error corrections were:

- Error correction in CO_2 from cement clinker production in 1990 and 1991;
- Other errors have been captured in the recalculations listed above.

9.2 The implications for emission levels

This section outlines the implications over time for the emission levels of the different improvements, described in *Section 9.1*. *Table 9.3* elaborates the differences between the submissions from last year and the current NIR, on the level of the different greenhouse gases. More detailed explanations are elaborated in the sector chapters, *Chapters 3 to 8*.

Table 9.1. Differences between NIR 2004 and NIR 2005 for 1990-2002 due to recalculations

Gas	Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CO_2 [Tg]	NIR 2004	**159.2**	166.2	165.0	166.6	167.5	172.0	180.2	165.0	171.0	166.0	169.3	175.6	175.2
Incl. LUCF	NIR 2005	**160.9**	165.7	163.8	168.2	168.2	172.3	180.0	173.0	174.9	169.7	171.7	177.1	176.7
	Difference	***1.1%***	***-0.3%***	***-0.7%***	***0.9%***	***0.4%***	***0.2%***	***-0.1%***	***4.8%***	***2.3%***	***2.2%***	***1.4%***	***0.8%***	***0.8%***
CO_2 [Tg]	NIR 2004	**160.6**	167.7	166.4	168.5	169.5	173.2	181.6	166.2	172.4	167.3	170.7	177.1	176.7
Excl. LUCF	NIR 2005	**158.0**	162.9	161.1	165.5	165.5	169.7	177.3	170.2	172.2	166.9	168.9	174.4	173.9
	Difference	***-1.6%***	***-2.8%***	***-3.2%***	***-1.7%***	***-2.3%***	***-2.1%***	***-2.3%***	***2.4%***	***-0.1%***	***-0.2%***	***-1.1%***	***-1.5%***	***-1.5%***
CH_4 [Gg]	NIR 2004	**1302**	1326	1283	1261	1233	1190	1181	1105	1068	1020	968	949	891
	NIR 2005	**1220**	1233	1211	1189	1155	1135	1106	1052	1013	963	929	905	868
	Difference	***-6.3%***	***-7.0%***	***-5.6%***	***-5.7%***	***-6.4%***	***-4.7%***	***-6.4%***	***-4.8%***	***-5.1%***	***-5.6%***	***-4.0%***	***-4.6%***	***-2.6%***
N_2O [Gg]	NIR 2004	**52.9**	53.7	56.9	59.3	58.0	58.4	57.4	57.2	56.6	55.7	53.4	51.0	49.3
	NIR 2005	**68.7**	70.0	72.2	74.6	71.9	72.3	71.6	70.8	70.0	67.6	64.2	60.9	58.0
	Difference	***30.0%***	***30.3%***	***27.0%***	***25.9%***	***23.9%***	***23.9%***	***24.6%***	***23.7%***	***23.7%***	***21.2%***	***20.2%***	***19.4%***	***17.6%***
PFCs [Mg]	NIR 2004	351.2	351.5	301.9	304.3	269.8	**265.4**	292.0	312.9	247.3	206.5	220.5	208.2	173.3
	NIR 2005	312.6	309.4	281.3	284.3	273.4	**266.2**	294.7	319.2	252.9	205.9	220.1	205.9	205.0
	Difference	***-11.0%***	***-12.0%***	***-6.8%***	***-6.6%***	***1.3%***	***0.3%***	***1.0%***	***2.0%***	***2.3%***	***-0.3%***	***-0.2%***	***-1.1%***	***18.3%***
HFCs [Mg]	NIR 2004	378.8	295.0	405.9	473.5	680.1	**700.2**	1113.0	1495.5	1585.2	1214.7	1056.1	649.3	533.0
	NIR 2005	378.8	295.0	405.9	473.5	704.1	**694.5**	1104.3	1486.5	1575.3	1173.5	1025.5	638.0	529.9
	Difference	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***3.5%***	***-0.8%***	***-0.8%***	***-0.6%***	***-0.6%***	***-3.4%***	***-2.9%***	***-1.7%***	***-0.6%***
SF_6 [Mg]	NIR 2004	9.1	5.6	6.0	6.3	8.0	**12.6**	13.1	14.4	13.8	13.3	14.0	14.9	14.4
	NIR 2005	9.1	5.6	6.0	6.3	8.0	**12.6**	13.1	14.4	13.8	13.3	14.0	14.9	15.0
	Difference	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.0%***	***0.2%***	***4.4%***
Total	NIR 2004	210.0	216.7	216.2	218.7	219.9	223.3	232.8	216.8	222.4	211.4	212.0	214.7	212.4
[Tg CO_2-eq.]	NIR 2005	214.6	219.0	218.1	223.3	223.3	226.7	235.4	227.9	229.3	217.5	216.8	218.3	216.2
Incl. LUCF	***Difference***	***2.2%***	***1.1%***	***0.9%***	***2.1%***	***1.5%***	***1.5%***	***1.1%***	***5.1%***	***3.1%***	***2.9%***	***2.3%***	***1.6%***	***1.8%***
Total.	NIR 2004	211.4	218.2	217.7	220.5	221.9	224.5	234.2	218.0	223.8	212.7	213.4	216.1	213.8
[Tg CO_2-eq]	NIR 2005	211.7	216.2	215.4	220.7	220.6	224.0	232.7	225.0	226.5	214.8	214.0	215.5	213.5
Excl. LUCF	*Difference*	***0.2%***	***-0.9%***	***-1.0%***	***0.1%***	***-0.6%***	***-0.2%***	***-0.6%***	***3.2%***	***1.2%***	***1.0%***	***0.3%***	***-0.3%***	***-0.1%***

Note: base year values are indicated in bold.

9.2.1 Recalculation of base year and year 2002

Base year (1990 for CO_2, CH_4 and N_2O; 1995 for F-gases)

The total CO_2-eq. emissions (including LUCF) in the base year 1990 increased by 4.6 Tg CO_2-eq, or 2.2 %, compared to last submission. The total CO_2-eq. emissions (excluding LUCF) increased by 0.2%. This can be explained by the following most relevant changes **(all are expressed as CO_2 equivalents)**:

- **CO_2 (excluding LUCF):** - 9.4 Tg in the *Energy* sector (1A) due to major recalculations using energy statistics, which also led to it being reallocated from the CO_2 emissions in *Waste* (6) to *Energy*; and + 0.9 Tg in *Fugitive emissions from fuel* (1B) due to recalculations based on improved sector data (see *Section 3.1* for more detailed information). The recalculations also increased the amounts of CO_2 emissions shown in *Industrial Processes* (2) by 6.5 Tg and in *Solvent and Other Product Use* by 0.3 Tg.
- **CO_2 (including LUCF):** Recalculating the *LUCF category 5A Forest* and adding *LUCF emissions from soils, categories 5B to 5D* resulted in a significant change in net emissions/removals from a net sink of about 1.5 Tg CO_2 in the previous submission that was based only on a partial estimate for 5A, to a net source of about 2.8 Tg CO_2. This is mainly due to the addition of emissions now estimated for cultivating organic soils in category 5D, partly compensated by a larger net sink in category 5A due to other biomass expansion factors and the inclusion of dead wood. These changes were made for the total time series.
- **CH_4:** recalculations related to the use of fossil fuel resulted in lower emission figure — a decrease of -1.5 Tg CO_2-eq — in *Energy (1)* and *Industrial Processes (2)*. The net decrease in CH_4 from *Agriculture (4)* arose from an increase of 0.8 Tg in *Manure Management* (4B) and a decrease of -1.1 Tg in *Enteric Fermentation (4A)* due to new, country-specific recalculations; CH_4 in the category *Waste* (6) showed an increase of by 0.15 Tg after *Wastewater Handling* emissions had been recalculated. The emissions in the *Others* sector (7) are now allocated in *Industrial Processes* (2). Other CH_4 emission figures were affected by the recalculations and reallocations to a lesser extent.
- **N_2O:** the national emissions increase of 28% occurred mainly in *Agriculture (4)*, where a new calculation for emissions from *Agricultural soils (4D)* had been introduced (4.3 Tg) and where *Manure Management (4B)* (0.5 Tg) had been recalculated. Recalculations in the other categories only slightly changed the emission data. N_2O emissions formerly reported under 7 are now included in *Agriculture (4)* and *Other industrial processes* (2G), because the method of calculation has been revised.
- **F-gases:** Changes in 1995 – the base year for the emissions of fluorinated gases – brought about because of recalculating, amount to -0.03 Tg CO_2-eq. for HFCs and -0.01 Tg for PFCs. SF_6 emissions did not change in 1995.
- **Bunkers:** Recalculating also caused the memo item *Bunkers* to decrease by -0.9 Tg (virtually all CO_2).

Please note that these recalculations were also carried out for subsequent years. However, in almost all cases, they were restricted to the emissions of CO_2, CH_4, N_2O and the F-gases. The values for precursor emissions showed no change, except for the emissions from transport (all years).

Year 2002: A full recalculation based on final statistics

The data for 2002 are now based on the final 2002 energy and production statistics. This implies that almost all emission data related to these statistics will show changes. Furthermore, the 2002 data were also recalculated using the methods described in the former paragraph, and in *Section 3.1*. The decrease in the total CO_2-eq. emissions (excluding LUCF) for 2002 was -0.3 Tg CO_2-eq., or -0.1%, compared with the last submission. The main changes (all shown as CO_2 equivalents) are for CO_2:

- -7.7 Tg in *Energy* (1A and 1B) due to using a new calculation method;
- +4.8 Tg in *Industrial Processes* (2) due to recalculations based on the new method.
- +0.2 Tg in *Solvent and Other Product Use* (3) due to using a new calculation method;

- +4.2 Tg from *LUCF* (5) because *Emissions and Removals from cultivated histosols* was included in the inventory.

The largest changes for CH_4 are found in:

- -1.5 Tg due to the recalculations in the sector *Fugitive fuel emissions* (1B) based on new data from oil and gas production and the gas distribution sector;
- +0.5 Tg due to recalculating the emissions from *Manure management* (4B) and *Enteric Fermentation* (4A);
- +0.3 Tg due to recalculating the emissions from *Waste* (6B and 6D).

For N_2O:

- +2.9 Tg increase in emissions from *Agricultural soils* (4D, indirect emissions) and *Manure management* (4B) due to recalculations;
- +0.7 Tg increase allocated to *Other industrial processes* (2G) following the recalculation of indirect N_2O emissions.

For HFCs, PFCs and SF_6: -0.01, +0.2 Tg and +0.02 Tg, respectively, following recalculations based on new data from that industrial branch.

9.2.2 Recalculation of other years/gases

The decrease in the total CO_2-eq. emissions (excluding LUCF) in 1991 to 1994, compared with the last submission, amounts to -2.0, -2.3, -0.2 and -1.2 Tg CO_2-eq or -0.9, -1.0, -0.1 and -0.6%, respectively. As would be expected, due to the full time series recalculation, the changes in these years are similar to those in the years mentioned before.

The changes in the total CO_2-eq. emissions (excluding LUCF) in 1995 to 2001 compared with previous submission amounts to -0.5, -1.8, +6.8, +2.7, +2.8, -0.6 and -0.3 Tg CO_2-eq or -0.2%, -0.8%, +3.1%, +1.2%, +1.0%, 0.3% and -0.1%, respectively. The main changes originate from the recalculations, as explained in Section *9.2.1*. The changes were positive for the years 1997 to 1999. This is because of CO_2 emissions in the Energy sector. As was assumed in the previous submission, the energy data for those years were of poor quality, especially for 1997 for which a large discrepancy with the CO_2 Reference Approach was observed. Using the new calculation method, data are now in line with the other years.

9.3 The implications for emission trends, including time-series consistency

The recalculations, in general, account for an improvement in the overall emission trends: data for all greenhouse gases and all sources are now consistent in methodology and allocation for the complete period 1990-2002. The differences in national total emissions per compound are presented in *Table 9.1* for each year in the period 1990 to 2002. The change in the 1990-2002 trend for the greenhouse gas emissions compared to the previous submission is presented in *Table 9.2*. From this table it can be concluded that due to recalculations the trend in the total national emissions decreased by -0.3% compared to the NIR 2004. The largest absolute changes in emission trends are observed for N_2O and CH_4 induced by the agriculture category.

On a more detailed level, the trends for all gases for all years can be found in the CRF file for 2003 (CRF Tables 10). These are also reproduced in *Appendix 7.3*. Furthermore, additional information on the trends is given in the sectoral sections. Although the allocation of sources is uniform, due to the ambiguous source descriptions and differences in data quality, the trends on the (sub)sector level may show more fluctuations, especially for the years 1991-1994, where the recalculations for the fossil-fuel-related emissions were carried out on a more aggregated level.

Table 9.2. Differences between NIR 2004 and NIR 2005 for the emission trends 1990-2002

Gas	**Trend (absolute)**			**Trend (percentage)**		
CO_2-eq. [Gg][1)]	**NIR 2004**	**NIR 2005**	*Difference*	**NIR 2004**	**NIR 2005**	*Difference*
CO_2	16,076	15,929	*-146*	10.0%	10.1%	*0.1%*
CH_4	-8,633	-7,409	*1,224*	-31.6%	-28.9%	*2.7%*
N_2O	-1,112	-3,341	*-2,228*	-6.8%	-15.7%	*-8.9%*
HFCs	-2,859	-2,865	*-6*	-64.5%	-64.7%	*-0.1%*
PFCs	-1,216	-699	*517*	-50.3%	-33.1%	*17.3%*
SF_6	126.3	141.5	*15.2*	58.1%	65.1%	*7.0%*
Total	2,380.7	1,756.4	*-624.3*	1.1%	0.8%	*-0.3%*

1) Excluding LUCF.

9.4 Recalculations, response to the review process and planned improvements

9.4.1 Revised source allocations

For domestic purposes, emissions in the Netherlands are grouped under the so-called Target Sectors on which environmental policy is focused. The definition of these sectors is provided in Olivier *et al.* (1999). An updated correspondence table for emissions from Target Sectors and IPCC Source Categories is provided in *Table 1.1*. As a further step towards uniform reporting at the more detailed source category level of the Common Reporting Format (CRF), all subcategories at the lowest aggregation level currently used for reporting for domestic purposes (the so-called reporting codes [*rapcodes*, in Dutch] have received an additional attribute ‘IPCC subsector’. For the year 2004, we introduced a new set of *rapcodes*, which include the recalculated emissions of CO_2, N_2O and CH_4 from sources related to stationary fossil-fuel combustion. New codes were also introduced for the CO_2 and CH_4 emissions from industrial processes. These *rapcodes* are now used for reporting the emissions of these gases in the Categories 1, 2 and (partly) 3. The Categories 4 to 6, and the emissions of precursors and F-gases for all other categories, are reported within the existing source codes. In this way, former constraints in the Dutch source coding could largely be eliminated, and compliance with the source category definitions in the *Revised 1996 IPCC Guidelines* identified (reporting codes) in the Dutch *Pollutant Emission Register* (Coenen and Olivier 2002) could be further improved, in particular with respect to distinguishing between CO_2 emissions from ‘feedstock/non-energy use’ and those from ‘fossil fuel combustion emissions’.

All emissions data (CO_2, CH_4, N_2O and F-gases) in this submission for the years 1990 and 1995 to 2003 were submitted to the Netherlands’ Emission Registration system using the updated source codes. This resulted in a fully comparable source allocation in the CRF for these years. Especially for CO_2 (and related emissions from combustion and processes), this resulted in reallocations between and within Sectors 1, 2, 3 and 6 (see also *Section 9.1*). Indirect N_2O emissions from leaching and run-off have been moved from Sector 7 to Categories 4D and 2G.

The energy statistics datasets for stationary sources for the 1991-1994 period have not been revised completely; thus source allocations, i.e. activity data, may differ at the more detailed subcategory level.

9.4.2 Completeness of sources

The Netherlands greenhouse gas emission inventory now includes all sources identified by the *Revised IPCC Guidelines (IPCC, 1997).* CH_4 emissions from *soils* have deceased over the past 40 years due to drainage and the lowering of water tables; these emissions have been included in the natural total; thus there are no net (i.e. positive) anthropogenic emissions. On the contrary, the total methane from soils acts, in fact, like a methane sink. Most sources lacking in the last submission are now included in the inventory and the CRF:

- Direct N_2O emissions from *agricultural soils* (crop residues and histosols) (Category 4D);
- Indirect N_2O emissions from *atmospheric deposition* (Category 4D and 2G);
- CH_4 and N_2O from *horse manure* (Category 4B);
- CH_4 and N_2O from the *explicit inclusion of solid manure* (Category 4B);
- Emissions/sinks for *LULUCF subcategories 5A to 5E*;
- CH_4 and N_2O emissions from *industrial* wastewater treatment and human sewage (6B) and from *large-scale compost production* from organic waste (6D).

Sources not estimated are:

- CO_2 from lime production (2A2), due to missing activity data;
- indirect CO_2 from NMVOC from oil transport, distribution of oil products (1B2a), negligible source;
- CO_2 from asphalt roofing and road paving with asphalt (2A6 and 2A7), due to negligible source;
- CH_4 from poultry (4A9), due to missing emission factors;
- N_2O from industrial wastewater (6B), due to negligible source;
- CH_4 and N_2O emissions from LUCF (5A-5D).

A survey made to check for possible unidentified sources of non-CO_2 emissions in the Netherlands revealed that some other minor sources of PFCs and SF_6 have also not been included in the present greenhouse gas inventory (DHV 2000). If they are monitored regularly, these may be included later.

9.4.3 Changes in CRF files compared to the previous submission

The tables included in *Appendix 7* represent the *printed summary version* of the annual submission for the Netherlands for 2005 of the CRF files of its greenhouse gas emission inventory in accordance with the UNFCCC and the EU *Greenhouse Gas Monitoring Mechanism.* These include:

- IPCC Summary Tables 7A for the base years 1990 and 1995, and for the last two years (2002 and 2003) (CRF Summaries 1);
- Trend Tables 10 for each gas individually and for all gases and sources, expressed in CO_2-eq. (*Netherlands - submission 2005 v2.0 - 2003.xls* is included in this file);
- Trend Tables 10 for precursor gases (*Netherlands - submission 2005 v2.0 - 2003.xls* is included in this file);
- Recalculation Tables and Explanation Table 8.a and 8.b for the base year 1990 and for period 1995-2002.

Completeness Table 9 for 1990 has been included in *Appendix 5*. The largest changes are (see copy of recalculation checklist below):

- Data for 2001 and 2002 have been updated – undertaken because of this year's major methodology and input data changes for the whole period (2002 data were partly based on activity data, estimated in the previous submission);
- Data for 2003 have been added (figures for 2003 are partly based on estimated activity data);
- Data for 1990-2000 have been updated in accordance with the latest data and methodology – undertaken because of this year's major methodology and input data changes for the whole period (see also *Sections 9.1* to *9.4*), including changes announced in the previous four inventory reports;
- The use of notation keys was largely extended and completed;
- Errors in formulas in the CRF files, as detected during the reviews, were removed.

Status report on the recalculations

For your information, we have summarised the recalculations (derived from the CRF status reports on recalculations) below. Please note that we have recalculated the complete time series for 1990-2003. All the recalculations are explained in Table 8 of the CRF.

	Energy	Ind.Processes	Solvent Use	LUCF	Agriculture	Waste
CO_2	x	x	x	x	x	x
CH_4	x	x		x	x	x
N_2O	x	x		x	x	x
HFCs, PFCs, SF_6		x				

9.4.4 Completeness of the CRF files

As mentioned above, the recalculation of the fuel-related greenhouse gas emissions yields sectoral background data for all CRF categories. For the years 1991-1994, the energy data may be somewhat less detailed for industrial subcategories, but they adequately cover all sectors and source categories. All emissions are now specified according to fuel type (solid, liquid and gaseous fossil fuels). Coal-derived gases (coke oven gas, blast furnace gas etc.) have been included under 'Solid fuels' and refinery gases and residual chemical gases under 'Liquid fuels' (also LPG, except for Transport). The fuel category 'Other fuels' is now only used to report the emissions from waste (the fossil part) in waste incineration (1A1a). Because the subsectors for industrial processes in the Netherlands often comprise only a few companies, it is generally not possible to report detailed and disaggregated data. Due to the small number of companies, some of the activity data cannot be reported because, as a rule, if there are less than three companies in a statistical subcategory, the data is considered as confidential.

Currently, for PFCs and SF_6, no potential emissions (= total consumption data) are reported. This is due to the limited number of companies for which individual consumption figures are currently available, and which are now used for estimating actual emissions (so-called Confidential Business Information). This replaces the use of aggregated figures on the consumption of CFCs, halons, HCFCs, HFCs, PFCs and SF_6 from the KPMG Annual Report. Some of these entries are therefore labelled 'C', but please note that, because of the CRF structure, most of the summed figures for potential emissions of PFCs and SF_6 show '0.0' or 'value'. Please note also that the Netherlands has introduced the sections 'HFC unspecified' and 'PFC unspecified' into the F gas tables, accompanied by an average GWP value. One should pay attention to this, when extracting CRF data for other calculations.

9.4.5 Response to the issues raised in other external reviews

The draft NIR was subjected to a general public review and a peer review. However, the time available for the reviews and the response to the issues raised was too short to be included in this NIR, mainly due to the late completion of all recalculations and descriptions of new methodologies and the data sources used. The issues identified in the peer review and comments received from the public review of the final version of the NIR 2005 will be input for further improvements which will be included in the NIR 2006.

9.4.6 Response to the issues raised in UNFCCC reviews

The Netherlands greenhouse gas inventory has been subjected to the following reviews by the Climate Secretariat: (a) A Desk Review and Centralised Review of the NIR 2000 and (b) Reviewed in the country section of the Synthesis & Assessment Report on the NIRs of 2001 and 2002. In 2003 a Centralised Review was conducted of the NIR 2003, followed by an in-country review of the NIR 2004 in the fall of 2004. In general, the findings of the different UNFCCC reviews have been well observed and described. In particular, last year's in-country review was very helpful in identifying and confirming priority areas for improvement. The Netherlands response to the general remarks in the executive summary and overview sections of the in-country review report are summarised below.

- ***Incompleteness of CRF***
  'Two potentially significant subcategories in the Agricultural soils category (N_2O emissions from crop residues and histosols and indirect N_2O from atmospheric deposition) and categories 5B to 5D of the LUCF sector are not reported in the inventory.'

These categories are now included in the NIR. Furthermore, revised estimates have been included for CH_4 and N_2O from wastewater handling (6B) and human sewage (6D). The very small source of CH_4 and N_2O from horse manure has now also been included.

- ***Revision of feedstock emissions***
  In the recalculation of the fuel-related emissions, the method of calculation and allocation of emissions of CO_2 by feedstock has also been provided. Details can be found in *Section 3.2.7*.

- ***Inconsistency in time series***
  'There are apparent gaps in the data for the years 1991–1994 that are related to the integration of the Dutch Pollutant Emission Register (PER) data set. These gaps are recognised in the NIR, but the consistency of the time series is affected by the procedures used to fill the gaps for those years. The expert review team (ERT) encourages the Netherlands to improve consistency further for the years 1991–1994'.
  For this submission, recalculations for the complete time series have been carried out for all major sectors. This has produced consistent time series in all sectors. In particular, this applies to greenhouse-gas emissions from stationary combustion in the energy and industry subsectors (1A1 and 1A2) and CO_2 and CH_4 emissions from industrial processes and the use of solvents and products (CRF sectors 2 and 3).

- ***Missing notation keys and other documentation in CRF tables***
  In this submission, additional notation keys have been included. Furthermore, the explanation of the NE (Not Estimated) and IE (Included Elsewhere) entries in the documentation boxes has been improved by including, in more detail, the allocation used by the party. This complies with the CRF recalculation tables.

- ***The use of the category 'Other' in the CRF to group existing IPCC categories***
  In recalculating, this issue has now been largely resolved for the fossil-fuel related emissions. However, for some industrial processes, not all detailed data can be disclosed due to confidentiality. Nevertheless, as shown in the in-country review, the Netherlands is able to present all relevant detailed data to the review teams. However, some of the F-gas-emission figures in the Dutch inventory cannot be allocated to the specific compounds or (industrial) activities, as requested in the CRF. This applies especially to those figures reported by individual firms.

9.4.7 Planned improvements

To comply in good time with the requirements for the National Systems under the Kyoto Protocol and under the EU Monitoring Mechanism, a monitoring improvement programme has been implemented in recent years (for more information, see Section 1.6). The improvement programme was started in 2000, based on the outcome of workshops on the quality of the methodology and data used for calculating greenhouse-gas emissions in the Netherlands (see e.g. Van Amstel *et al*., 2000a,b). A long list of possible actions has been elaborated and the interdepartmental committee, the *Working Group on Emission Monitoring of Greenhouse Gases* (WEB), was set up to prioritise the actions[1]. Since then, the WEB has regularly reassessed the quality of both the contents of the inventory and the procedures followed in compiling them. Where necessary, the programme has been adapted, using results from previous actions and UNFCCC reviews. The in-country review in 2004 confirmed and endorsed the relevance of the actions taken to improve this programme. At present, most of the actions planned, including most of the cross-cutting issues mentioned by the UNFCCC review team (see previous section), have been implemented. It is anticipated that the National System will be in line with UNFCCC and EU requirements by the end of 2005. In this section, we summarise the current status of this programme and indicate the most important actions that still have to be taken to bring about further improvements in this programme, including any additional issues identified by the UNFCCC In-Country Review.

[1] To focus the work, the WEB has initiated three Expert Project Groups to focus on CO_2, non-CO_2 and Sinks, respectively. Both the WEB and the Project Groups are composed of people from the relevant ministries and from institutes that are also involved in the inventory-related process. This ensures that the appropriate expertise will be incorporated and that there will be communication with the relevant parties.

Monitoring improvement

In previous years, the various actions taken to bring about improvements have led to changes in the methodologies and processes for estimating greenhouse-gas emissions and sinks in the Netherlands. For the present NIR/CRF 2005, several major and many small recalculations have been undertaken, focusing, in particular, on key sources such as CO_2 emissions from stationary fuel combustion and the use of fuels as feedstock and other non-energy uses (Sector 1A and 2), CH_4 emissions from fugitive sources (Sector 1B), CH_4 and N_2O emissions in agriculture (Sector 4) and the LUCF Sector (#5).

The results of these improvements are presented and described in the previous sections and in more detail in the sector chapters, Chapters 3 to 8. Although most of the planned actions to bring about improvements have been concluded, a few methodology-related actions have still to be undertaken. The most significant improvement projects planned for implementation and finalisation in 2005 are (a) last analyses of emissions and sinks in the LUCF Sector and the final conclusions on their strengths; (b) using country-specific CH_4 factors for gas distribution, and improving the transparency of other parts of the fugitive emissions sector, (c) possibly a more accurate accounting of specific agricultural sources; (d) an update of the uncertainty analysis.

Monitoring protocols

As part of the improvement process, the methodologies and procedures for estimating greenhouse-gas emission in the Netherlands have been reassessed and compared with UNFCCC and IPCC requirements. For the key emission sources, and for sinks, the methodologies and processes have been elaborated, re-assessed and revised where necessary, and used for the present CRF/NIR. Protocols describing the methodology, data sources and the rationale for their selection are available for most key sources (Ruyssenaars 2005). The remainder, i.e. protocols for the other, mostly non-key, sources and an update of present protocols should methodologies be changed (e.g. due to further refinement), is planned to be finalised by September 2005, in time for use in the next NIR/NIR.

Improving the QA/QC system

The recent restructuring and reorganisation of the maintenance of the Pollutant Emission Register (PER) system in the Netherlands (see *Section 1.6*) delayed various activities to improve on QA/QC. These could only be implemented recently. By September 2005, however, the QA/QC programme will be updated, and all the procedures and processes will be established in good time to meet the National System requirements. In addition to the QA/QC activities already in place, it is anticipated that by then:

- the QC process for greenhouse gases will be supported further, using updated checklists and tools;
- the processes for key-source selection and uncertainty estimates will have been reviewed and updated where necessary (also identified by the UNFCCC review team);
- approaches will be assessed and implemented to limit, as far as possible, the use of estimated data for calculations for the most recent year, which then have to be recalculated the following year (as has also been identified by the UNFCCC review);
- the update of the description of QA/QC of external agencies will have been finalised;
- collaborative intra-EU review options will have been assessed and, where possible, implemented as part of the national QA/QC system; by the end of 2005 the documentation and archiving will have been updated.

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ANNEXES

ANNEX 1: Key sources

1.1 Introduction

Key sources according to the *IPCC Good Practice Guidance* (IPCC, 2000) are those found in the accumulative 95% of the total annual emissions in the last reported year *or* belonging to the total trend, when ranked from contributing the largest to smallest share in annual total and in the trend. The IPCC also recommended which sources should be checked for their key source status.

For preliminary identification of key sources in the Netherlands inventory we allocated the national emissions according to the IPCC's potential key source list. The IPCC Tier 1 method consists of ranking this 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: 20 sources for annual level assessment and 22 sources for the trend assessment out of a total of 59 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 discussed in *Section 1.3* of this Annex. The results of the Tier 1 and Tier 2 level and trend assessments are summarised in *Table A1.1* and show that a total of 33 key sources.

Table A1.1. Preliminary list of key sources identified by the Tier 1 and 2 level and trend assessments

	Name	Gas	T1 Level	T1 Trend	T2 Level	T2 Trend
1A1	Emissions from stationary combustion: Energy Industries, excl. Waste incin.	CO_2	1	1	1	1
1A1	Emissions from waste incineration, reported in 1A1a *	CO_2	1	1		
1A2	Emissions from stationary combustion: Manufacturing Industries & Constr.	CO_2	1	1	1	1
1A4	Emissions from stationary combustion: Other Sectors	CO_2	1	1	1	
1A3	Mobile combustion: road vehicles	CO_2	1	1	1	1
1A3	N_2O emissions from mobile combustion: road vehicles *	N_2O		1	1	
1B2	Fugitive emissions from venting and flaring: CO_2 *	CO_2		1	1	
1B2	Fugitive emissions from oil and gas: gas production	CH_4		1		
2C	CO_2 Iron and steel production (carbon inputs) *	CO_2	1	1		
2B	Emissions from nitric acid production	N_2O	1	1	1	
2B	Emissions from ammonia production *	CO_2	1	1		
2B	Emissions from caprolactam production	N_2O	1	1	1	
2B	Other chemical product manufacture *	CO_2		1		
2G	Other industrial: N_2O (NOx) *	N_2O		1	1	
2F	HFC Emissions from substitutes for ozone depleting substances	HFC	1	1	1	
2E	HFC-23 emissions from HCFC-22 manufacture	HFC		1		1
2C	PFC emissions from aluminium production	PFC	1	1	1	
4A	CH_4 emissions from enteric fermentation in domestic cattle livestock	CH_4	1	1	1	
4A	CH_4 emissions from enteric fermentation: other *	CH_4	1		1	
4B	Emissions from cattle manure management	CH_4	1		1	
4B	Emissions from swine manure management	CH_4	1	1	1	
4D	Direct N_2O emissions from agricultural soils	N_2O	1		1	
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	1	1	1	
5	LUCF *	CO_2	1		1	
6A	CH_4 emissions from solid waste disposal sites	CH_4	1	1	1	
7	Miscellaneous N_2O	N_2O	1	1	1	
Tier 2 key sources not in Tier 1 key source list:						
1A	CH_4 emissions from stationary combustion	CH_4			1	
1A3	Mobile combustion: water-borne navigation	CO_2			1	
1B1	Coke production *	CO_2			1	
1B2	Fugitive emissions from oil and gas: gas distribution	CH_4			1	
2F	SF_6 emissions from SF_6 use	F-gas			1	
4B	N_2O emissions from manure management *	N_2O			1	
6B	N_2O emissions from waste water handling *	N_2O			1	
Number of sources:		**33**	**20**	**22**	**27**	**4**

* New key sources compared to previous NIR.

As could be expected, the Tier 2 level and trend assessment increases the importance of relatively very uncertain sources. Some of these sources, which are below the 95% cut-off line in the Tier 1 assessment, are shifted above this line in the Tier 2 assessment. *Table A1.1* presents the preliminary list of key sources, identified by combining the Tier 1 and Tier 2 levels and trend approach. It can be concluded that in using the results of a Tier 2 key source assessment, seven more sources are added to the list of 23 Tier 1 level and trend key sources:

- CH_4 emissions from stationary combustion
- CO_2 emissions from Mobile combustion: water-borne navigation
- CO_2 emissions from Coke production
- Fugitive CH_4 emissions from oil and gas: gas distribution
- SF_6 emissions from SF_6 use
- N_2O emissions from manure management
- N_2O emissions from waste water handling

Their share in the national annual total becomes more important when taking their uncertainty into account: 50-100% (*Table 1.4*). The subsequent sections will provide more details on the Tier 1 and Tier 2 key source assessment.

Changes compared to previous submission

The use of the new emission data for the key source identification resulted in the following changes compared to the previous NIR:

For energy:

- 1A - CO_2 Waste incineration: new key source;
- 1A - CO_2 Mobile combustion: other: now non-key;
- 1A - N_2O Mobile combustion: road vehicles: now key;
- 1B - CO_2 Coke production: new key source;
- 1B - CO_2 Fugitive emissions from venting and flaring: new key source.

For industrial processes (i.e. non-combustion):

- 2 - CO_2 Other Industrial: now non-key;
- 2 - CO_2 Iron and steel production (carbon inputs): new key source;
- 2 - CO_2 Ammonia production: new key source;
- 2 - N_2O Caprolactam production: new key source;
- 2 - CO_2 Other chemical manufacture: new key source;
- 2 - N_2O Other industrial: new key source.

For agriculture:

- 4 - CH_4 Emissions from enteric fermentation: other: now key;
- 4 - N_2O Emissions from manure management: now key.

For waste:

- 6 - N_2O Emissions from wastewater handling: now key.

And finally CO_2 from LUCF is new key source (and indeed a *source*, not a sink).

Table A1.2. Source ranking using IPCC Tier 1 level assessment 2003 (amounts in Gg CO_2-eq.)
Sources: Olivier *et al.* (2000) for emissions, Van Amstel *et al.* (2000a), IPCC (2000) and RIVM's expert judgement of uncertainties (Olivier and Brandes, 2005).

IPCC	Category	Gas	CO_2-eq 2003	Share	Cum. share
1A	Emissions from stationary combustion : Energy Industries, excl. Waste incin.	CO_2	65752	30.2%	30.2%
1A	Emissions from stationary combustion : Other Sectors	CO_2	40588	18.7%	48.9%
1A	Mobile combustion: road vehicles	CO_2	33433	15.4%	64.2%
1A	Emissions from stationary combustion : Manufacturing Industries and Construction	CO_2	27056	12.4%	76.7%
6A	CH_4 emissions from solid waste disposal sites	CH_4	6775	3.1%	79.8%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	CH_4	5418	2.5%	82.3%
2X	Nitric acid production	N_2O	5060	2.3%	84.6%
4D	Direct N_2O emissions from agricultural soils	N_2O	4817	2.2%	86.8%
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	3252	1.5%	88.3%
5	Land Use Change and Forestry	CO_2	2761	1.3%	89.6%
2X	Ammonia production	CO_2	2686	1.2%	90.8%
1A	Emissions from waste incineration, reported in 1A1a	CO_2	1595	0.7%	91.6%
2X	Iron and steel production (carbon inputs)	CO_2	1558	0.7%	92.3%
4B	Emissions from manure management : cattle	CH_4	1432	0.7%	92.9%
2X	PFC from aluminium production	PFC	1204	0.6%	93.5%
2X	Caprolactam production	N_2O	954	0.4%	93.9%
4B	Emissions from manure management : swine	CH_4	918	0.4%	94.3%
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	890	0.4%	94.7%
7X	OTHER N_2O	N_2O	781	0.4%	95.1%
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	644	0.3%	95.4%
2X	Other industrial: N_2O	N_2O	644	0.3%	95.7%
4B	Emissions from manure management	N_2O	598	0.3%	96.0%
1A	Mobile combustion: water-borne navigation	CO_2	580	0.3%	96.2%
2X	Limestone and dolomite use	CO_2	563	0.3%	96.5%
1A	Emissions from stationary combustion: non-CO_2	CH_4	541	0.2%	96.7%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	520	0.2%	97.0%
1A	Mobile combustion: road vehicles	N_2O	470	0.2%	97.2%
1B	CO_2 from coke production	CO_2	464	0.2%	97.4%
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	460	0.2%	97.6%
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	437	0.2%	97.8%
2X	Cement production	CO_2	434	0.2%	98.0%
2X	Other industrial: CO_2	CO_2	431	0.2%	98.2%
2X	CO_2 from aluminium production	CO_2	410	0.2%	98.4%
1B	Fugitive emissions venting/flaring: CO_2	CO_2	405	0.2%	98.6%
6B	Emissions from wastewater handling	N_2O	397	0.2%	98.8%
2X	Other minerals	CO_2	352	0.2%	98.9%
2X	SF_6 emissions from SF_6 use	SF6	334	0.2%	99.1%
2X	Other industrial: CH_4	CH_4	311	0.1%	99.2%
1A	Emissions from stationary combustion: non-CO_2	N_2O	288	0.1%	99.4%
2X	Other chemical product manufacture	CO_2	248	0.1%	99.5%
6B	Emissions from wastewater handling	CH_4	207	0.1%	99.6%
2X	PFC emissions from PFC use	PFC	192	0.1%	99.7%
2X	Indirect CO2 from solvents/product use	CO_2	160	0.1%	99.7%
1B	Fugitive emissions from oil and gas operations: other	CH_4	104	0.0%	99.8%
1A	Mobile combustion: other	CO_2	103	0.0%	99.8%
2X	HFC by-product emissions from HFC manufacture	HFC	100	0.0%	99.9%
4B	Emissions from manure management : other	CH_4	73	0.0%	99.9%
1A	Mobile combustion: road vehicles	CH_4	72	0.0%	100.0%
2X	Indirect N_2O from non-agricultural sources	N_2O	56	0.0%	100.0%
1A	Mobile comustion: aircraft	CO_2	41	0.0%	100.0%
1A	Mobile combustion: other	N_2O	2	0.0%	100.0%
1A	Mobile combustion: other	CH_4	1	0.0%	100.0%
7X	OTHER CH_4	CH_4	0	0.0%	100.0%
			217577		

1.2 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 2003 annual emissions total and to the base year to 2003 trend, respectively. This resulted in 20 level key sources and 22 trend key sources (indicated in the grey part at the top). Although it has no relevance for identifying whether a sources is a key source or not, it is interesting to note that 16 sources are found in both lists. This set forms the most robust list, since it does not include the uncertainty estimate for the emissions.

Table A1.3. Source ranking using IPCC Tier 1 trend assessment (amounts in Gg CO_2-eq.)

IPCC	Category	Gas	CO_2-eq 1990	CO_2-eq 2003	Level assessment 90/95	Level assessment 2003	Trend assessment	% Contr. to trend	Cumulative total
1A	Emissions from stationary combustion : Energy Industries, excl. Waste incin.	CO_2	51034	65752	24%	30%	6.5%	26.3%	26%
1A	Mobile combustion: road vehicles	CO_2	25472	33433	12%	15%	3.5%	14.2%	40%
1A	Emissions from stationary combustion : Manufacturing Industries and Construction	CO_2	32768	27056	15%	12%	2.7%	10.9%	51%
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	5759	460	3%	0%	2.4%	9.8%	61%
6A	CH_4 emissions from solid waste disposal sites	CH_4	12011	6775	6%	3%	2.4%	9.8%	71%
1A	Emissions from stationary combustion : Other Sectors	CO_2	37996	40588	18%	19%	1.1%	4.2%	75%
4D	Indirect N2O emissions from nitrogen used in agriculture	N_2O	4 976	3252	2%	1%	0.8%	3.2%	78%
2X	Nitric acid production	N_2O	6330	5060	3%	2%	0.6%	2.4%	81%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	CH_4	6561	5418	3%	2%	0.5%	2.2%	83%
1A	Emissions from waste incineration, reported in 1A1a	CO_2	592	1595	0%	1%	0.5%	1.8%	85%
2X	Iron and steel production (carbon inputs)	CO_2	2514	1558	1%	1%	0.4%	1.8%	87%
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	1252	437	1%	0%	0.4%	1.5%	88%
7X	OTHER N_2O	N_2O	1524	781	1%	0%	0.3%	1.4%	89%
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	240	890	0%	0%	0.3%	1.2%	91%
2X	PFC from aluminium production	PFC	1769	1204	1%	1%	0.3%	1.1%	92%
1B	Fugitive emissions venting/flaring: CO_2	CO_2	839	405	0%	0%	0.2%	0.8%	93%
2X	Ammonia production	CO_2	3058	2686	1%	1%	0.2%	0.7%	93%
2X	Caprolactam production	N_2O	1240	954	1%	0%	0.1%	0.5%	94%
2X	Other industrial: N_2O	N_2O	886	644	0%	0%	0.1%	0.5%	94%
2X	Other chemical product manufacture	CO_2	480	248	0%	0%	0.1%	0.4%	95%
4B	Emissions from manure management : swine	CH_4	1141	918	1%	0%	0.1%	0.4%	95%
1A	Mobile combustion: road vehicles	N_2O	271	470	0%	0%	0.1%	0.4%	95%
4B	Emissions from manure management : other	CH_4	255	73	0%	0%	0.1%	0.3%	96%
4D	Direct N_2O emissions from agricultural soils	N_2O	4604	4817	2%	2%	0.1%	0.3%	96%
1A	Mobile combustion: water-borne navigation	CO_2	403	580	0%	0%	0.1%	0.3%	96%
2X	Indirect CO_2 from solvents/product use	CO_2	316	160	0%	0%	0.1%	0.3%	97%
2X	PFC emissions from PFC use	PFC	37	192	0%	0%	0.1%	0.3%	97%
5	Land Use Change and Forestry	CO_2	2894	2761	1%	1%	0.1%	0.3%	97%
4B	Emissions from manure management : cattle	CH_4	1573	1432	1%	1%	0.1%	0.3%	98%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	647	520	0%	0%	0.1%	0.2%	98%
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	761	644	0%	0%	0.1%	0.2%	98%
2X	Limestone and dolomite use	CO_2	440	563	0%	0%	0.1%	0.2%	98%
6B	Emissions from wastewater handling	N_2O	513	397	0%	0%	0.1%	0.2%	99%
2X	HFC by-product emissions from HFC manufacture	HFC	12	100	0%	0%	0.0%	0.2%	99%
1A	Mobile combustion: road vehicles	CH_4	157	72	0%	0%	0.0%	0.2%	99%
6B	Emissions from wastewater handling	CH_4	290	207	0%	0%	0.0%	0.2%	99%
2X	Other minerals	CO_2	269	352	0%	0%	0.0%	0.1%	99%
2X	Cement production	CO_2	507	434	0%	0%	0.0%	0.1%	99%
4B	Emissions from manure management	N_2O	670	598	0%	0%	0.0%	0.1%	99%
1B	Fugitive emissions from oil and gas operations: other	CH_4	176	104	0%	0%	0.0%	0.1%	99%
1B	CO_2 from coke production	CO_2	403	464	0%	0%	0.0%	0.1%	100%
2X	Other industrial: CO_2	CO_2	380	431	0%	0%	0.0%	0.1%	100%
1A	Emissions from stationary combustion: non-CO_2	N_2O	246	288	0%	0%	0.0%	0.1%	100%
2X	SF_6 emissions from SF_6 use	SF6	301	334	0%	0%	0.0%	0.1%	100%
1A	Emissions from stationary combustion: non-CO_2	CH_4	508	541	0%	0%	0.0%	0.1%	100%
2X	CO_2 from aluminium production	CO2	395	410	0%	0%	0.0%	0.0%	100%
2X	Other industrial: CH_4	CH_4	297	311	0%	0%	0.0%	0.0%	100%
1A	Mobile combustion: other	CO_2	91	103	0%	0%	0.0%	0.0%	100%
2X	Indirect N_2O from non-agricultural sources	N_2O	52	56	0%	0%	0.0%	0.0%	100%
7X	OTHER CH_4	CH_4	1	0	0%	0%	0.0%	0.0%	100%
1A	Mobile combustion: other	N_2O	1	2	0%	0%	0.0%	0.0%	100%
1A	Mobile comustion: aircraft	CO_2	41	41	0%	0%	0.0%	0.0%	100%
1A	Mobile combustion: other	CH_4	1	1	0%	0%	0.0%	0.0%	100%
			215953	**217577**	**100%**	**100%**	**24.9%**	**100.0%**	

Sources: Van Amstel *et al.* (2000a), IPCC (2000) and RIVM's expert judgement of uncertainties.

1.3 Uncertainty assessment

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 1.4* were also used for a Tier 1-trend uncertainty assessment, which can be summarised as follows:

CO_2-eq.	±4%-points of 1% increase	N_2O	±15%-points of 19% decrease
CO_2	±5%-points of 12% increase	F-gases	±7%-points of 61% decrease
CH_4	±6%-points of 32% decrease		

Details on this calculation can be found in *Table A1.4*. 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.

1.4 Tier 2 key source assessment

Using the uncertainty estimate for each key source as a weighting factor, we performed the key source assessment again. This is called the Tier 2 key source assessment. The results of this assessment are presented in *Tables A1.5 and A1.6* for the contribution to the 2003 annual emissions total and to the base year to 2003 trend, respectively. Comparison with the Tier 1 assessment presented in *Tables A1.2 and A1.3* shows *more level* key sources (27 instead of 20) and *much lower trend* key sources (4 instead of 22). This is because in the Tier 2 trend contribution calculation, the contribution of the number 1 key source – CO_2 from energy industries – doubles, from 26% to 55%, now accounting for over half the total contribution to the trend according to the IPCC calculation rules.

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 A1.5* shows, three 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;
- CO_2 emissions from stationary combustion: Other Sectors;
- CO_2 emissions from Land Use Change and Forestry;
- Direct N_2O emissions from agricultural soils;
- N_2O emissions from Nitric acid production.

The uncertainty in these emissions is estimated to be in the range of 10 to 200%, with indirect N_2O emissions having an uncertainty of a factor of 2, which is one or two orders of magnitude higher than the 4% uncertainty estimated for CO_2 from the energy industries (*Table 1.7*).

[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). This conclusion holds for both annual uncertainties and the trend uncertainty (see *Section 1.7* for more details).

Table A1.4. Tier 1 trend uncertainty assessment 1990-2003 (for F-gases with base year 1995) with the categories of the IPCC potential key source list (without adjustment for correlations between sources)

IPCC	IPCC Source category	Gas	Base year emissions (1990/1995)	2003 Emissions	Activity data uncertainty	Emission factor uncertainty	Combined Uncertainty	Combined Uncertainty as % of total national emissions in 2003
1A	Emissions from stationary combustion : Energy Industries, excl. Waste incin.	CO_2	51034	65752	3%	2%	4%	1.1%
1A	Emissions from stationary combustion : Manufacturing Industries and Construction	CO_2	32768	27056	3%	1%	3%	0.4%
1A	Emissions from stationary combustion : Other Sectors	CO_2	37996	40588	10%	1%	10%	1.9%
1A	Emissions from waste incineration, reported in 1A1a	CO_2	592	1595	10%	5%	11%	0.1%
1A	Mobile combustion: road vehicles	CO_2	25472	33433	2%	2%	3%	0.4%
1A	Mobile combustion: water-borne navigation	CO_2	403	580	50%	2%	50%	0.1%
1A	Mobile comustion: aircraft	CO_2	41	41	50%	2%	50%	0.0%
1A	Mobile combustion: other	CO_2	91	103	50%	2%	50%	0.0%
1B	CO_2 from coke production	CO_2	403	464	50%	2%	50%	0.1%
1B	Fugitive emissions venting/flaring: CO_2	CO_2	839	405	50%	2%	50%	0.1%
2X	Cement production	CO_2	507	434	5%	10%	11%	0.0%
2X	Limestone and dolomite use	CO_2	440	563	25%	5%	25%	0.1%
2X	Other minerals	CO_2	269	352	25%	5%	25%	0.0%
2X	Ammonia production	CO_2	3058	2686	2%	1%	2%	0.0%
2X	Other chemical product manufacture	CO_2	480	248	50%	50%	71%	0.1%
2X	Iron and steel production (carbon inputs)	CO_2	2514	1558	3%	5%	6%	0.0%
2X	CO_2 from aluminium production	CO_2	395	410	2%	5%	5%	0.0%
2X	Indirect CO_2 from solvents/product use	CO_2	316	160	25%	10%	27%	0.0%
2X	Other industrial: CO_2	CO_2	380	431	5%	20%	21%	0.0%
5	Land Use Change and Forestry	CO_2	2894	2761	100%	100%	141%	1.8%
	TOTAL CO2	**CO_2**	**160893**	**179621**	**12%**	**increase**		
1A	Emissions from stationary combustion: non-CO_2	CH_4	508	541	3%	50%	50%	0.1%
1A	Mobile combustion: road vehicles	CH_4	157	72	5%	60%	60%	0.0%
1A	Mobile combustion: other	CH_4	1	1	50%	100%	112%	0.0%
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	1252	437	2%	25%	25%	0.1%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	647	520	2%	50%	50%	0.1%
1B	Fugitive emissions from oil and gas operations: other	CH_4	176	104	20%	50%	54%	0.0%
2X	Other industrial: CH_4	CH_4	297	311	10%	50%	51%	0.1%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	CH_4	6561	5418	5%	20%	21%	0.5%
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	761	644	5%	30%	30%	0.1%
4B	Emissions from manure management : cattle	CH_4	1573	1432	10%	100%	100%	0.7%
4B	Emissions from manure management : swine	CH_4	1141	918	10%	100%	100%	0.4%
4B	Emissions from manure management : other	CH_4	255	73	10%	100%	100%	0.0%
6A	CH_4 emissions from solid waste disposal sites	CH_4	12011	6775	15%	30%	34%	1.0%
6B	Emissions from wastewater handling	CH_4	290	207	20%	25%	32%	0.0%
7X	OTHER CH_4	CH_4	1	0	20%	25%	32%	0.0%
	TOTAL CH_4	**CH_4**	**25630**	**17455**	**-32%**	**(= decrease)**		
1A	Emissions from stationary combustion: non-CO_2	N_2O	246	288	3%	50%	50%	0.1%
1A	Mobile combustion: road vehicles	N_2O	271	470	5%	50%	50%	0.1%
1A	Mobile combustion: other	N_2O	1	2	50%	100%	112%	0.0%
2X	Nitric acid production	N_2O	6330	5060	10%	50%	51%	1.2%
2X	Caprolactam production	N_2O	1240	954	50%	50%	71%	0.3%
2X	Indirect N_2O from non-agricultural sources	N_2O	52	56	25%	200%	202%	0.1%
2X	Other industrial: N_2O	N_2O	886	644	50%	50%	71%	0.2%
4B	Emissions from manure management	N_2O	670	598	10%	100%	100%	0.3%
4D	Direct N_2O emissions from agricultural soils	N_2O	4604	4817	10%	60%	61%	1.3%
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	4976	3252	50%	200%	206%	3.1%
6B	Emissions from wastewater handling	N_2O	513	397	20%	50%	54%	0.1%
7X	OTHER N_2O	N_2O	1524	781	20%	50%	54%	0.2%
	TOTAL N_2O	**N_2O**	**21312**	**17321**	**-19%**	**(= decrease)**		
2X	SF_6 emissions from SF_6 use	SF_6	301	334	50%	25%	56%	0.1%
2X	PFC from aluminium production	PFC	1769	1204	2%	20%	20%	0.1%
2X	PFC emissions from PFC use	PFC	37	192	5%	25%	25%	0.0%
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	240	890	10%	50%	51%	0.2%
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	5759	460	10%	10%	14%	0.0%
2X	HFC by-product emissions from HFC manufacture	HFC	12	100	10%	50%	51%	0.0%
	TOTAL F-gases	F-gases	8118	3180	-61%	**(= decrease)**		
	TOTAL CO_2-eq.	**GHG**	**215953**	**217577**	**1%**	**increase**		**4.8%**

Table A1.4 (continued). Tier 1 trend uncertainty assessment 1990-2003 (for F-gases with base year 1995) with the categories of the IPCC potential key source list (without adjustment for correlations between sources)

IPCC	IPCC Source category	Gas	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
1A	Emissions from stationary combustion : Energy Industries, excl. Waste incin.	CO_2	5.4%	40.9%	0.1%	1.7%	1.7%
1A	Emissions from stationary combustion : Manufacturing Industries and Construction	CO_2	-5.9%	16.8%	-0.1%	0.7%	0.7%
1A	Emissions from stationary combustion : Other Sectors	CO_2	-1.1%	25.2%	0.0%	3.6%	3.6%
1A	Emissions from waste incineration, reported in 1A1a	CO_2	0.6%	1.0%	0.0%	0.1%	0.1%
1A	Mobile combustion: road vehicles	CO_2	3.1%	20.8%	0.1%	0.6%	0.6%
1A	Mobile combustion: water-borne navigation	CO_2	0.1%	0.4%	0.0%	0.3%	0.3%
1A	Mobile comustion: aircraft	CO_2	0.0%	0.0%	0.0%	0.0%	0.0%
1A	Mobile combustion: other	CO_2	0.0%	0.1%	0.0%	0.0%	0.0%
1B	CO_2 from coke production	CO_2	0.0%	0.3%	0.0%	0.2%	0.2%
1B	Fugitive emissions venting/flaring: CO_2	CO_2	-0.3%	0.3%	0.0%	0.2%	0.2%
2X	Cement production	CO_2	-0.1%	0.3%	0.0%	0.0%	0.0%
2X	Limestone and dolomite use	CO_2	0.0%	0.4%	0.0%	0.1%	0.1%
2X	Other minerals	CO_2	0.0%	0.2%	0.0%	0.1%	0.1%
2X	Ammonia production	CO_2	-0.5%	1.7%	0.0%	0.0%	0.0%
2X	Other chemical product manufacture	CO_2	-0.2%	0.2%	-0.1%	0.1%	0.1%
2X	Iron and steel production (carbon inputs)	CO_2	-0.8%	1.0%	0.0%	0.0%	0.1%
2X	CO_2 from aluminium production	CO_2	0.0%	0.3%	0.0%	0.0%	0.0%
2X	Indirect CO_2 from solvents/product use	CO_2	-0.1%	0.1%	0.0%	0.0%	0.0%
2X	Other industrial: CO_2	CO_2	0.0%	0.3%	0.0%	0.0%	0.0%
5	Land Use Change and Forestry	CO_2	-0.3%	1.7%	-0.3%	2.4%	2.4%
	TOTAL CO_2	**CO_2**					**5%p. in trend of 12%**
1A	Emissions from stationary combustion: non-CO_2	CH_4	0.8%	2.1%	0.4%	0.1%	0.4%
1A	Mobile combustion: road vehicles	CH_4	-0.1%	0.3%	-0.1%	0.0%	0.1%
1A	Mobile combustion: other	CH_4	0.0%	0.0%	0.0%	0.0%	0.0%
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	-1.6%	1.7%	-0.4%	0.0%	0.4%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	0.3%	2.0%	0.2%	0.1%	0.2%
1B	Fugitive emissions from oil and gas operations: other	CH_4	-0.1%	0.4%	0.0%	0.1%	0.1%
2X	Other industrial: CH_4	CH_4	0.4%	1.2%	0.2%	0.2%	0.3%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	CH_4	3.7%	21.1%	0.7%	1.5%	1.7%
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	0.5%	2.5%	0.1%	0.2%	0.2%
4B	Emissions from manure management : cattle	CH_4	1.4%	5.6%	1.4%	0.8%	1.6%
4B	Emissions from manure management : swine	CH_4	0.5%	3.6%	0.5%	0.5%	0.7%
4B	Emissions from manure management : other	CH_4	-0.4%	0.3%	-0.4%	0.0%	0.4%
6A	CH_4 emissions from solid waste disposal sites	CH_4	-5.5%	26.4%	-1.6%	5.6%	5.8%
6B	Emissions from wastewater handling	CH_4	0.0%	0.8%	0.0%	0.2%	0.2%
7X	OTHER CH_4	CH_4	0.0%	0.0%	0.0%	0.0%	0.0%
	TOTAL CH_4	**CH_4**					**6%p. in trend of -32%**
1A	Emissions from stationary combustion: non-CO_2	N_2O	0.4%	1.4%	0.2%	0.1%	0.2%
1A	Mobile combustion: road vehicles	N_2O	1.2%	2.2%	0.6%	0.2%	0.6%
1A	Mobile combustion: other	N_2O	0.0%	0.0%	0.0%	0.0%	0.0%
2X	Nitric acid production	N_2O	-0.4%	23.7%	-0.2%	3.4%	3.4%
2X	Caprolactam production	N_2O	-0.3%	4.5%	-0.1%	3.2%	3.2%
2X	Indirect N_2O from non-agricultural sources	N_2O	0.1%	0.3%	0.1%	0.1%	0.2%
2X	Other industrial: N_2O	N_2O	-0.4%	3.0%	-0.2%	2.1%	2.1%
4B	Emissions from manure management	N_2O	0.3%	2.8%	0.3%	0.4%	0.5%
4D	Direct N_2O emissions from agricultural soils	N_2O	5.0%	22.6%	3.0%	3.2%	4.4%
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	-3.7%	15.3%	-7.4%	10.8%	13.1%
6B	Emissions from wastewater handling	N_2O	-0.1%	1.9%	0.0%	0.5%	0.5%
7X	OTHER N_2O	N_2O	-2.1%	3.7%	-1.1%	1.0%	1.5%
	TOTAL N_2O	**N_2O**					**15%p. in trend of -19%**
2X	SF_6 emissions from SF_6 use	SF_6	2.7%	4.1%	0.7%	2.9%	3.0%
2X	PFC from aluminium production	PFC	6.3%	14.8%	1.3%	0.4%	1.3%
2X	PFC emissions from PFC use	PFC	2.2%	2.4%	0.5%	0.2%	0.6%
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	9.8%	11.0%	4.9%	1.5%	5.1%
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	-22.0%	5.7%	-2.2%	0.8%	2.3%
2X	HFC by-product emissions from HFC manufacture	HFC	1.2%	1.2%	0.6%	0.2%	0.6%
	TOTAL F-gases	**F-gases**					**7%p. in trend of -61%**
	TOTAL CO_2-eq.	**GHG**					

Note: Sensitivity values refer to the trend in total CO_2-equivalent emissions. The trend uncertainties per gas included in the sheet were calculated with different, gas-specific sensitivity values. For CO_2 from fossil fuel we used the CO_2 data from the IPCC Reference Approach, including feedstock data (adjusted to match the total in the National Approach), combined with transport data.

Table A1.5. Source ranking using IPCC Tier 2 level assessment 2003 (amounts in Gg CO_2-eq.)

IPCC	Category	Gas	CO2-eq 2003	Share	Uncertainty estimate	Level * Uncertainty	Cumulative total
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	3252	1%	206%	3.1%	1%
1A	Emissions from stationary combustion : Other Sectors	CO_2	40588	19%	10%	1.9%	20%
5	Land Use Change and Forestry	CO_2	2761	1%	141%	1.8%	21%
4D	Direct N_2O emissions from agricultural soils	N_2O	4817	2%	61%	1.3%	24%
2X	Nitric acid production	N_2O	5060	2%	51%	1.2%	26%
1A	Emissions from stationary combustion : Energy Industries, excl. Waste incin.	CO_2	65752	30%	4%	1.1%	56%
6A	CH4 emissions from solid waste disposal sites	CH_4	6775	3%	34%	1.0%	59%
4B	Emissions from manure management : cattle	CH_4	1432	1%	100%	0.7%	60%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	CH_4	5418	2%	21%	0.5%	62%
1A	Mobile combustion: road vehicles	CO_2	33433	15%	3%	0.4%	78%
4B	Emissions from manure management : swine	CH_4	918	0%	100%	0.4%	78%
1A	Emissions from stationary combustion : Manufacturing Industries and Construction	CO_2	27056	12%	3%	0.4%	91%
2X	Caprolactam production	N_2O	954	0%	71%	0.3%	91%
4B	Emissions from manure management	N_2O	598	0%	100%	0.3%	91%
2X	Other industrial: N_2O	N_2O	644	0%	71%	0.2%	92%
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	890	0%	51%	0.2%	92%
7X	OTHER N_2O	N_2O	781	0%	54%	0.2%	92%
1A	Mobile combustion: water-borne navigation	CO_2	580	0%	50%	0.1%	93%
1A	Emissions from stationary combustion: non-CO_2	CH_4	541	0%	50%	0.1%	93%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	520	0%	50%	0.1%	93%
2X	PFC from aluminium production	PFC	1204	1%	20%	0.1%	94%
1A	Mobile combustion: road vehicles	N_2O	470	0%	50%	0.1%	94%
1B	CO_2 from coke production	CO_2	464	0%	50%	0.1%	94%
6B	Emissions from wastewater handling	N_2O	397	0%	54%	0.1%	94%
1B	Fugitive emissions venting/flaring: CO_2	CO_2	405	0%	50%	0.1%	95%
4A	CH4 emissions from enteric fermentation in domestic livestock: other	CH_4	644	0%	30%	0.1%	95%
2X	SF_6 emissions from SF_6 use	SF_6	334	0%	56%	0.1%	95%
1A	Emissions from waste incineration, reported in 1A1a	CO_2	1595	1%	11%	0.1%	96%
2X	Other chemical product manufacture	CO_2	248	0%	71%	0.1%	96%
2X	Other industrial: CH_4	CH_4	311	0%	51%	0.1%	96%
1A	Emissions from stationary combustion: non-CO_2	N_2O	288	0%	50%	0.1%	96%
2X	Limestone and dolomite use	CO_2	563	0%	25%	0.1%	96%
2X	Indirect N_2O from non-agricultural sources	N_2O	56	0%	202%	0.1%	96%
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	437	0%	25%	0.1%	97%
2X	Iron and steel production (carbon inputs)	CO_2	1558	1%	6%	0.0%	97%
2X	Other minerals	CO_2	352	0%	25%	0.0%	97%
2X	Other industrial: CO_2	CO_2	431	0%	21%	0.0%	98%
4B	Emissions from manure management : other	CH_4	73	0%	100%	0.0%	98%
6B	Emissions from wastewater handling	CH_4	207	0%	32%	0.0%	98%
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	460	0%	14%	0.0%	98%
2X	Ammonia production	CO_2	2686	1%	2%	0.0%	99%
1B	Fugitive emissions from oil and gas operations: other	CH_4	104	0%	54%	0.0%	99%
1A	Mobile combustion: other	CO_2	103	0%	50%	0.0%	99%
2X	HFC by-product emissions from HFC manufacture	HFC	100	0%	51%	0.0%	99%
2X	PFC emissions from PFC use	PFC	192	0%	25%	0.0%	99%
2X	Cement production	CO_2	434	0%	11%	0.0%	100%
1A	Mobile combustion: road vehicles	CH_4	72	0%	60%	0.0%	100%
2X	Indirect CO_2 from solvents/product use	CO_2	160	0%	27%	0.0%	100%
2X	CO_2 from aluminium production	CO_2	410	0%	5%	0.0%	100%
1A	Mobile comustion: aircraft	CO_2	41	0%	50%	0.0%	100%
1A	Mobile combustion: other	N_2O	2	0%	112%	0.0%	100%
1A	Mobile combustion: other	CH_4	1	0%	112%	0.0%	100%

Table A1.6. Source ranking using IPCC Tier 2 trend assessment (in Gg CO_2-eq.)

IPCC	Category	Gas	CO2-eq 1990	CO2-eq 2003	Level assessment 90/95	Level assessment 2003	Trend assessment	% Contr. to trend	Trend * Uncertainty	% Contr. to trend	Cumulative total
1A	Emissions from stationary combustion : Energy Industries, excl. Waste incin.	CO_2	51034	65752	24%	30%	7%	26%	2%	54.8%	55%
1A	Mobile combustion: road vehicles	CO_2	25472	33433	12%	15%	4%	14%	1%	16.1%	71%
1A	Emissions from stationary combustion : Manufacturing Industries and Construction	CO_2	32768	27056	15%	12%	3%	11%	0%	9.5%	80%
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	5759	460	3%	0%	2%	10%	0%	7.6%	88%
6A	CH4 emissions from solid waste disposal sites	CH_4	12011	6775	6%	3%	2%	10%	0%	7.6%	96%
1A	Emissions from stationary combustion : Other Sectors	CO_2	37996	40588	18%	19%	1%	4%	0%	1.4%	97%
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	4976	3252	2%	1%	1%	3%	0%	0.8%	98%
2X	Nitric acid production	N_2O	6330	5060	3%	2%	1%	2%	0%	0.5%	98%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	CH4	6561	5418	3%	2%	1%	2%	0%	0.4%	99%
1A	Emissions from waste incineration, reported in 1A1a	CO_2	592	1595	0%	1%	0%	2%	0%	0.3%	99%
2X	Iron and steel production (carbon inputs)	CO_2	2514	1558	1%	1%	0%	2%	0%	0.3%	99%
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	1252	437	1%	0%	0%	2%	0%	0.2%	99%
7X	OTHER N_2O	N_2O	1524	781	1%	0%	0%	1%	0%	0.2%	100%
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	240	890	0%	0%	0%	1%	0%	0.1%	100%
2X	PFC from aluminium production	PFC	1769	1204	1%	1%	0%	1%	0%	0.1%	100%
1B	Fugitive emissions venting/flaring: CO_2	CO_2	839	405	0%	0%	0%	1%	0%	0.1%	100%
2X	Ammonia production	CO_2	3058	2686	1%	1%	0%	1%	0%	0.0%	100%
2X	Caprolactam production	N_2O	1240	954	1%	0%	0%	1%	0%	0.0%	100%
2X	Other industrial: N_2O	N_2O	886	644	0%	0%	0%	0%	0%	0.0%	100%
2X	Other chemical product manufacture	CO_2	480	248	0%	0%	0%	0%	0%	0.0%	100%
4B	Emissions from manure management : swine	CH_4	1141	918	1%	0%	0%	0%	0%	0.0%	100%
1A	Mobile combustion: road vehicles	N_2O	271	470	0%	0%	0%	0%	0%	0.0%	100%
4B	Emissions from manure management : other	CH_4	255	73	0%	0%	0%	0%	0%	0.0%	100%
4D	Direct N_2O emissions from agricultural soils	N_2O	4604	4817	2%	2%	0%	0%	0%	0.0%	100%
1A	Mobile combustion: water-borne navigation	CO_2	403	580	0%	0%	0%	0%	0%	0.0%	100%
2X	Indirect CO_2 from solvents/product use	CO_2	316	160	0%	0%	0%	0%	0%	0.0%	100%
2X	PFC emissions from PFC use	PFC	37	192	0%	0%	0%	0%	0%	0.0%	100%
5	Land Use Change and Forestry	CO_2	2894	2761	1%	1%	0%	0%	0%	0.0%	100%
4B	Emissions from manure management : cattle	CH_4	1573	1432	1%	1%	0%	0%	0%	0.0%	100%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	647	520	0%	0%	0%	0%	0%	0.0%	100%
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	761	644	0%	0%	0%	0%	0%	0.0%	100%
2X	Limestone and dolomite use	CO_2	440	563	0%	0%	0%	0%	0%	0.0%	100%
6B	Emissions from wastewater handling	N_2O	513	397	0%	0%	0%	0%	0%	0.0%	100%
2X	HFC by-product emissions from HFC manufacture	HFC	12	100	0%	0%	0%	0%	0%	0.0%	100%
1A	Mobile combustion: road vehicles	CH_4	157	72	0%	0%	0%	0%	0%	0.0%	100%
6B	Emissions from wastewater handling	CH_4	290	207	0%	0%	0%	0%	0%	0.0%	100%
2X	Other minerals	CO_2	269	352	0%	0%	0%	0%	0%	0.0%	100%
2X	Cement production	CO_2	507	434	0%	0%	0%	0%	0%	0.0%	100%
4B	Emissions from manure management	N_2O	670	598	0%	0%	0%	0%	0%	0.0%	100%
1B	Fugitive emissions from oil and gas operations: other	CH_4	176	104	0%	0%	0%	0%	0%	0.0%	100%
1B	CO_2 from coke production	CO_2	403	464	0%	0%	0%	0%	0%	0.0%	100%
2X	Other industrial: CO_2	CO_2	380	431	0%	0%	0%	0%	0%	0.0%	100%
1A	Emissions from stationary combustion: non-CO_2	N_2O	246	288	0%	0%	0%	0%	0%	0.0%	100%
2X	SF_6 emissions from SF_6 use	SF_6	301	334	0%	0%	0%	0%	0%	0.0%	100%
1A	Emissions from stationary combustion: non-CO_2	CH_4	508	541	0%	0%	0%	0%	0%	0.0%	100%
2X	CO_2 from aluminium production	CO_2	395	410	0%	0%	0%	0%	0%	0.0%	100%
2X	Other industrial: CH_4	CH_4	297	311	0%	0%	0%	0%	0%	0.0%	100%
1A	Mobile combustion: other	CO_2	91	103	0%	0%	0%	0%	0%	0.0%	100%
2X	Indirect N_2O from non-agricultural sources	N_2O	52	56	0%	0%	0%	0%	0%	0.0%	100%
7X	OTHER CH_4	CH_4	1	0	0%	0%	0%	0%	0%	0.0%	100%
1A	Mobile combustion: other	N_2O	1	2	0%	0%	0%	0%	0%	0.0%	100%
1A	Mobile comustion: aircraft	CO_2	41	41	0%	0%	0%	0%	0%	0.0%	100%
1A	Mobile combustion: other	CH_4	1	1	0%	0%	0%	0%	0%	0.0%	100%

ANNEX 2: Detailed discussion of methodology and data for estimating CO_2 emissions from fossil fuel combustion

2.1 Estimation of actual fossil-fuel related CO_2 emissions from fuel combustion

The general methodology for calculating emissions to air and water in the Netherlands' *Emission Registration* is described in Van der Most *et al.* (1998) [in Dutch]. The methodology for calculating emissions of greenhouse gases is described in more detail in a set of monitoring protocols of which are also electronically available in Dutch and in English (Ruyssenaars, 2005). The description provided in this Annex aims at reflecting better the IPCC source structure (IPCC, 1997) and methodological issues raised in the *Good Practice Guidance* report.

Carbon dioxide emissions are mainly caused by the combustion of fuel and are calculated on the basis of detailed energy statistics and carbon content of the energy carriers. A distinction is made between:

1. stationary combustion of fossil fuels;
2. mobile combustion sources;
3. waste incineration (fossil component).

Emissions from public electricity production, refineries, large industries and waste incineration are for about 75% directly reported by the individual companies in their annual environmental reports (MJVs). However, these data are presently often not fully transparent and inconsistent over time (as companies normally do not recalculate). Therefore, in order to comply with the IPCC and UNFCCC reporting guidelines, the greenhouse gas emissions from these combustion sectors are calculated on the basis of fuel consumption in the national energy statistics for the sectors and emission factors, which are mostly national defaults. For the most import fuels (natural gas, coal, coal products, diesel, petrol) country-specific CO_2 emission factors are used; otherwise default IPCC emission factors are used (see *Table A2.1*).

For blast furnace gas (and oxygen furnace gas), refinery gas and residual chemical gas mostly source-specific (or plant-specific) emission factors have been used (*Table A2.2*). The national default CO_2 emission factors used for biomass (calculated as memo item only; does not contribute to national total (biomass is assumed to contain so-called short cycle carbon, i.e. produced sustainably) and for fossil waste are listed in *Table A2.3).*

In some cases the use of default national or source-specific emission factors may lead to different emissions than reported in MJVs, but most differences are likely to be due to different definitions of the company owned combustion facilities (e.g. local cogeneration, that may be operated as joint-venture). The fuel combustion calculation includes combustion of blast furnace/oxygen furnace gas by the steel plant and by power generation and of refinery gas and residual chemical gas by the refineries and the petrochemical industry, respectively. It also includes a balance term for unaccounted for refinery gas.

For national policy purposes, emissions from *road transport* are in general calculated from transport statistics on vehicle-km. The means that for road transport CO_2 emissions are first calculated in the national approach from energy consumption derived from transport statistics in terms of vehicle-km and assumptions for fuel efficiency per vehicle-km travelled. However, since the *Revised IPCC Guidelines* ask countries to report greenhouse gas emissions from combustion on the basis of fuel consumption within the national territory, a correction was made to convert emissions related to vehicle-km to emissions related to statistics for fuel sales. Thus, next, to meet the IPCC definition for CO_2, CH_4 and N_2O emissions from this source category, the amounts of fuel consumption in the national approach are scaled, per fuel type, to match the statistics for fuel supply to fuelling stations included in the national energy balance. For more details on the actual differences between these two approaches see *Section 3.2.3.* (Emissions of all other compounds, including ozone precursors and SO_2, which are more directly involved in air quality, are therefore calculated using traffic activity data without subsequently correcting to match with fuel supply statistics).

Table A2.1 Default CO_2 emission factors for fossil fuels in the Netherlands.

Fuel type	Fuel (*sectoral subtype*)	Unit [d)] (CBS)	LHV (GJ/unit)	EF CO_2 (kg/GJ)	Notes	Source (if not IPCC)
Gaseous	Natural gas	m^3	31.65	56.1	1)	TNO (2002)
	Hydrogen	Nm^3	10.8	0		Vreuls (2004)
Solids	Bituminous coal (excl.coking coal)	kg	25.0	94.7	2)	TNO (2002)
	Coking coal	kg	28,7	94,0	**)	
	- Coking Coal (in coke ovens)	*kg*	*28,7*	*95,4*	3)	MJVs Corus
	- Coking Coal (in blast furnaces)	*kg*	*28,7*	*89,8*	3)	MJVs Corus
	Coke Oven/Gas Coke	kg	28.5	111.9	**) 4)	Corus (2004)
	Coke Oven gas	m^3 ae	31.65	41.2	4)	Corus (2004)
	Blast Furnace Gas	m^3 ae	31.65	247.4	*) 4) 5)	Corus (2004)
	Oxygen Furnace Gas	m^3 ae	31.65	191.9	6)	
	Phosphorous Furnace Gas	Nm^3	11.6	149.5	7)	
	Lignite	kg	20	101.2		
	Patent Fuel	kg	23.5	94.6		
	Coal bitumen	kg	41.9	80.7		
	Peat	kg	10.8	106.0		Vreuls (2004)
Liquids	Petrol (Gasoline)	kg	44	72.0	8)	Olivier (2004)
	Gas/Diesel Oil < 15cSt	kg	42.7	74.3	**) 8)	Olivier (2004)
	LPG, propane, butane	m^3 ae	31.65	66.7	8) 9)	Olivier (2004)
	Aviation gasoline (avgas)	kg	44	72.0		(same as petrol)
	Jet Kerosene	kg	43.5	71.5		
	Residual Fuel Oil >= 15cSt	kg	41	77.4		
	Refinery Gas	m^3 ae	31.65	66.7	*) 10)	
	Residual Chemical Gas	m^3 ae	31.65	66.7	*)**) 11)	MJVs, NAE
	Other Kerosene	kg	43.1	71.9		
	Other light oils **a)**	kg	44	73.3		
	Other oil products	kg	42.7	73.3		
(NEU)	Naphtha, aromatics	kg	44	73.3		
	Petroleum Coke	kg	35.2	100.8		
	Lubricants and greases **b)**	kg	41.4	73.3		
	Mineral waxes **c)**	kg	42.7	73.3	**)	
	Bitumen	kg	41.9	80.7		
	Mineral turpentine	kg	43.6	73.3		
(Inputs)	Crude oil	kg	42.7	73.3		
	Natural Gas Liquids	kg	44	63.1		

a) Also for fuel oxygenate additives to reduce engine knock.
b) Also for additives for lubricants.
c) Also for other oil products (recycled oil), Ch.27, and non-Ch.27 products (Chapter 27 in international commodity trade statistics); also for the feedstock for carbon black (with LHV of 38).
d) m^3 ae = m^3 expressed as natural gas equivalents ('*aardgas equivalent'* in Dutch).

Other notes:
(*) In addition, source-specific or plant-specific emission factor have been used (see numbered notes below).
(**) For the 1991-1994 energy statistics a special weighted average calculation was made for each year for:
- coking coal + coke oven coke (about 106) used in the iron and steel industry (Corus) (1A1 and 2C1);
- residual chemical gas (about 55) used in the chemical industry (1A2c);
- gas/diesel oil used in refineries (about 80) (1A1b);
- mineral waxes used in refineries (about 55) (1A1b).

More details can be found in Huurman (2005a).

1) Value for Groningen *gas* quality; also default for other so-called high calorific gases, since the emission factor differs only slightly from this value (Harmelen and Koch, 2002).
2) Country-specific and source-specific value of *bituminous coal* for power generation, average for 2000 (Harmelen and Koch, 2002).

<u>Continuation of notes to Table A2.1:</u>

3) Different defaults for specific applications of *coking coal* based on 3 year average (for 2001-2003) (Corus, MJVs).
4) Plant-specific values for *coke oven coke, coke oven gas and blast furnace gas* based on 3 year average (for 2001-2003) (Corus, 2004).
5) Blast Furnace gas always includes a small amount of Oxygen Furnace gas (the pure BF gas emission factor would be 1.5-2% higher) (Corus, 2004). The national energy statistics only accounts for blast furnace gas, being the sum of BF and OF gas, for which the country-specific value of 214.85 is used (calculated assuming a mixture of 90% BF gas and 10% OF gas, based on data reported in MJVs).
6) Emission factor for pure OF gas. Applicable if the steel plant uses or power plant purchases OF gas.
7) Plant-specific value for Phosphorous Furnace Gas (Thermphos, 2004).
8) Based on measured carbon contents of 50 samples of *petrol* and 50 samples of *diesel fuel* (average of winter and summer types) (Olivier, 2004).
9) Based on average composition of LPG in the Netherlands (based on a carbon content of 82.2% [mass] and heat content of 45.2 TJ/kg [LHV]) (Olivier, 2004).
10) Default for *refinery gas*. For 1990-1996 the value of 46 is used for calculations based on national energy statistics, since these are not expressed as m^3 ae ('aardgas equivalent'), but in m^3, for which this is the equivalent value.
11) Default for *residual chemical gas*. For 1995-2003, for 16 individual plants this fuel is either *hydrogen*, for which the specific emission factor of 0 is used (see gaseous fuels), or *phosphorous oven gas*, for which the specific emission factor of 149.5 is used (see secondary solid fuels). For another 9 companies, plant-specific emission factors were used based on MJVs or NEA (most in the 50-55 range, with exceptional values of 23 and 95). For 1990, an average sector-specific value for the chemical industry was calculated using the plant-specific factors for 1995 from the 4 largest companies and the amounts used per company in 1990.

Table A2.2. Source-specific CO_2 emission factors (other than national default factors).

CRF	Subcategory	Fuel type	EF CO_2 (kg/GJ)	Notes	Data source
1A1a	Public electricity and heat	- Blast Furnace gas/Oxygen Furnace gas average	214.85	1)	MJV Corus
		- Residual chemical gas (from liquids)	50-55	2)	See chemical industry
		- Residual chemical gas (from solids)	149.5	5)	See chemical industry
1A1c	Refinery	- Refinery gas	46.0	3)	Oil statistics
1A2a	Iron and steel	- Blast furnace gas/Oxygen furnace gas average	214.85	1)	MJV Corus
1A2c	Chemical industry	- Residual chemical gas (from liquids)	50-55	2)	MJV, NEA
		- Residual chemical gas (from solids)	149.5	5)	NEA
1A2f	Other industries	- Residual chemical gas (from liquids)	50-55	6)	MJV

1) Weighted average of national defaults for BF gas and OF gas separately using 10% OF and 90% BF.

2) Based on data of selected years and used for 1995-2003. Most are in the 50-55 range, with exceptional values of 23 and 95. 1990 weighted average of 1995 values; 1991-1994 interpolated values.

3) For 1990-1996, national emission factors adjusted for other definition of the amount of gas used (m^3 instead of m^3 ae).

4) This refers to other oil products (heavy fractions).

5) Factor for phosphorous oven gas, which is made from coke and therefore in CRF included in solid fuels.

6) Residual gas co-produced in the salt production.

Table A2.3. Default CO_2 emission factors for biomass and fossil waste in the Netherlands.

Fuel type	Fuel (*sectoral subtype*)	Unit (CBS)	LHV (GJ/unit)	EF CO_2 (g/GJ)	Notes	Source (if not IPCC)
Biomass	**Solid Biomass**	kg	15.1	109.6	1)	Vreuls (2004)
	Liquid Biomass	kg	39.4	71.2	1)	Vreuls (2004)
	Gas Biomass	Nm^3	21.8	90.8	1)	Vreuls (2004)
	- Biogas from WWTPs	*Nm^3*	*23.3*	*84.2*	1)	Vreuls (2004)
	- Landfill gas	*Nm^3*	*19.5*	*100.7*	1)	Vreuls (2004)
	- Industrial organic waste gas	*Nm^3*	*23.3*	*84.2*	1)	Vreuls (2004)
Other	Waste (fossil carbon)	kg	34.4	73.6	*) 2)	Vreuls (2004)

(*) In addition, source-specific or plant-specific emission factor have been used (see numbered notes below).

1) CO_2 emissions from biomass calculated as memo item only. Does not contribute to national total (biomass is assumed to contain so-called short cycle carbon, i.e. produced sustainably).

2) National default; for large-scale waste incineration (so-called AVIs), plant-specific factors are used, calculated from the waste composition and the fossil carbon fraction per waste type (see NIR Chapter 8).

Fossil-based CO_2 emissions from *waste incineration* are calculated from the total amount of waste that is incinerated, per waste stream split into six waste types, each with a specific carbon content and fraction of fossil C in total C, based on an analysis by Joosen and De Jager (2003).

The fuel use related to *statistical differences* is still included in the official national energy balance for 1991-1994, but have been removed by ECN for the inventory calculations by a similar but simpler process of data quality improvement that was done previously by *Statistics Netherlands* (CBS) for the other years. The energy balances 1991-1994 have not been modified in an identical fashion for the greenhouse gas emission calculation as for the other years (due to lack of details for individual fuels per subsector – only coal, coal derived gases, natural gas, oil/oil products, refinery gas and residual chemical gas were distinguished – and also some subsectors were defined differently at that time). Consequently, the time series may be somewhat less consistent for this 'source category' for the 1991-1994 period (this applies also to the data used in the reference approach).

Finally, for domestic environmental policy purposes a *temperature correction* of fuel use for space heating is applied, but only to CO_2 emissions from the consumption of natural gas. The restriction to natural gas is because this is by far the dominant fuel type for space heating (see *Figure A2.1*). A description of this method is given in *Annex 2.2* and calculation results are presented in Chapter 3.

Estimating emissions for year 't-1'

The methodology used for the *'t-1'* inventory of the PER dataset compiled in year *t* (in this submission the 2003 figures) is often somewhat different from the standard methodological description, due to preliminary statistics. The *t-1* methodology is partly based on extrapolation, since not all annual statistics and year-specific emission factors may be available in time (see *Annexes 2 and 3*). Details on *t-1* emission calculations are provided in the greenhouse gas monitoring protocols (Ruyssenaars, 2005).

However, due to the late recalculation for this report this does not apply to the 2003 data in this NIR 2005.

Carbon storage in the CO_2 Reference Approach

Feedstock/non-energy uses of fuels in the energy statistics are 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.2.4* we present the country-specific values used in the reference approach calculation. For more details on the determination we refer to *Annex 4, section 4.3*.

Table A2.4. Carbon storage fractions and carbon oxidation fractions used for feedstocks and other non-energy uses in the CO_2 Reference Approach.

Main Fuel	Fuel subtype	Fraction stored 1)	Fraction oxidized 2)	Notes	Source
Liquid	naphtha, lubricants, bitumen, gas/diesel oil, LPG, NGL, other kerosene, other oil, gasoline, crude oil, residual fuel oil	77.7%	22.3%	3)	Huurman (2005b)
Gaseous	natural gas	38.8%	61.2%	3)	Huurman (2005b)
Solids	coke oven coke, coal oils and tars (from coking coal), other bituminous coal	57.5%	42.5%	3)	Huurman (2005b)

1) Stored in the petrochemical product.
2) Oxidised during product manufacture; thus excluding emissions during product use.
3) Average calculated from storage/oxidation in 1995-2003; for liquid products averaged over all products, since net consumption figures are used, possibly with negative values when more is produced (from another fuel type) than consumed.

2.2 Temperature correction for CO_2 from energy consumption for space heating

A significant part of the energy consumption in the Netherlands is used for space heating. Despite the moderate sea climate, the energy consumption in cold winters is substantially higher than in mild winters, leading to a disturbance in the CO_2 trend of up to 4%. For domestic policy purposes, however, it is desirable to separate these climatic disturbances from fluctuations in CO_2 emissions due to other causes like economic developments, efficiency improvements and policy measures. Therefore, in order to enable an accurate monitoring of the effectiveness of policy instruments, the Netherlands' CO_2 emissions are corrected for outside temperature variations using a method described in Spakman *et al.* (1997) and outlined below. For other greenhouse gases, the contribution from energy consumption is much less than in the case of CO_2; the uncertainty of emission estimates for these gases is also much larger than for CO_2. Therefore no temperature correction is carried out for non-CO_2 gases. The calculation is described in detail below.

Limitation to natural gas

Nearly all the space heating in the Netherlands is done with natural gas. Thus, only natural gas consumption is corrected for outside temperature variations.

Correction formula

The temperature correction requires two multiplication factors, one for each economic sector:

- the *Heating-Degree Day (HDD) correction factor* G_T
- the sector-specific *application factor* T_S.

The total *correction factor* for gas consumption in space heating of a sector S in year T is calculated by multiplying the HDD correction factor G_T in year T by the sectoral application factor T_S. To give corrected energy consumption as:

$$\text{Gas consumption (year T, sector S)}_{\text{corrected}} = \text{Gas consumption (year T, sector S)}_{\text{uncorrected}} * G_T * T_S$$

The *Heating-Degree Day correction factor* for a specific year is defined as the ratio of the number of Heating-Degree Days (HDDs) of a ‘normal’ year (defined as a 30-year moving average, i.e. the HDD average of the number of HDD of the previous 30 years) to the *actual* number of HDD in the year for which the correction factor is calculated. For a relatively warm year (i.e. compared to the previous 30 years), the HDD correction factor is larger than 1. Subsequently, energy consumption and related emissions are increased to arrive at the temperature-corrected values [so-called ‘addition factor’ = (1- HDD correction factor) > 0]. The calculated numbers of HDDs of a ‘normal’ year are presented in *Table A.4.1* for the period 1970-1996.

Calculation of Heating-Degree Days

The *number of Heating-Degree Days (HDD)* daily is calculated uniformly for the Netherlands as a whole on the basis of the temperature record of one centrally located station, *De Bilt.* Thus, no regional calculations are carried out. Indoor space heating is assumed to take place when outdoor temperatures are below 18º C. The number of HDDs for a specific day is defined as the number of degrees Celsius of the mean daily temperature below the 18º C threshold. If, for example, the mean daily temperature for a specific day is 12º C, the number of HDDs for that day is 18-12 = 6. For a normal year the total number of HDD is about 3200; for a calendar year with relatively cold winter months, it is higher (e.g. 3717 in 1963) and for years with relatively warm winter months, it is lower (e.g. 2677 in 1990). The total annual number of HDDs is calculated by EnergieNed using data on mean daily temperature provided by the *Royal Netherlands Meteorological Institute* (KNMI) (see *Table A.2.5*).

For the sake of simplicity, unweighted HDDs are used, i.e. when daily mean temperatures are the same, no correction is carried out of the observed difference in consumer behaviour of less daily fuel consumption for space heating in autumn and spring compared with daily consumption in winter months. This has the advantage that calculations can be performed on the basis of total annual, in preference to monthly, figures for both HDD and gas consumption. The apparent accuracy of the present method used is discussed in *Section 3.2.4.3*.

Table A.2.5. Annual number of Heating-Degree Days (HDD), 30-year moving average for normal number of HDDs and the HDD correction factor for the period 1970-2003 based on weather statistics for De Bilt

Year	Actual number of HDD	30-year 'normal' HDD	HDD correction factor	Year	Actual number of HDD	30-year 'normal' HDD	HDD correction factor
1970	3295	3250	0.986	1987	3372	3219	0.955
1971	3133	3239	1.034	1988	2823	3231	1.144
1972	3379	3228	0.955	1989	2729	3219	1.179
1973	3234	3221	0.966	1990	2677	3211	1.199
1974	3033	3226	1.046	1991	3163	3198	1.011
1975	3083	3221	1.045	1992	2829	3203	1.132
1976	3097	3225	1.041	1993	3076	3177	1.033
1977	2997	3218	1.074	1994	2835	3156	1.113
1978	3304	3209	0.971	1995	2917	3140	1.076
1979	3476	3217	0.926	1996	3504	3123	0.891
1980	3301	3235	0.980	1997	2929	3135	1.070
1981	3244	3238	0.998	1998	2821	3133	1.111
1982	3005	3244	1.080	1999	2676	3118	1.165
1983	2999	3232	1.078	2000	2659	3098	1.165
1984	3177	3229	1.016	2001	2880	3076	1.068
1985	3487	3226	0.925	2002	2720	3068	1.128
1986	3333	3228	0.969	2003	2913	3046	1.046

Source: EnergieNed, 1995 (pers. comm.) and www.energiened.nl.

Definition of normal Heating-Degree Days

The number of HDD for a 'normal' year T is defined as the average number of HDDs of the *previous* 30 years. This 30-year moving average has been selected in preference to a fixed reference year (e.g. the 30-year average of the period 1961-1990) to be able to account - and thus to correct - for trends in daily temperatures (i.e. caused by climatic changes).

Compared to this moving average, winters in the Netherlands have in recent years been getting milder. From 1990 to 1995 and 1997 to 2000 each winter was milder than the average of the previous 30 years, thus making the HDD correction factor >1 for these years. The winter of 1996 was relatively cold. The moving 30-year average number of HDDs decreased by 3.5%, from 3231, to 3098 between 1990 and 2000 not only as a result by the relatively mild winters of recent years shifting into the 30-year average, but also due to shifting from the moving average of cold winters, e.g. those of 1962-1963. However, in view of observed increases of the annual average temperature, both globally and in the Netherlands, the question was raised whether or not to take into this effect more explicitly in the definition of the 'normal' than by comparing HDD with the average of the previous 30 years (see section 'Planned improvements' below).

Fraction of energy consumption used for space heating

The application factor for a specific sector (e.g. residential dwellings or the service sector) is defined as the fraction of fuel consumption of the space heating sector. This fraction has been derived from data provided by the Ministry of Economic Affairs for 1989 and 1991. However, the application factor may change in the course of time due to the increasing number of dwellings to which insulation measures are applied and to increasing or decreasing amounts of fuel used for other applications than space heating (e.g. cooking and hot-water supply for showers and baths). In the residential sector the space heating share in total gas consumption has also been observed to decrease, from 88% in 1980 to 76% in 2000. Therefore an application factor has been calculated for this sector by EnergieNed on an annual basis and annually reported in its 'Monitoring report of gas consumption of small users' [BAK] (EnergieNed, several years) (see *Table A.2.7*). Other sectors use fixed application factors provided by the Ministry of Economic Affairs (see *Table A.2.6*) (Wieleman, 1994).

Table A.2.6. Sectoral application factors

Sector	Application factor
Agriculture	0.825
Commercial and public services	0.825
Industry (average)	0.16
Basic industry	0.10
Light industry	0.50
Energy	0.05

Source: EZ, CBS.

Table A.2.7. Application factors for dwellings for the years 1980-1985 and 1990-2002

	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Residential sector	0.88	0.87	0.80	0.80	0.78	0.77	0.77	0.76	0.80	0.79	0.78	0.76	0.76	0.77	0.77	0.77

Source: EnergieNed, 1995-2004

Example calculation of temperature correction in 1990

As an example in *Table A.2.8* the calculation of the temperature correction of sectoral CO_2 emissions for 1990 has been summarised. In addition, *Table A.2.9* presents the variation of this correction over the last ten years, showing that in this period a difference up to 10 Mton occurs between the maximum and the minimum correction.

Table A.2.8. Example of temperature correction of energy consumption and CO_2 emissions in 1990 (using an emission factor for CO_2 from natural gas of 0.056 Tg/PJ)

	A	**B**	**C**	**D = B * (C-1)**	**E = D * A**	**F = 0.056 * E**
Sector	Gas consumption uncorrected [PJ]	Applicat-ion factor	HDD cor-rect-ion factor	Addition factor	Correction of gas consump-tion [PJ]	Correction of CO_2 emissions [Tg]
Agriculture	129	0.825	1.199	0.164	+ 21.1	+ 1.18
Industry	430	0.16	1.199	0.032	+ 13.8	+ 0.77
Services	137	0.825	1.199	0.164	+ 22.5	+ 1.26
Energy sector	278	0.05	1.199	0.010	+ 2.8	+ 0.16
Residentials	329	0.79	1.199	0.157	+ 51.7	+ 2.90
Total	**1303**				**+ 111.9**	**+ 6.27**

Source: Spakman *et al.* (1997). Please note that due to elimination of the statistical differences in the energy balances gas consumption figures, and thus CO_2 related temperature correction, has changed somewhat.

Table A.2.9. Temperature correction of carbon dioxide emissions per sector 1990-2003 (in Tg)

Source category	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
1A1a Energy sector	0.15	0.01	0.12	0.03	0.11	0.08	-0.12	0.08	0.14	0.21	0.2	0.09	0.17	0.06
1A2a-e Basic industry	0.31	0.02	0.2	0.05	0.16	0.1	-0.15	0.1	0.15	0.21	0.22	0.08	0.15	0.05
1A2f Light industry	0.33	0.02	0.25	0.06	0.2	0.14	-0.2	0.13	0.21	0.31	0.31	0.13	0.23	0.08
1A4a Commercial & public services	1.08	0.08	0.88	0.25	0.75	0.58	-0.97	0.54	0.85	1.05	1.11	0.54	1.05	0.42
1A4b Residential sector	2.95	0.19	1.94	0.51	1.66	1.18	-2.06	1.1	1.63	2.35	2.35	1.02	1.81	0.66
1A4c Agriculture	1.35	0.07	0.9	0.23	0.76	0.52	-0.78	0.43	0.67	0.96	1.0	0.4	0.75	0.26
Total CO_2 correction	**6.2**	**0.4**	**4.3**	**1.1**	**3.6**	**2.6**	**-4.3**	**2.4**	**3.6**	**5.1**	**5.2**	**2.3**	**4.2**	**1.5**
As % of uncorrected nat. total (excl. LUCF)	3.9%	0.2%	2.7%	0.7%	2.2%	1.5%	-2.4%	1.4%	2.1%	3.1%	3.1%	1.3%	2.4%	0.8%

Evaluation of the methodology

From *Table A.4.1* it can be observed that during the last years there has been a decreasing trend in the 30-year moving average used for the determination of the reference level of heating degree days. Other temperature correction methods sometimes use a fixed reference value for all years within a specific decade. The present temperature correction method has been evaluated with respect to parameters such as reference level, application fractions and threshold temperatures. Recently, a new weather and HDD analysis was made for the last 100 years, indicating a stronger decrease of the reference level in the 1990s than presently used (Visser, 2004). The results of this assessment will be presented in more detail in the next NIR.

ANNEX 3: Other detailed methodological descriptions for individual source or sink categories

3.1 Detailed methodological description for other sources [sectors 1B, 2, 3, 4, 6]

The general methodology for calculating emissions to air and water in the Netherlands' *Emission Registration* is described in Van der Most *et al.* (1998) [in Dutch]. The methodology for calculating emissions of greenhouse gases is described in more detail in a set of monitoring protocols of which are also electronically available in Dutch and in English (Ruyssenaars, 2005). The description provided in this Annex aims at reflecting better the IPCC source structure (IPCC, 1997) and methodological issues raised in the *Good Practice Guidance* report.

Carbon dioxide emissions for non-fossil fuel combustion sources

Fugitive emissions from solid fuel transformation and from oil and gas (in 1B) and feedstock uses of fossil fuels (in 2B,C,D,G) are fossil, non-combustion sources of CO_2. Fugitive emissions from coke production (1B1) and from oil and gas (1B2), comprising exploration, production (venting and flaring), on-site gas processing; onshore and offshore), and some emissions from gas transport (compressor stations) and gas distribution networks. CO_2 emissions related to transformation losses in coke production (1B1) are based on national energy statistics of coal inputs and coke and coke oven gas produced and a carbon balance calculation of the losses. Gas flaring and venting emissions (1B2) are based on the annual reports by the production companies, in particular NAM, and totalled by their industry organisation NOGEPA, using Tier 3 methods. Venting also contributes since gas produced with a high CO_2 content is partly directly vented and partly first processed with subsequent venting of the removed CO_2.

Industrial process emissions of CO_2 from ammonia production (2B1) are estimated from the amount of natural gas used as feedstock (equivalent to IPCC Tier 1b) and a country-specific emission factor based on a 17% fraction of carbon in the gas-feedstock oxidised during the ammonia manufacture, which was calculated from the carbon contained in the urea produced. Other minor chemical sources (in 2B5) for which country-specific methods and emission factors were used are industrial gases (e.g., hydrogen, carbon monoxide), mainly from natural gas with an oxidation fraction of 20% carbon electrodes, mainly produced from petroleum coke with an oxidation fraction of 5%; and activated carbon ('norit') using an emission factor derived from the carbon losses from peat use. CO_2 from other sources of production of silicon carbide, carbon black, ethylene and methanol are reported in fuel combustion category 1A2c, because all feedstock emissions are accounted for in the residual chemical gas resulting from these processes.

CO_2 emissions from iron and steel production (2C1) calculated for the carbon losses from coke and coal input used as reducing agent in blast and oxygen furnaces are calculated using a Tier 2 IPCC method and country-specific carbon contents of the fuels, thus also 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). Only the net carbon losses are reported in subcategory 2C1, i.e. not the carbon contained in the blast furnace gas and oxygen furnace gas produced as by-products and subsequently used as fuels for energy purposes. For the CO_2 emissions from the anodes used for primary aluminium production (2C2), the Tier 1a IPCC method is now used, which is based on aluminium production as activity data and a emission factor of 1.45 kg CO_2/ton aluminium, i.e. corrected to include the additional CO_2 produced in practice by the reaction of the carbon anode with oxygen in the air.

Minor CO_2 emissions by the food and drink industry (2D1) from non-energy use of coke for whitening of sugar is calculated using an emission factor based on the national default carbon content of coke and assuming that the carbon is fully oxidised. For CO_2 from lubricants and waxes (2G) oxidation factors of 50% and 100% are assumed, respectively. For bitumen, coal derivatives used by 'other consumers' and coal tars 0% oxidation is assumed (no emissions). Emissions from mineral turpentine are included in indirect CO_2 of solvent use (sector 3).

In addition to these fossil-fuel related CO_2 emissions, the following non-fossil, non-organic sources of CO_2 occur:

- Cement clinker production (category 2A);
- Limestone used for iron and steel production, glass production and flue gas desulphurisation (category 2A);
- Dolomite used in road construction (2A);
- Miscellaneous minor sources: fireworks (category 2G).

The Netherlands imports a large part of cement clinker used for cement production (2A1). Therefore, associated CO_2 emissions are calculated based on domestic clinker production reported through MJV/ER-I data. CO_2 emissions from the use of limestone and dolomite (2A2) are calculated from apparent consumption corrected for consumption for steel production and use in the agricultural sector, which emissions are separately reported, and default IPCC emission factors. Emissions from flue gas desulphurisation units (wet process) installed in public power plants are calculated from gypsum production reported by firms and a fixed emission factor. CO_2 from soda ash production (2A4) using the Solvay process are calculated from the non-energy use of coke assuming 100% oxidation. For soda use (2A4) consumption was calculated from apparent consumption, largely extrapolated. The CO_2 emissions from the *'Other'* subcategory refer to glass production (2A7) calculated from gross glass production data and a country-specific emission factor of 0.16 kg CO_2/ kg glass. Finally, CO_2 emissions from the use of fireworks (2G) are included as a minor miscellaneous source.

The (indirect) CO_2 emissions from non-energy products in the course of use are now calculated from the carbon fraction in non-combustion NMVOC emissions from solvents and other products, and are reported under '*Solvents and the use of other products'* (source category 3).

Methane

Methane emissions from fuel combustion (1A) are estimated using the energy statistics and country-specific and fuel-specific emission factors (*Table A3.1*) except for road transport. Road traffic emissions of CH_4 are calculated and reported according to the *Revised IPCC Guidelines* (i.e. initially based on vehicle-km, then calibrated to fuel supply statistics). The largest fuel combustion subcategory is the residential sector, where emissions from natural gas (including start-up losses) and biofuel combustion are the largest sources. For more details we refer to the description provided for CO_2. Fugitive methane emissions from oil and gas production (1B2) are estimated for onshore and offshore sites and for venting and flaring separately based on the annual reports by the production companies, in particular NAM, and totalled by their industry organisation NOGEPA. Other fugitive emission sources of methane are gas transport, gas distribution and oil refineries. For gas distribution a Tier 2 method is used based on the length of the network by type of material and emission factors per km pipeline.

Negligible industrial processes CH_4 emissions are calculated for the production of carbides, carbon black, ethylene, dichloroethene, styrene and methanol (2B) using Tier 1 methods and default IPCC/CORINAIR-EMEP emission factors. A very small source identified in the Netherlands is degassing of drinking water, which is reported in category 2G.

Methane from agriculture (4) is estimated on the basis of national statistics for animal numbers and manure production from *Statistics Netherlands* (CBS) and of country specifically developed emission factors. Information on the methodologies and datasets used for key sources is provided in the monitoring protocols (Ruyssenaars, 2005) and in more detail provided by Smink *et al.* (2004) on key source enteric fermentation by dairy cattle, by Van der Hoek and Van Schijndel (2005) on manure management for all (key and non-key) sources and by Van Amstel *et al.* (1993) on non-key sources for enteric fermentation.

Methane emissions from landfills (6A) are calculated using a first order decomposition model (first order decay function) with annual input of the total amounts deposited and characteristics of the landfilled waste and the amount of landfill gas extracted. Parameter values used in the landfill emissions model are:

- fraction of Degradable Organic Carbon (DOC): decreases from 13% in 1990 to 12% in 2001;

- methane 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 year, respectively;
- methane oxidation factor: 10%;
- fraction methane in landfill gas: 60%;
- fraction of DOC actually dissimilated (DOC_F): 0.58.

The change in DOC values is amongst others due to the prohibition of landfilling combustible wastes, whereas the change in k values is caused by a strong increase of the recycling of vegetable, fruit and garden waste in the early 1990s. The integration time for the emission calculation is for all years the period from 1945 to the year for which the calculation is made.

Methane emissions from wastewater treatment (including sludge) (6B) are very small because of the high fraction recovered (from 80% in 1990 to 98% at present). A country-specific methodology ise used for the CH_4 emissions which is equivalent to the IPCC Tier 2 method. Generally IPCC default emission factors are used. For anaerobic industrial WWTP, the CH_4 emission factor is defined as 0.056 kg/industry equivalent (i.e.) capacity and an utilisation rate of 80%. For septic tanks (6B) the emission factor for CH_4 is expressed as 7.5 kg/year per person connected to a septic tank, assuming an MCF of 0.5 and B_o of 0.25. A country-specific methodology is used industrial composting (6D) with emission factors from VROM (2002).

The reduced methane emissions from agricultural soils are regarded as 'natural' (non-anthropogenic) and are estimated on the basis of the methane background document (Van Amstel *et al.*, 1993). Since the IPCC methodology only considers CO_2 sinks, these reduced CH_4 emissions have been included in the 'natural emissions' total, although they act as a methane sink. Therefore, they are not reported. Other 'natural emissions' are methane emissions from wetlands and water.

Nitrous oxide

Nitrous oxide emissions from fuel combustion (1A) are estimated using the energy statistics and default IPCC emission factors (*Table A3.1*) except for road transport. Road traffic emissions of N_2O are calculated and reported according to the *Revised IPCC Guidelines* (i.e. initially based on vehicle-km, then calibrated to fuel supply statistics) and country-specific emission factors. The largest fuel combustion subcategory is road transport. Traffic emissions of N_2O are calculated and reported according to the *Revised IPCC Guidelines* (i.e. initially based on vehicle-km, then calibrated to fuel supply statistics); for more details we refer to the description provided for CO_2. For more details on the emission factors from road transport we refer to *Section 3.4* and the monitoring protocols.

N_2O emissions from the production of chemicals (2B) include N_2O from nitric acid, acrylonitril and caprolactam production and solvents as reported by the manufacturing industry and included in the Netherlands' *Pollutant Emission Register* (PER) (Spakman *et al.*, 2003). It also includes N_2O emissions from product use comprise N_2O used as anaesthesia and as propelling agent in aerosol cans. (sector 3). Moreover, indirect N_2O emissions from non-agricultural emissions of NO_x and NH_3 are now estimated cf. the IPCC Tier 1b method and reported under category 2G.

Nitrous oxide from agriculture (4B, 4D) is estimated on the basis of national statistics for animal numbers, manure production (volumes), manure N-excretion, chemical fertiliser, crop production area and ammonia emissions (from *Statistics Netherlands* (CBS)). For direct N_2O emissions the country-specific activity data are combined with country specifically developed emission factors for most direct N_2O emissions. Exceptions are N-fixing crops and crop residues where IPCC default emission factors are used. For indirect N_2O emissions from agricultural soils the country-specific activity data are combined with IPCC default values for the fraction leached and emission factors. Information on the methodologies and datasets used for key sources is provided in the monitoring protocols (Ruyssenaars, 2005) and in more detail provided by van der Hoek en Van Schijndel (2005) on agricultural soils and manure management (partly with reference to Kroeze (1994)).

For N_2O emissions from wastewater treatment (including sludge) (6B) a country-specific methodology is used which is equivalent to the IPCC Tier 2 method. N_2O emissions from human sewage are also reported under wastewater handling (6B).

Table A3.1. CH_4 and N_2O emission factors for stationary combustion in the Netherlands.

Gas	Fuel/Sector	Unit [d)] (CBS)	EF (g/GJ)	Notes	Source (if not IPCC)
CH_4	Solid fuels:			1)	
	- coking coal, bituminous coal		0.44		TNO
	- coke oven coke		44.0		TNO
	- lignite		4.4		TNO
	- coke oven gas		2.8		TNO
	- blast furnace gas		0.35		TNO
	- coal bitumen		1.6		TNO
	Liquid fuels			1)	TNO
	- crude oil, other oil inputs		1.4		TNO
	- NGL		1.9		TNO
	- refinery gas, residual chemical gas		3.6		TNO
	- LPG, propane, butane		0.7		TNO
	- lubricants and greases		1		TNO
	- mineral waxes		1.5		TNO
	- bitumen, feedstock for carbon black		1.6		TNO
	- petroleum coke		3.8		TNO
	- additives for lubricants, anti-knock		7.5		TNO
	- all other oil products		3.4		TNO
	Gaseous fuels: natural gas		5.7	1) 2)	TNO
	- start-up losses of gas in households		*35*	2)	
	Waste		p.m.	6)	p.m.
N_2O	Solid fuels	GJ	1.4		IPCC (1997)
	Liquid fuels	GJ	0.6	3)	IPCC (1997)
	Gaseous fuels	GJ	0.1	4)	IPCC (1997)
	Waste	1000 kg	20	5)	Spoelstra (1993)

1) Scheffer and Jonker (1997)
2) Start-up losses in cooking, warm water production and boilers for space heating in the residential sector are estimated separately and are not included in the general factor of 5.7. These emissions are reported as part of combustion emissions.
3) Excluding LPG.
4) All fuels in the gaseous phase, including LPG, CO, BF gas, OF gas, refinery gas, residual chemical gas, CH_4, hydrogen.
5) Factor for waste is based on Spoelstra (1993).
6) Presently neglected.

HFCs, PFCs and SF_6

By-product HFC and PFC emissions from HCFC-22 production and primary aluminium production, respectively, are based on measured data reported by halocarbon producing companies. In addition, the halocarbon producers report handling emissions of HFCs.

Emissions from HFC and PFC consumption are calculated using Tier 2 methodologies as described by Matthijsen and Kroeze (1996). Emissions of SF_6 are based on estimates of SF_6 consumption for the existing stock of Gas Insulated Switchgear (GIS) equipment, addition of new GIS equipment and manufacturing of GIS equipment, for semiconductor manufacture and for the production of SF_6 containing soundproof double glazed windows. The latter source has been included for 1995 onwards.

Estimating emissions for year 't-1'

The methods used for the *'t-1'* inventory of the PER dataset compiled in year *t* (in this submission the 2003 figures) is generally different from those for older years which were described above, due to absence or limited data from individual firms and incomplete statistics. Details on *t-1* emission calculations are provided in the greenhouse gas monitoring protocols (Ruyssenaars, 2005).

However, due to the late recalculation for this report this does not apply to the 2003 data in this NIR 2005.

3.2 Detailed methodological description of Land Use Change and Forestry (LUCF) [sector 5]

Forest definition

Forest has been defined according to international standards with minor deviations (Protocol forest land, 2005). According to definition, forest Land is land with woody vegetation and with tree crown cover of more than 20 per cent, an area of more than 0.5 ha and a minimum width of 30 m.. The trees should be able to reach a minimum height of 5 m at maturity in situ. Forest according to definition 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 are areas normally forming part of the forest area which are temporally un stocked as a result of human intervention or natural causes but which are expected to revert to forest.

Forest and nature area determination

The Dutch national system consists of land use maps combined (partly through a stepwise modelling approach) with a variety of databases. The topographical maps of 1990 and 2000 served as a basis. However these maps are based on aerial photographs and intensive field work. Therefore not all sheets are inventoried in the same year. The sheets inventoried as close to 1990 and 2000, respectively are chosen. The classification of the maps is done step wise. First an automatically classification for the selection of land use with a unique colour, followed by a more specific classification for those land use that do not have a specific colour code (e.g. cropland and buildings in cities). For this second step statistics on land use are used which allow the delineation of the built-up area. In the aggregation process to the final land use map, as much as possible of the resolution was maintained. So, if a small patch of cropland at 25 x 25 m (< 0.06 ha) occurs within a forested area, it is maintained as a patch of cropland, and a patch of forest within cropland is maintained as forest (more accurate: 'trees outside the forest'). In figure 7.2 an example of the 1990 and 2000 land use map is shown including a map showing the changes in land use. The land use classes defined in the historical land use map are allocated to one of the six land use categories as identified in the *Good Practice Guidance* on LULUCF (IPCC, 2003). Within the land use category forest, 3 subcategories have been identified (see *Table A3.2*).

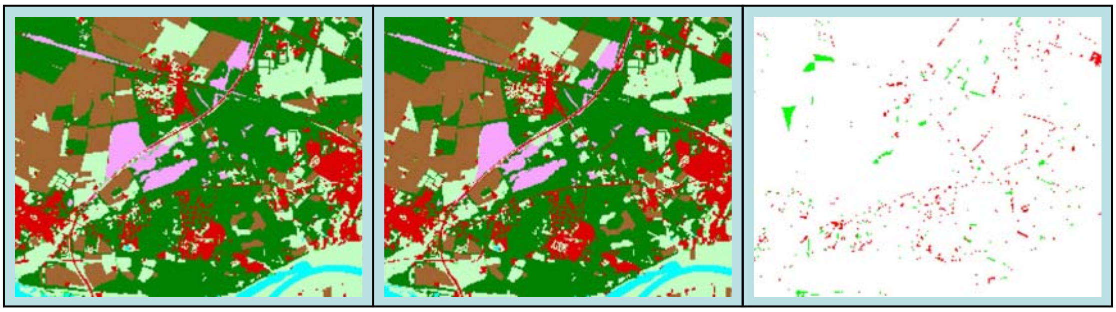

Figure A3.1. Land use change. Example of a map representing land use in the vicinity of Oosterbeek for 1990 (left.) and 2000 (middle); land use changes for forestry have been obtained by comparing the land use maps for 1990 and 2000 to achieve a land use change map forestry (right); this map locates both afforestation and deforestation. The maps are based on digitized topographical information for cells of 25 × 25 m (0.06 ha).

Table A3.2. Land use classes as defined in the historical land use map of the Netherlands (HGN) and the equivalent land use category in LULUCF Good Practice Guidance 2003

HGN Basis	HGN subdivision	GPG classes
Forest	Forest according to forest definition	Forest
	Trees outside the forest (<0,5 ha or 8 pixels)	Forest
	Heather/peat and other nature terrains	Forest
Grassland		Grassland
Cropland / bare soil		Cropland
Settlement	Settlement	Settlement
	Road	Settlement
Water		Not terrestrial
Reed swamp		Wetland
Sand	Bare coastal dune	Other land
	Beach	Other land
	Inland sand dune	Other land
Other	Other	Other land
	Water	Other land

Although the current dataset is based on best available information and GIS techniques the results, i.e. the transition matrices might show some overestimation of changes in landuse. Especially line elements might cause an overestimation. These inadequacies have the attention of the authors and are subject to validation and quality analysis and quality control in the near future. An enhancement is foreseen to be executed before the end of this year. Detailed ground truth analysis will be part of the steps that are taken to get a more accurate change matrix.

Forest biomass and dead wood stock changes

Forest biomass

The basic assumption is that the net flux can be derived from converting the change in growing stock volume in the forest to carbon. The reported forest land use is combined with the national forest inventory databases, which stem volume data are converted to whole tree carbon through selection of allometric equations from a large European equation and biomass database. 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 dead wood. For more information about the used data sets and calculation method is referred to *Box A3.1*.

Dead wood

The net C flux to dead wood is defined as the remainder of the input of dead wood due to mortality minus the decay of dead wood. In the Netherlands there is likely to exist a net build up of carbon in dead wood. The mortality rate was assumed to be a fixed fraction of the standing volume (0.4% per year). MFV data provide a current stock of dead wood volume of 6.6% of the living wood volume. The decay of dead wood is determined by the total time needed to fully decompose. The wood density varies strongly during this decomposition but was assumed to be 50% of the basic wood density of the living trees.

CO_2 emissions and removals from soil [5D]

Cultivation of mineral soils

The change in organic matter as result of cultivation of mineral soil is discussed under the sub category '5D Other' because it only addresses the change in carbon stocks from changes in area, location with soil type and groundwater level of specific land uses according to categories identified in Good Practice Guidance 2003. This calculation does not yet include changes in carbon due to land and soil management and cultivation practices. Carbon stores for specific combination of soil type and groundwater level have been considered constant (De Groot *et al.*, 2005). Land use has been quantified following the procedure outlines in *Section 7.2.2* under CO_2 from forestry.

Box A3.1. Datasets and methodology used for forest biomass calculation.

Data: For the calculation of the living biomass carbon balance the Dutch National Forest Inventory has been used. This was available for two periods a) 1988-1992 (HOSP data) and b) 2001-20002 (MFV data).
- HOSP plot level data (2007 plots ~ 400 plots 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 for growing stock volume, increment, age, tree species, height, tree number and dead wood were used. In total 1440 plot recordings with forest cover were available for the years 2001 and 2002. MFV continues in 2004 as well with another 900 plots, with litter layer thickness as well. MFV data were used as one set of data. I.e. the resulting carbon balance is applied to the year 2000, 2001 and 2002.

Calculation method: First the age of the stand and the limit of dominant height are calculated. Followed by a calculation of height and expected volume in the next year. From the expected volume for the next year and from the number of trees the average tree volume for 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 with the equations from the COST E21 database. The desired net flux is derived from the difference in tree mass between two years, the basic wood density and the carbon content of the dry mass. This last step is represented in the below given equation.

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

in which:

$\Delta C(trees)_{plot}$	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)

Cultivation of organic soils

The cultivation and drainage of organic soils results in subsidence of the surface as result of oxidation of organic materials exposed to oxygen and consolidation and shrinkage by drying. Typically in the Netherlands the ditch water levels are regularly adapted to the lowered soil surface. In this way the ditch water level and groundwater level over time is on average at the same level below the soil surface. By comparing the amount of organic matter and subsidence in a soil profile in the past and in more recent years it is possible to calculate the amount of organic matter that has been oxidized (Kuikman *et al.,* 2005; see *Box A3.2*).

Activity data necessary to quantify CO_2 emission is derived from soil maps, datasets with attribute information and empirical relations between groundwater tables, ditch water levels and subsistence, based on long term monitoring data. The information on the area of peatland in the 1990 till present was based on land use maps (information gathered using remote sensing techniques) and soil (profile) chemical and pedological analysis (Pleijter, 2004; De Groot *et al.,* 2005; Kuikman *et al.,* 2005; Kramer and Knol, 2005).

A recent inventory of the area of organic soils in the Netherlands (De Vries, 2004) provides as best estimate a number of 223,000 ha of organic soil managed for agricultural use in the 1990-2003 period. For this total area a net change in carbon stock as result of oxidation only is calculated based on detailed information on subsidence and oxidation as result of several degrees of intensity of drainage and peat profile. Annual CO_2 emissions from cultivation of organic soils are based on an average subsidence per ha of about 8 mm; the emission per mm subsidence is calculated at 2,259 kg CO_2/ha yr. The annual average CO_2 emission is 4,246 Gg CO_2. This figure is used for all years in the 1990-2003 period.

Liming of agricultural soils

The liming of agricultural soils is based on data on application of limestone and dolomite based fertilizers in agriculture. Since 1990 there is decrease in the application of these products as fertiliser and subsequent in the emission of CO_2 (Van den Born, 2005). In 1990 the amount was 183 Gg CO_2 and in 2003 this was reduced to 86 Gg CO_2 (see table A3.3).

Table A3.3. CO_2 emissions and removals from soils: liming of agricultural soils (IPCC category 5D)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CO_2 emissions from limestone and dolomite	183	147	141	120	96	98	111	110	104	84	98	80	85	86

Unit: Gg CO_2

Other (due to change in land use)

The category 'other' includes the soil related sinks and sources due to changes in land use between 1990 and 2000. Relevant inputs for the calculation are: the change in area and location of each of the land use categories identified, the soils map and the soil C content (De Groot *et al.*, 2005). A constant C stock has been assumed for each land use and soil type combination over time. The changes in C stock as result of (changes in) management have not been included as data are not available yet. A quantification of the impact would be highly uncertain. Therefore no attempt is made to calculate the contribution.

Although the changes in land use between major land use types are significant (forest, agriculture, settlement), and also within agriculture (conversion from maize into grass and vice versa grassland in rotation) a reliable quantification of carbon stock change is not possible without further analysis of the data on the impact of land use change on carbon stock. Even under apparent extreme situation where agricultural land is converted into settlement the release of carbon might be rather limited, since in practise the top layer of the converted grassland will be reused elsewhere or covered by buildings, roads or otherwise

The net emission from these land use changes is 125 Gg CO_2. This is the sum of an emission of 710 Gg CO_2 and a sink of about -584 Gg CO_2 (see *Table A3.4*). This relates primarily to changes from agricultural and forest land to other land and vice versa (see *Table A3.5*).

Table A3.4. CO_2 emissions and removals from soil: 'Others'

Land use	**area in 1990** (x 1000 ha)	**C-stock 1990** (Gg C)	**area in 2000** (x 1000 ha)	**C-stock 2000** (Gg C)	**Net C removals** (Gg C per annum)	**Net C emission** (Gg C per annum)	**Net C change** (Gg C per annum)	**Net CO_2 change** (Gg CO_2 per annum)
Cropland	976.93	92,834	973.98	92,834	-9.60	0.00	-9.60	-35.21
Forest	362.91	29,063	368.22	29,063	-8.36	0.00	-8.36	-30.67
Trees outside forest	50.53	4,074	48.98	4,074	-3.48	0.00	-3.48	-12.76
Nature areas and heather	21.90	2152	22.79	2,152	-6.76	0.00	-6.76	-24.80
Grassland	1,489.55	165,490	1,376.45	165,490	-89.87	0.00	-89.87	-329.51
Other Land	38.81	0	37.63	0	0.00	13.67	13.67	50.13
Other land (water)	776.47	0	781.10	0	0.00	180.01	180.01	660.04
Settlements	429.21	42,481	540.02	42,481	-41.30	0.00	-41.30	-151.42
Wetland	2.85	356	0.00	356			0.00	0.00
Total	4,149.16	336,450	4,149.16	336,450	-159.37	193.68	34.31	125.80

Note: The net removals and emission are based on the land use changes from 'other land' to cropland, forest, trees outside forest, nature area and heather and grassland and vice versa.

Table A3.5. Conversion matrix showing the changes in land use between 1990 and 2000 (in kha).

		Land Use end 1990									
		crop land	*forest*	*natural areas and heather*	*small forested areas*	*grass land*	*other land*	*other land (water)*	*set-tlement s*	*wet land*	*total (in 2000)*
Land Use 2000	*cropland*	778.4	1.2	0.1	0.9	188.3	0.0	0.8	4.8	0.0	974.0
	forest	9.4	337.1	4.9	2.3	9.6	0.5	0.6	3.8	0.1	368.2
	natural areas and heather	0.6	2.9	43.4	0.2	0.8	0.6	0.3	0.3	0.0	49.0
	small forested areas	1.4	3.1	0.2	12.2	3,.5	0.1	0.3	2.0	0.0	22.8
	grassland	143.8	9.4	0.8	2.9	1,185.8	1.2	6.4	24.5	1.9	1,376.5
	other land	0.1	0.6	0.3	0.1	0.6	33.6	2.1	0.2	0.0	37.6
	other land (wa-ter)	3.2	0.9	0.6	0.2	7.8	2.2	763.3	2.4	0.5	781.1
	settlements	39.7	8.2	0.3	3.8	82.8	0.5	3.2	401.4	0.1	540.0
	total (in 1990)	976.7	363.3	50.6	21.9	1,479.3	38.7	776.9	439.3	2.6	4,149.2

Box A3.2. Calculation of oxidation of organic matter (Kuikman et al., 2005)

In formula: $CO_{2,\,em} = S_{mv} * \rho_{so} * fr_{os} * fr_c * 44/12 * 10^4$

In which:

$CO_{2,\,em}$ = CO_2 emission (kg. CO_2 ha.a^{-1})
S_{mv} = subsidence rate (m.ar^{-1})
ρ_{so} = bulk density of the unripe peat soil (kg.m^{-3})
fr_{os} =organic matter fraction of the peat soil (-)
fr_c = carbon fraction of the organic matter (-)

The above calculation leads to a CO_2 emission of 2259 kg CO_2 ha^{-1} a^{-1} for each mm of subsidence. In case peat layers are less than 1.2 m thick, the above equation has been modified (Kuikman *et al.*, 2005).

ANNEX 4: CO_2 Reference Approach and comparison with Sectoral Approach

4.1 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, 2000). 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 1990-2003 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 1.4% for 2002 and +4.9% for 1991, with an average of 3.0%. 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
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
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
Gaseous fuels	71.0	79.3	77.2	79.7	76.7	78.9	87.4	81.8	81.3	79.0	80.0	82.4	82.1	82.6
Others	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 RA	**154.8**	**161.0**	**159.6**	**162.4**	**162.7**	**165.1**	**173.1**	**166.0**	**166.9**	**161.3**	**164.3**	**169.2**	**168.5**	**172.2**
National Approach														
Liquid fuels	47.0	47.0	47.4	49.0	49.8	50.1	50.5	49.9	51.3	52.4	52.6	53.9	53.7	55.0
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	32.0
Gaseous fuels	67.1	75.0	73.0	75.8	72.5	74.7	83.3	77.6	77.3	75.1	75.8	78.7	78.5	79.3
Others [2]	3.3	3.2	3.2	3.2	3.0	3.1	3.3	3.6	3.6	3.4	3.2	3.1	3.1	2.9
Total NA	**148.4**	**153.5**	**152.3**	**157.1**	**156.3**	**160.3**	**168.1**	**161.0**	**163.5**	**158.2**	**160.4**	**166.5**	**166.1**	**169.1**
Difference [3] (%)														
Liquid fuels	6%	7%	8%	4%	5%	3%	4%	4%	2%	1%	2%	1%	0%	1%
Solid fuels	10%	11%	9%	8%	9%	7%	8%	9%	7%	7%	6%	5%	6%	7%
Gaseous fuels	6%	6%	6%	5%	6%	6%	5%	5%	5%	5%	5%	5%	5%	4%
Other	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%	-100%
Total	**4.3%**	**4.9%**	**4.8%**	**3.4%**	**4.1%**	**3.0%**	**3.0%**	**3.1%**	**2.1%**	**2.0%**	**2.5%**	**1.6%**	**1.4%**	**1.8%**

[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.

[3] Defined as: (NA-RA)/RA.

The *Reference Approach* (RA) data show 12% increase in emissions from liquid fuels (1990-2002) and a 16% increase from gaseous fuels; CO_2 emissions from solid fuels increased in this period only by 0.3%. The *National Approach* (NA) data on the other hand show 17% increase in emissions from liquid fuels (1990-2002) and a 18% increase from gaseous fuels; CO_2 emissions from solid fuels increased in this period by 3%. The emissions from others (i.e. fossil carbon in waste and LPG in road transport) decreased by 13%. However, as will be discussed below, these numbers cannot be compared well since the RA includes sources not in includes in the NA and vice versa. Therefore, a corrected comparison will be made below.

4.2 Causes of differences between the two approaches

There are six main reasons for differences in the two approaches, of which three 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);
3. In the fuel type mix, the liquids and other fuel component in the RA are different from the NA, in that the ***LPG in transport*** is in the National Approach reported under 'other fuel' versus in 'liquid fuel' in the Reference Approach;

and others are ***country-specific***:

4. 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;
5. The use of ***plant-specific emission factors*** in the NA vs. national defaults in the RA;
6. 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 recalculations of this year 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 all *fugitive CO_2 emissions* included in CRF sector 1B.

If we correct for the fossil waste not included in the RA and the 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 all below 2%: between -1.0% in 1992 and +0.8% in 1998 and 1999, with an average of 0.2%.

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
Difference RA-NA	**6.4**	**7.5**	**7.3**	**5.3**	**6.4**	**4.8**	**5.0**	**5.1**	**3.4**	**3.1**	**4.0**	**2.7**	**2.3**	**3.1**
Reference Approach:	154.8	161.0	159.6	162.4	162.7	165.1	173.1	166.0	166.9	161.3	164.3	169.2	168.5	172.2
o.w. LPG road transp.	2.7	2.7	2.6	2.5	2.4	2.3	2.2	2.3	2.2	1.9	1.7	1.6	1.5	1.3
o.w. fossil C in waste	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	1.6
RA incl. fossil waste:	**155.3**	**161.6**	**160.2**	**163.1**	**163.3**	**165.9**	**174.2**	**167.3**	**168.3**	**162.8**	**165.8**	**170.7**	**170.1**	**173.8**
Diff. RAincl.Waste-NA:	6.9	8.1	7.9	6.0	7.0	5.6	6.1	6.4	4.8	4.6	5.5	4.2	3.9	4.7
National Approach:	148.4	153.5	152.3	157.1	156.3	160.3	168.1	161.0	163.5	158.2	160.4	166.5	166.1	169.1
CO_2 fossil in sector 1B:														
1B1b. Solid Fuel Transf.	0.4	0.4	0.4	0.4	0.5	0.5	0.7	0.5	0.5	0.4	0.4	0.4	0.4	0.5
1B2c Flaring	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
CO_2 fossil in sector 2:	6.2	6.1	5.6	5.3	5.8	6.1	5.6	6.0	5.7	5.6	5.5	4.7	4.7	4.6
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
B. Chemical industry														
1. Ammonia production	3.1	3.4	3.5	3.4	3.6	3.5	3.3	3.5	3.6	3.5	3.6	3.0	2.9	2.7
4. Other, excl. act. carbon	0.4	0.4	0.4	0.3	0.4	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
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
D. Other Production														
1. Pulp and Paper	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
G. Other ***(please specify)***														
Other economic sectors	0.3	0.2	0.3	0.2	0.2	0.5	0.5	0.5	0.4	0.5	0.6	0.4	0.4	0.4
Not in NA-1A:	**6.9**	**6.8**	**6.3**	**6.0**	**6.6**	**6.8**	**6.4**	**6.7**	**6.3**	**6.2**	**6.0**	**5.2**	**5.2**	**5.2**
NA+1B+Ind. Proc-Waste	154.7	159.7	158.0	162.4	162.2	166.2	173.4	166.4	168.4	162.8	164.9	170.2	169.7	172.7
RA:	154.8	161.0	159.6	162.4	162.7	165.1	173.1	166.0	166.9	161.3	164.3	169.2	168.5	172.2
New difference (abs)	**0.0**	**-1.3**	**-1.6**	**-0.1**	**-0.5**	**1.2**	**0.3**	**0.3**	**1.5**	**1.5**	**0.5**	**1.0**	**1.3**	**0.5**
New difference (%)	*0.0%*	*-0.8%*	*-1.0%*	*0.0%*	*-0.3%*	*0.7%*	*0.2%*	*0.2%*	*0.9%*	*0.9%*	*0.3%*	*0.6%*	*0.8%*	*0.3%*

The corrected RA and NA comparison per fuel type, including the correction of LPG in the NA to liquid fuels, is presented in *Table A4.3*. This shows that the largest differences do not concentrate in a particular corner of the period. The corrected 1990-2003 trends also differ only slightly: 11.6% for the corrected *National Approach* (NA) (= sum of sectoral emissions in source category 1A plus selected 1B and 2) and 11.3% for the corrected *Reference Approach* (= including fossil waste in the total). We conclude that in total annual emissions the remaining differences are now all smaller than ±1% and on average only 0.2%.

The corrected approaches show differences in emissions from liquid fuels up to 3% vs. 8% for uncorrected comparisons; up to 2% vs. 11% for solid fuels and 1% vs. 6% for gaseous fuels, if corrections are made for LPG (in road transport) in RA-liquids; 2G (lubricants and waxes) in NA-liquids, 1B (coke production) and 2C1 (blast furnaces) and others in NA-solids; and 1B1 (gas flaring) 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 A.4.3. Comparison of CO_2 emissions: differences between corrected Reference Approach (RA) versus corrected National Approach [(NA-RA)/RA)] (in %)

Fuel type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Liquids [RA incl. LPG (road)] incl. 2G	-0.7%	1.0%	1.5%	-1.0%	-0.2%	-2.8%	-1.7%	-1.8%	-3.2%	-3.3%	-1.9%	-2.3%	-3.6%	-2.2%
Solids incl. 1B1,2A,2B4,2C1,2D	-0.5%	0.9%	1.4%	0.7%	0.5%	-0.9%	0.2%	0.1%	-0.4%	-0.3%	-0.1%	-1.0%	-0.1%	0.5%
Gas, incl. 1B2, 2B1	0.8%	0.7%	0.5%	0.4%	0.5%	0.7%	0.6%	0.7%	0.4%	0.4%	0.6%	0.7%	0.8%	0.7%
Total corrected (excl. waste)	0.0%	-0.8%	-1.0%	0.0%	-0.3%	0.7%	0.2%	0.2%	0.9%	0.9%	0.3%	0.6%	0.8%	0.3%

4.3 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* we present the calculation of annual oxidation fractions for 1995-2002 and the average values derived from them. 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 present storage fractions of non-energy use of fuels are now about 4%-points higher for (most) oil products (was 82%) and about 30%-points for natural gas (was 10%). The large change for natural gas is due to the use of old statistics that were later updated and the inclusion of carbon stored in urea produced (of which a large fraction is exported). 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.

Table A4.4. Derivation of carbon storage factors for in the IPCC Reference Approach calculated from feedstock use of energy carriers and residual gases produced or fossil products manufactured: annual factors 1995-2002 for liquid, solid and gaseous fossil fuels, averages and 95% Confidence Interval.

Fuel type	1995	1996	1997	1998	1999	2000	2001	2002	Average	CI
Liquid	0.78	0.76	0.77	0.77	0.77	0.80	0.79	0.77	77.7%	2%
Solids	0.64	0.64	0.61	0.63	0.49	0.50	0.53	0.57	55.5%	13%
Gaseous	0.38	0.39	0.39	0.36	0.37	0.38	0.41	0.42	38.8%	4%

Table A4.5. 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	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Trend
Liquids [1) 2)]	5.0	5.0	4.7	3.9	4.0	5.2	4.9	5.1	5.3	5.8	6.2	6.6	6.8	7.8	2.8
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	0.4	0.4	0.0
Gaseous	3.5	3.5	3.5	3.3	3.5	3.8	3.6	3.9	3.7	3.7	3.9	3.4	3.3	3.1	-0.3
Total	**8.9**	**8.9**	**8.5**	**7.6**	**7.9**	**9.3**	**8.9**	**9.4**	**9.4**	**9.8**	**10.5**	**10.4**	**10.6**	**11.4**	**2.5**
As % of RA	5.7%	5.7%	5.4%	4.9%	5.0%	6.0%	5.8%	6.1%	6.1%	6.4%	6.8%	6.7%	6.9%	7.3%	

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.

In *Table A.4.5* 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 almost 30% or 2.5 Tg CO_2 (from 8.9 to 11.4 Tg CO_2), of which most are due to changes in emissions from liquid fuels (*Table 3.34*).

To see how the updated storage factors have affected the RA calculation, we show in *Tables A.4.6 and A4.7* the carbon storage in the RA calculation in the NIR 2005 and NIR 2004. Its shows, that in the Netherlands about 20 to 30 Tg CO_2 or 12 to 15% of all carbon in the apparent consumption of fossil fuels is stored. These figures are about 6 Tg CO_2 higher than in the previous calculations.

Table A4.6. Carbon storage in the IPCC Reference Approach for CO_2 from fossil fuel use (in Tg CO_2)

Fuel type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	Trend
Liquids	17.4	19.3	19.9	18.1	19.0	18.0	17.0	17.9	17.7	19.7	21.4	22.9	23.8	27.2	+17.4
Solids	0.6	0.0	0.0	0.0	0.0	0.5	0.6	0.6	0.6	0.5	0.5	0.5	0.6	0.6	+0.6
Gaseous	2.2	2.4	2.3	2.2	2.4	2.4	2.3	2.5	2.3	2.3	2.4	2.2	2.1	2.0	+2.2
Total	**20.2**	**21.6**	**22.2**	**20.4**	**21.4**	**20.9**	**19.8**	**20.9**	**20.6**	**22.6**	**24.4**	**25.7**	**26.5**	**29.8**	**+20.2**
% gross RA [1)]	12%	12%	12%	11%	12%	11%	10%	11%	11%	12%	13%	13%	14%	15%	

1) Expressed as part of total carbon in apparent consumption of fossil fuels (without subtracting the stored part).

Table A4.7. Carbon storage cf. IPCC Reference Approach in NIR 2004 and compares to NIR 2005 (in Tg CO_2)

Fuel type	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
CO_2 storage cf. RA 04													
Liquids	13.1	18.0	16.8	14.3	14.5	13.9	12.6	14.2	13.9	15.8	17.8	19.0	18.7
Solids	0.6	0.5	0.5	0.7	0.6	0.6	0.6	0.6	0.6	0.2	0.2	0.3	0.4
Gaseous	0.5	0.6	0.6	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5
Total	**14.3**	**19.2**	**17.9**	**15.5**	**15.7**	**15.1**	**13.8**	**15.4**	**15.0**	**16.6**	**18.6**	**19.8**	**19.6**
Diff. RA 2005 - RA 2004													
Liquids	4.3	1.2	3.1	3.9	4.5	4.1	4.4	3.6	3.9	3.9	3.6	3.9	5.1
Solids	0.0	-0.5	-0.5	-0.7	-0.6	-0.1	0.0	0.0	0.0	0.4	0.3	0.2	0.2
Gaseous	1.7	1.8	1.8	1.7	1.8	1.8	1.7	1.8	1.7	1.7	1.9	1.7	1.6
Total	**5.9**	**2.5**	**4.3**	**4.8**	**5.7**	**5.8**	**6.1**	**5.4**	**5.6**	**6.0**	**5.8**	**5.8**	**6.8**

4.4 Recalculations and error corrections of CO_2 from fossil fuel

Reference Approach

Apart from different ***storage fractions*** of non-energy use of fuels as presented in *Table A4.4* (now about 4%-points more for oil products and about 30%-points for natural gas, other changes are found in:

- ***carbon contents (i.e. CO_2 emission factors) used***
  For the fuels used in the Reference Approach the factors used and the changes compared to the previous NIR are summarised in *Table A4.8*. Analysis shows that this has had the largest impact on total carbon contained in crude oil, natural gas liquids (NGL), diesel oil and other bituminous coal and lesser changes in petrol (gasoline) and jet kerosene.
- ***amount of fuel use for non-energy purposes***
  These changes are due to the re-assessment of the fuel consumption data labelled as 'feedstock' as described in *Chapter 4*. The most significant changes are found in naphtha, NGL, natural gas (higher) and LPG (lower).

In addition, some changes were made in the 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.

Table A4.8. Carbon contents used in the Reference Approach: comparison with previous submission (expressed as kg CO_2/GJ)

Fuel type	**Fuel**	**EF CO_2**	**(kg CO_2/GJ)**	
		NIR2005	**NIR2004**	**Diff.**
Liquid	Crude Oil	73.3	73.0	0.3
	Natural Gas Liquids	63.1	66.0	-2.9
	Petrol (Gasoline)	72.0	73.0	-1.0
	Jet Kerosene	71.5	73.0	-1.5
	Other Kerosene	71.9	73.0	-1.1
	Gas / Diesel Oil	74.3	73.0	1.3
	Residual Fuel Oil	77.4	77.0	0.4
	LPG	66.7	66.0	0.7
	Naphtha	73.3	73.0	0.3
	Bitumen	80.7	77.0	3.7
	Lubricants	73.3	73.0	0.3
	Other Oil	73.3	73.0	0.3
Solid	Other Bit. Coal	94.7	96.7	-2.0
	BKB & Patent Fuel	80.7	94.0	-13.3
	Coke Oven/Gas Coke	111.9	103.0	8.9
Gaseous	Natural Gas (Dry)	56.1	56.0	0.1

National Approach

This year the CO_2 emissions in the *National Approach* of the fuel combustion sector 1A have been recalculated for all years, showing decreases for all years between 1% and 7.5%. However, most of these changes are due to a reallocation of fossil fuel related emissions to industrial processes (Sector 2) and fugitive emissions (sector 1B). Changes in emission factors can be summarised as follows:

- ***natural gas:*** no change;
- ***coal and coal products:*** for power plants and iron and steel production based on plant-specific data, thus no large differences expected from previously used MJV data;
- ***refinery gas and residual gas:*** mostly plant-specific data, thus no large differences expected from previously used MJV data;
- ***road transport fuels:***
    - o diesel: now 74.3 kg CO_2/GJ (was: 73.3);
    - o petrol: now 72.0 kg CO_2/GJ (was: 72.3);
    - o LPG: now 66.3 kg CO_2/GJ (was: 66.4).

For more details on recalculations in sectoral emissions, we refer to *Section 9.1* and *Chapter 3.* The effect of these recalculations in subsequent submissions of the NIR on total CO_2 emissions from fossil fuel combustion reported under source category 1A are presented in *Table A4.9* This shows changes of -6.0%, 0.8, -0.4 and -0.9% in the base year 1990 emissions in the NIRs of 2005, 2004, 2003 and 2002, respectively. It clearly shows the major change to sector 1A emissions of this year's recalculation and reallocation compared to the changes made in previous years. For the years 1997 and later the figures show every year a decrease of emissions. The largest change was -6.8% in 1997 in the NIR 2002.

Table A4.9. Differences of CO_2 emissions from fuel combustion (1A) in the National Approach 1990-2002 due to recalculations (revisions, error corrections and reallocations between source category 1A and other categories) (in Tg and %)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
NIR 2005	148.4	153.5	152.3	157.1	156.3	160.3	168.1	161.0	163.5	158.2	160.4	166.5	166.1
Difference 05/04	***-6.0%***	***-7.4%***	***-7.5%***	***-5.7%***	***-6.6%***	***-5.8%***	***-5.6%***	***-1.0%***	***-3.5%***	***-3.4%***	***-4.5%***	***-4.3%***	***-4.0%***
NIR 2004	157.8	165.7	164.6	166.6	167.3	170.1	178.1	162.5	169.4	163.8	167.9	174.0	
Difference 04/03	***0.8%***	*0.1%*	*0.4%*	*0.1%*	*0.1%*	***0.5%***	***0.7%***	***-1.5%***	***-0.6%***	***-1.8%***	***-1.6%***	***-1.5%***	
NIR 2003	156.5	165.5	164.0	166.4	167.1	169.2	176.9	165.0	170.5	166.8	170.7	176.7	
Difference 03/02	***-0.4%***	0.1%	*0.0%*	*0.0%*	*0.0%*	***-0.6%***	***-0.1%***	***-0.7%***	***-0.6%***	***-1.1%***	***0.4%***		
NIR 2002	157.1	165.4	164.0	166.4	167.1	170.3	177.0	166.1	171.6	168.7	170.1		
Difference 01/01	***-0.9%***	*0.5%*	*0.4%*	*0.3%*	*0.2%*	***-1.6%***	***-1.7%***	***-6.8%***	***-3.3%***	***-1.1%***			
NIR 2001	158.5	164.5	163.4	165.9	166.8	173.0	180.1	178.3	177.4	170.6			

Historical trend of Reference Approach/National Approach comparisons

Table A4.10 summarises the reported comparisons between *Reference Approach* and *National Approach* (i.e. 1A) for the last five National Inventory Reports. This shows that recalculations and improvements in both approaches do not have the same impact for each year. This year major changes in the 1A emissions due to reallocation of process emissions to CRF sector 2 and from product use to CRF sector 3 caused NA totals of sector 1A to by significantly lower than in the previous NIR. Similarly, the recalculated carbon storage factors, based on a new analysis of carbon inputs and outputs in the sectoral energy statistics and a few auxiliary industrial production statistics, caused the reference approach be lower than in the previous NIR.

For 1990 the change in differences is from -0.6% in the NIR 2001 to 4.3% in the NIR 2005; for 1995 the changes are from 0.1% to 2.0%. The largest changes are for 1997, where in the NIR 2001 a difference of -0.4% was reported, this was 5.8% in the NIR 2004 and currently the difference is 3.1%. For a discussion of the causes of these discrepancies we refer to discussion above.

However, as discussed above the standard comparison between NA and RA is generally hampered by the inherent differences when CO_2 sources are allocated as required by the IPCC Reporting Guidelines. The larger difference now observed for the present dataset does *not* reflect a decline of the accuracy and consistency but on the contrary a substantial improvement (as explained in *Section 4.2* of this Annex).

Table A4.10. Effect of recalculations on the comparison of CO_2 emissions from fuel combustion in the Reference Approach versus National Approach (1A) (in Tg), NIRs 2001-2005 (uncorrected NA emissions).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
NIR 2005													
Reference Approach	154.8	161.0	159.6	162.4	162.7	165.1	173.1	166.0	166.9	161.3	164.3	169.2	168.5
National Approach	148.4	153.5	152.3	157.1	156.3	160.3	168.1	161.0	163.5	158.2	160.4	166.5	166.1
Difference	4.3%	4.9%	4.8%	3.4%	4.1%	3.0%	3.0%	3.1%	2.1%	2.0%	2.5%	1.6%	1.4%
NIR 2004													
Reference Approach	159.6	163.7	161.4	166.4	165.3	170.1	178.7	172.0	172.4	167.3	170.1	175.9	
National Approach	157.8	165.7	164.6	166.6	167.3	170.1	178.1	162.5	169.4	163.8	167.9	174.0	
Difference	***1.1%***	***-1.2%***	***-1.9%***	***-0.1%***	***-1.2%***	***0.0%***	***0.3%***	***5.8%***	***1.8%***	***2.2%***	***1.3%***	***1.1%***	
NIR 2003													
Reference Approach	159.6	163.7	161.4	166.4	165.3	170.1	178.7	172	172.4	167.3	170.1	175.9	
National Approach	156.5	165.5	164	166.4	167.1	169.2	176.9	165	170.5	166.8	170.9	176.7	
Difference	***2.0%***	***-1.1%***	***-1.6%***	***0.0%***	***-1.1%***	***0.5%***	***1.0%***	***4.2%***	***1.2%***	***0.3%***	***-0.3%***	***-0.5%***	
NIR 2002													
Reference Approach	159.6	164.5	161	163.4	162.6	170.1	178.7	171.9	171.8	167.3	174.5		
National Approach	157.1	165.4	164	166.4	167.1	170.3	177	166.1	171.6	168.7	170.1		
Difference	***1.5%***	***-0.6%***	***-1.8%***	***-1.8%***	***-2.7%***	***-0.1%***	***0.9%***	***3.5%***	***0.1%***	***-0.8%***	***2.6%***		
NIR 2001													
Reference Approach	157.7	164.9	161	163.4	162.6	173.1	180.9	177.5	176.1	167.3			
National Approach	158.5	164.5	163.4	165.9	166.8	173	180.1	178.3	177.4	170.6			
Difference	***-0.6%***	***-0.2%***	***-1.5%***	***-1.5%***	***-2.5%***	***0.1%***	***0.4%***	***-0.4%***	***-0.7%***	***-2.0%***			

ANNEX 5: Assessment of completeness and (potential) sources and sinks excluded

The Netherlands greenhouse gas emission inventory presently includes *all* sources identified by the *Revised IPCC Guidelines* (IPCC, 1997) *except* for the following (see *Table A5.1*):

- CO_2 from *lime production* (2A2), due to missing activity data;
- indirect CO_2 from NMVOC from oil transport, distribution of oil products (1B2a), negligible source;
- CO_2 from *asphalt roofing and road paving with asphalt* (2A6 and 2A7), negligible source;
- CH_4 from *poultry* (4A9), due to missing emission factors;
- N_2O from *industrial wastewater* (6B), negligible source;
- CH_4 and N_2O emissions from *LUCF* (5A-5D);
- *CH_4 emissions from soils*. These have deceased in the last 40 years, due to drainage and the lowering of water tables, so they have been included in the natural total; thus not as net (i.e. positive) anthropogenic emissions, because, on the contrary, they act, in fact, as methane sinks;
- emissions from *multilateral operations* (Memo item) have not been estimated separately but are included in the national total (1A5);
- *precursor emissions* (i.e. CO, NO_x, NMVOC and SO_2) from *international bunkers (international transport)* have not been estimated/ reported for this inventory.

In response to reviews of previous submissions we improved and extended the use of notation keys in the CRF files. For more details on *sources reported elsewhere* ('IE') see the Completeness Table 9 for 1990 in *Annex 5* and the documentation boxes in the CRF files, which are also included in the sectoral descriptions in the *Chapters 3 to 9*.

Improvements made

Most sources lacking in last submission are now included in the inventory and the CRF:

- Direct N_2O emissions from *agricultural soils* (crop residues and histosols) (category 4D);
- Indirect N_2O emissions from *atmospheric deposition* (category 4D and 2G);
- CH_4 and N_2O from *horse manure* (category 4B);
- CH_4 and N_2O from *explicit inclusion of solid manure* (category 4B);
- Emissions/sinks for *LULUCF subcategories 5A to 5E*;
- CH_4 and N_2O emissions from *industrial* wastewater treatment and human sewage (6B) and from *large-scale compost production* from organic waste (6D).

A survey made to check for *unaccounted 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). These sources may be included in a later stage if it has been decided to monitor them regularly.

Table A5.1. CRF Completeness Table 9 for 1990

Sources and sinks not reported (NE)[1]			
GHG	Sector[2]	Source/sink category [2]	Explanation
CO_2	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.a.i exploration	Minor source and no specific data available
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.a.iii transport	Minor source and no specific data available
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.a.v distribution of oil products	Minor source and no specific data available
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.b.iii Other Leakage at industrial	Minor source and no specific data available
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.b.iii Other Leakage in residentia	Minor source and no specific data available
	Total Industrial Processes	2.A.5. Asphalt Roofing	Minor source and no specific data available
	Total Industrial Processes	2.A.6. Road Paving with Asphalt	Minor source and no specific data available
	Total Industrial Processes	2.A.2. Lime production	No specific proces emissions available
CH_4	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.a.iii transport	Minor source and no specific data available
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.a.v distribution of oil products	Minor source and no specific data available
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.b.iii Other Leakage at industrial	Minor source and no specific data available
	Total Agriculture	4.A.9. Poultry	No specific enteric fermentation emissions estimated (minor source)
	Total Land-Use Change and Forestry	5.B. Forest and Grassland Conversion	No specific emissions estimated
N_2O	Wastewater Handling	6.B. Industrial Wastewater	Minor source and no data available
	Total Land-Use Change and Forestry	5.B. Forest and Grassland Conversion	No specific emissions estimated
HFCs	Total Potential Emissions of Halocarbons (by chemical) and S	F(p) Import in bulk & in products	No data available , please look to the line "filled in new products"
	Total Potential Emissions of Halocarbons (by chemical) and S	F(p) Export in bulk & in products	No data available , please look to the line "filled in new products"
PFCs	Total Potential Emissions of Halocarbons (by chemical) and S	F(p) Import in bulk & in products	No data available , please look to the line "filled in new products"
	Total Potential Emissions of Halocarbons (by chemical) and S	F(p) Export in bulk & in products	No data available , please look to the line "filled in new products"
SF_6			

Sources and sinks reported elsewhere (IE)[3]				
GHG	Source/sink category	Allocation as per IPCC	Allocation used by the Party	Explanation
CO_2	Energy sector	1A1c Other energy industries, coke pr	Partly 1A1a Iron and Steel	The on-site coke plant is due to integrated nature of steel plant included there.
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.a.ii oil production	1. B. 2. b. Natural Gas	Due to the small amount of oil produced, oil related emissions are included in the natural gas emissions
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.a.iv refining / storage	1.A.1.b. Petroleum Refining	Due to the small amount of oil produced, oil related emissions are included in the petroleum refining combustion emissions
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.b. Exploration	1.B.2.c Venting	No specific distinguisable proces emissions available
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.c. oil venting	1.B.2.c natural gas venting	Due to the small amount of oil produced, oil related emissions are included in the natural gas emissions
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.c. oil flaring	1.B.2.c natural gas flaring	Due to the small amount of oil produced, oil related emissions are included in the natural gas emissions
	Total Industrial Processes	2.B.4 Silicon Carbide	1.A.2	Emissions are concidered combustion emissions
	Total Industrial Processes	2.B.5. specific processes (ethylene)	2B5 Production other chemicals	No specific attributable proces emissions available.
	Total Agriculture	4.D	5	CO2 from agricultural soils included in LULUCF
	Total Waste	6.C. Waste Incineration	1.A.1	Waste Incineration generates electricity and heat for public use.
	Memo Items	Mulitilateral operations	1A5 Other (military marine and aviation)	No data available to separate out
CH_4				
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.a.i exploration	1.B.2.c Venting	Due to the small amount of oil produced, oil related emissions are included in the natural gas emissions
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.a.ii oil production	1.A.1.b. Petroleum Refining	Due to the small amount of oil produced, oil related emissions are included in the petroleum refining combustion emissions
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.b. Exploration	1.B.2.c Venting	No specific proces emissions available
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.b.i Production / processing	1.B.2.c Venting	No specific proces emissions available
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.b.iii Other Leakage in residentia	1.B.2.b Distribution	No specific proces emissions available
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.c. oil venting	1.B.2.c Venting	Due to the small amount of oil produced, oil related emissions are included in the natural gas emissions
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.c. oil flaring	1.B.2.c Venting	Due to the small amount of oil produced, oil related emissions are included in the natural gas emissions
	Total Industrial Processes	2.B.1. Ammonia Production	2.B.5. Production other chemicals	No specific proces emissions available
	Total Industrial Processes	2.B.5. Specific processes	2.B.5. Production other chemicals	No specific proces emissions available.
	Total Agriculture	4.B.(b). N2O from manure manageme	4.B..(b). National total excretion	Data split to different animals not available
	Total Agriculture	4D2 CH4 Animal production	4B Manure management	Due to the specific Dutch calculation method
	Total Waste	6.B. Sludge	6.B. Wastewater	No distinction between emission from sludge and water due to Dutch estimation method
	Total Waste	6.B. CH4 Recovery Wastewater (Dom	6.B. CH4 Recovery Sludge	No distinction between emission from sludge and water due to Dutch estimation method
	Total Waste	6.C. Waste Incineration	1.A.1	Waste Incineration generates electricity and heat for public use.
	Memo Items	Mulitilateral operations	1A5 Other (military marine and aviation)	No data available to separate out
N_2O	Solid Fuel Transformation	1.B.1. Solid fuels	1.A.1	Detailed proces emissions not distinguisable in inventory data.
	Fugitive Emissions from Oil, Natural Gas and Other Sources	1.B.2.c. oil flaring	1.A.1	Due to the small amount of oil produced, oil related emissions are included in the natural gas emissions
	Total Waste	6.C. Waste Incineration	1.A.1	Waste Incineration generates electricity and heat for public use.
	Memo Items	Mulitilateral operations	1A5 Other (military marine and aviatio	No data available to separate out
HFCs	Consumption of Halocarbons and SF6	2.1. Domestic, Commercial and Trans	2.1. industrial Air-Conditioning	Due to confidentiallity.
	Consumption of Halocarbons and SF6	2.1. Stationary Air-Conditioning	2.1. industrial Air-Conditioning	Due to confidentiallity.
PFCs				
SF_6				

ANNEX 6: Additional information to be considered as part of the NIR submission

The following reports should be considered as part of this NIR submission (besides the CRF files and trend and check tables compiled from CRF data and other tables presented in this NIR, which are also available as spreadsheets files) and are available from links at website: www.greenhousegases.nl:

Methodological description

- Ruyssenaars, 2005: *Methodologies applied for the Netherlands Greenhouse Gas Inventory (NIR/CRF 2005).* RIVM/MNP, Bilthoven, *In prep*. Summary listing the emission calculation protocol versions used for calculation the PER 2005 greenhouse gas emissions.
- Spakman, J., Van Loon, M.M.J., Van der Auweraert, R.J.K., Gielen, D.J., Olivier, J.G.J. and E.A. Zonneveld, 1997: *Method for calculation of greenhouse gas emissions*. VROM-HIMH, The Hague. Report Emission Registration **no. 37b**, March 2003. Electronic update of original report No. 37 of July 1997. *Electronic version only; available in Dutch and in English.*
- TNO, 2005: *Meta information on PER 2005 dataset* (in Dutch). TNO, Apeldoorn.

Documentation of uncertainties used in IPCC Tier 1 uncertainty assessments and Tier 2 key source identification

- Olivier, J.G.J. and L.J. Brandes, 2005: *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.

Detailed methodology (partly obsolete; check protocols) 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.
- Van Amstel, A.R., Swart, R.J., Krol, M.S., Beck, J.P., Bouwman, A.F. and K.W. van der Hoek, 1993: *Methane the other greenhouse gas; research and policy in the Netherlands.* RIVM, Bilthoven. Report no. 481507 001. April, 1993.
- Kroeze, C., 1994: *Nitrous oxide (N_2O). Emission inventory and options for control in the Netherlands.* RIVM, Bilthoven. Report no. 773001 004.
- Matthijsen, A.J.C.M. and C. Kroeze, 1996: *Emissions of HFCs, PFCs, FICs and SF_6 in the Netherlands in 1990, 1994, 2000, 2005, 2010 and 2020* (in Dutch). RIVM, Bilthoven. Report no. 773001 008.
- Kuikman, P.J., J.J.H van den Akker and F. de Vries, 2005: *Nitrous oxide emissions from organic agricultural soils* (in Dutch). Alterra, Wageningen. Alterra rapport 1035-II. *In prep.*

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.
- WEM/CCDM, 2003: *Project Plan Annual Emission Monitor Report 2003* (in Dutch). Ministry of VROM/VI, The Hague.
- Coenen, P.W.H.G., 2005: QA/QC activities performed on CRF 2005 datasets compiled for EU and UNFCCC. Memo TNO, Apeldoorn.
- Coenen, P.W.H.G. and J.G.J. Olivier, 2005: *Documentation of the activities within the framework of the completion of the CRF for the 2005 submission to the UNFCCC.* TNO-MEP, Apeldoorn. *In prep.*

ANNEX 7: Selection of Common Reporting Format tables

This annex shows a copy of selected sheets from the CRF data files (the electronic annexes to this national inventory report), presenting unrounded figures. The number of digits shown does not represent the uncertainty estimated for the emissions (see *Section 1.7*).

Please note that the SF_6 emissions reported in these tables are expressed in mass units, not in CO_2-eq.; for SF_6 emissions in Gg CO_2-eq. we refer to *Table A7.23.*

Annex 7.1 CRF Summary Table 7A for the base years 1990 and 1995 and the last four years (2000 - 2003)

Annex 7.2 Recalculation tables for base years 1990 and 1995 and for 1996-2002 (CRF Tables 8.a and 8.b)

Annex 7.3 CRF Trend Tables 10 for the gases CO_2, CH_4, N_2O, F-gases; and for all gases and source categories in CO_2-eq.

Annex 7.4 Trend Tables for the precursor gases and SO_2.

7.1 IPCC Tables 7A for base years 1990 and 1995 and for 2000-2003

Table A.7.1. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1990***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1] P	HFCs[1] A	PFCs[1] P	PFCs[1] A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**160 892.55**	**0.00**	**1 220.46**	**68.75**	**0.00**	**4 431.82**	**0.00**	**2 115.33**	**0.00**	**0.01**	**560.07**	**1 127.02**	**482.65**	**189.53**
1. Energy	**149 639.13**		**130.50**	**1.67**							**544.13**	**995.82**	**267.44**	**178.28**
A. Fuel Combustion — Reference Approach [2]	154 755.02													
Sectoral Approach [2]	148 397.78		31.69	1.67							544.00	989.72	212.50	170.68
1. Energy Industries	51 625.97		2.76	0.51							99.97	16.15	3.65	105.07
2. Manufacturing Industries and Construction	32 767.77		2.68	0.10							84.60	151.15	4.60	45.61
3. Transport	26 007.58		7.51	0.88							278.13	733.94	185.85	13.32
4. Other Sectors	37 430.73		18.69	0.15							81.30	88.48	18.40	6.68
5. Other	565.72		0.05	0.03							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	1 241.35		98.81	0.00							0.13	6.10	54.94	7.60
1. Solid Fuels	402.67		1.44	0.00							0.00	0.00	0.00	0.00
2. Oil and Natural Gas	838.68		97.37	0.00							0.13	6.10	54.94	7.60
2. Industrial Processes	**8 042.80**		**14.13**	**27.44**	**0.00**	**4 431.82**	**0.00**	**2 115.33**	**0.00**	**0.01**	**12.03**	**129.27**	**83.51**	**7.08**
A. Mineral Products	1 216.28		0.00	0.00							1.28	3.51	1.04	6.31
B. Chemical Industry	3 538.00		12.13	24.42	0.00	0.00	0.00	0.00	0.00	0.00	9.24	0.00	29.25	0.00
C. Metal Production	2 908.84		0.00	0.00				2 097.07		0.00	0.00	118.80	4.17	0.00
D. Other Production [3]	72.54										0.00	0.00	10.76	0.00
E. Production of Halocarbons and SF_6						4 431.82		0.00		0.00				
F. Consumption of Halocarbons and SF_6					0.00	0.00	0.00	18.26	0.00	0.01				
G. Other	307.14		2.01	3.03	0.00	0.00	0.00	0.00	0.00	0.00	1.51	6.96	38.29	0.77

Table A.7.1. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1990 (continued)***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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	**0.00**	**0.00**	**490.05**	**37.25**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			348.67											
B. Manure Management			141.38	2.16									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	[4] IE	[4] IE	0.00	35.09									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 Change and Forestry	[5] **2 894.19**	[5] **0.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0.00	[5] -2 505.33												
B. Forest and Grassland Conversion	865.64		NE	NE							NE	NE	NE	
C. Abandonment of Managed Lands	[5] 0.00	[5] -21.07												
D. CO_2 Emissions and Removals from Soil	[5] 4 554.95	[5] 0.00												
E. Other	[5] 0.00	[5] 0.00	NE	NE							NE	NE	NE	NE
6. Waste	**0.00**		**585.78**	**1.66**							**3.91**	**1.93**	**1.56**	**4.17**
A. Solid Waste Disposal on Land	[4] 0.00		571.93									0.00	1.45	
B. Wastewater Handling			13.79	1.66							0.00	0.00	0.00	
C. Waste Incineration	[4] IE		IE	IE							IE	IE	IE	IE
D. Other	0.00		0.06	0.00							3.91	1.93	0.11	4.17
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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: [7]														
International Bunkers	**38 774.94**		**1.06**	**0.31**							**0.00**	**0.00**	**0.00**	**0.00**
Aviation	4 540.34		0.22	0.04							NE	NE	NE	NE
Marine	34 234.60		0.84	0.27							NE	NE	NE	NE
Multilateral Operations	**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**5 597.91**													

Table A.7.2. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1995***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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	**172 315.44**	**0.00**	**1 134.73**	**72.33**	**928.40**	**6 010.90**	**0.00**	**1 805.90**	**0.00**	**0.01**	**475.04**	**848.99**	**355.76**	**127.75**
1. Energy	**161 267.78**		**126.41**	**2.34**							**466.27**	**782.05**	**201.64**	**124.42**
A. Fuel Combustion — Reference Approach [2]	165 064.84													
Sectoral Approach [2]	160 298.38		31.22	2.34							465.69	774.10	158.83	114.21
1. Energy Industries	61 134.27		3.53	0.54							81.37	18.00	5.58	68.29
2. Manufacturing Industries and Construction	27 891.27		2.31	0.07							61.89	156.91	4.90	27.77
3. Transport	29 145.97		5.63	1.54							231.22	517.84	131.63	12.98
4. Other Sectors	41 614.77		19.70	0.15							91.21	81.35	16.72	5.17
5. Other	512.10		0.05	0.03							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	969.41		95.19	0.00							0.58	7.95	42.81	10.21
1. Solid Fuels	516.87		1.45	0.00							0.00	0.00	0.00	0.00
2. Oil and Natural Gas	452.54		93.74	0.00							0.58	7.95	42.81	10.21
2. Industrial Processes	**8 153.88**		**14.14**	**26.91**	**928.40**	**6 010.90**	**0.00**	**1 805.90**	**0.00**	**0.01**	**6.39**	**66.54**	**51.96**	**3.07**
A. Mineral Products	1 426.28		0.00	0.00							1.31	2.46	0.45	2.76
B. Chemical Industry	4 046.73		12.13	24.25	0.00	0.00	0.00	0.00	0.00	0.00	4.69	0.00	15.64	0.00
C. Metal Production	2 184.13		0.00	0.00				1 769.17		0.00	0.00	61.32	3.18	0.00
D. Other Production [3]	22.40										0.00	0.00	7.33	0.00
E. Production of Halocarbons and SF_6						5 770.76		0.00		0.00				
F. Consumption of Halocarbons and SF_6					928.40	240.14	0.00	36.72	0.00	0.01				
G. Other	474.33		2.01	2.66	0.00	0.00	0.00	0.00	0.00	0.00	0.39	2.76	25.36	0.31

Table A.7.2. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1995(continued)***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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**	**100.24**	NO
4. Agriculture	**0.00**	**0.00**	**479.21**	**40.81**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			334.38											
B. Manure Management			144.83	2.39									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	[4] IE	[4] IE	0.00	38.42									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 Change and Forestry	[5] **2 651.50**	[5] **0.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0.00	[5] -2 557.70												
B. Forest and Grassland Conversion	865.64		NE	NE							NE	NE	NE	
C. Abandonment of Managed Lands	[5] 0.00	[5] -126.44												
D. CO_2 Emissions and Removals from Soil	[5] 4 470.00	[5] 0.00												
E. Other	[5] 0.00	[5] 0.00	NE	NE							NE	NE	NE	NE
6. Waste	**0.00**		**514.98**	**1.63**							**2.38**	**0.40**	**1.76**	**0.26**
A. Solid Waste Disposal on Land	[6] 0.00		500.07									0.00	1.27	
B. Wastewater Handling			11.48	1.49							0.00	0.00	0.00	
C. Waste Incineration	[6] IE		IE	IE							IE	IE	IE	IE
D. Other	0.00		3.43	0.14							2.38	0.40	0.49	0.26
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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: [7]														
International Bunkers	**43 011.75**		**1.24**	**0.34**							**0.00**	**0.00**	**0.00**	**0.00**
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	**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**5 473.97**													

Table A.7.3. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 2000***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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	**171 684.26**	**0.00**	**929.43**	**64.18**	**2 744.00**	**3 839.06**	**0.00**	**1 520.98**	**0.00**	**0.01**	**395.31**	**696.40**	**259.10**	**73.07**
1. Energy	**161 178.98**		**80.92**	**2.44**							**390.80**	**590.48**	**149.79**	**70.64**
A. Fuel Combustion — Reference Approach (2)	164 320.22													
Sectoral Approach (2)	160 353.24		29.41	2.44							390.40	586.21	121.08	64.14
1. Energy Industries	63 186.90		4.51	0.63							65.49	28.95	4.69	41.67
2. Manufacturing Industries and Construction	26 602.78		2.34	0.08							41.72	63.57	3.17	14.45
3. Transport	32 364.79		4.10	1.56							199.26	416.35	97.55	4.32
4. Other Sectors	37 615.57		18.41	0.14							83.93	77.34	15.67	3.70
5. Other	583.19		0.06	0.03							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	825.74		51.51	0.00							0.40	4.27	28.71	6.50
1. Solid Fuels	421.71		1.06	0.00							0.00	0.00	0.00	0.00
2. Oil and Natural Gas	404.03		50.45	0.00							0.40	4.27	28.71	6.50
2. Industrial Processes	**7 522.16**		**14.32**	**25.36**	**2 744.00**	**3 839.06**	**0.00**	**1 520.98**	**0.00**	**0.01**	**4.50**	**105.91**	**37.87**	**2.43**
A. Mineral Products	1 353.65		0.00	0.00							0.97	1.56	0.19	2.04
B. Chemical Industry	3 784.15		12.42	23.03	0.00	0.00	0.00	0.00	0.00	0.00	2.87	0.00	10.75	0.00
C. Metal Production	1 764.79		0.00	0.00				1 335.59		0.00	0.00	101.91	2.14	0.00
D. Other Production (3)	48.98										0.00	0.00	6.22	0.00
E. Production of Halocarbons and SF_6						2 838.43		0.00		0.00				
F. Consumption of Halocarbons and SF_6					2 744.00	1 000.64	0.00	185.39	0.00	0.01				
G. Other	570.58		1.90	2.34	0.00	0.00	0.00	0.00	0.00	0.00	0.66	2.44	18.57	0.39

Table A.7.3. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 2000 (continued)***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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	**169.23**			**0.44**							**NO**	**NO**	**70.22**	NO
4. Agriculture	**0.00**	**0.00**	**434.30**	**34.40**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			306.99											
B. Manure Management			127.31	2.39									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	(4) IE	(4) IE	0.00	32.01									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 Change and Forestry	(5) **2 813.90**	(5) **0.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	(5) 0.00	(5) -2 289.35												
B. Forest and Grassland Conversion	865.64		NE	NE							NE	NE	NE	
C. Abandonment of Managed Lands	(5) 0.00	(5) -231.81												
D. CO_2 Emissions and Removals from Soil	(5) 4 469.42	(5) 0.00												
E. Other	(5) 0.00	(5) 0.00	NE	NE							NE	NE	NE	NE
6. Waste	**0.00**		**399.89**	**1.53**							**0.01**	**0.01**	**1.06**	**0.00**
A. Solid Waste Disposal on Land	(4) 0.00		385.72									0.00	0.99	
B. Wastewater Handling			10.50	1.38							0.00	0.00	0.00	
C. Waste Incineration	(4) IE		IE	IE							IE	IE	IE	IE
D. Other	0.00		3.67	0.15							0.01	0.01	0.07	0.00
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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: [7]														
International Bunkers	**52 473.98**		**1.49**	**0.42**							**0.00**	**0.00**	**0.00**	**0.00**
Aviation	9 749.35		0.46	0.08							NE	NE	NE	NE
Marine	42 724.63		1.02	0.33							NE	NE	NE	NE
Multilateral Operations	**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**7 827.51**													

Table A.7.4. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 2001***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2 emissions	CO_2 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		**177 127.69**	**0.00**	**905.01**	**60.90**	**2 382.60**	**1 492.11**	**0.00**	**1 416.98**	**0.00**	**0.01**	**384.05**	**660.58**	**241.02**	**73.18**
1. Energy		**167 328.09**		**81.32**	**2.46**							**379.80**	**557.97**	**141.78**	**70.86**
A. Fuel Combustion	Reference Approach (2)	169 203.00													
	Sectoral Approach (2)	166 505.89		30.06	2.46							379.32	553.38	113.80	64.08
1. Energy Industries		67 312.76		4.72	0.66							59.35	26.01	4.12	43.76
2. Manufacturing Industries and Construction		25 944.22		2.20	0.07							42.51	63.74	2.95	14.24
3. Transport		32 878.40		3.88	1.55							192.33	386.59	91.08	2.49
4. Other Sectors		39 896.55		19.21	0.16							85.13	77.04	15.65	3.59
5. Other		473.96		0.05	0.03							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels		822.20		51.26	0.00							0.48	4.59	27.98	6.78
1. Solid Fuels		412.17		1.11	0.00							0.00	0.00	0.00	0.00
2. Oil and Natural Gas		410.03		50.15	0.00							0.48	4.59	27.98	6.78
2. Industrial Processes		**6 866.55**		**14.24**	**23.51**	**2 382.60**	**1 492.11**	**0.00**	**1 416.98**	**0.00**	**0.01**	**3.86**	**102.50**	**31.38**	**2.28**
A. Mineral Products		1 461.38		0.00	0.00							1.04	1.41	0.23	2.15
B. Chemical Industry		3 217.02		12.39	21.23	0.00	0.00	0.00	0.00	0.00	0.00	2.34	0.00	9.13	0.00
C. Metal Production		1 736.94		0.00	0.00				1 276.41		0.00	0.00	98.79	1.91	0.00
D. Other Production (3)		42.82										0.00	0.00	5.52	0.00
E. Production of Halocarbons and SF_6							641.47		0.00		0.00				
F. Consumption of Halocarbons and SF_6						2 382.60	850.64	0.00	140.57	0.00	0.01				
G. Other		408.40		1.85	2.29	0.00	0.00	0.00	0.00	0.00	0.00	0.48	2.30	14.59	0.13

Table A.7.4. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 2001 (continued)***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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	**157.84**			**0.36**							**NO**	**NO**	**66.65**	NO
4. Agriculture	**0.00**	**0.00**	**432.97**	**33.04**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			307.45											
B. Manure Management			125.52	2.38									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	(4) IE	(4) IE	0.00	30.66									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 Change and Forestry	(5) **2 775.22**	(5) **0.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	(5) 0.00	(5) -2 289.35												
B. Forest and Grassland Conversion	865.64		NE	NE							NE	NE	NE	
C. Abandonment of Managed Lands	(5) 0.00	(5) -252.89												
D. CO_2 Emissions and Removals from Soil	(5) 4 451.81	(5) 0.00												
E. Other	(5) 0.00	(5) 0.00	NE	NE							NE	NE	NE	NE
6. Waste	**0.00**		**376.48**	**1.53**							**0.39**	**0.11**	**1.05**	**0.04**
A. Solid Waste Disposal on Land	(6) 0.00		362.67									0.00	0.93	
B. Wastewater Handling			10.47	1.39							0.00	0.00	0.00	
C. Waste Incineration	(6) IE		IE	IE							IE	IE	IE	IE
D. Other	0.00		3.34	0.13							0.39	0.11	0.12	0.04
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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: (7)														
International Bunkers	**56 561.83**		**1.58**	**0.45**							**0.00**	**0.00**	**0.00**	**0.00**
Aviation	9 538.72		0.45	0.08							NE	NE	NE	NE
Marine	47 023.11		1.12	0.37							NE	NE	NE	NE
Multilateral Operations	**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**8 151.80**													

Table A.7.5. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 2002***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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	**176 686.44**	**0.00**	**867.65**	**57.97**	**2 456.40**	**1 566.46**	**0.00**	**1 416.15**	**0.00**	**0.02**	**373.03**	**628.42**	**229.11**	**65.66**
1. Energy	**166 986.81**		**80.21**	**2.48**							**369.43**	**558.52**	**132.94**	**63.09**
A. Fuel Combustion — Reference Approach (2)	168 459.37													
Sectoral Approach (2)	166 147.82		29.28	2.48							368.97	554.23	106.65	57.11
1. Energy Industries	66 622.98		4.96	0.69							60.93	30.26	3.00	38.07
2. Manufacturing Industries and Construction	26 662.49		2.22	0.07							40.60	83.49	2.17	13.65
3. Transport	33 580.19		3.72	1.56							185.64	364.40	86.12	1.87
4. Other Sectors	38 783.11		18.34	0.14							81.80	76.08	15.36	3.52
5. Other	499.05		0.05	0.03							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	838.99		50.92	0.00							0.46	4.29	26.29	5.98
1. Solid Fuels	430.32		1.06	0.00							0.00	0.00	0.00	0.00
2. Oil and Natural Gas	408.66		49.86	0.00							0.46	4.29	26.29	5.98
2. Industrial Processes	**6 780.89**		**14.69**	**22.49**	**2 456.40**	**1 566.46**	**0.00**	**1 416.15**	**0.00**	**0.02**	**3.08**	**69.55**	**30.88**	**2.55**
A. Mineral Products	1 398.46		0.00	0.00							0.47	1.40	0.23	2.17
B. Chemical Industry	3 125.50		12.89	20.23	0.00	0.00	0.00	0.00	0.00	0.00	2.18	0.00	8.89	0.00
C. Metal Production	1 820.90		0.00	0.00				1 248.82		0.00	0.00	66.03	1.97	0.00
D. Other Production (3)	31.79										0.00	0.00	5.12	0.00
E. Production of Halocarbons and SF_6						782.44		0.00		0.00				
F. Consumption of Halocarbons and SF_6					2 456.40	784.02	0.00	167.33	0.00	0.02				
G. Other	404.23		1.81	2.26	0.00	0.00	0.00	0.00	0.00	0.00	0.43	2.12	14.67	0.38

Table A.7.5. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 2002 (continued)***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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	**159.98**			**0.29**							**NO**	**NO**	**64.15**	NO
4. Agriculture	**0.00**	**0.00**	**413.28**	**31.21**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			292.86											
B. Manure Management			120.42	2.38									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	[4] IE	[4] IE	0.00	28.83									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 Change and Forestry	[5] **2 758.75**	[5] **0.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0.00	[5] -2 289.35												
B. Forest and Grassland Conversion	865.64		NE	NE							NE	NE	NE	
C. Abandonment of Managed Lands	[5] 0.00	[5] -273.96												
D. CO_2 Emissions and Removals from Soil	[5] 4 456.42	[5] 0.00												
E. Other	[5] 0.00	[5] 0.00	NE	NE							NE	NE	NE	NE
6. Waste	**0.00**		**359.48**	**1.51**							**0.52**	**0.35**	**0.98**	**0.02**
A. Solid Waste Disposal on Land	[6] 0.00		345.38									0.00	0.88	
B. Wastewater Handling			10.67	1.37							0.00	0.00	0.00	
C. Waste Incineration	[6] IE		IE	IE							IE	IE	IE	IE
D. Other	0.00		3.42	0.14							0.52	0.35	0.10	0.02
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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: [7]														
International Bunkers	**56 445.68**		**1.58**	**0.45**							**0.00**	**0.00**	**0.00**	**0.00**
Aviation	9 981.87		0.47	0.08							NE	NE	NE	NE
Marine	46 463.81		1.10	0.36							NE	NE	NE	NE
Multilateral Operations	**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**8 318.98**													

Table A.7.6. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 2003***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2 emissions	CO_2 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		**179 621.28**	**0.00**	**831.19**	**55.87**	**2 456.40**	**1 449.91**	**0.00**	**1 396.06**	**0.00**	**0.01**	**366.28**	**611.24**	**225.24**	**64.78**
1. Energy		**170 017.53**		**79.86**	**2.45**							**364.55**	**596.93**	**129.26**	**62.37**
A. Fuel Combustion	Reference Approach (2)	172 232.85													
	Sectoral Approach (2)	169 147.97		29.28	2.45							364.23	593.22	103.20	56.57
1. Energy Industries		67 347.39		4.97	0.70							60.96	31.07	2.99	37.60
2. Manufacturing Industries and Construction		27 055.94		2.19	0.07							42.31	137.02	2.62	13.55
3. Transport		34 156.68		3.50	1.52							178.14	350.93	82.44	1.89
4. Other Sectors		40 151.29		18.57	0.14							82.82	74.20	15.15	3.53
5. Other		436.67		0.04	0.03							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels		869.56		50.58	0.00							0.32	3.71	26.06	5.80
1. Solid Fuels		464.43		1.08	0.00							0.00	0.00	0.00	0.00
2. Oil and Natural Gas		405.12		49.50	0.00							0.32	3.71	26.06	5.80
2. Industrial Processes		**6 683.22**		**14.81**	**21.66**	**2 456.40**	**1 449.91**	**0.00**	**1 396.06**	**0.00**	**0.01**	**1.21**	**13.96**	**30.03**	**2.39**
A. Mineral Products		1 349.33		0.00	0.00							0.42	1.29	0.21	2.02
B. Chemical Industry		2 934.68		12.97	19.40	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.00	10.48	0.00
C. Metal Production		1 968.35		0.00	0.00				1 203.63		0.00	0.00	10.57	1.19	0.00
D. Other Production (3)		46.09										0.00	0.00	4.91	0.00
E. Production of Halocarbons and SF_6							560.27		0.00		0.00				
F. Consumption of Halocarbons and SF_6						2 456.40	889.64	0.00	192.43	0.00	0.01				
G. Other		384.76		1.85	2.26	0.00	0.00	0.00	0.00	0.00	0.00	0.37	2.10	13.24	0.37

Table A.7.6. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 2003 (continued)***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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	**159.98**			**0.29**							**NO**	**NO**	**64.85**	NO
4. Agriculture	**0.00**	**0.00**	**404.05**	**30.19**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			288.69											
B. Manure Management			115.36	1.93									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	(4) IE	(4) IE	0.00	28.26									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 Change and Forestry	(5) **2 760.54**	(5) **0.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	(5) 0.00	(5) -2 289.35												
B. Forest and Grassland Conversion	865.64		NE	NE							NE	NE	NE	
C. Abandonment of Managed Lands	(5) 0.00	(5) -273.96												
D. CO_2 Emissions and Removals from Soil	(5) 4 458.21	(5) 0.00												
E. Other	(5) 0.00	(5) 0.00	NE	NE							NE	NE	NE	NE
6. Waste	**0.00**		**332.47**	**1.28**							**0.52**	**0.35**	**0.94**	**0.02**
A. Solid Waste Disposal on Land	(4) 0.00		322.61									0.00	0.88	
B. Wastewater Handling			9.86	1.28							0.00	0.00	0.00	
C. Waste Incineration	(4) IE		IE	IE							IE	IE	IE	IE
D. Other	0.00		0.00	0.00							0.52	0.35	0.06	0.02
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 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: (7)														
International Bunkers	**53 261.69**		**1.49**	**0.42**							**0.00**	**0.00**	**0.00**	**0.00**
Aviation	9 817.17		0.47	0.08							NE	NE	NE	NE
Marine	43 444.52		1.02	0.34							NE	NE	NE	NE
Multilateral Operations	**NE**		**NE**	**NE**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**8 246.71**													

7.2 Recalculation and Completeness Tables for 1990 and 1995-2002

This appendix shows information from sheets from the CRF data files of 1990 and for the period 1995-2002.
In principle, all figures for 2002 have been revised, due to best estimates of activity data that were used for 2002 in the previous submission.

Table A.7.7. CRF Recalculation Table 8.a for 1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**160 578.35**	**160 892.55**	**0.20**	**27 347.91**	**25 629.73**	**-6.28**	**16 392.45**	**21 312.14**	**30.01**
1. Energy		**158 116.42**	**149 639.13**	**-5.36**	**4 476.25**	**2 740.52**	**-38.78**	**518.17**	**518.13**	**-0.01**
1.A.	Fuel Combustion Activities	157 808.27	148 397.78	-5.96	722.04	665.44	-7.84	518.17	517.94	-0.04
1.A.1.	Energy Industries	51 304.82	51 625.97	0.63	69.69	57.93	-16.88	144.51	158.58	9.74
1.A.2.	Manufacturing Industries and Construction	42 192.12	32 767.77	-22.34	61.16	56.22	-8.07	35.61	32.30	-9.30
1.A.3.	Transport	29 398.66	26 007.58	-11.53	161.24	157.62	-2.24	309.25	272.20	-11.98
1.A.4.	Other Sectors	34 911.91	37 430.73	7.21	20.37	18.69	-8.22	28.80	45.07	56.48
1.A.5.	Other	0.76	565.72	74 533.23	2.24	1.10	-50.70	0.00	9.79	100.00
1.B.	Fugitive Emissions from Fuels	308.15	1 241.35	302.84	3 754.21	2 075.07	-44.73	0.00	0.19	100.00
1.B.1.	Solid fuel	IE	IE		0.00	30.24	100.00	0.00	0.00	0.00
1.B.2.	Oil and Natural Gas	308.15	838.68	172.16	3 754.21	2 044.83	-45.53	0.00	0.19	100.00
2. Industrial Processes		**1 580.63**	**8 042.80**	**408.83**	**68.58**	**296.83**	**332.80**	**7 554.02**	**8 507.71**	**12.62**
2.A.	Mineral Products	1 124.07	1 216.28	8.20	4.42	0.00	-100.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	3 538.00	100.00	63.49	254.63	301.03	7 554.02	7 569.69	0.21
2.C.	Metal Production	0.00	2 908.84	100.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	IE	72.54	100.00						
2.G.	Other	456.56	307.14	-32.73	0.67	42.21	6 194.01	0.00	938.02	100.00
3. Solvent and Other Product Use		**0.00**	**316.43**	**100.00**				**224.75**	**224.75**	**0.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**10 611.93**	**10 291.05**	**-3.02**	**6 789.00**	**11 547.50**	**70.09**
4.A.	Enteric Fermentation				8 439.06	7 322.07	-13.24			
4.B.	Manure Management				2 172.87	2 968.98	36.64	204.60	669.60	227.27
4.C.	Rice Cultivation				0.00	NO	-100.00			
4.D.	Agricultural Soils (2)	NE	IE		0.00	IE	-100.00	6 584.40	10 877.90	65.21
4.E.	Prescribed Burning of Savannas				0.00	NO	-100.00	0.00	NO	-100.00
4.F.	Field Burning of Agricultural Residues				0.00	NO	-100.00	0.00	NO	-100.00
4.G.	Other				0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net) (3)		**-1 421.91**	**2 894.19**	**-303.54**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks		-2 505.33	100.00						
5.B.	Forest and Grassland Conversion		865.64	100.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C.	Abandonment of Managed Lands		-21.07	100.00						
5.D.	CO_2 Emissions and Removals from Soil		4 554.95	100.00						
5.E.	Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.7. CRF Recalculation Table 8.a for 1990 (continued)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO₂			CH₄			N₂O		
		Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste		**881.09**	**0.00**	**-100.00**	**12 148.09**	**12 301.33**	**1.26**	**125.53**	**514.06**	**309.51**
6.A.	Solid Waste Disposal on Land	0.00	0.00	0.00	12 010.54	12 010.54	0.00			
6.B.	Wastewater Handling				137.55	289.60	110.54	125.53	513.36	308.95
6.C.	Waste Incineration	IE	IE		IE	IE		IE	IE	
6.D.	Other	881.09	0.00	-100.00	0.00	1.19	100.00	0.00	0.70	100.00
7. Other *(please specify)*		**0.21**	**0.00**	**-100.00**	**43.05**	**0.00**	**-100.00**	**1 180.98**	**0.00**	**-100.00**
	Solvents and other product use	0.21		-100.00	1.05		-100.00	2.98		-100.00
	Polluted surface water	0.00		0.00	0.00		-100.00	1 178.00		-100.00
	Degassing drinkwater from ground water	0.00		0.00	42.00		-100.00	0.00		0.00
Memo Items:										
International Bunkers		**39 764.52**	**38 774.94**	**-2.49**	**2.92**	**22.19**	**660.59**	**13.40**	**95.18**	**610.06**
Multilateral Operations		**NE**	**NE**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass		**3 392.38**	**5 597.91**	**65.01**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		HFCs			PFCs			SF₆		
		Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions		**4 431.84**	**4 431.82**	**0.00**	**2 416.48**	**2 115.33**	**-12.46**	**217.32**	**217.32**	**0.00**
2.C.3.	Aluminium Production				2 398.10	2 097.07	-12.55	0.00		0.00
2.E.	Production of Halocarbons and SF_6	4 431.84	4 431.82	0.00	0.00		0.00	0.00		0.00
2.F.	Consumption of Halocarbons and SF_6	0.00	0.00	0.00	18.38	18.26	-0.64	217.32	217.32	0.00
	Other	0.00		0.00	0.00		0.00	0.00		0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**0.00**	**0.00**	0.00	**C**	**C**		**C**	**C**	

	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry (3)	209 962.45	214 598.89	2.21
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (3)	211 384.35	211 704.70	0.15

Table A.7.8. CRF Recalculation Explanation Table 8.b for 1990

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO			
			CHANGES IN:			Addition/removal/ replacement of source/sink categories
			Methods [2]	Emission factors [2]	Activity data [2]	

1.A.	Fuel Combustion Activities	All	Based on energy statistics	Improved data	Improved data	
1.B.2.	Oil and Natural Gas	All		Improved data	Improved data	
2.A.	Mineral Products	All		Improved data	Improved data	
2.B.	Chemical Industry	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.C.	Metal Production	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.D.	Other Production	All		Improved data	Improved data	
2.G.	Other	All				Data formerly reported under 7. Now also includes indirect emissions
3.	Solvent and Other Product Use	CO2	NEW	NEW	NMVOC emission	
4.A.	Enteric Fermentation	CH4	Revised method	revised EF cf IPCC	Improved data	
4.B.	Manure Management	CH4, N2O		Improved data, new EF's	Improved data	Distinction between different wast management systems
4.D.	Agricultural Soils	N2O	NEW	Improved data	Improved data	Now includes indirect emissions and direct emissions from histosoils and crop residue
5.A.	Changes in Forest and Other Woody Biomass Stocks		NEW	Improved data	Improved data	
5.B.	Forest and Grassland Conversion		NEW	Improved data	Improved data	First time reporting of this sector
5.C.	Abandonment of Managed Lands		NEW	Improved data	Improved data	First time reporting of this sector
5.D.	CO2 Emissions and Removals from Soil		NEW	Improved data	Improved data	First time reporting of this sector
6.B.	Wastewater Handling	CH4, N2O	NEW	Improved data	Improved data	includes industrial wastewater and septic tanks. Furthermore we included the estimate for N2O from human sewage.
6.D.	Other	CH4, N2O	NEW	Improved data	Improved data	new source "large scale waste composting"
7.	Other	All				emissions transferred to 2G
MEMO	International Bunkers		Based on energy statistics	Improved data	Improved data	
MEMO	CO2 Emissions from Biomass	CO2		Improved data	Improved data	
F_GASSES						
2.C.3.	Aluminum Production	PFC			Improved data	
2.F.	Consumption of Halocarbons and SF6	PFC, SF6			Improved data	

Table A.7.9. CRF Recalculation Table 8.a for 1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2			CH_4			N_2O		
	Previous submission	Latest submission	Difference (1)	Previous submission	Latest submission	Difference (1)	Previous submission	Latest submission	Difference (1)
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals	**173 247.97**	**172 315.44**	**-0.54**	**24 995.05**	**23 829.39**	**-4.66**	**18 101.54**	**22 421.18**	**23.86**
1. Energy	**170 897.05**	**161 267.78**	**-5.63**	**4 346.40**	**2 654.52**	**-38.93**	**736.46**	**724.39**	**-1.64**
1.A. Fuel Combustion Activities	170 087.03	160 298.38	-5.76	769.57	655.60	-14.81	736.46	724.32	-1.65
1.A.1. Energy Industries	56 516.14	61 134.27	8.17	102.52	74.20	-27.63	150.74	168.75	11.95
1.A.2. Manufacturing Industries and Construction	42 626.88	27 891.27	-34.57	106.53	48.50	-54.47	39.46	22.87	-42.04
1.A.3. Transport	32 103.17	29 145.97	-9.21	123.41	118.14	-4.27	518.70	478.92	-7.67
1.A.4. Other Sectors	38 836.89	41 614.77	7.15	20.51	19.70	-3.94	27.57	45.01	63.27
1.A.5. Other	3.94	512.10	12 887.04	6.37	0.99	-84.52	0.00	8.76	100.00
1.B. Fugitive Emissions from Fuels	810.02	969.41	19.68	3 576.83	1 998.91	-44.11	0.00	0.07	100.00
1.B.1. Solid fuel	IE	IE		0.00	30.40	100.00	0.00	0.00	0.00
1.B.2. Oil and Natural Gas	810.02	452.54	-44.13	3 576.83	1 968.52	-44.96	0.00	0.07	100.00
2. Industrial Processes	**1 442.31**	**8 153.88**	**465.33**	**55.30**	**296.89**	**436.92**	**7 493.18**	**8 343.02**	**11.34**
2.A. Mineral Products	1 113.90	1 426.28	28.04	2.17	0.00	-100.00	0.00	0.00	0.00
2.B. Chemical Industry	0.00	4 046.73	100.00	52.28	254.63	387.05	7 493.18	7 517.80	0.33
2.C. Metal Production	16.53	2 184.13	13 113.23	0.00	0.00	0.00	0.00	0.00	0.00
2.D. Other Production	IE	22.40	100.00						
2.G. Other	311.88	474.33	52.09	0.84	42.27	4 921.65	0.00	825.21	100.00
3. Solvent and Other Product Use	**0.00**	**242.28**	**100.00**				**197.57**	**197.57**	**0.00**
4. Agriculture	**0.00**	**0.00**	**0.00**	**10 017.84**	**10 063.41**	**0.45**	**8 323.50**	**12 651.10**	**51.99**
4.A. Enteric Fermentation				7 911.12	7 021.98	-11.24			
4.B. Manure Management				2 106.72	3 041.43	44.37	229.40	740.90	222.97
4.C. Rice Cultivation				0.00	NO	-100.00			
4.D. Agricultural Soils (2)	NE	IE		0.00	IE	-100.00	8 094.10	11 910.20	47.15
4.E. Prescribed Burning of Savannas				0.00	NO	-100.00	0.00	NO	-100.00
4.F. Field Burning of Agricultural Residues				0.00	NO	-100.00	0.00	NO	-100.00
4.G. Other				0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net) (3)	**-1 232.28**	**2 651.50**	**-315.17**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A. Changes in Forest and Other Woody Biomass Stocks		-2 557.70	100.00						
5.B. Forest and Grassland Conversion		865.64	100.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C. Abandonment of Managed Lands		-126.44	100.00						
5.D. CO_2 Emissions and Removals from Soil		4 470.00	100.00						
5.E. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.9. CRF Recalculation Table 8.a for 1995 (continued)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2			CH_4			N_2O		
	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste	**908.26**	**0.00**	**-100.00**	**10 532.18**	**10 814.57**	**2.68**	**167.84**	**505.10**	**200.93**
6.A. Solid Waste Disposal on Land	0.00	0.00	0.00	10 501.52	10 501.52	0.00			
6.B. Wastewater Handling				30.65	241.00	686.24	156.26	462.53	195.99
6.C. Waste Incineration	IE	IE		0.00	IE	-100.00	0.00	IE	-100.00
6.D. Other	908.26	0.00	-100.00	0.01	72.06	787 622.68	11.58	42.58	267.58
7. Other *(please specify)*	**0.35**	**0.00**	**-100.00**	**43.34**	**0.00**	**-100.00**	**1 182.98**	**0.00**	**-100.00**
Solvents and other product use	0.35		-100.00	1.34		-100.00	4.98		-100.00
Polluted surface water	0.00		0.00	0.00		-100.00	1 178.00		-100.00
Degassing drinkwater from ground water	0.00		0.00	42.00		-100.00	0.00		0.00
Memo Items:									
International Bunkers	**44 286.00**	**43 011.75**	**-2.88**	**3.03**	**26.12**	**761.80**	**15.18**	**105.52**	**594.95**
Multilateral Operations	**NE**	**NE**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass	**3 580.44**	**5 473.97**	**52.89**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs			PFCs			SF_6		
	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions	**6 018.31**	**6 010.90**	**-0.12**	**1 836.07**	**1 805.90**	**-1.64**	**301.26**	**301.26**	**0.00**
2.C.3. Aluminium Production				1 799.10	1 769.17	-1.66	0.00		0.00
2.E. Production of Halocarbons and SF_6	5 770.76	5 770.76	0.00	0.00		0.00	0.00		0.00
2.F. Consumption of Halocarbons and SF_6	247.55	240.14	-2.99	36.97	36.72	-0.66	301.26	301.26	0.00
Other	0.00		0.00	0.00		0.00	0.00		0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**928.40**	**928.40**	0.00	**C**	**C**		**C**	**C**	

	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry (3)	223 267.91	226 684.06	1.53
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (3)	224 500.20	224 032.57	-0.21

Table A.7.10. CRF Recalculation Explanation Table 8.b for 1995

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO			
			CHANGES IN:			Addition/removal/ replacement of source/sink categories
			Methods [2]	Emission factors [2]	Activity data [2]	

1.A.	Fuel Combustion Activities	All	Based on energy statistics	Improved data	Improved data	
1.B.2.	Oil and Natural Gas	All		Improved data	Improved data	
2.A.	Mineral Products	All		Improved data	Improved data	
2.B.	Chemical Industry	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.C.	Metal Production	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.D.	Other Production	All		Improved data	Improved data	
2.G.	Other	All				Data formerly reported under 7. Now also includes indirect emissions
3.	Solvent and Other Product Use	CO2	NEW	NEW	NMVOC emission	
4.A.	Enteric Fermentation	CH4	Revised method	revised EF cf IPCC	Improved data	
4.B.	Manure Management	CH4, N2O		Improved data, new EF's	Improved data	Distinction between different wast management systems
4.D.	Agricultural Soils	N2O	NEW	Improved data	Improved data	Now includes indirect emissions and direct emissions from histosoils and crop residue
5.A.	Changes in Forest and Other Woody Biomass Stocks		NEW	Improved data	Improved data	
5.B.	Forest and Grassland Conversion		NEW	Improved data	Improved data	First time reporting of this sector
5.C.	Abandonment of Managed Lands		NEW	Improved data	Improved data	First time reporting of this sector
5.D.	CO2 Emissions and Removals from Soil		NEW	Improved data	Improved data	First time reporting of this sector
6.B.	Wastewater Handling	CH4, N2O	NEW	Improved data	Improved data	includes industrial wastewater and septic tanks. Furthermore we included the estimate for N2O from human sewage.
6.D.	Other	CH4, N2O	NEW	Improved data	Improved data	new source "large scale waste composting"
7.	Other	All				emissions transferred to 2G
MEMO	International Bunkers		Based on energy statistics	Improved data	Improved data	
MEMO	CO2 Emissions from Biomass	CO2		Improved data	Improved data	
F_GASSES						
2.C.3.	Aluminum Production	PFC			Improved data	
2.F.	Consumption of Halocarbons and SF6	PFC, SF6			Improved data	

Table A.7.11. CRF Recalculation Table 8.a for 1996

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**181 571.94**	**179 988.02**	**-0.87**	**24 829.22**	**23 230.65**	**-6.44**	**17 809.45**	**22 185.89**	**24.57**
1. Energy		**179 129.98**	**169 233.38**	**-5.52**	**4 737.97**	**2 597.20**	**-45.18**	**645.77**	**753.47**	**16.68**
1.A.	Fuel Combustion Activities	178 126.98	168 103.75	-5.63	782.85	714.11	-8.78	645.77	753.39	16.67
1.A.1.	Energy Industries	58 337.61	62 217.84	6.65	119.70	82.69	-30.92	3.74	187.19	4 910.96
1.A.2.	Manufacturing Industries and Construction	43 026.06	28 569.94	-33.60	38.48	49.69	29.11	86.41	22.25	-74.25
1.A.3.	Transport	32 625.56	29 908.11	-8.33	115.04	110.24	-4.17	525.49	487.45	-7.24
1.A.4.	Other Sectors	44 129.02	46 899.61	6.28	23.98	22.40	-6.59	30.13	47.44	57.45
1.A.5.	Other	8.72	508.24	5 726.56	5.97	1.03	-82.82	0.00	9.06	100.00
1.B.	Fugitive Emissions from Fuels	1 003.00	1 129.63	12.62	3 955.12	1 883.10	-52.39	0.00	0.08	100.00
1.B.1.	Solid fuel	IE	IE		0.00	30.67	100.00	0.00	0.00	0.00
1.B.2.	Oil and Natural Gas	1 003.00	479.06	-52.24	3 955.12	1 852.42	-53.16	0.00	0.08	100.00
2. Industrial Processes		**1 385.84**	**7 889.44**	**469.29**	**119.89**	**295.88**	**146.79**	**7 503.29**	**8 305.65**	**10.69**
2.A.	Mineral Products	899.16	1 331.58	48.09	2.41	0.00	-100.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	3 899.21	100.00	109.20	254.63	133.17	7 503.29	7 502.00	-0.02
2.C.	Metal Production	0.03	2 134.64	8 000 814.29	6.30	0.00	-100.00	0.00	0.00	0.00
2.D.	Other Production	IE	49.37	100.00						
2.G.	Other	486.65	474.64	-2.47	1.98	41.25	1 979.17	0.00	803.65	100.00
3. Solvent and Other Product Use		**0.00**	**193.97**	**100.00**				**145.70**	**193.13**	**32.55**
4. Agriculture		**0.00**	**0.00**	**0.00**	**9 735.08**	**9 878.40**	**1.47**	**8 182.45**	**12 437.20**	**52.00**
4.A.	Enteric Fermentation				7 683.12	6 879.60	-10.46			
4.B.	Manure Management				2 051.95	2 998.80	46.14	224.44	725.40	223.20
4.C.	Rice Cultivation				0.00	NO	-100.00			
4.D.	Agricultural Soils [2]	NE	IE		0.00	IE	-100.00	7 958.01	11 711.80	47.17
4.E.	Prescribed Burning of Savannas				NO	NO		0.00	NO	-100.00
4.F.	Field Burning of Agricultural Residues				NO	NO		0.00	NO	-100.00
4.G.	Other				0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net) [3]		**-1 397.68**	**2 671.23**	**-291.12**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks		-2 529.26	100.00						
5.B.	Forest and Grassland Conversion		865.64	100.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C.	Abandonment of Managed Lands		-147.52	100.00						
5.D.	CO_2 Emissions and Removals from Soil		4 482.36	100.00						
5.E.	Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.11. CRF Recalculation Table 8.a for 1996 (continued)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste		**1 055.71**	**0.00**	**-100.00**	**10 175.01**	**10 459.17**	**2.79**	**148.41**	**496.44**	**234.51**
6.A.	Solid Waste Disposal on Land	0.00	0.00	0.00	10 148.43	10 148.43	0.00			
6.B.	Wastewater Handling				26.58	237.55	793.83	148.41	453.20	205.37
6.C.	Waste Incineration	IE	IE		0.00	IE	-100.00	0.00	IE	-100.00
6.D.	Other	1 055.71	0.00	-100.00	0.00	73.19	100.00	0.00	43.24	100.00
7. Other *(please specify)*		**0.41**	**0.00**	**-100.00**	**61.28**	**0.00**	**-100.00**	**1 183.84**	**0.00**	**-100.00**
	Solvents and other product use	0.00		0.00	0.81		-100.00	5.84		-100.00
	Polluted surface water	0.00		0.00	0.00		-100.00	1 178.00		-100.00
	Degassing drinkwater from ground water	0.00		0.00	0.00		0.00	0.00		0.00
Memo Items:										
International Bunkers		**45 445.00**	**44 262.79**	**-2.60**	**3.07**	**26.66**	**767.14**	**15.61**	**108.57**	**595.74**
Multilateral Operations		NE	NE		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass		**5 285.34**	**5 988.21**	**13.30**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		HFCs			PFCs			SF_6		
		Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions		**7 675.65**	**7 664.34**	**-0.15**	**2 014.30**	**2 001.64**	**-0.63**	**312.40**	**312.40**	**0.00**
2.C.3.	Aluminium Production				1 964.30	1 952.20	-0.62	0.00		0.00
2.E.	Production of Halocarbons and SF_6	7 110.50	7 110.50	0.00	0.00		0.00	0.00		0.00
2.F.	Consumption of Halocarbons and SF_6	565.16	553.84	-2.00	50.00	49.43	-1.13	312.40	312.40	0.00
	Other	0.00		0.00	0.00		0.00	0.00		0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**1 955.90**	**1 955.90**	0.00	C	C		C	C	

	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry (3)	223 267.91	235 382.93	5.43
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (3)	224 500.20	232 711.70	3.66

Table A.7.12. CRF Recalculation Explanation Table 8.b for 1996

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO			
			CHANGES IN:			Addition/removal/ replacement of source/sink categories
			Methods [2]	Emission factors [2]	Activity data [2]	

1.A.	Fuel Combustion Activities	All	Based on energy statistics	Improved data	Improved data	
1.B.2.	Oil and Natural Gas	All		Improved data	Improved data	
2.A.	Mineral Products	All		Improved data	Improved data	
2.B.	Chemical Industry	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.C.	Metal Production	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.D.	Other Production	All		Improved data	Improved data	
2.G.	Other	All				Data formerly reported under 7. Now also includes indirect emissions
3.	Solvent and Other Product Use	CO2	NEW	NEW	NMVOC emission	
4.A.	Enteric Fermentation	CH4	Revised method	revised EF cf IPCC	Improved data	
4.B.	Manure Management	CH4, N2O		Improved data, new EF's	Improved data	Distinction between different wast management systems
4.D.	Agricultural Soils	N2O	NEW	Improved data	Improved data	Now includes indirect emissions and direct emissions from histosoils and crop residue
5.A.	Changes in Forest and Other Woody Biomass Stocks		NEW	Improved data	Improved data	
5.B.	Forest and Grassland Conversion		NEW	Improved data	Improved data	First time reporting of this sector
5.C.	Abandonment of Managed Lands		NEW	Improved data	Improved data	First time reporting of this sector
5.D.	CO2 Emissions and Removals from Soil		NEW	Improved data	Improved data	First time reporting of this sector
6.B.	Wastewater Handling	CH4, N2O	NEW	Improved data	Improved data	includes industrial wastewater and septic tanks. Furthermore we included the estimate for N2O from human sewage.
6.D.	Other	CH4, N2O	NEW	Improved data	Improved data	new source "large scale waste composting"
7.	Other	All				emissions transferred to 2G
MEMO	International Bunkers		Based on energy statistics	Improved data	Improved data	
MEMO	CO2 Emissions from Biomass	CO2		Improved data	Improved data	
F_GASSES						
2.C.3.	Aluminum Production	PFC			Improved data	
2.F.	Consumption of Halocarbons and SF6	PFC, SF6			Improved data	

Table A.7.13. CRF Recalculation Table 8.a for 1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2			CH_4			N_2O		
	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals	**166 227.69**	**173 027.56**	**4.09**	**23 226.09**	**22 090.00**	**-4.89**	**17 746.28**	**21 957.94**	**23.73**
1. Energy	**163 553.79**	**161 751.78**	**-1.10**	**3 906.76**	**1 987.92**	**-49.12**	**711.43**	**759.01**	**6.69**
1.A. Fuel Combustion Activities	162 535.92	160 976.84	-0.96	621.18	649.08	4.49	711.43	758.93	6.68
1.A.1. Energy Industries	57 180.81	62 977.66	10.14	62.06	89.84	44.76	5.88	190.85	3 143.23
1.A.2. Manufacturing Industries and Construction	35 485.37	27 103.34	-23.62	21.02	47.98	128.22	149.62	21.56	-85.59
1.A.3. Transport	33 062.43	30 303.72	-8.34	108.90	104.15	-4.36	530.06	494.48	-6.71
1.A.4. Other Sectors	36 806.08	40 106.98	8.97	20.19	19.34	-4.22	25.86	43.72	69.04
1.A.5. Other	1.23	485.14	39 392.76	5.12	0.94	-81.70	0.00	8.33	100.00
1.B. Fugitive Emissions from Fuels	1 017.86	774.94	-23.87	3 285.58	1 338.84	-59.25	0.00	0.07	100.00
1.B.1. Solid fuel	IE	IE		0.00	30.50	100.00	0.00	0.00	0.00
1.B.2. Oil and Natural Gas	1 017.86	270.41	-73.43	3 285.58	1 308.34	-60.18	0.00	0.07	100.00
2. Industrial Processes	**1 428.25**	**8 257.42**	**478.15**	**55.90**	**295.84**	**429.26**	**7 487.38**	**8 260.21**	**10.32**
2.A. Mineral Products	1 083.73	1 274.93	17.64	2.91	0.00	-100.00	0.00	0.00	0.00
2.B. Chemical Industry	0.00	4 028.52	100.00	51.73	254.63	392.23	7 487.38	7 502.00	0.20
2.C. Metal Production	2.50	2 443.92	97 656.86	0.00	0.00	0.00	0.00	0.00	0.00
2.D. Other Production	IE	48.32	100.00						
2.G. Other	342.02	461.73	35.00	1.26	41.22	3 168.76	0.00	758.21	100.00
3. Solvent and Other Product Use	**0.00**	**174.30**	**100.00**				**128.65**	**170.85**	**32.80**
4. Agriculture	**0.00**	**0.00**	**0.00**	**9 361.80**	**9 675.75**	**3.35**	**8 055.66**	**12 276.00**	**52.39**
4.A. Enteric Fermentation				7 405.44	6 685.56	-9.72			
4.B. Manure Management				1 956.36	2 990.19	52.84	214.83	719.20	234.78
4.C. Rice Cultivation				0.00	NO	-100.00			
4.D. Agricultural Soils [2]	NE	IE		0.00	IE	-100.00	7 840.83	11 556.80	47.39
4.E. Prescribed Burning of Savannas				0.00	NO	-100.00	0.00	NO	-100.00
4.F. Field Burning of Agricultural Residues				0.00	NO	-100.00	0.00	NO	-100.00
4.G. Other				0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net) [3]	**-1 180.35**	**2 844.06**	**-340.95**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A. Changes in Forest and Other Woody Biomass Stocks		-2 334.78	100.00						
5.B. Forest and Grassland Conversion		865.64	100.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C. Abandonment of Managed Lands		-168.59	100.00						
5.D. CO_2 Emissions and Removals from Soil		4 481.79	100.00						
5.E. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.13. CRF Recalculation Table 8.a. for 1997 (continued)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2			CH_4			N_2O		
	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste	**1 245.20**	**0.00**	**-100.00**	**9 840.44**	**10 130.49**	**2.95**	**178.73**	**491.87**	**175.21**
6.A. Solid Waste Disposal on Land	0.00	0.00	0.00	9 823.83	9 823.83	0.00			
6.B. Wastewater Handling				16.62	231.62	1 293.84	178.73	447.53	150.40
6.C. Waste Incineration	IE	IE		0.00	IE	-100.00	0.00	IE	-100.00
6.D. Other	1 245.20	0.00	-100.00	0.00	75.04	100.00	0.00	44.34	100.00
7. Other *(please specify)*	**0.46**	**0.00**	**-100.00**	**61.19**	**0.00**	**-100.00**	**1 184.44**	**0.00**	**-100.00**
Solvents and other product use	0.46		-100.00	0.79		-100.00	6.44		-100.00
Polluted surface water	0.00		0.00	0.00		-100.00	1 178.00		-100.00
Degassing drinkwater from ground water	0.00		0.00	60.39		-100.00	0.00		0.00
Memo Items:									
International Bunkers	**48 436.00**	**47 159.68**	**-2.64**	**3.26**	**28.00**	**758.02**	**16.63**	**115.61**	**595.28**
Multilateral Operations	**NE**	**NE**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass	**6 042.21**	**6 681.32**	**10.58**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs			PFCs			SF_6		
	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions	**8 306.57**	**8 294.85**	**-0.14**	**2 164.13**	**2 176.69**	**0.58**	**344.85**	**344.85**	**0.00**
2.C.3. Aluminium Production				2 064.50	2 078.19	0.66	0.00		0.00
2.E. Production of Halocarbons and SF_6	7 415.62	7 415.62	0.00	0.00		0.00	0.00		0.00
2.F. Consumption of Halocarbons and SF_6	890.95	879.23	-1.32	99.63	98.51	-1.13	344.85	344.85	0.00
Other	0.00		0.00	0.00		0.00	0.00		0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**2 117.50**	**2 117.50**	0.00	**C**	**C**		**C**	**C**	

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry[3]	216 835.28	227 891.89	5.10
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	218 015.62	225 047.83	3.23

Table A.7.14. CRF Recalculation Explanation Table 8.b for 1997

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO			
			CHANGES IN:			Addition/removal/ replacement of source/sink categories
			Methods [2]	Emission factors [2]	Activity data [2]	

1.A.	Fuel Combustion Activities	All	Based on energy statistics	Improved data	Improved data	
1.B.2.	Oil and Natural Gas	All		Improved data	Improved data	
2.A.	Mineral Products	All		Improved data	Improved data	
2.B.	Chemical Industry	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.C.	Metal Production	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.D.	Other Production	All		Improved data	Improved data	
2.G.	Other	All				Data formerly reported under 7. Now also includes indirect emissions
3.	Solvent and Other Product Use	CO2	NEW	NEW	NMVOC emission	
4.A.	Enteric Fermentation	CH4	Revised method	revised EF cf IPCC	Improved data	
4.B.	Manure Management	CH4, N2O		Improved data, new EF's	Improved data	Distinction between different wast management systems
4.D.	Agricultural Soils	N2O	NEW	Improved data	Improved data	Now includes indirect emissions and direct emissions from histosoils and crop residue
5.A.	Changes in Forest and Other Woody Biomass Stocks		NEW	Improved data	Improved data	
5.B.	Forest and Grassland Conversion		NEW	Improved data	Improved data	First time reporting of this sector
5.C.	Abandonment of Managed Lands		NEW	Improved data	Improved data	First time reporting of this sector
5.D.	CO2 Emissions and Removals from Soil		NEW	Improved data	Improved data	First time reporting of this sector
6.B.	Wastewater Handling	CH4, N2O	NEW	Improved data	Improved data	includes industrial wastewater and septic tanks. Furthermore we included the estimate for N2O from human sewage.
6.D.	Other	CH4, N2O	NEW	Improved data	Improved data	new source "large scale waste composting"
7.	Other	All				emissions transferred to 2G
MEMO	International Bunkers		Based on energy statistics	Improved data	Improved data	
MEMO	CO2 Emissions from Biomass	CO2		Improved data	Improved data	
F_GASSES						
2.C.3.	Aluminum Production	PFC			Improved data	
2.F.	Consumption of Halocarbons and SF6	PFC, SF6			Improved data	

Table A.7.15. CRF Recalculation Table 8.a for 1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference (1)	Previous submission	Latest submission	Difference (1)	Previous submission	Latest submission	Difference (1)
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**172 421.22**	**174 900.60**	**1.44**	**22 434.17**	**21 279.59**	**-5.15**	**17 540.37**	**21 694.48**	**23.68**
1. Energy		**170 997.17**	**164 263.90**	**-3.94**	**3 731.27**	**1 910.30**	**-48.80**	**734.45**	**771.06**	**4.98**
1.A.	Fuel Combustion Activities	169 443.22	163 481.16	-3.52	653.61	626.94	-4.08	734.45	770.99	4.98
1.A.1.	Energy Industries	60 185.04	65 346.59	8.58	92.44	91.76	-0.74	142.90	198.08	38.62
1.A.2.	Manufacturing Industries and Construction	39 177.77	27 347.57	-30.20	36.09	48.69	34.90	31.56	23.24	-26.36
1.A.3.	Transport	34 154.34	31 043.26	-9.11	104.78	99.54	-5.00	534.82	497.49	-6.98
1.A.4.	Other Sectors	35 915.13	39 223.79	9.21	415.43	18.38	-95.58	25.13	43.09	71.47
1.A.5.	Other	10.94	519.94	4 651.78	4.87	1.03	-78.92	0.04	9.09	20 644.70
1.B.	Fugitive Emissions from Fuels	1 553.95	782.74	-49.63	3 077.66	1 283.36	-58.30	0.00	0.07	100.00
1.B.1.	Solid fuel	IE	IE		0.00	29.80	100.00	0.00	0.00	0.00
1.B.2.	Oil and Natural Gas	1 553.95	290.54	-81.30	3 077.66	1 253.56	-59.27	0.00	0.07	100.00
2. Industrial Processes		**1 318.99**	**7 711.28**	**484.64**	**50.48**	**295.55**	**485.45**	**7 471.00**	**8 216.65**	**9.98**
2.A.	Mineral Products	1 025.40	1 324.18	29.14	2.68	0.00	-100.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	3 800.97	100.00	46.72	255.11	446.08	7 471.00	7 471.00	0.00
2.C.	Metal Production	0.00	2 109.51	100.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	IE	41.29	100.00						
2.G.	Other	293.59	435.32	48.28	1.08	40.44	3 631.54	0.00	745.65	100.00
3. Solvent and Other Product Use		**0.00**	**189.14**	**100.00**				**160.30**	**161.31**	**0.63**
4. Agriculture		**0.00**	**0.00**	**0.00**	**9 128.91**	**9 365.79**	**2.59**	**7 825.95**	**12 043.50**	**53.89**
4.A.	Enteric Fermentation				7 169.19	6 594.63	-8.01			
4.B.	Manure Management				1 959.72	2 771.16	41.41	207.70	778.10	274.63
4.C.	Rice Cultivation				0.00	NO	-100.00			
4.D.	Agricultural Soils (2)	NE	IE		0.00	IE	-100.00	7 618.25	11 265.40	47.87
4.E.	Prescribed Burning of Savannas				0.00	NO	-100.00	0.00	NO	-100.00
4.F.	Field Burning of Agricultural Residues				0.00	NO	-100.00	0.00	NO	-100.00
4.G.	Other				0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net) (3)		**-1 379.57**	**2 736.29**	**-298.34**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks		-2 415.48	100.00						
5.B.	Forest and Grassland Conversion		865.64	100.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C.	Abandonment of Managed Lands		-189.66	100.00						
5.D.	CO_2 Emissions and Removals from Soil		4 475.79	100.00						
5.E.	Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.15. CRF Recalculation Table 8.a for 1998 (continued)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2			CH_4			N_2O		
	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste	**104.60**	**0.00**	**-100.00**	**9 482.84**	**9 707.95**	**2.37**	**164.23**	**501.96**	**205.64**
6.A. Solid Waste Disposal on Land	0.00	0.00	0.00	9 403.37	9 403.37	0.00			
6.B. Wastewater Handling				79.47	230.36	189.87	164.23	458.09	178.93
6.C. Waste Incineration	IE	IE		0.00	IE	-100.00	0.00	IE	-100.00
6.D. Other	104.60	0.00	-100.00	0.00	74.22	100.00	0.00	43.87	100.00
7. Other *(please specify)*	**0.46**	**0.00**	**-100.00**	**40.67**	**0.00**	**-100.00**	**1 184.44**	**0.00**	**-100.00**
Solvents and other product use	40.67		-100.00	40.67		-100.00	6.44		-100.00
Polluted surface water	0.00		0.00	0.00		-100.00	1 178.00		-100.00
Degassing drinkwater from ground water	0.00		0.00	0.00		0.00	0.00		0.00
Memo Items:									
International Bunkers	**49 531.00**	**48 414.10**	**-2.25**	**0.00**	**29.21**	**100.00**	**0.00**	**118.84**	**100.00**
Multilateral Operations	**NE**	**NE**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass	**5 247.29**	**6 896.25**	**31.42**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs			PFCs			SF_6		
	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions	**9 360.41**	**9 347.56**	**-0.14**	**1 737.58**	**1 729.65**	**-0.46**	**328.84**	**328.84**	**0.00**
2.C.3. Aluminium Production				1 624.62	1 618.46	-0.38	0.00		0.00
2.E. Production of Halocarbons and SF_6	8 309.72	8 309.72	0.00	0.00		0.00	0.00		0.00
2.F. Consumption of Halocarbons and SF_6	1 050.69	1 037.84	-1.22	112.95	111.18	-1.57	328.84	328.84	0.00
Other	0.00		0.00	0.00		0.00	0.00		0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**2 277.20**	**2 277.20**	0.00	**C**	**C**		**C**	**C**	

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry [3]	222 443.01	229 280.73	3.07
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry [3]	223 822.58	226 544.44	1.22

Table A.7.16. CRF Recalculation Explanation Table 8.b for 1998

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO			
			CHANGES IN:			Addition/removal/ replacement of source/sink categories
			Methods [2]	Emission factors [2]	Activity data [2]	

1.A.	Fuel Combustion Activities	All	Based on energy statistics	Improved data	Improved data	
1.B.2.	Oil and Natural Gas	All		Improved data	Improved data	
2.A.	Mineral Products	All		Improved data	Improved data	
2.B.	Chemical Industry	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.C.	Metal Production	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.D.	Other Production	All		Improved data	Improved data	
2.G.	Other	All				Data formerly reported under 7. Now also includes indirect emissions
3.	Solvent and Other Product Use	CO2	NEW	NEW	NMVOC emission	
4.A.	Enteric Fermentation	CH4	Revised method	revised EF cf IPCC	Improved data	
4.B.	Manure Management	CH4, N2O		Improved data, new EF's	Improved data	Distinction between different wast management systems
4.D.	Agricultural Soils	N2O	NEW	Improved data	Improved data	Now includes indirect emissions and direct emissions from histosoils and crop residue
5.A.	Changes in Forest and Other Woody Biomass Stocks		NEW	Improved data	Improved data	
5.B.	Forest and Grassland Conversion		NEW	Improved data	Improved data	First time reporting of this sector
5.C.	Abandonment of Managed Lands		NEW	Improved data	Improved data	First time reporting of this sector
5.D.	CO2 Emissions and Removals from Soil		NEW	Improved data	Improved data	First time reporting of this sector
6.B.	Wastewater Handling	CH4, N2O	NEW	Improved data	Improved data	includes industrial wastewater and septic tanks. Furthermore we included the estimate for N2O from human sewage.
6.D.	Other	CH4, N2O	NEW	Improved data	Improved data	new source "large scale waste composting"
7.	Other	All				emissions transferred to 2G
MEMO	International Bunkers		Based on energy statistics	Improved data	Improved data	
MEMO	CO2 Emissions from Biomass	CO2		Improved data	Improved data	
F_GASSES						
2.C.3.	Aluminum Production	PFC			Improved data	
2.F.	Consumption of Halocarbons and SF6	PFC, SF6			Improved data	

Table A.7.17. CRF Recalculation Table 8.a for 1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**167 261.50**	**169 663.56**	**1.44**	**21 424.24**	**20 222.61**	**-5.61**	**17 277.62**	**20 947.93**	**21.24**
1. Energy		**165 273.62**	**159 027.98**	**-3.78**	**3 725.46**	**1 754.87**	**-52.90**	**720.64**	**749.81**	**4.05**
1.A.	Fuel Combustion Activities	163 758.07	158 178.26	-3.41	694.78	612.51	-11.84	720.64	749.76	4.04
1.A.1.	Energy Industries	56 660.42	61 480.11	8.51	126.06	93.15	-26.10	141.66	173.52	22.49
1.A.2.	Manufacturing Industries and Construction	38 175.42	27 069.95	-29.09	61.31	47.69	-22.21	20.50	22.83	11.35
1.A.3.	Transport	34 995.52	32 005.16	-8.54	99.85	95.10	-4.76	534.69	500.45	-6.40
1.A.4.	Other Sectors	33 926.67	36 973.53	8.98	401.98	17.87	-95.56	23.79	40.88	71.85
1.A.5.	Other	0.04	649.50	1 665 287.44	5.58	1.37	-75.38	0.00	12.08	100.00
1.B.	Fugitive Emissions from Fuels	1 515.55	849.72	-43.93	3 030.68	1 142.36	-62.31	0.00	0.05	100.00
1.B.1.	Solid fuel	IE	IE		0.00	24.43	100.00	0.00	0.00	0.00
1.B.2.	Oil and Natural Gas	1 515.55	404.10	-73.34	3 030.68	1 117.93	-63.11	0.00	0.05	100.00
2. Industrial Processes		**1 315.45**	**7 708.96**	**486.03**	**56.91**	**298.19**	**423.95**	**7 201.07**	**7 952.80**	**10.44**
2.A.	Mineral Products	974.97	1 396.15	43.20	2.95	0.00	-100.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	3 749.37	100.00	53.17	257.34	383.96	7 189.65	7 201.62	0.17
2.C.	Metal Production	0.00	1 994.92	100.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	IE	51.39	100.00						
2.G.	Other	340.48	517.14	51.89	0.79	40.85	5 090.82	11.42	751.18	6 478.52
3. Solvent and Other Product Use		**0.00**	**196.86**	**100.00**				**153.62**	**153.62**	**0.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**8 925.21**	**9 258.27**	**3.73**	**7 822.85**	**11 609.50**	**48.40**
4.A.	Enteric Fermentation				7 011.69	6 537.93	-6.76			
4.B.	Manure Management				1 913.52	2 720.34	42.16	202.28	784.30	287.74
4.C.	Rice Cultivation				NO	NO				
4.D.	Agricultural Soils (2)	NE	IE		IE	IE		7 620.58	10 825.20	42.05
4.E.	Prescribed Burning of Savannas				NO	NO		0.00	NO	-100.00
4.F.	Field Burning of Agricultural Residues				NO	NO		0.00	NO	-100.00
4.G.	Other				0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net) (3)		**-1 235.57**	**2 729.75**	**-320.93**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks		-2 381.33	100.00						
5.B.	Forest and Grassland Conversion		865.64	100.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C.	Abandonment of Managed Lands		-210.74	100.00						
5.D.	CO_2 Emissions and Removals from Soil		4 456.17	100.00						
5.E.	Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.17. CRF Recalculation Table 8.a for 1999 (continued)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2			CH_4			N_2O		
	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste	**671.86**	**0.00**	**-100.00**	**8 675.76**	**8 911.28**	**2.71**	**193.38**	**482.20**	**149.35**
6.A. Solid Waste Disposal on Land	0.00	0.00	0.00	8 637.71	8 602.64	-0.41			
6.B. Wastewater Handling				38.06	235.78	519.55	182.43	439.13	140.72
6.C. Waste Incineration	IE	IE		IE	IE		IE	IE	
6.D. Other	671.86	0.00	-100.00	0.00	72.86	100.00	10.95	43.06	293.11
7. Other *(please specify)*	**0.57**	**0.00**	**-100.00**	**40.90**	**0.00**	**-100.00**	**1 186.05**	**0.00**	**-100.00**
Solvents and other product use	0.57		-100.00	0.40		-100.00	8.05		-100.00
Polluted surface water	0.00		0.00	40.50		-100.00	1 178.00		-100.00
Degassing drinkwater from ground water	0.00		0.00	0.00		0.00	0.00		0.00
Memo Items:									
International Bunkers	**51 213.63**	**50 031.32**	**-2.31**	**NE**	**29.99**	**100.00**	**0.00**	**122.76**	**100.00**
Multilateral Operations	**NE**	**NE**		**NE**	**0.00**	**100.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass	**4 933.62**	**6 948.60**	**40.84**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs			PFCs			SF_6		
	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions	**4 921.92**	**4 868.38**	**-1.09**	**1 470.84**	**1 465.90**	**-0.34**	**317.03**	**317.03**	**0.00**
2.C.3. Aluminium Production				1 326.03	1 323.42	-0.20	0.00		0.00
2.E. Production of Halocarbons and SF_6	3 824.53	3 824.52	0.00	0.00		0.00	0.00		0.00
2.F. Consumption of Halocarbons and SF_6	1 097.39	1 043.86	-4.88	144.81	142.48	-1.61	317.03	317.03	0.00
Other	0.00		0.00	0.00		0.00	0.00		0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**P**	**2 616.20**	100.00	**C**	**C**		**C**	**C**	

	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry (3)	211 437.58	217 485.41	2.86
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (3)	212 673.15	214 755.67	0.98

Table.A.7.18. CRF Recalculation Explanation Table 8.b for 1999

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO			
			CHANGES IN:			Addition/removal/ replacement of source/sink categories
			Methods [2]	Emission factors [2]	Activity data [2]	

1.A.	Fuel Combustion Activities	All	Based on energy statistics	Improved data	Improved data	
1.B.2.	Oil and Natural Gas	All		Improved data	Improved data	
2.A.	Mineral Products	All		Improved data	Improved data	
2.B.	Chemical Industry	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.C.	Metal Production	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.D.	Other Production	All		Improved data	Improved data	
2.G.	Other	All				Data formerly reported under 7. Now also includes indirect emissions
3.	Solvent and Other Product Use	CO_2	NEW	NEW	NMVOC emission	
4.A.	Enteric Fermentation	CH_4	Revised method	revised EF cf IPCC	Improved data	
4.B.	Manure Management	CH_4, N_2O		Improved data, new EF's	Improved data	Distinction between different wast management systems
4.D.	Agricultural Soils	N_2O	NEW	Improved data	Improved data	Now includes indirect emissions and direct emissions from histosoils and crop residue
5.A.	Changes in Forest and Other Woody Biomass Stocks		NEW	Improved data	Improved data	
5.B.	Forest and Grassland Conversion		NEW	Improved data	Improved data	First time reporting of this sector
5.C.	Abandonment of Managed Lands		NEW	Improved data	Improved data	First time reporting of this sector
5.D.	CO_2 Emissions and Removals from Soil		NEW	Improved data	Improved data	First time reporting of this sector
6.B.	Wastewater Handling	CH_4, N_2O	NEW	Improved data	Improved data	includes industrial wastewater and septic tanks. Furthermore we included the estimate for N_2O from human sewage.
6.D.	Other	CH_4, N_2O	NEW	Improved data	Improved data	new source "large scale waste composting"
7.	Other	All				emissions transferred to 2G
MEMO	International Bunkers		Based on energy statistics	Improved data	Improved data	
MEMO	CO_2 Emissions from Biomass	CO_2		Improved data	Improved data	
F_GASSES						
2.C.3.	Aluminum Production	PFC			Improved data	
2.F.	Consumption of Halocarbons and SF6	PFC, SF6			Improved data	

Table A.7.19. CRF Recalculation Table 8.a for 2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**169 305.23**	**171 684.26**	**1.41**	**20 337.07**	**19 518.11**	**-4.03**	**16 551.76**	**19 894.30**	**20.19**
1. Energy		**169 480.47**	**161 178.98**	**-4.90**	**3 456.72**	**1 699.42**	**-50.84**	**724.19**	**756.69**	**4.49**
1.A.	Fuel Combustion Activities	167 889.74	160 353.24	-4.49	706.50	617.70	-12.57	724.19	756.63	4.48
1.A.1.	Energy Industries	61 222.17	63 186.90	3.21	125.11	94.71	-24.30	150.71	196.00	30.05
1.A.2.	Manufacturing Industries and Construction	36 278.18	26 602.78	-26.67	66.93	49.23	-26.44	36.67	24.81	-32.35
1.A.3.	Transport	35 212.50	32 364.79	-8.09	91.46	86.04	-5.92	512.05	482.14	-5.84
1.A.4.	Other Sectors	35 176.90	37 615.57	6.93	19.88	18.41	-7.41	24.75	42.94	73.49
1.A.5.	Other	0.00	583.19	100.00	5.58	1.22	-78.15	0.00	10.75	100.00
1.B.	Fugitive Emissions from Fuels	1 590.73	825.74	-48.09	2 750.22	1 081.71	-60.67	0.00	0.05	100.00
1.B.1.	Solid fuel	IE	IE		0.00	22.33	100.00	0.00	0.00	0.00
1.B.2.	Oil and Natural Gas	1 590.73	404.03	-74.60	2 750.22	1 059.38	-61.48	0.00	0.05	100.00
2. Industrial Processes		**1 237.61**	**7 522.16**	**507.80**	**32.35**	**300.70**	**829.58**	**7 120.46**	**7 862.92**	**10.43**
2.A.	Mineral Products	857.12	1 353.65	57.93	3.04	0.00	-100.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	3 784.15	100.00	28.89	260.72	802.37	7 120.46	7 137.97	0.25
2.C.	Metal Production	0.00	1 764.79	100.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	IE	48.98	100.00						
2.G.	Other	380.48	570.58	49.96	0.41	39.98	9 607.26	0.00	724.95	100.00
3. Solvent and Other Product Use		**0.00**	**169.23**	**100.00**				**137.66**	**137.66**	**0.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**8 621.13**	**9 120.30**	**5.79**	**7 192.00**	**10 664.00**	**48.28**
4.A.	Enteric Fermentation				6 708.03	6 446.79	-3.89			
4.B.	Manure Management				1 913.10	2 673.51	39.75	192.20	740.90	285.48
4.C.	Rice Cultivation				NO	NO				
4.D.	Agricultural Soils (2)	NE	IE		IE	IE		6 999.80	9 923.10	41.76
4.E.	Prescribed Burning of Savannas				NO	NO		NO	NO	
4.F.	Field Burning of Agricultural Residues				NO	NO		NO	NO	
4.G.	Other				0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net) (3)		**-1 413.26**	**2 813.90**	**-299.11**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks		-2 289.35	100.00						
5.B.	Forest and Grassland Conversion		865.64	100.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C.	Abandonment of Managed Lands		-231.81	100.00						
5.D.	CO_2 Emissions and Removals from Soil		4 469.42	100.00						
5.E.	Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.19. CRF Recalculation Table 8.a for 2000 (continued)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2			CH_4			N_2O		
	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste	**0.00**	**0.00**	**0.00**	**8 186.77**	**8 397.70**	**2.58**	**193.55**	**473.04**	**144.40**
6.A. Solid Waste Disposal on Land	0.00	0.00	0.00	8 170.48	8 100.10	-0.86			
6.B. Wastewater Handling				16.29	220.49	1 253.71	193.55	427.47	120.85
6.C. Waste Incineration	IE	IE		IE	IE		IE	IE	
6.D. Other	0.00	0.00	0.00	0.00	77.11	10 993 103.59	0.00	45.57	100.00
7. Other *(please specify)*	**0.42**	**0.00**	**-100.00**	**40.11**	**0.00**	**-100.00**	**1 183.90**	**0.00**	**-100.00**
Solvents and other product use	0.42		-100.00	0.50		-100.00	5.90		-100.00
Polluted surface water	0.00		0.00				1 178.00		-100.00
Degassing drinkwater from ground water	0.00		0.00	39.61		-100.00	0.00		0.00
Memo Items:									
International Bunkers	**53 500.11**	**52 473.98**	**-1.92**	**39.61**	**31.19**	**-21.27**	**0.00**	**128.66**	**100.00**
Multilateral Operations	**0.00**	**NE**	**-100.00**	**NE**	**0.00**	**100.00**	**NE**	**0.00**	**100.00**
CO_2 Emissions from Biomass	**4 988.57**	**7 827.51**	**56.91**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs			PFCs			SF_6		
	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions	**3 878.85**	**3 839.06**	**-1.03**	**1 577.56**	**1 520.98**	**-3.59**	**335.15**	**335.15**	**0.00**
2.C.3. Aluminium Production				1 390.36	1 335.59	-3.94	0.00		0.00
2.E. Production of Halocarbons and SF_6	2 838.43	2 838.43	0.00	0.00		0.00	0.00		0.00
2.F. Consumption of Halocarbons and SF_6	1 040.42	1 000.64	-3.82	187.20	185.39	-0.97	335.15	335.15	0.00
Other	0.00		0.00	0.00		0.00	0.00		0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**2 744.00**	**2 744.00**	0.00	**C**	**C**		**C**	**C**	

	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry (3)	211 985.63	216 791.86	2.27
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (3)	213 398.89	213 977.96	0.27

Table.A.7.20. CRF Recalculation Explanation Table 8.b for 2000

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO			
			CHANGES IN:			Addition/removal/ replacement of source/sink categories
			Methods [2]	Emission factors [2]	Activity data [2]	

1.A.	Fuel Combustion Activities	All	Based on energy statistics	Improved data	Improved data	
1.B.2.	Oil and Natural Gas	All		Improved data	Improved data	
2.A.	Mineral Products	All		Improved data	Improved data	
2.B.	Chemical Industry	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.C.	Metal Production	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.D.	Other Production	All		Improved data	Improved data	
2.G.	Other	All				Data formerly reported under 7. Now also includes indirect emissions
3.	Solvent and Other Product Use	CO2	NEW	NEW	NMVOC emission	
4.A.	Enteric Fermentation	CH4	Revised method	revised EF cf IPCC	Improved data	
4.B.	Manure Management	CH4, N2O		Improved data, new EF's	Improved data	Distinction between different wast management systems
4.D.	Agricultural Soils	N2O	NEW	Improved data	Improved data	Now includes indirect emissions and direct emissions from histosoils and crop residue
5.A.	Changes in Forest and Other Woody Biomass Stocks		NEW	Improved data	Improved data	
5.B.	Forest and Grassland Conversion		NEW	Improved data	Improved data	First time reporting of this sector
5.C.	Abandonment of Managed Lands		NEW	Improved data	Improved data	First time reporting of this sector
5.D.	CO2 Emissions and Removals from Soil		NEW	Improved data	Improved data	First time reporting of this sector
6.B.	Wastewater Handling	CH4, N2O	NEW	Improved data	Improved data	includes industrial wastewater and septic tanks. Furthermore we included the estimate for N2O from human sewage.
6.D.	Other	CH4, N2O	NEW	Improved data	Improved data	new source "large scale waste composting"
7.	Other	All				emissions transferred to 2G
MEMO	International Bunkers		Based on energy statistics	Improved data	Improved data	
MEMO	CO2 Emissions from Biomass	CO2		Improved data	Improved data	
F_GASSES						
2.C.3.	Aluminum Production	PFC			Improved data	
2.F.	Consumption of Halocarbons and SF6	PFC, SF6			Improved data	

Table A.7.21. CRF Recalculation Table 8.a for 2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[(1)]	Previous submission	Latest submission	Difference[(1)]	Previous submission	Latest submission	Difference[(1)]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**177 063.16**	**177 127.69**	**0.04**	**19 925.34**	**19 005.18**	**-4.62**	**15 814.84**	**18 878.30**	**19.37**
1. Energy		**175 707.57**	**167 328.09**	**-4.77**	**3 502.64**	**1 707.66**	**-51.25**	**678.76**	**762.15**	**12.28**
1.A.	Fuel Combustion Activities	174 014.28	166 505.89	-4.31	685.71	631.23	-7.94	678.76	762.09	12.28
1.A.1.	Energy Industries	64 649.12	67 312.76	4.12	114.62	99.12	-13.52	116.16	203.18	74.91
1.A.2.	Manufacturing Industries and Construction	36 443.62	25 944.22	-28.81	47.02	46.17	-1.81	31.66	20.98	-33.71
1.A.3.	Transport	35 505.69	32 878.40	-7.40	87.03	81.49	-6.36	505.07	480.54	-4.86
1.A.4.	Other Sectors	37 415.46	39 896.55	6.63	20.55	19.21	-6.48	25.88	48.80	88.61
1.A.5.	Other	0.38	473.96	123 973.64	5.59	0.97	-82.59	0.00	8.58	100.00
1.B.	Fugitive Emissions from Fuels	1 693.29	822.20	-51.44	2 816.93	1 076.43	-61.79	0.00	0.05	100.00
1.B.1.	Solid fuel	IE	IE		0.00	23.25	100.00	0.00	0.00	0.00
1.B.2.	Oil and Natural Gas	1 693.29	410.03	-75.78	2 816.93	1 053.18	-62.61	0.00	0.05	100.00
2. Industrial Processes		**1 355.15**	**6 866.55**	**406.70**	**49.68**	**299.00**	**501.84**	**6 601.69**	**7 289.18**	**10.41**
2.A.	Mineral Products	958.73	1 461.38	52.43	2.74	0.00	-100.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	3 217.02	100.00	42.20	260.20	516.57	6 563.02	6 580.70	0.27
2.C.	Metal Production	0.00	1 736.94	100.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	IE	42.82	100.00						
2.G.	Other	396.42	408.40	3.02	4.74	38.80	718.87	38.68	708.49	1 731.81
3. Solvent and Other Product Use		**0.00**	**157.84**	**100.00**				**115.04**	**110.70**	**-3.77**
4. Agriculture		**0.00**	**0.00**	**0.00**	**8 603.22**	**9 092.37**	**5.69**	**7 002.90**	**10 242.40**	**46.26**
4.A.	Enteric Fermentation				6 752.34	6 456.45	-4.38			
4.B.	Manure Management				1 850.88	2 635.92	42.41	195.30	737.80	277.78
4.C.	Rice Cultivation				NO	NO				
4.D.	Agricultural Soils [(2)]	NE	IE		IE	IE		6 807.60	9 504.60	39.62
4.E.	Prescribed Burning of Savannas				NO	NO		NO	NO	
4.F.	Field Burning of Agricultural Residues				NO	NO		NO	NO	
4.G.	Other				0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net) [(3)]		**-1 413.26**	**2 775.22**	**-296.37**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks		-2 289.35	100.00						
5.B.	Forest and Grassland Conversion		865.64	100.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C.	Abandonment of Managed Lands		-252.89	100.00						
5.D.	CO_2 Emissions and Removals from Soil		4 451.81	100.00						
5.E.	Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.21. CRF Recalculation Table 8.a for 2001 (continued)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste		**0.00**	**0.00**	**0.00**	**7 730.92**	**7 906.15**	**2.27**	**232.18**	**473.87**	**104.09**
6.A.	Solid Waste Disposal on Land	0.00	0.00	0.00	7 715.87	7 616.12	-1.29			
6.B.	Wastewater Handling				15.05	219.90	1 360.98	186.69	432.42	131.62
6.C.	Waste Incineration	IE	IE		IE	IE		IE	IE	
6.D.	Other	0.00	0.00	0.00	0.00	70.13	100.00	45.49	41.45	-8.87
7. Other *(please specify)*		**0.44**	**0.00**	**-100.00**	**38.88**	**0.00**	**-100.00**	**1 184.26**	**0.00**	**-100.00**
	Solvents and other product use	0.44		-100.00	0.46		-100.00	6.26		-100.00
	Polluted surface water	0.00		0.00				1 178.00		-100.00
	Degassing drinkwater from ground water	0.00		0.00	38.42		-100.00	0.00		0.00
Memo Items:										
International Bunkers		**53 500.11**	**56 561.83**	**5.72**	**38.42**	**33.08**	**-13.91**	**#VALUE!**	**138.50**	**100.00**
Multilateral Operations		**0.00**	**NE**	**-100.00**	**NE**	**0.00**	**100.00**	**NE**	**0.00**	**100.00**
CO_2 Emissions from Biomass		**4 988.57**	**8 151.80**	**63.41**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		HFCs			PFCs			SF_6		
		Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions		**1 506.87**	**1 492.11**	**-0.98**	**1 482.26**	**1 416.98**	**-4.40**	**356.25**	**356.95**	**0.19**
2.C.3.	Aluminium Production				1 322.68	1 276.41	-3.50	0.00		0.00
2.E.	Production of Halocarbons and SF_6	641.47	641.47	0.00	0.00		0.00	0.00		0.00
2.F.	Consumption of Halocarbons and SF_6	865.39	850.64	-1.71	159.58	140.57	-11.91	356.25	356.95	0.19
	Other	0.00		0.00	0.00		0.00	0.00		0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**2 382.60**	**2 382.60**	0.00	**C**	**C**		**C**	**C**	

	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry (3)	214 735.46	218 277.20	1.65
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (3)	216 148.72	215 501.99	-0.30

Table A.7.22. CRF Recalculation Explanation Table 8.b for 2001

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO			
			CHANGES IN:			Addition/removal/ replacement of source/sink categories
			Methods [2]	Emission factors [2]	Activity data [2]	

1.A.	Fuel Combustion Activities	All	Based on energy statistics	Improved data	Improved data	
1.B.2.	Oil and Natural Gas	All		Improved data	Improved data	
2.A.	Mineral Products	All		Improved data	Improved data	
2.B.	Chemical Industry	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.C.	Metal Production	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.D.	Other Production	All		Improved data	Improved data	
2.G.	Other	All				Data formerly reported under 7. Now also includes indirect emissions
3.	Solvent and Other Product Use	CO2	NEW	NEW	NMVOC emission	
4.A.	Enteric Fermentation	CH4	Revised method	revised EF cf IPCC	Improved data	
4.B.	Manure Management	CH4, N2O		Improved data, new EF's	Improved data	Distinction between different wast management systems
4.D.	Agricultural Soils	N2O	NEW	Improved data	Improved data	Now includes indirect emissions and direct emissions from histosoils and crop residue
5.A.	Changes in Forest and Other Woody Biomass Stocks		NEW	Improved data	Improved data	
5.B.	Forest and Grassland Conversion		NEW	Improved data	Improved data	First time reporting of this sector
5.C.	Abandonment of Managed Lands		NEW	Improved data	Improved data	First time reporting of this sector
5.D.	CO2 Emissions and Removals from Soil		NEW	Improved data	Improved data	First time reporting of this sector
6.B.	Wastewater Handling	CH4, N2O	NEW	Improved data	Improved data	includes industrial wastewater and septic tanks. Furthermore we included the estimate for N2O from human sewage.
6.D.	Other	CH4, N2O	NEW	Improved data	Improved data	new source "large scale waste composting"
7.	Other	All				emissions transferred to 2G
MEMO	International Bunkers		Based on energy statistics	Improved data	Improved data	
MEMO	CO2 Emissions from Biomass	CO2		Improved data	Improved data	
F_GASSES						
2.C.3.	Aluminum Production	PFC			Improved data	
2.F.	Consumption of Halocarbons and SF6	PFC, SF6			Improved data	

Table A.7.23. CRF Recalculation Table 8.a for 2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total National Emissions and Removals		**176 654.00**	**176 686.44**	**0.02**	**18 714.65**	**18 220.74**	**-2.64**	**15 280.00**	**17 971.26**	**17.61**
1. Energy		**174 664.26**	**166 986.81**	**-4.40**	**3 191.49**	**1 684.32**	**-47.22**	**713.94**	**768.74**	**7.68**
1.A.	Fuel Combustion Activities	173 024.62	166 147.82	-3.97	668.90	614.93	-8.07	713.94	768.69	7.67
1.A.1.	Energy Industries	63 779.92	66 622.98	4.46	103.12	104.24	1.09	155.87	212.99	36.64
1.A.2.	Manufacturing Industries and Construction	35 791.09	26 662.49	-25.51	47.39	46.63	-1.60	27.94	20.72	-25.84
1.A.3.	Transport	36 250.61	33 580.19	-7.37	84.28	78.04	-7.40	504.39	483.50	-4.14
1.A.4.	Other Sectors	37 202.99	38 783.11	4.25	20.39	18.34	-10.06	25.74	42.84	66.43
1.A.5.	Other	0.00	499.05	100.00	5.98	0.97	-83.72	0.00	8.64	100.00
1.B.	Fugitive Emissions from Fuels	1 639.64	838.99	-48.83	2 522.59	1 069.39	-57.61	0.00	0.05	100.00
1.B.1.	Solid fuel	IE	IE		0.00	22.34	100.00	0.00	0.00	0.00
1.B.2.	Oil and Natural Gas	1 639.64	408.66	-75.08	2 522.59	1 047.04	-58.49	0.00	0.05	100.00
2. Industrial Processes		**1 989.28**	**6 780.89**	**240.87**	**46.87**	**308.52**	**558.22**	**6 257.66**	**6 972.00**	**11.42**
2.A.	Mineral Products	1 431.35	1 398.46	-2.30	2.40	0.00	-100.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	3 125.50	100.00	44.46	270.60	508.63	6 257.66	6 271.94	0.23
2.C.	Metal Production	172.36	1 820.90	956.46	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	NE	31.79	100.00						
2.G.	Other	385.57	404.23	4.84	0.01	37.93	343 876.66	0.00	700.06	100.00
3. Solvent and Other Product Use		**0.00**	**159.98**	**100.00**				**90.24**	**88.59**	**-1.83**
4. Agriculture		**0.00**	**0.00**	**0.00**	**8 170.47**	**8 678.88**	**6.22**	**6 801.40**	**9 675.10**	**42.25**
4.A.	Enteric Fermentation				6 421.38	6 150.06	-4.23			
4.B.	Manure Management				1 749.09	2 528.82	44.58	182.90	737.80	303.39
4.C.	Rice Cultivation				NO	NO				
4.D.	Agricultural Soils (2)	NE	IE		IE	IE		6 618.50	8 937.30	35.04
4.E.	Prescribed Burning of Savannas				NO	NO		NO	NO	
4.F.	Field Burning of Agricultural Residues				NO	NO		NO	NO	
4.G.	Other				0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net) (3)		**-1 413.26**	**2 758.75**	**-295.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks		-2 289.35	100.00						
5.B.	Forest and Grassland Conversion		865.64	100.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C.	Abandonment of Managed Lands		-273.96	100.00						
5.D.	CO_2 Emissions and Removals from Soil		4 456.42	100.00						
5.E.	Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.23. CRF Recalculation Table 8.a for 2002 (continued)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2			CH_4			N_2O		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste		**0.00**	**0.00**	**0.00**	**7 267.82**	**7 549.02**	**3.87**	**232.18**	**466.83**	**101.06**
6.A.	Solid Waste Disposal on Land	0.00	0.00	0.00	7 252.77	7 253.04	0.00			
6.B.	Wastewater Handling				15.05	224.13	1 389.09	186.69	424.39	127.32
6.C.	Waste Incineration	IE	IE		IE	IE		IE	IE	
6.D.	Other	0.00	0.00	0.00	0.00	71.84	100.00	45.49	42.44	-6.70
7. Other *(please specify)*		**0.47**	**0.00**	**-100.00**	**37.99**	**0.00**	**-100.00**	**1 184.58**	**0.00**	**-100.00**
	Solvents and other product use	0.00		0.00	0.00		0.00	0.00		0.00
	Polluted surface water	0.00		0.00				0.00		0.00
	Degassing drinkwater from ground water	0.00		0.00	0.00		0.00	0.00		0.00
Memo Items:										
International Bunkers		**57 403.88**	**56 445.68**	**-1.67**	**3.89**	**33.12**	**752.19**	**19.66**	**138.25**	**603.06**
Multilateral Operations		**NE**	**NE**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass		**7 200.55**	**8 318.98**	**15.53**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		HFCs			PFCs			SF_6		
		Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]	Previous submission	Latest submission	Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions		**1 572.42**	**1 566.46**	**-0.38**	**1 200.39**	**1 416.15**	**17.97**	**343.59**	**358.81**	**4.43**
2.C.3.	Aluminium Production				1 040.81	1 248.82	19.99	0.00		0.00
2.E.	Production of Halocarbons and SF_6	782.43	782.44	0.00	0.00		0.00	0.00		0.00
2.F.	Consumption of Halocarbons and SF_6	789.99	784.02	-0.76	159.58	167.33	4.85	343.59	358.81	4.43
	Other	0.00		0.00	0.00		0.00	0.00		0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**2 456.40**	**2 456.40**	0.00	**C**	**C**		**C**	**C**	

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry[3]	212 351.79	216 219.86	1.82
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	213 765.05	213 461.10	-0.14

Table.A.7.24. CRF Recalculation Explanation Table 8.b for 2002

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO			
			CHANGES IN:			Addition/removal/ replacement of source/sink categories
			Methods [2]	Emission factors [2]	Activity data [2]	

1.A.	Fuel Combustion Activities	All	Based on energy statistics	Improved data	Improved data	
1.B.2.	Oil and Natural Gas	All		Improved data	Improved data	
2.A.	Mineral Products	All		Improved data	Improved data	
2.B.	Chemical Industry	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.C.	Metal Production	All	Now partly based on NEU from energy statistics	Improved data	Improved data	
2.D.	Other Production	All		Improved data	Improved data	
2.G.	Other	All				Data formerly reported under 7. Now also includes indirect emissions
3.	Solvent and Other Product Use	CO2	NEW	NEW	NMVOC emission	
4.A.	Enteric Fermentation	CH4	Revised method	revised EF cf IPCC	Improved data	
4.B.	Manure Management	CH4, N2O		Improved data, new EF's	Improved data	Distinction between different wast management systems
4.D.	Agricultural Soils	N2O	NEW	Improved data	Improved data	Now includes indirect emissions and direct emissions from histosoils and crop residue
5.A.	Changes in Forest and Other Woody Biomass Stocks		NEW	Improved data	Improved data	
5.B.	Forest and Grassland Conversion		NEW	Improved data	Improved data	First time reporting of this sector
5.C.	Abandonment of Managed Lands		NEW	Improved data	Improved data	First time reporting of this sector
5.D.	CO2 Emissions and Removals from Soil		NEW	Improved data	Improved data	First time reporting of this sector
6.B.	Wastewater Handling	CH4, N2O	NEW	Improved data	Improved data	includes industrial wastewater and septic tanks. Furthermore we included the estimate for N2O from human sewage.
6.D.	Other	CH4, N2O	NEW	Improved data	Improved data	new source "large scale waste composting"
7.	Other	All				emissions transferred to 2G
MEMO	International Bunkers		Based on energy statistics	Improved data	Improved data	
MEMO	CO2 Emissions from Biomass	CO2		Improved data	Improved data	
F_GASSES						
2.C.3.	Aluminum Production	PFC			Improved data	
2.F.	Consumption of Halocarbons and SF6	PFC, SF6			Improved data	

7.3 CRF Trend Tables 10 for greenhouse gases

This appendix shows a copy of sheets from the CRF data files, presenting unrounded figures. The number of digits shown does not represent the uncertainty estimated for the emissions (see *Section 1.7*).

Sheets are presented for, respectively:

- CO_2
- CH_4
- N_2O
- HFCs, PFCs and SF_6
- All gases and source categories in CO_2-eq.

Table A.7.25. Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: CO_2***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	(Gg)														
1. Energy	**149 639**	**149 639**	**154 727**	**153 459**	**158 139**	**157 416**	**161 268**	**169 233**	**161 752**	**164 264**	**159 028**	**161 179**	**167 328**	**166 987**	**170 018**
A. Fuel Combustion (Sectoral Approach)	148 398	148 398	153 486	152 302	157 130	156 300	160 298	168 104	160 977	163 481	158 178	160 353	166 506	166 148	169 148
1. Energy Industries	51 626	51 626	52 319	52 377	54 708	57 462	61 134	62 218	62 978	65 347	61 480	63 187	67 313	66 623	67 347
2. Manufacturing Industries and Construction	32 768	32 768	32 246	32 826	32 054	30 476	27 891	28 570	27 103	27 348	27 070	26 603	25 944	26 662	27 056
3. Transport	26 008	26 008	26 281	27 544	28 155	28 623	29 146	29 908	30 304	31 043	32 005	32 365	32 878	33 580	34 157
4. Other Sectors	37 431	37 431	42 102	39 002	41 675	39 254	41 615	46 900	40 107	39 224	36 974	37 616	39 897	38 783	40 151
5. Other	566	566	539	553	538	486	512	508	485	520	650	583	474	499	437
B. Fugitive Emissions from Fuels	1 241	1 241	1 241	1 157	1 009	1 116	969	1 130	775	783	850	826	822	839	870
1. Solid Fuels	403	403	430	431	446	559	517	651	505	492	446	422	412	430	464
2. Oil and Natural Gas	839	839	811	726	563	557	453	479	270	291	404	404	410	409	405
2. Industrial Processes	**8 043**	**8 043**	**7 959**	**7 425**	**7 197**	**7 918**	**8 154**	**7 889**	**8 257**	**7 711**	**7 709**	**7 522**	**6 867**	**6 781**	**6 683**
A. Mineral Products	1 216	1 216	1 254	1 228	1 258	1 496	1 426	1 332	1 275	1 324	1 396	1 354	1 461	1 398	1 349
B. Chemical Industry	3 538	3 538	3 858	3 915	3 787	3 976	4 047	3 899	4 029	3 801	3 749	3 784	3 217	3 126	2 935
C. Metal Production	2 909	2 909	2 548	1 953	1 888	2 189	2 184	2 135	2 444	2 110	1 995	1 765	1 737	1 821	1 968
D. Other Production	73	73	49	54	50	29	22	49	48	41	51	49	43	32	46
E. Production of Halocarbons and SF_6															
F. Consumption of Halocarbons and SF_6															
G. Other	307	307	249	275	213	228	474	475	462	435	517	571	408	404	385
3. Solvent and Other Product Use	**316**	**316**	**239**	**215**	**208**	**214**	**242**	**194**	**174**	**189**	**197**	**169**	**158**	**160**	**160**
4. Agriculture	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
A. Enteric Fermentation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Manure Management	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C. Rice Cultivation	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
D. Agricultural Soils [2]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Prescribed Burning of Savannas	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
F. Field Burning of Agricultural Residues	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
G. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5. Land-Use Change and Forestry [3]	**2 894**	**2 894**	**2 796**	**2 673**	**2 620**	**2 623**	**2 651**	**2 671**	**2 844**	**2 736**	**2 730**	**2 814**	**2 775**	**2 759**	**2 761**
A. Changes in Forest and Other Woody Biomass Stocks	-2 505	-2 505	-2 546	-2 642	-2 653	-2 605	-2 558	-2 529	-2 335	-2 415	-2 381	-2 289	-2 289	-2 289	-2 289
B. Forest and Grassland Conversion	866	866	866	866	866	866	866	866	866	866	866	866	866	866	866
C. Abandonment of Managed Lands	-21	-21	-42	-63	-84	-105	-126	-148	-169	-190	-211	-232	-253	-274	-274
D. CO_2 Emissions and Removals from Soil	4 555	4 555	4 519	4 513	4 491	4 468	4 470	4 482	4 482	4 476	4 456	4 469	4 452	4 456	4 458
E. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6. Waste	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
A. Solid Waste Disposal on Land	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Waste-water Handling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7. Other *(please specify)*	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Total Emissions/Removals with LUCF [4]	**160 893**	**160 893**	**165 720**	**163 773**	**168 163**	**168 171**	**172 315**	**179 988**	**173 028**	**174 901**	**169 664**	**171 684**	**177 128**	**176 686**	**179 621**
Total Emissions without LUCF [4]	**157 998**	**157 998**	**162 924**	**161 100**	**165 544**	**165 548**	**169 664**	**177 317**	**170 183**	**172 164**	**166 934**	**168 870**	**174 352**	**173 928**	**176 861**
Memo Items:															
International Bunkers	**38 775**	**38 775**	**40 180**	**41 267**	**43 137**	**41 528**	**43 012**	**44 263**	**47 160**	**48 414**	**50 031**	**52 474**	**56 562**	**56 446**	**53 262**
Aviation	4 540	4 540	4 845	5 649	6 214	6 535	7 584	8 080	8 740	9 560	9 832	9 749	9 539	9 982	9 817
Marine	34 235	34 235	35 335	35 618	36 923	34 994	35 428	36 183	38 420	38 854	40 199	42 725	47 023	46 464	43 445
Multilateral Operations	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**5 598**	**5 598**	**6 448**	**6 343**	**6 647**	**6 226**	**5 474**	**5 988**	**6 681**	**6 896**	**6 949**	**7 828**	**8 152**	**8 319**	**8 247**

Table A.7.26. ***Emissions of greenhouse gases in the Netherlands; CRF Trend Table 10:*** CH_4

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	(Gg)														
Total Emissions	**1 220.46**	**1 220.46**	**1 232.84**	**1 210.99**	**1 188.54**	**1 154.62**	**1 134.73**	**1 106.22**	**1 051.90**	**1 013.31**	**962.98**	**929.43**	**905.01**	**867.65**	**831.19**
1. Energy	**130.50**	**130.50**	**131.20**	**128.83**	**128.83**	**126.66**	**126.41**	**123.68**	**94.66**	**90.97**	**83.57**	**80.92**	**81.32**	**80.21**	**79.86**
A. Fuel Combustion (Sectoral Approach)	31.69	31.69	32.50	31.06	31.89	30.79	31.22	34.01	30.91	29.85	29.17	29.41	30.06	29.28	29.28
1. Energy Industries	2.76	2.76	3.07	3.15	3.49	3.43	3.53	3.94	4.28	4.37	4.44	4.51	4.72	4.96	4.97
2. Manufacturing Industries and Construction	2.68	2.68	2.60	2.61	2.52	2.47	2.31	2.37	2.28	2.32	2.27	2.34	2.20	2.22	2.19
3. Transport	7.51	7.51	6.58	6.41	6.09	5.80	5.63	5.25	4.96	4.74	4.53	4.10	3.88	3.72	3.50
4. Other Sectors	18.69	18.69	20.20	18.84	19.74	19.05	19.70	22.40	19.34	18.38	17.87	18.41	19.21	18.34	18.57
5. Other	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.05	0.07	0.06	0.05	0.05	0.04
B. Fugitive Emissions from Fuels	98.81	98.81	98.70	97.77	96.94	95.86	95.19	89.67	63.75	61.11	54.40	51.51	51.26	50.92	50.58
1. Solid Fuels	1.44	1.44	1.44	1.44	1.44	1.45	1.45	1.46	1.45	1.42	1.16	1.06	1.11	1.06	1.08
2. Oil and Natural Gas	97.37	97.37	97.26	96.33	95.50	94.41	93.74	88.21	62.30	59.69	53.23	50.45	50.15	49.86	49.50
2. Industrial Processes	**14.13**	**14.13**	**14.14**	**14.12**	**14.07**	**14.11**	**14.14**	**14.09**	**14.09**	**14.07**	**14.20**	**14.32**	**14.24**	**14.69**	**14.81**
A. Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Chemical Industry	12.13	12.13	12.13	12.13	12.13	12.13	12.13	12.13	12.13	12.15	12.25	12.42	12.39	12.89	12.97
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Other Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6															
F. Consumption of Halocarbons and SF_6															
G. Other	2.01	2.01	2.02	2.00	1.94	1.98	2.01	1.96	1.96	1.93	1.95	1.90	1.85	1.81	1.85
3. Solvent and Other Product Use	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
4. Agriculture	**490.05**	**490.05**	**496.02**	**487.77**	**480.88**	**470.75**	**479.21**	**470.40**	**460.75**	**445.99**	**440.87**	**434.30**	**432.97**	**413.28**	**404.05**
A. Enteric Fermentation	348.67	348.67	353.69	346.97	340.33	335.94	334.38	327.60	318.36	314.03	311.33	306.99	307.45	292.86	288.69
B. Manure Management	141.38	141.38	142.33	140.80	140.55	134.81	144.83	142.80	142.39	131.96	129.54	127.31	125.52	120.42	115.36
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	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	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**585.78**	**585.78**	**591.48**	**580.28**	**564.77**	**543.10**	**514.98**	**498.06**	**482.40**	**462.28**	**424.35**	**399.89**	**376.48**	**359.48**	**332.47**
A. Solid Waste Disposal on Land	571.93	571.93	572.31	560.46	544.52	526.80	500.07	483.26	467.80	447.78	409.65	385.72	362.67	345.38	322.61
B. Waste-water Handling	13.79	13.79	18.39	18.33	18.30	13.40	11.48	11.31	11.03	10.97	11.23	10.50	10.47	10.67	9.86
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0.06	0.06	0.77	1.48	1.95	2.90	3.43	3.49	3.57	3.53	3.47	3.67	3.34	3.42	0.00
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Memo Items:															
International Bunkers	**0.84**	**0.84**	**NE**	**NE**	**NE**	**NE**	**0.88**	**0.89**	**0.92**	**0.94**	**0.96**	**1.02**	**1.12**	**1.10**	**NE**
Aviation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine	0.84	0.84	0.87	0.88	0.88	0.84	0.88	0.89	0.92	0.94	0.96	1.02	1.12	1.10	NE
Multilateral Operations	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass															

Table A.7.27. Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: N_2O***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	(Gg)														
Total Emissions	**68.75**	**68.75**	**70.03**	**72.25**	**74.60**	**71.86**	**72.33**	**71.57**	**70.83**	**69.98**	**67.57**	**64.18**	**60.90**	**57.97**	**55.87**
1. Energy	**1.67**	**1.67**	**1.79**	**1.95**	**2.12**	**2.23**	**2.34**	**2.43**	**2.45**	**2.49**	**2.42**	**2.44**	**2.46**	**2.48**	**2.45**
A. Fuel Combustion (Sectoral Approach)	1.67	1.67	1.79	1.95	2.12	2.23	2.34	2.43	2.45	2.49	2.42	2.44	2.46	2.48	2.45
1. Energy Industries	0.51	0.51	0.48	0.48	0.51	0.54	0.54	0.60	0.62	0.64	0.56	0.63	0.66	0.69	0.70
2. Manufacturing Industries and Construction	0.10	0.10	0.10	0.10	0.10	0.09	0.07	0.07	0.07	0.07	0.07	0.08	0.07	0.07	0.07
3. Transport	0.88	0.88	1.02	1.19	1.33	1.43	1.54	1.57	1.60	1.60	1.61	1.56	1.55	1.56	1.52
4. Other Sectors	0.15	0.15	0.15	0.14	0.15	0.14	0.15	0.15	0.14	0.14	0.13	0.14	0.16	0.14	0.14
5. Other	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Oil and Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Industrial Processes	**27.44**	**27.44**	**27.69**	**27.86**	**29.54**	**28.23**	**26.91**	**26.79**	**26.65**	**26.51**	**25.65**	**25.36**	**23.51**	**22.49**	**21.66**
A. Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Chemical Industry	24.42	24.42	24.70	24.90	26.70	25.50	24.25	24.20	24.20	24.10	23.23	23.03	21.23	20.23	19.40
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Other Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6															
F. Consumption of Halocarbons and SF_6															
G. Other	3.03	3.03	2.99	2.96	2.84	2.73	2.66	2.59	2.45	2.41	2.42	2.34	2.29	2.26	2.26
3. Solvent and Other Product Use	**0.73**	**0.73**	**0.73**	**0.73**	**0.70**	**0.66**	**0.64**	**0.62**	**0.55**	**0.52**	**0.50**	**0.44**	**0.36**	**0.29**	**0.29**
4. Agriculture	**37.25**	**37.25**	**38.10**	**40.00**	**40.55**	**39.01**	**40.81**	**40.12**	**39.60**	**38.85**	**37.45**	**34.40**	**33.04**	**31.21**	**30.19**
A. Enteric Fermentation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Manure Management	2.16	2.16	2.24	2.38	2.43	2.29	2.39	2.34	2.32	2.51	2.53	2.39	2.38	2.38	1.93
C. Rice Cultivation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Agricultural Soils	35.09	35.09	35.86	37.62	38.12	36.72	38.42	37.78	37.28	36.34	34.92	32.01	30.66	28.83	28.26
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	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	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**1.66**	**1.66**	**1.72**	**1.71**	**1.69**	**1.73**	**1.63**	**1.60**	**1.59**	**1.62**	**1.56**	**1.53**	**1.53**	**1.51**	**1.28**
A. Solid Waste Disposal on Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Waste-water Handling	1.66	1.66	1.69	1.65	1.61	1.61	1.49	1.46	1.44	1.48	1.42	1.38	1.39	1.37	1.28
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0.00	0.00	0.03	0.06	0.08	0.12	0.14	0.14	0.14	0.14	0.14	0.15	0.13	0.14	0.00
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Memo Items:															
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Aviation	0.04	0.04	NE	NE	NE	NE	0.06	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.08
Marine	0.27	0.27	0.28	0.28	0.29	0.27	0.28	0.28	0.30	0.30	0.31	0.33	0.37	0.36	0.34
Multilateral Operations	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass															

Table A.7.28. Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: HFCs, PFCs and SF_6***

<u>Note</u>: The emissions of individual compounds (not shaded) are reported here in mass units, not in CO_2-eq.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	(Gg)														
Emissions of HFCs[5] - CO_2 equivalent (Gg)	**6 010.90**	**4 431.82**	**3 451.56**	**4 447.33**	**4 998.04**	**6 517.86**	**6 010.90**	**7 664.34**	**8 294.85**	**9 347.56**	**4 868.38**	**3 839.06**	**1 492.11**	**1 566.46**	**1 449.91**
HFC-23	492.21	378.79	295.01	377.99	422.80	536.57	492.21	588.62	573.39	665.86	294.02	206.91	38.44	58.51	39.36
HFC-32	2.40	0.00	0.00	0.00	0.00	0.00	2.40	0.00	3.00	1.00	0.00	0.60	12.43	0.24	6.34
HFC-41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-43-10mee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-125	3.83	0.00	0.00	0.00	0.00	0.00	3.83	8.98	15.52	36.32	45.60	61.52	78.38	64.86	75.20
HFC-134	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-134a	175.78	0.00	0.00	18.01	12.16	116.97	175.78	425.86	678.28	700.25	723.73	602.06	428.81	326.05	328.30
HFC-152a	17.86	0.00	0.00	9.93	28.79	24.00	17.86	25.00	0.00	0.00	0.00	21.93	6.51	2.04	3.93
HFC-143	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-143a	1.70	0.00	0.00	0.00	2.64	6.28	1.70	34.72	12.64	35.80	36.50	77.89	45.42	51.53	72.84
HFC-227ea	0.00														
HFC-236fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-245ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC Unspecified	0.75	0.00	0.00	0.00	7.14	20.26	0.75	21.12	203.67	136.08	73.69	54.64	27.97	26.71	23.54
Emissions of PFCs[5] - CO_2 equivalent (Gg)	**1 805.90**	**2 115.33**	**2 094.88**	**1 905.49**	**1 926.38**	**1 853.44**	**1 805.90**	**2 001.64**	**2 176.69**	**1 729.65**	**1 465.90**	**1 520.98**	**1 416.98**	**1 416.15**	**1 396.06**
CF_4	236.86	280.93	277.76	251.94	254.17	243.85	236.86	261.19	277.98	217.28	153.53	179.94	171.97	168.21	162.15
C_2F_6	24.96	29.46	29.18	26.49	26.80	25.71	24.96	27.66	29.49	22.40	35.38	18.04	17.24	16.90	16.27
C_3F_8															
C_4F_{10}															
c-C_4F_8															
C_5F_{12}															
C_6F_{14}															
PFC unspecified	4.37	2.17	2.50	2.88	3.31	3.80	4.37	5.89	11.73	13.24	16.96	22.07	16.74	19.92	22.91
Emissions of SF_6[5] - CO_2 equivalent (Gg)	**301.26**	**217.32**	**133.91**	**143.09**	**149.90**	**191.20**	**301.26**	**312.40**	**344.85**	**328.84**	**317.03**	**335.15**	**356.95**	**358.81**	**334.48**
SF_6	12.61	9.09	5.60	5.99	6.27	8.00	12.61	13.07	14.43	13.76	13.27	14.02	14.94	15.01	14.00

Chemical	GWP
HFCs	
HFC-23	11700
HFC-32	650
HFC-41	150
HFC-43-10mee	1300
HFC-125	2800
HFC-134	1000
HFC-134a	1300
HFC-152a	140
HFC-143	300
HFC-143a	3800
HFC-227ea	2900
HFC-236fa	6300
HFC-245ca	560
HFC Unspecified	3000
PFCs	
CF_4	6500
C_2F_6	9200
C_3F_8	7000
C_4F_{10}	7000
c-C_4F_8	8700
C_5F_{12}	7500
C6F14	7400
PFC unspecified	8400
SF_6	23900

Table A.7.29. Emissions of greenhouse gases in the Netherlands; CRF Trend Table 10: All gases and source categories in CO_2-eq

GREENHOUSE GAS EMISSIONS	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	CO_2 equivalent (Gg)														
Net CO_2 emissions/removals	160 892.55	160 892.55	165 720.34	163 772.54	168 163.36	168 170.96	172 315.44	179 988.02	173 027.56	174 900.60	169 663.56	171 684.26	177 127.69	176 686.44	179 621.28
CO_2 emissions (without LUCF) [4]	157 998.36	157 998.36	162 924.12	161 099.72	165 543.52	165 548.28	169 663.94	177 316.79	170 183.50	172 164.31	166 933.81	168 870.36	174 352.47	173 927.69	176 860.74
CH_4	25 629.73	25 629.73	25 889.58	25 430.82	24 959.39	24 246.93	23 829.39	23 230.65	22 090.00	21 279.59	20 222.61	19 518.11	19 005.18	18 220.74	17 455.01
N_2O	21 312.14	21 312.14	21 707.85	22 397.12	23 125.64	22 275.64	22 421.18	22 185.89	21 957.94	21 694.48	20 947.93	19 894.30	18 878.30	17 971.26	17 320.58
HFCs	6 010.90	4 431.82	3 451.56	4 447.33	4 998.04	6 517.86	6 010.90	7 664.34	8 294.85	9 347.56	4 868.38	3 839.06	1 492.11	1 566.46	1 449.91
PFCs	1 805.90	2 115.33	2 094.88	1 905.49	1 926.38	1 853.44	1 805.90	2 001.64	2 176.69	1 729.65	1 465.90	1 520.98	1 416.98	1 416.15	1 396.06
SF_6	301.26	217.32	133.91	143.09	149.90	191.20	301.26	312.40	344.85	328.84	317.03	335.15	356.95	358.81	334.48
Total (with net CO_2 emissions/removals)	**215 952.47**	**214 598.89**	**218 998.13**	**218 096.39**	**223 322.71**	**223 256.04**	**226 684.06**	**235 382.93**	**227 891.89**	**229 280.73**	**217 485.41**	**216 791.86**	**218 277.20**	**216 219.86**	**217 577.32**
Total (without CO_2 from LUCF) [6][8]	**213 058.28**	**211 704.70**	**216 201.91**	**215 423.57**	**220 702.88**	**220 633.36**	**224 032.57**	**232 711.70**	**225 047.83**	**226 544.44**	**214 755.67**	**213 977.96**	**215 501.99**	**213 461.10**	**214 816.78**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	CO_2 equivalent (Gg)														
1. Energy	152 897.77	152 897.77	158 037.41	156 769.57	161 501.25	160 768.41	164 646.69	172 584.05	164 498.71	166 945.25	161 532.67	163 635.08	169 797.89	169 439.87	172 454.79
2. Industrial Processes	24 965.39	23 611.81	22 518.64	22 852.91	23 723.92	25 527.28	24 911.84	26 469.34	27 629.86	27 629.53	22 611.27	21 380.96	17 720.76	17 402.83	16 889.02
3. Solvent and Other Product Use	541.18	541.18	464.65	442.64	424.10	418.80	439.85	387.10	345.15	350.45	350.48	306.89	268.54	248.57	250.16
4. Agriculture	21 838.55	21 838.55	22 227.42	22 643.17	22 668.98	21 978.85	22 714.51	22 315.60	21 951.75	21 409.29	20 867.77	19 784.30	19 334.77	18 353.98	17 843.95
5. Land-Use Change and Forestry [7]	2 894.19	2 894.19	2 796.22	2 672.82	2 619.83	2 622.68	2 651.50	2 671.23	2 844.06	2 736.29	2 729.75	2 813.90	2 775.22	2 758.75	2 760.54
6. Waste	12 815.39	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	9 393.48	8 870.74	8 380.02	8 015.85	7 378.86
7. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

7.4 Trend Tables for precursor gases and SO_2

This appendix shows information from sheets from the CRF data files, presented in trend table format and presenting unrounded figures. The number of digits shown does not represent the uncertainty estimated for the emissions (see Section 2.4).

Please note that all data for 2003 are preliminary.

Sheets are presented for, respectively:

- NO_x
- CO
- NMVOC
- SO_2

In addition the trends in NO_x, CO, NMVOC and SO_2 for the period 1990-2003 are presented in graph format:

- A7.30. Shares and trends in NO_x emissions per IPCC sector 1990-2003.
- A7.31. Shares and trends in CO emissions per IPCC sector 1990-2003.
- A7.32. Shares and trends in NMVOC emissions per IPCC sector 1990-2003.
- A7.33. Shares and trends in SO_2 emissions per IPCC sector 1990-2003.

Table A.7.30. Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10:*** NO_x

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
	(Gg)													
Total National Emissions and Removals	**560.07**	**431.62**	**422.91**	**406.57**	**380.35**	**475.04**	**455.32**	**418.19**	**410.07**	**413.56**	**395.31**	**384.05**	**373.03**	**366.28**
1. Energy	**544.13**	**431.44**	**422.75**	**406.41**	**380.19**	**466.27**	**452.87**	**415.77**	**405.00**	**411.93**	**390.80**	**379.80**	**369.43**	**364.55**
A. Fuel Combustion — Reference Approach (2)														
Sectoral Approach (2)	544.00	430.24	421.45	405.41	379.69	465.69	452.37	415.00	404.19	409.02	390.40	379.32	368.97	364.23
1. Energy Industries	99.97	95.60	95.90	91.80	81.40	81.37	72.98	64.00	58.51	66.21	65.49	59.35	60.93	60.96
2. Manufacturing Industries and Construction	84.60	16.01	15.45	16.37	14.82	61.89	73.49	63.37	63.15	54.89	41.72	42.51	40.60	42.31
3. Transport	278.13	274.13	268.30	251.34	241.77	231.22	220.15	210.33	205.81	204.47	199.26	192.33	185.64	178.14
4. Other Sectors	81.30	44.50	41.80	45.90	41.70	91.21	85.75	77.30	76.72	83.45	83.93	85.13	81.80	82.82
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	0.13	1.20	1.30	1.00	0.50	0.58	0.50	0.77	0.81	2.91	0.40	0.48	0.46	0.32
1. Solid Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Oil and Natural Gas	0.13	1.20	1.30	1.00	0.50	0.58	0.50	0.77	0.81	2.91	0.40	0.48	0.46	0.32
2. Industrial Processes	**12.03**	**0.18**	**0.16**	**0.16**	**0.16**	**6.39**	**2.34**	**2.39**	**5.02**	**0.76**	**4.50**	**3.86**	**3.08**	**1.21**
A. Mineral Products	1.28	0.00	0.00	0.00	0.00	1.31	1.16	1.23	1.01	0.62	0.97	1.04	0.47	0.42
B. Chemical Industry	9.24	0.00	0.00	0.00	0.00	4.69	0.07	0.03	3.86	0.00	2.87	2.34	2.18	0.42
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00
D. Other Production (3)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6														
F. Consumption of Halocarbons and SF_6														
G. Other	1.51	0.18	0.16	0.16	0.16	0.39	1.11	1.11	0.15	0.14	0.66	0.48	0.43	0.37
3. Solvent and Other Product Use	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
4. Agriculture	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A. Enteric Fermentation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Manure Management	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Rice Cultivation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Agricultural Soils	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Prescribed Burning of Savannas	NO	NO	NO	NO	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	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**3.91**	**0.00**	**0.00**	**0.00**	**0.00**	**2.38**	**0.11**	**0.03**	**0.05**	**0.87**	**0.01**	**0.39**	**0.52**	**0.52**
A. Solid Waste Disposal on Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Wastewater Handling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	3.91	0.00	0.00	0.00	0.00	2.38	0.11	0.03	0.05	0.87	0.01	0.39	0.52	0.52
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items: (7)														
International Bunkers	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Aviation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass														

Table A.7.31. Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: CO***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
		(Gg)													
Total National Emissions and Removals		**1 127.02**	**785.07**	**751.52**	**708.44**	**691.37**	**848.99**	**832.10**	**753.72**	**744.56**	**721.31**	**696.40**	**660.58**	**628.42**	**611.24**
1. Energy		**995.82**	**780.27**	**747.02**	**704.36**	**687.11**	**782.05**	**795.18**	**714.14**	**631.99**	**682.96**	**590.48**	**557.97**	**558.52**	**596.93**
A. Fuel Combustion	Reference Approach [2]														
	Sectoral Approach [2]	989.72	772.07	741.32	698.36	679.51	774.10	787.11	706.57	625.74	678.45	586.21	553.38	554.23	593.22
1. Energy Industries		16.15	18.90	16.40	15.40	17.00	18.00	47.31	22.34	23.38	28.86	28.95	26.01	30.26	31.07
2. Manufacturing Industries and Construction		151.15	10.03	9.68	10.26	9.29	156.91	175.62	145.61	77.41	136.95	63.57	63.74	83.49	137.02
3. Transport		733.94	645.64	616.94	569.40	552.12	517.84	482.72	459.70	446.57	440.29	416.35	386.59	364.40	350.93
4. Other Sectors		88.48	97.50	98.30	103.30	101.10	81.35	81.46	78.92	78.38	72.35	77.34	77.04	76.08	74.20
5. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels		6.10	8.20	5.70	6.00	7.60	7.95	8.07	7.57	6.25	4.51	4.27	4.59	4.29	3.71
1. Solid Fuels		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Oil and Natural Gas		6.10	8.20	5.70	6.00	7.60	7.95	8.07	7.57	6.25	4.51	4.27	4.59	4.29	3.71
2. Industrial Processes		**129.27**	**4.80**	**4.50**	**4.08**	**4.26**	**66.54**	**36.91**	**39.58**	**112.56**	**38.04**	**105.91**	**102.50**	**69.55**	**13.96**
A. Mineral Products		3.51	0.00	0.00	0.00	0.00	2.46	1.01	1.63	1.51	1.69	1.56	1.41	1.40	1.29
B. Chemical Industry		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Metal Production		118.80	0.00	0.00	0.00	0.00	61.32	33.03	34.96	108.89	32.26	101.91	98.79	66.03	10.57
D. Other Production [3]		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Consumption of Halocarbons and SF_6		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Other		6.96	4.80	4.50	4.08	4.26	2.76	2.87	2.99	2.16	4.09	2.44	2.30	2.12	2.10
3. Solvent and Other Product Use		**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
4. Agriculture		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A. Enteric Fermentation		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Manure Management		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Rice Cultivation		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Agricultural Soils		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Prescribed Burning of Savannas		NO	NO	NO	NO	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	NO	NO	NO	NO
G. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste		**1.93**	**0.00**	**0.00**	**0.00**	**0.00**	**0.40**	**0.01**	**0.00**	**0.01**	**0.31**	**0.01**	**0.11**	**0.35**	**0.35**
A. Solid Waste Disposal on Land		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Wastewater Handling		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Waste Incineration		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other		1.93	0.00	0.00	0.00	0.00	0.40	0.01	0.00	0.01	0.31	0.01	0.11	0.35	0.35
7. Other *(please specify)*		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items: [7]															
International Bunkers		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Aviation		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass															

Table A.7.32. Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: NMVOC***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
		(Gg)													
Total National Emissions and Removals		**482.65**	**278.06**	**261.58**	**246.74**	**242.83**	**355.76**	**321.90**	**290.31**	**289.05**	**278.34**	**259.10**	**241.02**	**229.11**	**225.24**
1. Energy		**267.44**	**183.46**	**175.80**	**163.94**	**157.42**	**201.64**	**192.77**	**172.36**	**163.79**	**157.15**	**149.79**	**141.78**	**132.94**	**129.26**
A. Fuel Combustion	Reference Approach (2)														
	Sectoral Approach (2)	212.50	183.39	175.72	163.85	157.32	158.83	150.78	136.30	132.17	127.08	121.08	113.80	106.65	103.20
1. Energy Industries		3.65	4.10	4.30	3.60	3.90	5.58	7.46	3.18	3.57	4.58	4.69	4.12	3.00	2.99
2. Manufacturing Industries and Construction		4.60	1.79	1.73	1.83	1.66	4.90	3.71	3.06	4.41	3.29	3.17	2.95	2.17	2.62
3. Transport		185.85	166.00	157.99	145.82	140.26	131.63	122.11	113.86	108.07	104.00	97.55	91.08	86.12	82.44
4. Other Sectors		18.40	11.50	11.70	12.60	11.50	16.72	17.50	16.20	16.12	15.21	15.67	15.65	15.36	15.15
5. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels		54.94	0.07	0.08	0.09	0.10	42.81	41.99	36.06	31.62	30.07	28.71	27.98	26.29	26.06
1. Solid Fuels		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Oil and Natural Gas		54.94	0.07	0.08	0.09	0.10	42.81	41.99	36.06	31.62	30.07	28.71	27.98	26.29	26.06
2. Industrial Processes		**83.51**	**0.30**	**0.41**	**0.47**	**0.62**	**51.96**	**49.20**	**45.95**	**45.13**	**39.55**	**37.87**	**31.38**	**30.88**	**30.03**
A. Mineral Products		1.04	0.00	0.00	0.00	0.00	0.45	0.44	0.41	0.28	0.23	0.19	0.23	0.23	0.21
B. Chemical Industry		29.25	0.30	0.41	0.47	0.62	15.64	18.00	16.26	12.14	13.33	10.75	9.13	8.89	10.48
C. Metal Production		4.17	0.00	0.00	0.00	0.00	3.18	2.43	2.50	3.25	2.91	2.14	1.91	1.97	1.19
D. Other Production (3)		10.76	0.00	0.00	0.00	0.00	7.33	5.70	5.52	6.20	5.48	6.22	5.52	5.12	4.91
E. Production of Halocarbons and SF_6		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Consumption of Halocarbons and SF_6		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Other		38.29	0.00	0.00	0.00	0.00	25.36	22.63	21.26	23.26	17.60	18.57	14.59	14.67	13.24
3. Solvent and Other Product Use		**129.98**	**92.85**	**83.95**	**80.95**	**83.45**	**100.24**	**78.01**	**70.34**	**78.50**	**80.38**	**70.22**	**66.65**	**64.15**	**64.85**
4. Agriculture		0.16	0.00	0.00	0.00	0.00	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
A. Enteric Fermentation		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Manure Management		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Rice Cultivation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils		0.16	0.00	0.00	0.00	0.00	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
E. Prescribed Burning of Savannas		NO	NO	NO	NO	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	NO	NO	NO	NO
G. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste		**1.56**	**1.46**	**1.42**	**1.38**	**1.34**	**1.76**	**1.76**	**1.50**	**1.47**	**1.10**	**1.06**	**1.05**	**0.98**	**0.94**
A. Solid Waste Disposal on Land		1.45	1.46	1.42	1.38	1.34	1.27	1.23	1.19	1.14	1.05	0.99	0.93	0.88	0.88
B. Wastewater Handling		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Waste Incineration		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other		0.11	0.00	0.00	0.00	0.00	0.49	0.53	0.31	0.33	0.05	0.07	0.12	0.10	0.06
7. Other *(please specify)*		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items: (7)															
International Bunkers		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Aviation		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass															

Table A.7.33. Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: SO_2***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
					(Gg)										
Total National Emissions and Removals		**189.53**	**107.68**	**100.70**	**98.25**	**86.51**	**127.75**	**120.51**	**101.65**	**93.51**	**88.16**	**73.07**	**73.18**	**65.66**	**64.78**
1. Energy		**178.28**	**107.66**	**100.66**	**98.23**	**86.47**	**124.42**	**117.12**	**98.57**	**91.00**	**85.68**	**70.64**	**70.86**	**63.09**	**62.37**
A. Fuel Combustion	Reference Approach [2]														
	Sectoral Approach [2]	170.68	107.66	100.66	98.23	86.47	114.21	106.65	88.43	83.16	76.62	64.14	64.08	57.11	56.57
1. Energy Industries		105.07	88.60	81.10	77.40	66.20	68.29	64.09	55.42	52.82	49.98	41.67	43.76	38.07	37.60
2. Manufacturing Industries and Construction		45.61	1.14	1.10	1.17	1.06	27.77	27.91	23.65	20.91	16.66	14.45	14.24	13.65	13.55
3. Transport		13.32	13.82	14.26	13.86	13.81	12.98	10.14	5.23	5.57	6.02	4.32	2.49	1.87	1.89
4. Other Sectors		6.68	4.10	4.20	5.80	5.40	5.17	4.51	4.13	3.86	3.96	3.70	3.59	3.52	3.53
5. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels		7.60	0.00	0.00	0.00	0.00	10.21	10.47	10.14	7.84	9.06	6.50	6.78	5.98	5.80
1. Solid Fuels		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Oil and Natural Gas		7.60	0.00	0.00	0.00	0.00	10.21	10.47	10.14	7.84	9.06	6.50	6.78	5.98	5.80
2. Industrial Processes		**7.08**	**0.02**	**0.04**	**0.02**	**0.04**	**3.07**	**3.37**	**3.08**	**2.50**	**2.46**	**2.43**	**2.28**	**2.55**	**2.39**
A. Mineral Products		6.31	0.00	0.00	0.00	0.00	2.76	2.74	2.46	2.24	2.42	2.04	2.15	2.17	2.02
B. Chemical Industry		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Metal Production		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Other Production [3]		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Consumption of Halocarbons and SF_6		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Other		0.77	0.02	0.04	0.02	0.04	0.31	0.63	0.62	0.26	0.03	0.39	0.13	0.38	0.37
3. Solvent and Other Product Use		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Agriculture		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A. Enteric Fermentation		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Manure Management		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Rice Cultivation		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Agricultural Soils		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Prescribed Burning of Savannas		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Field Burning of Agricultural Residues		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Abandonment of Managed Lands		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste		**4.17**	**0.00**	**0.00**	**0.00**	**0.00**	**0.26**	**0.02**	**0.00**	**0.01**	**0.02**	**0.00**	**0.04**	**0.02**	**0.02**
A. Solid Waste Disposal on Land		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Wastewater Handling		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Waste Incineration		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other		4.17	0.00	0.00	0.00	0.00	0.26	0.02	0.00	0.01	0.02	0.00	0.04	0.02	0.02
7. Other *(please specify)*		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items: [7]															
International Bunkers		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Aviation		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass															

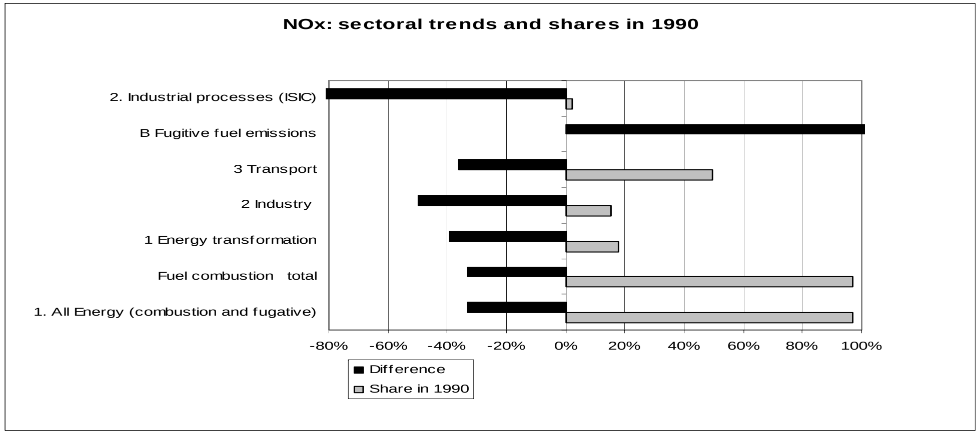

Figure A.7.1. Shares and trends in NO_x emissions per IPCC sector 1990-2003

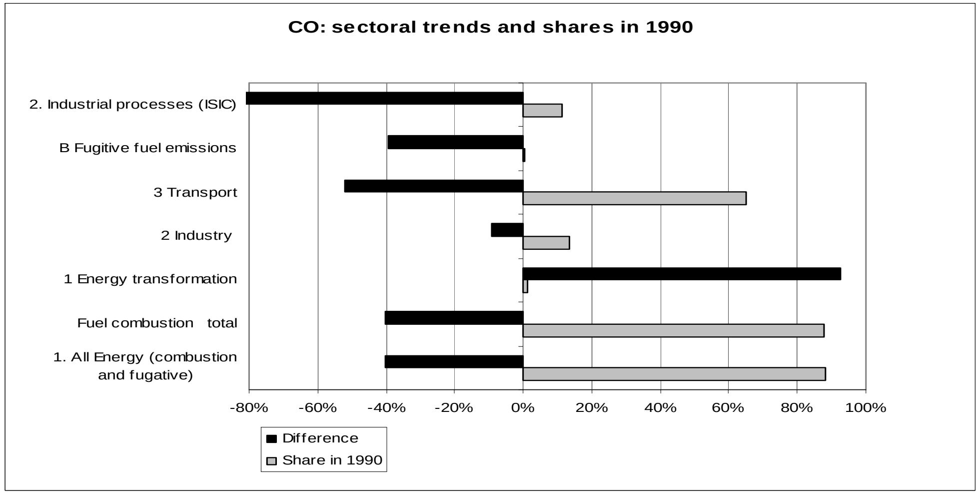

Figure A.7.2. Shares and trends in CO emissions per IPCC sector 1990-2003

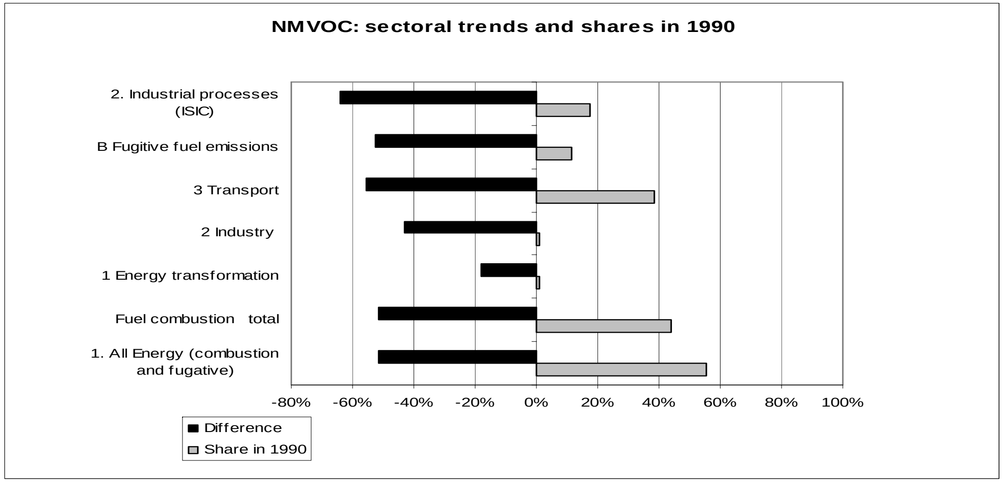

Figure A.7.3. Shares and trends in NMVOC emissions per IPCC sector 1990-2003

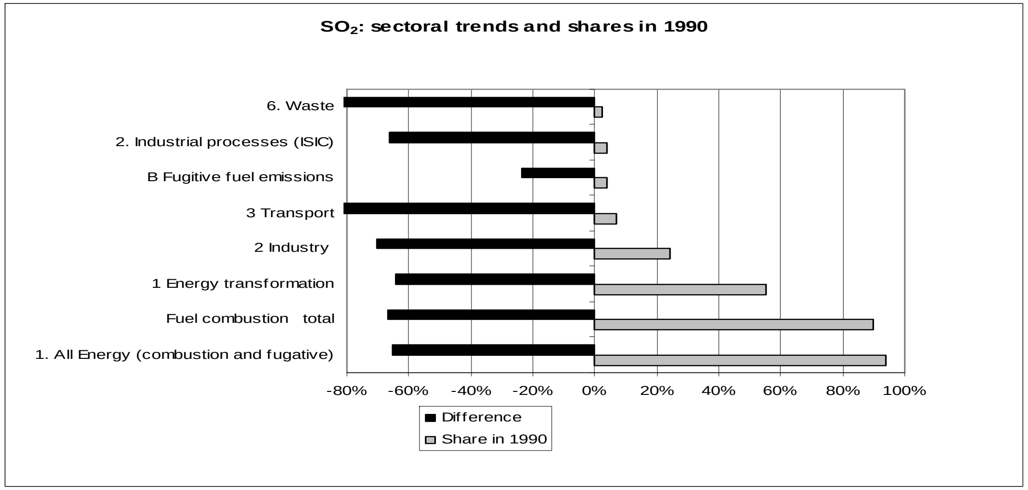

Figure A.7.4. Shares and trends in SO_2 emissions per IPCC sector 1990-2003

ANNEX 8: Chemical compounds, Units, Global Warming Potentials, Other conversion factors and Internet links

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)

Global Warming Potentials for selected greenhouse gases [1)]

Gas	Atmospheric lifetime	20-year GWP	100-year GWP	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: Second Assessment Report (SAR), 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.

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)

Other conversion factors for emissions

From element basis to full molecular mass:		From full molecular mass to element basis:	
$C \rightarrow CO_2$:	x 44/12 = 3.67	$CO_2 \rightarrow C$:	x 12/44 = 0.27
$C \rightarrow CH_4$:	x 16/12 = 1.33	$CH_4 \rightarrow C$:	x 12/16 = 0.75
$C \rightarrow CO$:	x 28/12 = 2.33	$CO \rightarrow C$:	x 12/28 = 0.43
$N \rightarrow N_2O$:	x 44/28 = 1.57	$N_2O \rightarrow N$:	x 28/44 = 0.64
$N \rightarrow NO$:	x 30/14 = 2.14	$NO \rightarrow N$:	x 14/30 = 0.47
$N \rightarrow NO_2$:	x 46/14 = 3.29	$NO_2 \rightarrow N$:	x 14/46 = 0.30
$N \rightarrow NH_3$:	x 17/14 = 1.21	$NH_3 \rightarrow N$:	x 14/17 = 0.82
$N \rightarrow HNO_3$:	x 63/14 = 4.50	$HNO_3 \rightarrow N$:	x 14/63 = 0.22
$S \rightarrow SO_2$:	x 64/32 = 2.00	$SO_2 \rightarrow S$:	x 32/64 = 0.50

Internet links to UNFCCC and IPCC Guidelines used for this report

UNFCCC guidelines on reporting and review
(Present guidelines; FCCC/CP/1999/7 of 16 February 2000)

Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, part I: UNFCCC reporting guidelines on annual inventories
(New guidelines into effect for reporting NIR 2004; FCCC/SBSTA/2002/L.5/Add.1 of 12 June 2002)

Revised IPCC 1996 Guidelines for National Greenhouse Gas Inventories (IPCC, 1997)

IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (IPCC, 2000)

ANNEX 9: 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)
NB	Nota Bene
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
NOP-MLK	Dutch National research Programme on Global Air Pollution and Climate Change
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
VI	VROM Inspectorate
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