RIVM report 773201008 / 2004

Greenhouse Gas Emissions in the Netherlands 1990-2002. National Inventory Report 2004

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National Inventory 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 2002]

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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, RIVM, TNO and AOO) 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 hundreds of pollutants (see *Section 1.6*). This annual project is led by the VROM Inspectorate (VI) and the *Co-ordinating Committee on Target Group Monitoring* (CCDM). 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 9) of the various sources has been made in cooperation with the following RIVM experts: Mr. Jan-Anne Annema (transport), Mr. Guus van den Berghe (AOO) (waste), Mr. Gert-Jan van der Born (land use), Mr. Laurens Brandes (key sources), Mr. Anco Hoen (transport, bunkers), Mr. Romuald te Molder (miscellaneous), Mrs. Johanna Montfoort (energy, fugitive emissions), Mr. Durk Nijdam (small combustion, solvent and product use), Mr. Kees Peek (industrial processes, waste water, other waste) and Mrs. Marian van Schijndel (agriculture). In addition, Mr. Ed Zonneveld of CBS has provided pivotal information on CO_2 related to energy use. This group has also provided activity data and additional information for the CRF files in cases where these were not included in the data sheets submitted by the ER Task Forces.

We 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 for checking and improving the English of the general chapters of the report.

Contents

Samenvatting (Dutch)

National Inventory Report (NIR)

Dit rapport over de Nederlandse inventarisatie van broeikasgasemissies is opgesteld om te voldoen aan de nationale rapportageverplichtingen in 2004 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 1990-2002; een analyse van zgn. 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 zgn. *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 1990-2002 (alle cijfers voor 2002 zijn voorlopig), 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.*

Belangrijkste wijzigingen ten opzichte van het vorige NIR-rapport

Emissies: De CO_2-emissies zijn 3 tot 4 Tg lager voor 1997 en later, in verband met een herberekening bij de industrie. Kleinere wijzigingen zijn er in hogere CH_4-emissies in de vroege 90-er jaren en in hogere emissies vanaf 1999 die vooral het gevolg zijn van een herberekening van de emissies van stortplaatsen, lagere N_2O-emissies in verband met een herberekening van overig wegtransport, lagere HFK- en PFK-emissies en hogere SF_6-emissies. De emissies in 1990 zijn hierdoor 0,7% hoger en de uitstoot in 2001 is nu 1,6% lager, waarmee de toename in de periode 1990-2001 daalde van 3,8% naar 2,3%. Bij dit *National Inventory Report* zijn nu ook spreadsheets toegevoegd met checktabellen en trendtabellen die op de bijgevoegde CRF-data files gebaseerd zijn.

Sleutelbronnen: 2-CO_2-Overige industrie en 3-CO_2-Diversen zijn nu *sleutelbronnen;* 1A3-CO_2-Luchtvaart en 6B-CH_4-Afvalwater zijn nu *geen sleutelbron* meer.

Secties: Methodiekwijzigingen in *Sectie 1.4*; resultaten van de trendverificatie in *Box 1.2* en in *Hoofdstuk 10* over herberekeningen en verbeteringen. Secties over herberekeningen zijn toegevoegd bij: CO_2 van de industrie (1A2), overig transport (1A3e) en overige sectoren (1A4); bij N_2O van wegtransport (1A3b); HFK's en PFK's van het gebruik van F-gassen (2F); CH_4 van stortplaatsen (6A) en CO_2 van overig afval (6D).

Emissietrends broeikasgassen

De totale broeikasgasemissies waren in 2002 gelijk aan die in het basisjaar (1990, maar 1995 voor de F-gassen). Na temperatuurcorrectie voor de zachte winter in 2002 zijn de emissies 3% hoger. In periode 1990-2002 zijn de emissies van CO_2 met 10% toegenomen, terwijl de CH_4 en N_2O-emissies met resp. 32% en 7% afnamen. Van de zogenaamde F-gassen, waarvoor 1995 het referentiejaar is, nam de totale emissie met 60% af. De HFK- en PFK-emissies namen met resp 65% en 35% af in 2002 ten opzichte van 1995, terwijl de emissies van SF_6 met 14% toenamen. Hieronder wordt per IPCC-categorie de verklaring voor de trend 1990-2002 gegeven:

- De emissies van *energiegebruik* en *-productie* (categorie 1) is met ca. 10% toegenomen ten opzichte van 1990, met name door de toename van CO_2-emissies van de centrales en de transportsector (resp. 24 en 23% toename). De verdubbeling van de elektriciteitimport in 1999 van 10 naar 20% voor het binnenlandse elektriciteitsverbruik veroorzaakte een tijdelijke afname van de CO_2-emissies in deze sector en het landelijk totaal. De stijging van de CO_2-emissies die in de periode vóór 1999 te zien was zet zich vanaf 2000 weer door.

- De *industriële procesemissies* (d.w.z. niet-verbrandingsemissies) (categorie 2) zijn 30% gedaald ten opzichte van 1990, met name door de sterke afname van de HFK-emissies en een afname van de N_2O-emissies van de salpeterzuurproductie. Ook de PFK-emissies zijn met 50% afgenomen.
- Emissies van *oplosmiddelen en andere producten* (categorie 3) dragen maar weinig bij tot het nationale totaal, de emissietrend vertoont een daling door een afname van de emissie van N_2O van spuitbussen.
- De *landbouwemissies* (categorie 4) zijn sinds 1990 met 14% afgenomen. Dit komt door de sterke afname van het aantal dieren, waardoor CH_4-emissies afkomstig van fermentatie en mest met 23% zijn gedaald.
- De CO_2-vastlegging in *bossen* (categorie 5) bedraagt circa 1% van het landelijke totaal. De jaarlijkse fluctuaties (-1,2 tot -1,9 Mton) worden veroorzaakt door jaarlijkse veranderingen in de dataset die gebruikt wordt voor het berekenen van deze categorie zoals houtkap en aangroei.
- De emissies van de *afvalsector* (categorie 6) zijn sinds 1990 circa 43% afgenomen, met name door een afname van CH_4-emissies van stortplaatsen. De aan fossiele brandstoffen gerelateerde emissie van afvalverbrandingsinstallaties zijn opgenomen in categorie 1A1.
- De sector 'overig' (categorie 7) bestaat grotendeels uit de emissie van N_2O door vervuild oppervlaktewater; deze bijdrage is constant gehouden over de jaren.
- Internationale transportemissies van lucht- en scheepvaart worden ook gerapporteerd, volgens de IPCC-richtlijn, maar als een aparte categorie die niet tot het nationale totaal gerekend wordt. Nederland rapporteert sinds dit jaar ook de – zeer geringe – CH_4- en N_2O-emissies. De CO_2-emissies zijn sinds 1990 met 44% of 18 Mton toegenomen door een toename van de emissies van scheepvaartbunkers (+12 Mton) en vliegverkeer (+6 Mton).

De grootste wijzigingen in totale broeikasgasemissies *in 2002 ten opzichte van 2001* worden veroorzaakt door een afname van de methaanuitstoot van 58 Gg, wat correspondeert met 1,2 Mton CO_2-eq. en de afname van de CO_2-emissies met resp. 0,4 Mton CO_2 . Ook de N_2O-uitstoot is in 2002 afgenomen met 1,7 Gg, ofwel 0,5 Mton CO_2-eq. De daling in 2002 van 6% van de methaanemissies komt vooral door een sterke afname van de uitstoot bij de landbouw (met name veeteelt), bij stortplaatsen en bij de productie van olie en gas.

Wijzigingen ten opzichte van de NIR-rapportage van 2003

De indeling van het rapport is volgens de nieuwe richtlijnen van de UNFCCC die dit rapportagejaar van kracht zijn geworden. De emissiecijfers in deze rapportage komen overeen met de emissiecijfers gepubliceerd in de *Emissiemonitor 2003* voor 1990, 1995 en 2000-2002, die medio 2003 zijn vastgesteld. De emissies in de *Milieubalans 2004* verschillen van dit rapport omdat die recenter (voorjaar 2004) zijn vastgesteld. De belangrijkste wijzigingen ten opzichte van de vorige NIR-rapportage zijn het gevolg van methodiekverandering, verbetering in allocatie en herstel van fouten:

- *Methodiekwijzigingen:* met name herberekening van emissies van verkeer voor alle stoffen en jaren (1A3), van CH_4-emissies van stortplaatsen en toevoeging van de – geringe – CH_4- en N_2O-emissies van internationaal transport;
- *Allocatie van bronnen:* nadere opsplitsing van vluchtige CH_4-emissies voor 1991-1994 in de categorie 1B2 en verschuiving van de emissies van verbranding van biogas van RWZI's van de afvafsector (6D) naar de energiesector (1A4);
- *Foutencorrectie:* aanpassing van gasgebruik en bijbehorende emissies van huishoudens (1A4) in 1990 en 1995-2002; van gasgebruik (1990-2001) en dubbeltelling in CO_2-emissies van de chemische industrie (1A2c) (1997-2001) met 3-4 Mton CO_2 in de jaren vanaf 1997, van gasoliegebruik in 1A1b (1995-2002), verwijdering van CO_2-emissies van overig afval (6D) voor 1998-2001, CO_2- en N_2O-emissies van gebruik van biobrandstof (Memo-item en 1A4) en aerosolen (3D) in huishoudens voor 1990-2002 en correctie van NO_2 van landbouwbodems (4D) voor 1990-1995.

Als gevolg van deze herberekeningen zijn in het basisjaar de totale CO_2-equivalente emissies nu 1,4 Mton CO_2-eq. of 0,7% hoger dan in de vorige opgave. Door herberekeningen is de trend ten opzicht van het basisjaar met 2% naar beneden is bijgesteld. Volgens de huidige inventarisatie is totale uitstoot van broeikasgassen in 2002 gelijk aan die in het basisjaar (1990 maar 1995 voor de F-gassen). De CO_2-emissies zijn in het basisjaar (1990) bij de 'Overige sectoren' (huishoudens, diensten) nu 0,7 Mton hoger door een herberekening in het aardgasgebruik, bij de industrie 0,3 Mton hoger door een foutcorrectie en in de transportsector nu 0,4 Mton hoger door herberekeningen. De wijzigingen bij de andere gassen zijn minimaal.

Onzekerheden

De onzekerheid in de emissiecijfers voor 2002 en in de emissietrend is waarschijnlijk groter als gevolg van een tijdelijk verslechtering van de kwaliteit van de emissiecijfers voor de laatste jaren ten opzichte van de data voor eerdere jaren. Dit wordt veroorzaakt door (a) een andere rapportagewijze door individuele bedrijven (thans rechtstreeks via de milieujaarverslagen) en (b) vertraging in de beschikbaarheid van (voorlopige) statistieken voor het voorgaande kalenderjaar, met name voor het energiegebruik.
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 3%, gebaseerd op de zgn. '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 ±3%, 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 resp. ±3%, ±6%, ±11% and ±9%-punten. Deze onzekerheden zijn exclusief het mogelijke effect op de emissies van herberekeningen als gevolg van methodiekwijzigingen.

Respons naar aanleiding van reviews

De Nederlandse emissieregistratie voor broeikasgassen heeft de volgende reviews gehad door het VN-Klimaat-secretariaat: 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. De belangrijkste opmerkingen betroffen: inconsistentie in tijdreeksen; missende toelichtingen bij CRF-tabellen; incompleetheid van de datasets; literatuurverwijzingen; en vergelijking van activiteiten-data met internationale statistieken. In deze rapportage zijn de CRF-tabellen verbeterd door correctie van typ/eenheid-fouten, verbeterde geaggregeerde emissiefactoren bij de industriële verbrandingssectoren door een meer systematische toedeling naar type brandstof, en verbeterde allocatie van vluchtige methaanemissies voor 1991-1994.

Verbeteringen in de toekomst

Om te voldoen aan de richtlijnen van het IPCC met betrekking tot de emissieregistratie van broeikasgassen is in 2000 een programma gestart om de bestaande monitoringprocedures aan te passen aan de internationale eisen. Dit programma valt onder verantwoordelijkheid van het Ministerie van VROM en wordt gecoördineerd door Novem. Er is een interdepartementale werkgroep geformeerd – de *Werkgroep Emissiemonitoring Broeikasgassen*, WEB – die belast is met advisering over de verschillende uit te voeren acties. Volgens EU-afspraken moeten de lidstaten zgn. *National Systems* zo spoedig mogelijk, maar uiterlijk per 31 december 2005, geïmplementeerd hebben. In het kader van de afronding van het verbeterprogramma zal daarom volgens plan vóór 31 december 2004 opnieuw een bijstelling volgen van mogelijk enkele procenten: voor veel bronnen en stoffen zullen de emissies herberekend worden opdat voldaan wordt aan de eisen van de EU, de UNFCCC en het Kyoto Protocol. Voor een belangrijk deel bestaan deze uit herberekeningen van zgn. *sleutelbronnen* om de kwaliteit (transparantie, consistentie in de tijd, compleetheid en nauwkeurigheid) te verbeteren van de CO_2-emissies, als hierover overeenstemming is bereikt:

- De *verbrandingsemissies van stationaire bronnen* (IPCC categorie 1A) zullen, indien goedgekeurd, mogelijk volledig worden herberekend voor de periode 1990-2003 op basis van sectorale energiestatistieken in plaats van met gebruikmaking van de MJV/ER-data, waarbij dan ook een aantal verbeterde emissiefactoren gebruikt worden.
- De emissies van mobiele bronnen zullen worden aangepast aan verbeterde toerekening van brandstofgebruik aan binnenlandse en buitenlandse scheepvaart en luchtvaart, en voor wegtransport, indien goedgekeurd, aan nieuwe voor Nederland specifieke emissiefactoren.
- Herberekening van de CO_2-emissies van *non-energetisch gebruik van energiedragers* (als chemische grondstof), waarbij de directe emissies tijdens de productie van de petrochemische producten en de emissies bij het gebruik van deze fossiel-koolstofhoudende producten apart worden onderscheiden (resp. IPCC categorieën 2 en 3). Behalve een toerekening naar industriële processen en productgebruik conform de UNFCCC-rapportagerichtlijnen in plaats van de huidige rapportage als onderdeel van de verbrandingsemissies, verbetert hiermee ook de berekening van de Nederlandse emissies. Bij de huidige methodiek worden namelijk de gebruiksemissies berekend voor alle in Nederland geproduceerde petrochemische producten, terwijl een groot deel hiervan geëxporteerd wordt. Daarnaast worden de koolstofvastleggingsfracties bij de productie aangepast aan de laatste inzichten.
- De fossiele CO_2-emissies van *afvalverbranding* (IPCC categorie 6C of 1A) worden herberekend voor de hele periode 1990-2003 met een verbeterde, consistente splitsing van de koolstof in de fossiele en organische fracties.

Ook bij de methaan- en lachgas-emissies zijn belangrijke herberekeningen voorzien:

- *CH_4-emissies:* De emissies van de *distributie van aardgas* (1B) zullen worden herberekend op basis van de lengte van het leiding-netwerk en het materiaaltype in plaats van de aardgas doorvoer als basis voor de emissiefactor. Ook zullen de emissies van het *afblazen van gas* (1B) bij de olie- en gaswinning worden herberekend. De methaanemissies van *enterische fermentatie bij vee* (4A) worden mogelijk herberekend met behulp van met nieuwe voor Nederland specifieke emissiefactoren. Verder zullen de methaanemissies van *stortplaatsen* (6A) en van RWZI's worden herberekend terwijl de emissies van industriële waterzuiveringen indien mogelijk zullen worden toegevoegd.
- *N_2O-emissies:* De zgn. indirecte emissies van N_2O van *landbouwbodems* (4D) als gevolg van *depositie uit de atmosfeer* worden nu niet gerapporteerd. Alle indirecte N_2O-emissies zullen worden herberekend met behulp van de aanbevolen IPCC-methodiek met gebruikmaking van met nieuwe voor Nederland specifieke factoren en activiteitendata.

Executive Summary

Major changes from the previous National Inventory Report

Emissions: Decreased CO_2 emissions by 3 to 4 Tg from 1997 onwards, in particular due to revision in the manufacturing industry. Smaller changes are found in increased CH_4 emissions in the early '90s and increased emissions from 1999 onwards mainly due to revision of landfill emissions, decreased N_2O emissions due to revision in other transport, decreased HFC and PFC emissions and increased SF_6 emissions. Resulting 1990 emissions increased by 0.7% and 2001 emissions decreased by 1.6%, adjusting the 1990-2001 increase from 3.8% to 2.3%. In addition, the user will find the check tables compiled from CRF data and other information spreadsheets and the (trend) tables presented in this National Inventory Report (NIR) as a supplement to this report.
Key sources: 2-CO_2 Other Industrial and 3-CO_2 Miscellaneous: are now *key;* 1A3-CO_2 Aircraft and 6B-CH_4 Wastewater are now *non-key*.
Sections: Methodological changes in *Section 1.4*; results of the trend verification in *Box 1.2* and *Chapter 10* on recalculations and improvements. Recalculation sections were added for CO_2 from manufacturing industry (1A2), other transport (1A3e) and other sectors (1A4); N_2O from road transport (1A3b); HFC and PFCs from F-gas consumption (2F); CH_4 from landfills (6A) and CO_2 from other waste (6D).

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

This report documents the 2004 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) 2004* therefore provides explanations of the trends in greenhouse gas emissions for the 1990-2001 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 *Environmental Balance 2003*. Please note that the emissions presented in this dataset for 2002, i.e. for the most recent year, have been compiled using sometimes estimated activity data and may therefore have been calculated somewhat differently than the emissions of other years (see *Annexes 2.1* and *3*).
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 category '*Land-use change and forestry'* (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 2004, for example, should contain emission data up to the year 2002. The *UNFCCC Guidelines* prescribe the source categories, calculation methodologies, and the contents and the format for 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. 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 *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 of which the total adds up to 95% of the national total are 18 sources for annual level assessment and 16 sources for the trend assessment out of a total of 56 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. This refined result is a list of about 27 source categories out of a total of 56 that could be identified as 'key sources' (see *Table 1.4*).
For these sources in principle a higher Tier emission calculation method should be used. For key sources a brief comparison is made of the Netherlands' methodologies with the IPCC Tiers in the methodological sections of the sectoral Chapters 2 to 9 (also see *Table 1.4*). From this analysis it seems clear that for CH_4 from natural gas distribution and CH_4 from enteric fermentation of cattle, for instance, the methods used will probably need to be improved in future.

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. To meet the UNFCCC and IPCC requirements additional actions are (still) necessary. 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 Division* of the Ministry of VROM (VROM/DGM/KVI) is responsible for organising the reporting process. *Figure ES.1* presents this process, the relation with the PER and the responsibilities. The *Co-ordination Committee for Target Sector Monitoring* (CCDM) under

auspices of the VROM Inspectorate is responsible for the data collection in the PER process, resulting in an intermediate database, hosted by TNO.
The NIR report, also containing a selection of CRF tables, has been primarily drafted by RIVM, with contributions by CBS, TNO and Novem. This year organisations and individuals could make, for the second time, comments to the draft NIR. This process was organised by Novem and RIVM, using the site www.greenhousegases.nl. Six persons provided comments, which is much less than last year, mostly on the LUCF chapter. Data collected in the National Inventory Report are based on the PER.
A Greenhouse Gas Inventory Improvement Programme was started in 2000. This programme is guided by the *Working Group Emission Monitoring of Greenhouse Gases* (WEB), which directs future actions aimed at improving the monitoring of greenhouse gas emissions, relevant to reporting to the UNFCCC in all aspects. At the end of this Executive Summary we summarise the main actions; more details can be found in *Section 10.4*. Some actions already resulted in improved data; others are related to future improvements. One of the actions is aimed at improving the process of data collection and calculations by the use of protocols, which should be included in the PER system from 2004 onwards.

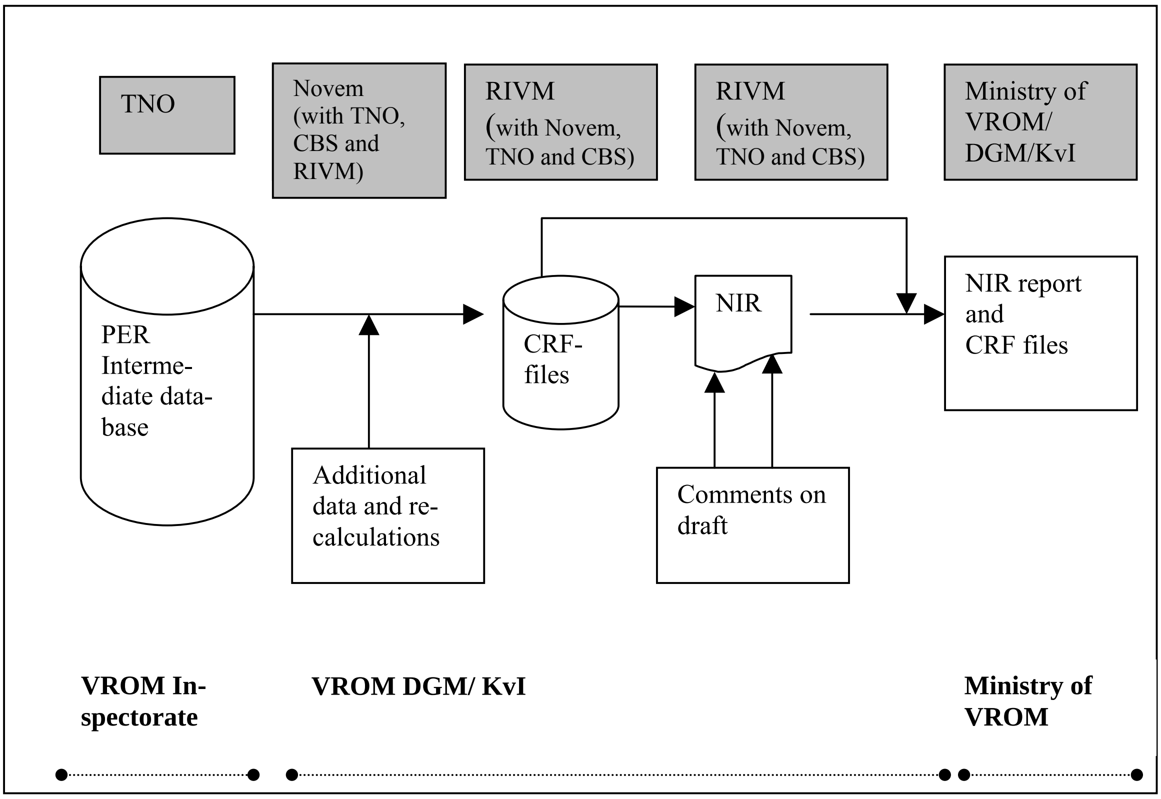


Figure ES.1. NIR and CRF preparation process, relation with the Pollutant Emission Register (PER) and responsibilities

Organisation of the report

The structure of this report complies with the new UNFCCC reporting guidelines for this year's submission (UNFCCC, 2002). 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. The final *Chapter 10* presents information on recalculations, improvements and response to issues raised in external reviews. In addition, the report contains 9 *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

In *Table ES.1* the trends in national total (net) CO_2-equivalent emissions are summarised for 1990-2002. Total greenhouse gas emissions were in 2002 the same as in the base year, which is defined as 1990 for greenhouse gases and 1995 for fluorinated gases. The 2002 emissions would be 3%-points higher when corrected for temperature (the mild winter). In *Table ES.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 anthropogenic trend in the CO_2 emissions. Using temperature-corrected CO_2 emissions in 1990 and 2002, the structural *anthropogenic* trend of total greenhouse gas emissions in the past 11 years is estimated to be a 1%-point lower than the actual trend in CO_2-eq. emissions of 1% increase. CO_2 emissions increased by about 10% from 1990 to 2002, mainly due to the increase in the emissions in the energy (24%) and transport sectors (23%). 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 and 2001 the annual increase of the pre-1999 years has resumed. CO_2 emissions peaked in 1996 due to a very cold winter.

Table ES.1. Total greenhouse gas emissions in CO_2-eq. and indexed 1990-2002 (no temperature correction)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002[1]
Nat. Emissions (Tg CO_2-eq)													
CO_2 with LUCF	159.2	166.2	164.8	166.4	167.0	172.0	180.2	165.0	171.0	166.0	169.3	175.6	175.2
CO_2 excluding LUCF	***160.6***	167.8	166.3	168.2	168.9	173.2	181.6	166.2	172.4	167.3	170.7	177.1	176.7
CH_4	***27.3***	27.8	26.7	26.2	25.7	25.0	24.8	23.2	22.4	21.4	20.3	19.9	18.7
N_2O	***16.4***	16.7	17.6	18.4	18.0	18.1	17.8	17.7	17.5	17.3	16.6	15.8	15.3
HFCs	4.4	3.5	4.4	5.0	6.5	***6.0***	7.7	8.3	9.4	4.9	3.9	1.5	1.6
PFCs	2.4	2.4	2.1	2.1	1.9	***1.8***	2.0	2.2	1.7	1.5	1.6	1.5	1.2
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	0.3
Total [group of six] [212.4 [5,2]]	**210.0**	**216.7**	**215.9**	**218.2**	**219.2**	**223.3**	**232.8**	**216.8**	**222.4**	**211.4**	**212.0**	**214.7**	**212.4**
Index (1990=100)	**211.4**	**218.2**	**217.3**	**220.0**	**221.2**	**224.5**	**234.2**	**218.0**	**223.8**	**212.7**	**213.4**	**216.1**	**213.8**
Index CO_2 [2]	100	104.4	103.6	104.5	104.9	108.1	113.2	103.7	107.5	104.3	106.4	110.4	110.1
Index CH_4	100	101.7	97.8	95.8	94.0	91.4	90.7	84.9	82.0	78.3	74.4	72.9	68.4
Index N_2O	100	101.6	107.6	112.0	109.6	110.4	108.6	108.2	107.0	105.4	101.0	96.5	93.2
Total [group of three]	**100**	**103.9**	**103.1**	**104.1**	**104.1**	**105.9**	**109.7**	**101.4**	**104.0**	**100.8**	**101.6**	**104.2**	**103.1**
Index HFCs	100	77.9	100.3	112.8	146.4	135.8	173.2	187.4	211.2	111.1	87.5	34.0	35.5
Index PFCs	100	100.1	86.0	86.7	77.1	76.0	83.4	89.6	71.9	60.9	65.3	61.3	49.7
Index SF_6 (potential)	100	61.6	65.8	69.0	88.0	138.6	143.7	158.7	151.3	145.9	154.2	163.9	158.1
Index [group of six] [2]	**100**	**103.2**	**102.8**	**103.9**	**104.4**	**106.3**	**110.9**	**103.3**	**105.9**	**100.7**	**101.0**	**102.3**	**101.1**
Index (1995 = 100)													
Index HFCs	73.6	57.4	73.9	83.0	107.8	100	127.5	138.0	155.5	81.8	64.5	25.0	26.1
Index PFCs	131.6	131.8	113.2	114.1	101.5	100	109.7	117.9	94.6	80.1	85.9	80.7	65.4
Index SF6	72.1	44.5	47.5	49.8	63.5	100	103.7	114.5	109.2	105.2	111.2	118.3	114.0
Index [group of new gases]	**86.6**	**73.6**	**81.8**	**88.8**	**104.7**	**100**	**122.6**	**132.6**	**140.1**	**82.3**	**71.0**	**41.0**	**38.2**
Index ('90; new gases '95) [5]													
Index [group of six composite]	**98.8**	**102.0**	**101.6**	**102.7**	**103.2**	**105.1**	**109.6**	**102.0**	**104.7**	**99.5**	**99.8**	**101.1**	**99.9**
International Bunkers	39.8	41.3	42.4	44.3	42.9	44.3	45.5	48.5	49.6	51.2	53.5	57.6	57.4
Index bunkers CO2 (1990 = 100)	100.0	103.8	106.6	111.3	107.7	111.4	114.3	121.8	124.6	128.8	134.5	144.8	144.4

[1] The *'t-1'* dataset is holds a higher uncenrtainty than the *'t-2'* dataset dus to the data collection process (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, shaded/bold-italic figures): 212.4 Tg CO_2-eq.

Table ES.2. Total greenhouse gas emissions with temperature correction, in CO_2-eq. and indexed, 1990-2002

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Emissions (Tg CO_2-eq)													
CO2 with LUCF (T-corrected)	165.4	166.6	169.1	167.5	170.7	174.6	175.8	167.4	174.7	171.2	174.7	178.0	179.5
CO2 excluding LUCF (T-corrected)	166.8	168.1	170.6	169.3	172.7	175.9	177.2	168.6	176.1	172.4	176.1	179.4	181.0
Total [group of six] [1)]	**217.6**	**218.6**	**221.7**	**221.1**	**224.9**	**227.1**	**229.8**	**220.4**	**227.5**	**217.8**	**218.8**	**218.5**	**218.1**
Index (1990 = 100)													
Index CO_2 excluding LUCF (T-corrected)	100	100.8	102.3	101.5	103.5	105.4	106.2	101.1	105.6	103.4	105.6	107.6	108.5
Total [group of three] [1)]	**100**	**101.0**	**102.1**	**101.6**	**102.8**	**104.0**	**104.4**	**99.5**	**102.6**	**100.3**	**101.2**	**102.2**	**102.1**
Index [1990; F-gases 1995]													
Index [group of 6 composite]	**99.5**	**100.0**	**101.4**	**101.1**	**102.8**	**103.8**	**105.1**	**100.8**	**104.0**	**99.6**	**100.0**	**99.9**	**99.7**

[1)] Excluding LUCF.

CH_4 emissions decreased by 32% in 2002 compared to the 1990 level, mainly due to the decrease in the waste sector (-40%), the agricultural sector (-23%) and fugitive emissions from oil and gas (-33%). N_2O emissions decreased by about 7% in 2002 compared to 1990, mainly due to the decrease in the emissions from industrial processes (-17%), which compensated increases of emissions from fossil fuel combustion of 38% (mainly from transport).
Of the fluorinated greenhouse gases, emissions of HFCs and PFCs decreased in 2001 by about 75% and 35%, respectively, while SF_6 emissions increased by 14%. Total emissions of all F-gases decreased by about 60% compared to the 1995 reference year level. In 2001 the largest changes showed an increase of 6 Mton of CO_2 – of which 3 Mton was due to the colder winter compared to 2000 – and decrease of over 1 Mton in HFC emissions. Along with the increased import of electricity since 1999, this is the primary reason why total greenhouse gas emissions have stabilised since 1997.

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

Table ES.3 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 75% in 1990 to about 82% in 2002. In contrast, emissions of the other main categories decreased, the largest being those of industrial processes (from 8 to 5% share), waste (from 6 to 4% share) and agriculture (from 8 to 7% in 2002). The sectors showing the largest growth in CO_2-eq. emissions since 1990 are the transport sector (23%) and the energy sector (24%). CO_2-eq emissions from the energy combustion as a whole showed a growth of about 9%.
Clear exceptions are the waste sector, industrial processes and agriculture, which showed a decrease in CO_2-eq. emissions of 42% 30% and 14% respectively. Emissions from the residential sector increased by 2%, but weather effects substantially influence these: when the temperature correction was included, these emissions decreased by about 3%.

Energy Sector (CRF sector 1)

The emissions from the energy sector (category 1) 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. Responsible for the increasing trend in this sector are the energy industries and the transport sector, of which CO_2 emissions increased by 24 and 23% since 1990. In contrast, the energy-related CO_2 emissions from manufacturing industries decreased a few per cent in 2000 and 2002. Actual CO_2 emissions from the other sectors (residential, services and agriculture) increased by about 2%. The relatively strong increases in emissions from the energy sector and the transport sector result in increases of their CO_2 share in the national CO_2-eq. total (by 6% and 3%-points, respectively) to 30% and 17% in the 2002. The 24% increase of the energy sector emissions is partly mitigated by about 10%-points due to the strong increase in net import of electricity since 1999, which is equivalent to about 4 Mton of CO_2 coming from domestic fossil-fuel generated electricity. We note that fugitive methane emissions from oil and natural gas decreased by 33% since 1990.

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

Source category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1A. Energy: fuel combustion	**159.0**	**167.0**	**165.9**	**168.0**	**168.6**	**171.6**	**179.6**	**163.9**	**170.8**	**165.2**	**169.3**	**175.4**	**174.4**
CO_2: 1. Energy industries	51.3	52.2	54.1	53.8	56.0	56.5	58.3	57.2	60.2	56.7	61.2	64.6	63.8
CO_2: 2. Manufacturing industries	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
CO_2: 3. Transport	29.4	29.4	30.6	31.2	31.3	32.1	32.6	33.1	34.2	35.0	35.2	35.5	36.3
CO_2: 4. Other sectors	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
CO_2: 5. Other	0.0	1.1	0.0	1.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CH_4	0.7	0.8	0.8	0.7	0.7	0.8	0.8	0.6	0.7	0.7	0.7	0.7	0.7
N_2O	0.5	0.6	0.6	0.7	0.6	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.7
1B2. Energy: fugitives from oil & gas	**4.1**	**4.4**	**3.8**	**3.7**	**3.9**	**4.4**	**5.0**	**4.3**	**4.6**	**4.5**	**4.3**	**4.5**	**4.2**
CO_2	0.3	0.5	0.4	0.4	0.2	0.8	1.0	1.0	1.6	1.5	1.6	1.7	1.6
CH_4	3.8	4.0	3.4	3.3	3.5	3.6	4.0	3.3	3.1	3.0	2.8	2.8	2.5
N_2O	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2. Industrial processes [1)]	**16.3**	**15.2**	**15.7**	**16.8**	**18.0**	**17.1**	**19.0**	**19.8**	**20.3**	**15.3**	**14.2**	**11.4**	**11.4**
CO_2	1.6	1.5	1.3	1.2	1.4	1.4	1.4	1.4	1.3	1.3	1.2	1.4	2.0
CH_4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
N_2O	7.6	7.7	7.7	8.3	7.9	7.5	7.5	7.5	7.5	7.2	7.1	6.6	6.3
HFCs	4.4	3.5	4.4	5.0	6.5	6.0	7.7	8.3	9.4	4.9	3.9	1.5	1.6
PFCs	2.4	2.4	2.1	2.1	1.9	1.8	2.0	2.2	1.7	1.5	1.6	1.5	1.2
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	0.3
3. Solvent and other product use [1)]	**0.2**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.1**	**0.1**	**0.2**	**0.2**	**0.1**	**0.1**	**0.1**
CO_2	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
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)
N_2O	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.1
4. Agriculture	**17.4**	**17.8**	**18.4**	**18.4**	**18.0**	**18.3**	**17.9**	**17.4**	**17.0**	**16.7**	**15.8**	**15.6**	**15.0**
CH_4: Enteric fermentation	8.4	8.6	8.4	8.2	8.0	7.9	7.7	7.4	7.2	7.0	6.7	6.8	6.4
CH_4: Manure management	2.2	2.2	2.2	2.2	2.1	2.1	2.1	2.0	2.0	1.9	1.9	1.9	1.7
N_2O: Manure management	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
N_2O: Agricultural soils	6.6	6.7	7.6	7.7	7.6	8.1	8.0	7.8	7.6	7.6	7.0	6.8	6.6
5A. Changes in forest/biomass stocks	**-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**
CO_2	-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
6. Waste	**13.2**	**12.3**	**12.0**	**11.7**	**11.3**	**11.6**	**11.4**	**11.3**	**9.8**	**9.5**	**8.4**	**8.0**	**7.5**
CO_2	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
CH_4	12.1	12.1	11.8	11.6	11.2	10.5	10.2	9.8	9.5	8.7	8.2	7.7	7.3
N_2O	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2
7. Other	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
CH_4: Solvents 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
N_2O: Polluted surface water	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
NATIONAL TOTAL EMISSIONS [2)]	**210.0**	**216.7**	**215.9**	**218.2**	**219.2**	**223.3**	**232.8**	**216.8**	**222.4**	**211.4**	**212.0**	**214.7**	**212.4**
Memo item, not included in national total:													
International bunkers	**39.8**	**41.3**	**42.4**	**44.3**	**42.9**	**44.3**	**45.5**	**48.5**	**49.6**	**51.2**	**53.5**	**57.6**	**57.4**
CO_2 Marine	35.3	36.3	36.5	37.8	36.1	36.6	37.2	39.5	39.8	41.1	43.4	47.7	47.1
CO_2 Aviation	4.5	5.0	5.9	6.5	6.7	7.7	8.2	8.9	9.7	10.1	10.1	9.9	10.3

[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 (category 2) have decreased by 30% since 1990. As can be seen in *Table ES.3,* N_2O emissions, mainly from nitric acid manufacture, is the main contributor to this source category. However, 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. The F-gas emissions had a share of almost 50% in total source category emissions in 1995; their share is now about 25%, of which HFCs and PFCs form by far the largest part. PFC emissions in the Netherlands stem mainly from aluminium production. CO_2 emissions from industrial processes contribute 18% to the group total and stem only for 1/3 from cement clinker production. A large fraction of cement production in the Netherlands uses imported cement clinker. Emissions of SF_6 contribute about 3% to the group total.

Solvents and other product use (CRF sector 3)

The emissions from 'Solvent and other product use' (category 3) should be discussed in conjunction with (very small) methane emissions reported under category 7, since the IPCC tables do not allow for methane emissions under category 3. This category contributes very little to the national total: only 0.1%, primarily in the form of N_2O from dispersive uses. We note the CO_2 emissions related to the use of products from non-energy use of fuels (e.g. lubricants, waxes, etc.) are not reported in this category but are included in the fuel combustion emissions reported under the manufacturing industry (1A2).

Agriculture (CRF sector 4)

The emissions of the agricultural sector have decreased by 14% since 1990, mainly through a decrease in CH_4 emissions from enteric fermentation (4A) of 24% by reduced livestock numbers. In its wake, CH_4 from manure management (4B) has also decreased similarly over time. At present, enteric fermentation contributes about 45% to this category's emissions as does N_2O emissions from agricultural soils (4D); N_2O from manure management only contributes 1% to the group total. N_2O from agricultural soils increased until 1995 due to changing practices in animal manure spreading on the fields (incorporation into the soil with the aim of reducing ammonia emissions). The decrease since 1998 is mainly due to a reduction of the use of synthetic fertilisers. At present, due to historic reasons, the Netherlands reports no CO_2 emissions from agricultural soils. Indirect N_2O emissions from leaching and run-off of nitrogen from agricultural soils are reported under IPCC category 7, because the Netherlands' method provides only aggregated figures that include industrial sources as well.

Changes in biomass stocks (LUCF) (CRF sector 5)

Of the Land Use Change and Forestry (LUCF) sector, the Netherlands presently only reports the net changes of CO_2 due to changes in forests and other biomass stocks (IPCC category 5A). These result in a sink of about 1% on the national net total emissions. The variation over time is between -1.2 and -1.9 Mton CO_2. Emissions for 2001 and 2002 are set on the same level as for the year 2000.

Waste (CRF sector 6)

The emissions from the waste sector have decreased by about 40% since 1990, mainly through decreasing CH_4 emissions – predominantly from landfills – which is the dominating gas (97 % of total emissions, CO_2 and N_2O emissions contributing the remaining 3%). The fossil-fuel related emissions from waste incineration 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.

Other (CRF sector 7)

The Netherlands uses IPCC category 7 to reports its – very minor – CH_4 emissions from solvents and other product use, because the present reporting framework does not allow for CH_4 emissions under IPCC category 3. Total indirect N_2O emissions from leaching and run-off of nitrogen from agricultural soils and industrial sources are reported here, because the Netherlands' method provides only aggregated figures that include industrial sources. The indirect N_2O emissions are labelled as '*Polluted surface water'* and are constant over time.

International transport

Emissions from international transport are not part of the national total but are reported separately. This year the – very minor – CH_4 and N_2O emissions from international bunkers were included in the inventory. Total CO_2 emissions from this source category have increased by 44% or 17.6 Mton since 1990. In particular, marine bunker emissions contributed (+33% or 12 Mton) due to the large share in this category, but percentage-wise the emissions from international aviation increased much more (+130% or about 5 Mton). Total international transport emissions have increased as percentage of the national total greenhouse gas emissions from 19% in 1990 to 27% in 2002.

ES.4. Other information

Differences with the domestic national emission inventory

The *Climate Convention* uses a specific definition of the emissions that should be included in the national total. 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. To the extent that biofuels 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 CO_2 from 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' emissions of so-called Target Sectors are mostly analysed by their total emissions.
Another specific issue is the distinction that the IPCC makes between CO_2 from non-energy/feedstock use of fuels, CO_2 emissions from other non-combustion processes and CO_2 from fossil fuel combustion. The requirement of separating CO_2 emissions from a Target Sector into these specific subcategories poses limitations to the Netherlands. In the Netherlands these different sources of CO_2 cannot be decomposed in cases where individual companies report their emissions at a too aggregated level. Another difference is found in the definition of national versus international transport. Whereas the national method uses vehicle statistics to estimate road transport emissions, the UNFCCC requires the use of fuel delivery data as the basis for calculating the emissions from this source category. As illustrated in *Chapter 3*, this results for the Netherlands in annual differences between 5 and 10%.

Differences with other national publications

The emission data presented in this report are identical to the PER dataset that has been fixed in mid 2003 and officially published for 1990, 1995 and 1999-2002 in the *Emission Monitor for the Netherlands in a Nutshell 2003*, published by the VROM Inspectorate. The emissions differ from the figures published in the *Environmental Balance 2004* in May 2004 of RIVM, since these are based on the most recent update (spring 2004) of the national Pollutant Emission Register (PER).

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	±3%	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 2002 is:

IPCC	IPCC Source category	Uncertainty (as % of total national emissions in 2002)
4D	Direct N_2O emissions from agricultural soils	1.5%
4D	Indirect N_2O emissions from nitrogen used in agriculture	1.4%
2X	N_2O Emissions from nitric acid production	1.3%
6A	CH_4 emissions from solid waste disposal sites	1.1%
7X	N_2O Emissions from polluted surface water	1.1%
1A	CO_2 Emissions from stationary combustion: energy industries	1.1%
1A	CO_2 Emissions from feedstock oil	1.0%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	0.6%
1A	CO_2 Emissions from mobile combustion: other	0.6%
1A	CO_2 Emissions from stationary combustion: other sectors	0.6%

The result is a trend uncertainty in the total CO_2-eq. emissions for 1990-2002 (1995 for F-gases) of ±3% points. This means that the increase in total CO_2-eq. emissions between 1990 and 2002, will be between +1 and +7%. Per individual gas, the trend uncertainty in total emissions of CO_2, CH_4, N_2O and the total group of F-gases has been calculated at ±3%, ±6%, ±11% and ±9% 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 Emissions from stationary combustion : energy industries	1.3%
6A	CH_4 emissions from solid waste disposal sites	1.0%
1A	CO_2 Emissions from mobile combustion: other	0.8%
1A	CO_2 Emissions from stationary combustion : other sectors	0.7%
1A	CO_2 Emissions from mobile combustion: water-borne navigation	0.6%
2X	HFC-23 emissions from HCFC-22 manufacture	0.6%
1A	CO_2 Emissions from feedstock oil	0.6%
4D	Indirect N_2O emissions from nitrogen used in agriculture	0.5%
1A	CO_2 Emissions from mobile combustion: road vehicles	0.4%
1A	CO_2 Emissions from stationary combustion : manufacturing industries	0.4%

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

At present, the Netherlands greenhouse gas emission inventory includes *all* sources identified by the *Revised 1996 IPCC Guidelines except* for the following:

- Indirect N_2O emissions from *atmospheric deposition* (category 4D) are not estimated/reported due to historic reasons;
- CO_2 emissions from *agricultural soils* (category 4D) are not estimated/reported due to historic reasons;
- In addition, it has been observed that *CH_4 and N_2O from horse manure* (category 4B) is missing; this is because no manure production estimates from horses have been made to date and no emission factors for this source category have been defined;
- CH_4 emissions from soils decreased in the last 40 years due to drainage and 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 decrease of total methane from soils acts in fact as methane sink;
- Emissions/sinks for *LUCF subcategories 5A to 5E*, except for the CO_2 sink in category 5A2. New datasets are being compiled but are still under discussion, so no data for these subcategories have been included in this submission.
- CH_4 and N_2O emissions from industrial wastewater treatment (6B) and from large-scale compost production from organic waste (6D) (DHV, 2000).

This year CH_4 and N_2O emissions from *international bunkers* were included in the inventory for the complete 1990- 2002 period.

The incorporation of these sources into the national greenhouse gas inventory is part of the inventory improvement programme. For some of these sources, for example indirect emissions of N_2O, bringing the methodology in compliance to *IPCC Good Practice Guidance* may result in adjustments of a few percent (i.e. several Tg [= Mton] of CO_2-eq.) The impact of these methodological changes on emissions is not included in the uncertainty estimates presented here.

Recalculations and improvements

The consequences of recalculations on the different greenhouse gas emissions compared to the previous NIR are presented in the *Table ES.4*. Since recalculations were mostly only performed for 1990 and 1995, emission figures have, in general, remained unchanged for the years 1991-1994 compared to the previous submission.

Table ES.4. Differences between NIR 2003 and NIR 2004 for 1990-2001 due to recalculations

Gas	Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CO_2 [Tg]	NIR2003	**157.8**	166.0	164.2	166.1	166.8	171.2	178.9	167.5	172.4	169.5	172.4	178.4
Incl. LUCF	NIR2004	**159.2**	166.2	165.0	166.6	167.5	172.0	180.2	165.0	171.0	166.0	169.3	175.6
	Difference	*0.8%*	*0.1%*	*0.4%*	*0.3%*	*0.4%*	*0.5%*	*0.7%*	*-1.5%*	*-0.8%*	*-2.0%*	*-1.8%*	*-1.6%*
CO_2 [Tg]	NIR2003	**159.3**	167.5	165.7	167.9	168.8	172.4	180.3	168.7	173.8	170.7	173.8	179.9
Excl. LUCF	NIR2004	**160.6**	167.7	166.4	168.5	169.5	173.2	181.6	166.2	172.4	167.3	170.7	177.1
	Difference	*0.8%*	*0.1%*	*0.4%*	*0.3%*	*0.4%*	*0.5%*	*0.7%*	*-1.4%*	*-0.8%*	*-2.0%*	*-1.8%*	*-1.6%*
CH_4 [Gg]	NIR2003	**1292.4**	1308.5	1253.1	1225.9	1202.9	1170.2	1173.7	1100.1	1064.6	1037.5	983.2	973.2
	NIR2004	**1302.3**	1325.9	1282.5	1261.0	1233.0	1190.2	1181.4	1105.1	1068.3	1020.1	968.4	948.8
	Difference	*0.8%*	*1.3%*	*2.3%*	*2.9%*	*2.5%*	*1.7%*	*0.7%*	*0.4%*	*0.3%*	*-1.7%*	*-1.5%*	*-2.5%*
N_2O [Gg]	NIR2003	**53.4**	54.2	57.9	60.2	59.1	58.6	57.9	57.4	56.9	56.0	53.7	51.8
	NIR2004	**52.9**	53.7	56.9	59.3	58.0	58.4	57.4	57.2	56.6	55.7	53.4	51.0
	Difference	*-0.9%*	*-0.9%*	*-1.7%*	*-1.6%*	*-1.8%*	*-0.4%*	*-0.8%*	*-0.2%*	*-0.5%*	*-0.5%*	*-0.6%*	*-1.6%*
PFCs [Mg]	NIR2003	353	354	304	307	273	**269**	295	312	246	203	214	205
	NIR2004	351	352	302	304	270	**265**	292	313	247	207	220	208
	Difference	*-0.5%*	*-0.6%*	*-0.8%*	*-0.9%*	*-1.2%*	*-1.4%*	*-1.1%*	*0.4%*	*0.5%*	*1.5%*	*2.8%*	*1.5%*
HFCs [Mg]	NIR2003	379	295	406	474	680	**700**	1113	1496	1585	1196	1053	704
	NIR2004	379	295	406	474	680	**700**	1.113	1.496	1.585	1.215	1.056	649
	Difference	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*1.6%*	*0.3%*	*-7.8%*
SF_6 [Mg]	NIR2003	8	4	4	5	6	**12**	12	13	12	11	11	12
	NIR2004	9	6	6	6	8	**13**	13	14	14	13	14	15
	Difference	*16%*	*33%*	*35%*	*36%*	*29%*	*9%*	*10%*	*11%*	*12%*	*20%*	*25%*	*20%*
Total	NIR2003	210.0	217.8	216.7	219.6	220.9	223.3	232.9	220.3	225.2	216.4	216.8	219.7
[Tg CO_2-eq.]	NIR2004	211.4	218.2	217.7	220.5	221.9	224.5	234.2	218.0	223.8	212.7	213.4	216.1
Incl. LUCF	*Difference*	*0.7%*	*0.2%*	*0.5%*	*0.4%*	*0.5%*	*0.5%*	*0.6%*	*-1.1%*	*-0.6%*	*-1.7%*	*-1.6%*	*-1.6%*
Total	NIR2003	208.6	216.3	215.2	217.8	218.9	222.1	231.5	219.1	223.8	215.2	215.4	218.3
[Tg CO_2-eq.]	NIR2004	210.0	216.7	216.2	218.7	219.9	223.3	232.8	216.8	222.4	211.4	212.0	214.7
	Difference	*0.7%*	*0.2%*	*0.5%*	*0.4%*	*0.5%*	*0.5%*	*0.6%*	*-1.1%*	*-0.6%*	*-1.8%*	*-1.6%*	*-1.6%*

Note: base year values are indicated in bold.

For recalculation a distinction is made between:

- *Methodological changes:* new data based on revised or new estimation methods; improved emission factors are also included under methodological changes;
- *Allocation:* changes in allocation of emissions to the different sectors (only affect the totals per sector);

- *Error corrections:* repair of incorrect data transfer from the PER to the CRF.

This year methodological changes were made for the years 1990, 1995, 2000, 2001 and (new) 2002. This means that for 1991-1994 and 1996-1999 no recalculations were made, except in the cases explicitly mentioned below. The following ***methodological changes*** were made:

- Recalculation of the emissions from traffic and transport (all gases, all years) based on updated emission factors and recalculated gas oil data for other mobile sources (category 1A3);
- Revision of HFC emissions for the years 2000-2002 based on improved analysis of data (category 2);
- Revision of PFC and SF_6 emissions for the years 1990-2001 based on improved data from the industry (category 2).
- Recalculation of the CH_4 emissions from landfills based on improved calculation parameters, activity data and recovery rates (category 6A);
- CH_4, N_2O emissions from *international bunkers (international transport)* are now included in the inventory for the years 1990, 1995 to 2002 (category Memo Items).

In this submission the ***source allocation*** was improved in the following case:

- *Waste*: The emissions from combustion of biogas at wastewater treatment facilities were previously allocated in category 6D. Because this combustion is partly used for heat or power generation at the plant we now allocated the emissions under category 1A4.

The most obvious ***error corrections*** were:

- Recalculation of the natural gas use and thus emissions in category 1A4 (1990, 1995-2001) based on revised fuel use statistics for the residential sector.
- Recalculation of the natural gas use and thus emissions in chemical industry category 1A2c (1990, 1997-2001) based on in-depth analysis of fuel data of about 1 Tg CO_2 and identification of a double-counting error for 1997-2001 of about 2.5 Tg CO_2;
- Recalculation of the gas oil use and thus emissions in refinery category 1A1b (1995-2001), based on in-depth analysis of fuel data;
- Removal of part of the CO_2 emissions (in other waste, 6D) in the years 1998 to 2001 which could not be accounted for in the energy statistics;
- Error correction in calculation of CO_2 and N_2O emissions from the residential sector (fire places, using non fossil fuels e.g. wood and N_2O from aerosols) for the total period 1990-2002;
- Error correction of NO_2 emissions from agricultural soils (4D) for the years 1990 to 1995 based on revised data for manure applied to soil.

Recalculation of base year

The total CO_2-eq. emissions in the base year 1990 increased by 1.4 Tg CO_2-eq or 0.7% compared to last submission. This increase can be explained by the following changes (all in CO_2 equivalent):

- For CO_2: + 0.7 Tg in the category *Other sectors* (1A4) due to recalculations of natural gas use based on new statistics; and + 0.3 Tg in the category *Manufacturing industry* (1A2) due to error correction on the basis of detailed analysis of inventory data an energy statistics; and +0.3 Tg in *Transport* (3) due to recalculation (see *Sections 3.2.2.4, 3.2.2.5* and *3.2.2.5* for more information);
- For the other gases the changes are very small; the largest: 0.01 Tg for CH_4 in Waste (6) due to recalculation of emissions from landfills.

The changes for F-gases in 1995 (the base year for the F-gas emissions) due to recalculations amount to +0.06 Tg CO_2-eq.: +0.02 Tg for PFCs and +0.03 Tg for SF_6 emissions.

Recalculation of year 2001

The data for 2001 are now based on the final 2001 energy and production statistics, which implicitly leads to changes in almost all emission data, related to these statistics. The decrease in the total CO_2-eq. emissions for 2001 was -3.5 Tg CO_2-eq or -1.6% compared to last submission. For the finalisation of the 2001 figures a different method is used than the last year, when the emissions of 2001 had to be estimated partly by extrapolation of incomplete data, which obviously leads to changes in emission data. The main changes are (all in CO_2 equivalent):

- For CO_2: -3.7 Tg in *Manufacturing industry* (1A2) due to removal of double counting of the emissions from a major chemical plant. During detailed analysis of fuel data this major error was detected (see *Section 3.2.2.4* for more information);
- For CO_2: +1.3 Tg in the category *Other sectors* (1A4) due to recalculations of natural gas use based on new statistics (see *Section 3.2.2.4* for more information);
- For CO_2: In the sectors *Energy* (1A1) and *Transport* (1A3) and *Waste* (6D) the emissions decreased (-0.1, -0.1 and -0.4 Tg). In the industrial processes the emissions increased + 0.2 Tg. These changes were based on final statistical data. In the waste sector an error correction lead to a decrease of 0.4 Tg.
- For CH_4: -0.5 Tg mainly due the final statistics for the emissions from *Landfills* (6A);
- For N_2O: -0.001 Tg mainly due the an decrease in the energy sector and *Agricultural soils* (4D);
- For HFCs, PFCs and SF_6: -0.07, +0.03 Tg and -0.06 Tg, respectively due to recalculations based on new data from the industry.

Implications for emission trends, including time-series consistency

The trend in emissions for the years 1990 to 2002 is shown in *Table ES.5*. From this table it can be concluded that due to recalculations the trend in the total national emissions decreased by 1.5% compared to the NIR 2003. The largest relative changes in emission trends are for CH_4 and SF_6.

Table ES.5. Differences between NIR 2003 and NIR 2004 for the emission trends 1990-2001

Gas	**Trend (absolute)**			**Trend (percentage)**		
[Gg CO_2-eq.]	**NIR 2003**	**NIR 2004**	*Difference*	**NIR 2003**	**NIR 2004**	*Difference*
CO_2 [1)]	19.163	16.485	*-2.678*	11.9%	10.3%	*-1.7%*
CH_4	-6.705	-7.423	*-718*	-24.7%	-27.1%	*-2.4%*
N_2O	-729	-578	*151*	-4.4%	-3.5%	*0.9%*
HFCs	-2.848	-2.925	*-77*	-64.3%	-66.0%	*-1.7%*
PFCs	-975	-934	*41*	-40.1%	-38.7%	*1.4%*
SF_6	109	139	*30*	58.4%	63.9%	*5.5%*
Total [1)]	8.016	4.764	*-3.251*	3.8%	2.3%	*-1.5%*

[1)] Excluding LUCF.

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 ES.6*. The CO and NMVOC emissions were reduced in 2002 by 40 and 50%, respectively, compared to 1990. For SO_2 this is even 60%, and for NO_x, the 2002 emissions are about 30% lower than the 1990 level. 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.6 Trend in emissions of ozone and aerosol precursors 1990-2002 (in Gg)

Compound	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Total NO_x	599.5	586.5	578.8	554.5	529.9	517.8	501.7	470.7	460.8	464.3	447.2	436.2	429.9
Total CO	1130.4	1039.0	985.1	963.9	924.6	851.4	834.6	758.8	746.9	728.2	701.8	675.7	656.5
Total NMVOC	490.5	461.8	437.5	403.6	389.3	361.9	308.2	281.4	298.0	287.0	267.1	251.2	244.3
Total SO_2	203.5	173.4	167.4	160.3	146.2	142.5	135.5	117.7	109.8	104.8	90.8	90.1	85.4

Response to the issues raised in UNFCCC reviews

The Netherlands greenhouse gas inventories were subject to the following reviews by the UNFCCC Secretariat: a Desk Review of the NIR 2000 and Centralised Reviews of the NIR's of 2001 to 2003 and country sections in the Synthesis & Assessment reports on the NIR's of 2001 to 2003. In general the findings of the different UNFCCC reviews are well observed and described. The Netherlands response to the general remarks is as recorded below. The Netherlands responded and made improvements in this NIR on the following aspects: inconsistency in time series, missing notation keys, incompleteness of CRF, additional information on methodology and data sources in the NIR. Partly in response to the reviews and partly as a result of the national improvement programme changes were made in the CRF tables (see *Section 10.4.6* for details):

- CRF tables were improved further by replacing 0 by notation keys NE, NA, NO, IE, C, where applicable;
- Correction of typing/unit errors as observed;
- In the 2003 submission the fuel split was made uniform for the years 1990, 1995 to 2002;
- A physical link between the CRF files and the tables of the NIR was established to make sure that the data in both are equal.

Planned improvements

The *UNFCCC Guidelines for reporting* the emissions and the *Guidelines for National Systems* for annual emission monitoring under the Kyoto Protocol have added additional requirements to the present *Pollutant Emission Register* (PER) of the Netherlands. In 2000 a programme was started to adapt the monitoring procedures of greenhouse gases in the Netherlands to meet these requirements. Similar requirements were imposed by the European Union, which is also a Party to the Convention and the Protocol, which require the EU Member States' National Systems to be operational as early as possible and in any case by 31 December 2005 at the latest.

The national system improvement programme is being implemented under the responsibility of the Netherlands Ministry of Spatial Planning, Housing and the Environment (VROM), who delegated the practical co-ordination to Novem. To comply with the EU requirements, the intention for the Netherlands National System is to be operational by early 2005.

Ultimately, all improvements and arrangements will become an integral part of the larger system of annual emission monitoring (PER). In recent years a series of source-specific activities to improve the greenhouse gas inventory have been concluded. Some examples are a re-evaluation of CO_2 emission factors for fuels, a Tier 2-feedstock analysis, identification of non-CO_2 sources that are not yet included in the inventory, and a sinks assessment. Other more general activities aim at improving the national system, such as the development of protocols and process descriptions (methodologies, procedures, tasks and responsibilities, described in a transparent way), elaboration and implementation of a QA/QC system as part of the National System (through a three phased project by developing – or rather adapting – the QA/QC system for the Netherlands' greenhouse gas monitoring (part of the PER) and the NIR/CRF compilation process).

To meet the early 2005 goals, final recalculations of the Netherlands' greenhouse gas inventory are planned for the second half of 2004, which will include all remaining key issues identified by the Netherlands' improvement programme and by the UNFCCC reviews carried out to date. These improvements of the quality (transparency, consistency over time, completeness and accuracy) of emissions will comprise most sectors and most gases, such as:

- CO_2 emissions from *fuel combustion* (1A) for stationary sources, if approved and agreed upon (based on the results of a feasibility study which is underway), based on the sectoral energy statistics for the period 1990-2003 instead of using reported emissions from individual industrial companies and including corrections of bunker and domestic transport statistics for shipping and aviation and, if approved, newly established country-specific emission factors for road transport;
- CO_2 emissions from *non-energy use of fuels* distinguishing direct (prompt) process emissions during manufacture of products and emissions from the *domestic* use of non-energy-use products,

the latter based on statistics of the usage of the products, and allocated to IPCC sectors 2 and 3, respectively, instead of including these in fossil fuel combustion (sector 1A);

- Fossil-fuel related CO_2 emissions from *waste incineration* (6C/1A) (improved split into organic and non-organic carbon);
- CH_4 emissions from *natural gas distribution* (1B), based on data on the length of the natural gas network and the leak rate per type of material, and from *venting* of associated gas (1B);
- CH_4 emissions from *enteric fermentation by cattle* (4A), based on updated country-specific emission factors, if available;
- N_2O emissions (indirect) from soils (4D) due to *atmospheric deposition* will be added (not yet included), based on specific Netherlands activity data in conformity with the recommended *IPCC Good Practice* method;
- CH_4 emissions from *landfills* (6A) and (non-industrial) *wastewater treatment plants (6B)*, using e.g. updated information on methane venting/recovery;
- CH_4 and N_2O emissions CH_4 and N_2O emissions from <u>*industrial*</u> *wastewater treatment* (6B) and from *large-scale compost production* from organic waste (6D) will be added if possible (not yet included).

1. INTRODUCTION

Major changes from the previous National Inventory Report

Changes in historical data
Apart from the regular update of last year's emissions dataset (extending with one year (*t-1*) and updating partially estimated data for the year *t-2*), the following major changes in the data have been made: decreased CO_2 emissions by 3 to 4 Tg from 1997 onwards, in particular due to revision in the manufacturing industry. Smaller changes are found in increased CH_4 emissions in the early '90s and increased emissions from 1999 onwards, mainly due to revision of landfill emissions, decreased N_2O emissions due to revision in other transport, decreased HFC and PFC emissions and increased SF_6 emissions. Resulting 1990 emissions increased by 0.7% and 2001 emissions decreased by 1.6%, adjusting the 1990-2001 increase from 3.8% to 2.3%. In addition, the user will find the check tables compiled from CRF data and other information spreadsheets and the (trend) tables presented in this National Inventory Report (NIR) as electronic annex to this report.

Key sources
The key source identification with the new emissions data resulted in the following changes: 1A3-CO_2 Aircraft: now *non-key*; 2-CO_2 Other Industrial: now *key*; 3-CO_2 Miscellaneous: now *key*; and 6B-CH_4 Wastewater: now *non-key*.

Sections of the report
The summary of methodological changes in *Section 1.4*, of results of the trend verification in *Box 1.2* and *Chapter 10* on recalculations and improvements. Most other sections have been updated only slightly in view of the revised data. Recalculation sections were added for CO_2 from manufacturing industry (1A2), other transport (1A3e) and other sectors (1A4); N_2O from road transport (1A3b); HFC and PFCs from F-gas consumption (2F); CH_4 from landfills (6A) and CO_2 from other waste (6D).

1.1 Background information on greenhouse gas inventories and climate change

This report documents the 2004 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 (IPCC, 1997, 2000), 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 (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 1990-2002 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.

Please note that the emissions presented in this dataset for 2002, i.e. for the most recent year, have been compiled using sometimes estimated activity data and may therefore have been be calculated somewhat differently than the emissions of other years (see *Annexes 2.1* and *3*). In particular, estimates for fuel combustion are, just as done previously, based on energy statistics for the first three quarters of 2002 only, since data for the fourth quarter were not available on time.

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, 2003, in Dutch), the *Third Netherlands' National Communication on Climate Change Policies* (VROM, 2001) and a special assessment by Jeeninga *et al.* (2002), available in Dutch only.

Twelve so-called *Common Reporting Format* (CRF) spreadsheet files, containing data on emissions, activity data and implied emission factors, accompany this report as electronic annexes. These files, with file names '*Netherlands - submission 2004 v 2.0 - NNNN.xls*' with NNNN = 1990 .. 2002, have been compressed into three zip files: crf-nld-2004-v2-90-93.zip; crf-nld-2003-v2-94-97.zip; crf-nld-2003-v2-98-02.zip. The complete set of CRF files as well as the NIR in pdf format can be found at 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 in one zipped file trend-tables-nir-nld-review-v2.zip.

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).

Actually, HFCs and PFCs comprise two groups of gases, but the greenhouse gases above are often in short called the 'six greenhouse gases'. Although each of these greenhouse gases individually has a heating effect on the atmosphere, one kg consisting of different gases will make a different contribution to this phenomenon. 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 meant to control greenhouse gas emissions. This is the *Global Warming Potential* or *GWP*, expressing the emissions of a gas in CO_2-equivalent emissions. The exact definition of this concept is subject to discussion; it can, for instance, be expressed as the total warming effect during 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). In *Annex 8*, the relevant GWP values used in this report have been summarised.
In addition to these so-called *direct* greenhouse gases there are other gases that also 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 species act *indirectly* as greenhouse gas or as cooling agents in the atmosphere, such as CO, NO_x and NMVOC. These are precursors of tropospheric ozone, a greenhouse gas, and of SO_2, which leads to aerosol formation with 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 it was decided to limit the detailed reporting for the *Climate Convention* and the *Kyoto Protocol* to the six direct greenhouse gases mentioned above and only request summary information on the national emissions of CO, NO_x, NMVOC and SO_2.

1.1.2 Climate Convention and Kyoto Protocol

In 1992 the ***United Nations Framework Convention on Climate Change*** (UNFCCC) was adopted at the United Nations Headquarters in New York and was open for signature at the Earth Summit in Rio de Janeiro from June 1992. The Convention entered into force in March 1994. The Convention sets an *ultimate objective* of stabilising atmospheric concentrations of greenhouse gases at levels that would prevent 'dangerous' human interference with the climate system. Such levels, which the Convention does not quantify, should be achieved within a time frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner. 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 Annex 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 have historically 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 March 1999 the Protocol had received 84 signatures. Those Parties that have not yet signed the Kyoto Protocol may accede to it at any time. The Protocol is subject to ratification, acceptance, approval or accession by Parties to the Convention. It shall enter into force on the 90th day after the date on which not less than 55 Parties to the Convention, incorporating Annex I Parties, which accounted in total for at least 55 % of the total carbon dioxide emissions for 1990 from that group, have deposited their instruments of ratification, acceptance, approval or accession.
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. Only Parties to the Convention that have also become Parties to the Protocol, however (that is, by ratifying, accepting, approving, or acceding to it), will be bound by the Protocol's commitments, once it comes 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 as the equivalent in carbon dioxide) 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%; 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 the land use, land-use change and forestry (LULUCF) sector (including CO_2 in the agricultural sector);
- options to include emission reductions abroad in the assigned amounts through the so-called Kyoto Mechanisms of emissions trading (referred to as ET, JI and CDM);
- requirements for institutional and procedural arrangements for inventory compilation (so-called *National System Guidelines*).

Please note that the definition of what should be reported under the source/sink category '*Land-use change and forestry'* (LUCF) to the ***United Nations Framework Convention on Climate Change*** – as in this report – is considerably different from the definition of emissions/sinks to be included in the national total under the *Kyoto Protocol*.
According to the Kyoto *Protocol Parties* may offset their emissions by increasing the amount of greenhouse gases removed from the atmosphere by so-called carbon 'sinks' in the LULUCF sector. However, only certain activities in this sector are eligible: *afforestation*, *reforestation* and *deforestation* (defined as eligible by the Kyoto Protocol) and *forest management*, *cropland management*, *grazing land management* and *revegetation* (added to the list of eligible activities by the Marrakesh Accords). Greenhouse gases removed from the atmosphere through eligible sink activities generate credits known as ***removal units.*** Any greenhouse gas *emissions* from eligible activities, in turn, must be offset by greater emission cuts or removals elsewhere.

1.1.3 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 EITs) and data up to the last but one year prior to submission. Inventories due 15 April 2004, for example, should contain emission data up to the year 2002. National communications are subject to an individual *in-depth review* by teams of experts, including in-country visits. Since 2000, annual inventories have also been subject to a *technical review*.
In addition, Annex I Parties must regularly submit reports, known as *National Communications,* detailing their climate change policies and measures. Most Annex I Parties have now submitted three national communications. The third national communications were due on 30 November 2001.

UNFCCC

The *UNFCCC Guidelines* prescribe the source categories, calculation methodologies, and the contents and the format for 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 *Annex 8*). The UNFCCC reporting requirements for Annex I countries are formed by the submission of 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 emissions, activity data, so-called implied or aggregated emission factors and additional information. Countries may choose to print their *National Inventory Report* (NIR) or publish it in its entirety, electronically only, 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 simplest and requires the 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 or capacity permitting and more detailed/advanced uncertainty assessments or more advanced key source assessments. The rationale behind this generic approach of methods, uncertainty assessments and key source assessment is to give recommendations to countries which have more detailed datasets and more capacity to calculation emissions, as well as to countries with less data and manpower available. However, it also serves as a means for balancing efforts in industrialised countries, by not going into details where irrelevant, thereby saving capacity for other more important but relatively weak parts of the inventory.
To aid priority setting, the *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. This report also provides guidance in inventory compilation, reporting, documenting, quality assurance and quality control (QA/QC) comparable with the formal ISO 9001-2000 quality assurance system.
The Netherlands generally applies country-specific, higher Tier methods for calculation 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 has to submit similar datasets and reports for the collective 15 EU Member States as national Parties have, the EU imposes some additional guidelines to EU Member States through the *EU Greenhouse Gas Monitoring Mechanism* to guarantee that the EU meets its reporting commitments:

- submission of the same national dataset (CRF files and NIR) that will be submitted to the Climate Secretariat to the EU, but some weeks ahead of the UNFCCC deadline of 15 April to provide preparation time for the EU inventory and the EU NIR;
- reporting of international transport emissions with a distinction of intra- and extra-EU transport;

- requirements for a National System at Member State level to be in place by, preferably, 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. Also, the EU has decided on a emission trade system within EU countries.
Within the EU burden-sharing agreement, the Netherlands has a 6% decrease target. Although CO_2 emissions for domestic policy purposes are often corrected for temperature to filter out the effect of accidental mild or cold winters, the calculation of the *assigned amount* of the Kyoto Protocol only considers the actual emissions in the base year and the commitment period. The Kyoto Protocol also requires Annex I countries to have a so-called National System in place for the annual compilation and reporting of the emissions. *National System Guidelines* have been defined in which institutional and procedural arrangements are described. In addition, the EU has developed its own guidelines for the Member States to ensure that the National System at EU level complies with the requirements of the Kyoto Protocol.

1.1.5 Differences with the domestic national emission inventory

The *Climate Convention* uses a specific definition of the emissions that should be included in the national total. In general, this differs from domestic national inventories by the way transport emissions are handled and by limiting CO_2 emissions to non-organic anthropogenic sources, i.e. excluding CO_2 from biomass combustion from the national total.
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' emissions of so-called 'Target Sectors' are mostly analysed by their total emissions. Another specific issue is the distinction that the IPCC makes between CO_2 from non-energy use/feedstock use of fuels and CO_2 emissions from other non-combustion processes. This requirement poses limitations to the extent that the Netherlands in its reporting can decompose these different sources in cases where individual companies report their emissions at a too aggregated level. The country-specific allocation of emissions from non-energy use of fuels (such as chemical feedstocks), co-generation, coke ovens, transport and military activities are explained in detail in *Sections 3.1* and *3.2*.
Another difference is found in the definition of national versus international transport. Whereas the national method uses vehicle statistics to estimate road transport emissions, the UNFCCC requires the use of fuel delivery data as the basis for calculating the emissions from this source category. As illustrated in *Chapter 3*, this results for the Netherlands in annual differences between 5 and 10%.

Differences with other national publications

The emission data presented in this report are identical to those officially published for 1990, 1995 and 2000-2002 in the *Emission Monitor 2003* published by the VROM Inspectorate (VROM, 2004).

1.1.6 Correspondence between Netherlands' Target Sectors and IPCC source categories

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 7 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
7. Miscellaneous

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 1.1* presents the correspondence between the Netherlands' 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 than the source category definition in the *Revised IPCC Guidelines* (IPCC, 1997). The source allocation for 1991-1994 may also be different than for other years due to subsequent revisions of national source codes and of the correspondence table with IPCC sectors, which have not yet been implemented for these years. This may show up as discontinuities at subcategory levels for years 1990/1991 and 1995/1996, in particular in source categories 1A1 and 1A2 (combustion), 2 (industrial non-combustion processes) and 6D (other waste).

Table 1.1. Correspondence between the Netherlands' Target Sector emissions to IPCC source categories

Target Sector	**Code**	**IPCC: Combustion emissions**	**Code**	**IPCC: Process emissions**
Agriculture	1A4c	Fuel combustion; Other sectors; c.	4	Agriculture [1)]
Industry	1A2	Fuel combustion; Manufacturing industries and construction [2)]	2	Industrial processes [2)]
Refineries [6)]	1A1b	Fuel combustion; Energy industries; sub b (Petroleum refining)	1B2	Fugitive emissions from oil and natural gas
Energy sector				
- power generation	1A1a	Fuel combustion; Energy industries; a (electricity and heat production)	1B	Fugitive emissions [3)]
- fossil fuel production/ transmission		-	1B2	Fugitive emissions from oil and natural gas
Waste handling				
- landfills		-	6A	Waste; Solid waste disposal
- waste incineration ('AVI')	1A1a	Fuel combustion; Energy industries; a (electricity and heat production) [4)]		
- WWTP ('RWZI')	1A4a	Other sectors; Other	6B	Waste; Wastewater handling
- Other	6D	Waste; Other	6D	Waste; Other
Transport and Traffic	1A3	Fuel combustion; Transport		-
Consumers	1A4b	Fuel combustion; Other sectors; b (residential)	3	Solvents and other product use [5)]
Trade, Services, Government ('HDO')	1A4a	Fuel combustion; Other sectors; a (commercial/institutional)	3	Solvents and other product use [5)]
Construction	1A2	Fuel combustion; Manufacturing industries and construction	2	Industrial processes
Drinking-water treatment	1A4a	Fuel combustion; Other sectors; a (commercial/institutional)	7	Miscellaneous (CH_4)

[1)] N_2O from polluted surface water: *7 Miscellaneous*
[2)] CO_2 from non-energy use of fuels e.g. chemical feedstock reported under *1A2 Fuel combustion*
[3)] CO_2 from flue gas desulphurisation: *2 Industrial processes*; sub G
[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
[5)] CH_4 and NMVOC: *7 Miscellaneous* (since IPCC tables of source category 3 allow reporting these gases).
HFCs, PFCs and SF_6: *2 Industrial Processes*.
[6)] 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

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

- Completeness Table 9 for 1990 (in *Annex 5*);
- IPCC Summary Tables 7A for 1990-2000 (CRF Summaries 1);
- Recalculation Tables and Explanation Table 8.a and 8.b for 1990 and 1995-2001;
- Trend Tables 10 for each gas individually and for all gases and source in CO_2-eq.;

- Trend Tables 10 for precursor gases and SO_2.

Section 10.4 provides details on the extent that the CRF data files for 1990-2002 have been completed. For this NIR report, a special effort was made to:

- improve the implied emission factors in 1A1 and 1A2 subcategories by a more systematic moving of inconsistent fuel consumption/emissions data from ER-I sources from specific fuel types to 'unspecified fuels';
- re-evaluate the CO_2 emissions from the ER-I datasets to improve the dataset, resulting in new data (i.e. zero emissions) for 1998-2002 for 'Other waste' (6D);
- reallocation of fugitive emissions of CH_4 for 1991-1994 over the subcategories of 1B2 instead of lumping the total under 'Other, non-specified' in 1B2;
- to add CH_4 and N_2O emissions from international bunkers;
- to improve on the use of notation keys, where applicable.

In general, completeness of the CRF tables is hampered by the present level of detail of ER-I data storage, in particular for IPCC categories 1A1, 1A2 and 2 (see *Table 10.5*). These are the sectors that are largely reported by individual firms of which the level of detail, completeness and quality vary 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 currently consumption figures are available and used for estimating actual emissions (so-called Confidential Business Information). Some of these entries are therefore labelled 'C', but note 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 have been reported from all known sources.

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 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 at the Netherlands' part of the continental shelf are included. Emissions from all electricity generation in the Netherlands are accounted for, including the fraction of the domestically produced electricity that is exported. Until 1999, the Netherlands imported about 10% of its electricity; in 1999, however, the net import increased by 55% due to the liberalisation of the European electricity markets.

1.1.9 Presentation of figures: rounding off and summation

Please note that the same number of decimal digits is used within all tables (or per compound column). Therefore, the number of (decimal) digits shown does not correspond with the number of significant digits of the numbers presented. Please note too that the numbers in the tables may not exactly add up to the (sub)totals because of independent rounding off. We refer to *Section 1.7* for information about the uncertainty in sectoral and national total emissions.

1.1.10 Organisation of the report

This year we have changed the structure of the report into the format that will become compulsory as of next year (UNFCCC, 2002). This was done to identify in advance the elements of the report that need extra attention in the next submission. However, due to time constraints in the preparation of the report, the reader will notice marked differences in the level of detail in the descriptive sections of *Chapters 3 to 9*.

Following the new format, in this chapter we further present the institutional arrangements for the inventory compilation process, a brief description of methodologies, data sources used, identified key sources, the QA/QC plan and a general evaluation of the uncertainty and the completeness of the inventory. *Chapter 2* discusses the trends in total emissions at an aggregated level in CO_2-equivalents, by gas and by source. Subsequently, *Chapters 3 to 9* discuss the emission sources/sinks per main IPCC sector, with a description of sources/sinks, methodological issues and uncertainty, and time-series con-

sistency (explanation of emission trends). Anticipating the new reporting requirements, we have, in principle, now included all additional information tables from the present CRF files in the report itself in these chapters. The main report concludes with *Chapter 10* on recalculations performed since the last NIR submission and planned improvements.
Finally, the annexes to the report include the following compulsory topics: information on key sources, detailed description of methodologies, and comparison between the so-called *IPCC Reference Approach* for CO_2 (estimating emissions from fuel use by using apparent consumption by fuel type as activity data and correction for carbon storage in feedstock products). Furthermore, we here include the (national) *Sectoral Approach*, completeness and any other information to be considered as part of the NIR. For ease of referencing we have also inserted annexes with copies of key CRF tables: IPCC summary tables '7A' for specific years, recalculation tables and trend tables. Other annexes 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 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. To meet the UNFCCC and IPCC requirements additional actions are (still) necessary. Around the year 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*. In the following section we will present information for both (interrelated) processes in separate sections. One will deal with the PER and one with the NIR and the CRF files.

1.2.1 The Pollutant Emission Register (PER)

The Netherlands has had a *Pollutant Emission Register* (PER) for many years, in Dutch also referred to as *Emission Registration* (ER), where data on emissions to air, water and soil are collected. This inventory has been established in co-operation:

- Inspectorate of Housing, Spatial Planning and the Environment of the Netherlands Ministry of Spatial Planning, Housing and the Environment (VROM Inspectorate, VI)[1]
- Statistics Netherlands (CBS)
- National Institute of Public Health and Environment (RIVM)
- Ministry of Agriculture, Nature Conservation and Food Quality (LNV) through representation by the National Reference Centre for Agriculture (EC-LNV, formerly IKC-L)
- Ministry of Transport, Public Works and Water Management (V&W) through representation by the National Institute of Water Management and Waste Treatment (RWS/RIZA), and
- Netherlands Organisation for Applied Scientific Research (TNO)

The PER (see *Figure 1.1*) comprises the registration, analysis, localisation and presentation of emission data of both industrial and non-industrial sources in the Netherlands. Emission data is gathered from the source categories industry, public utilities, traffic, households, agriculture and natural sources. So-called *Task Forces* collect the data required and perform the emission calculations Agreement on definitions, methods and emission factors, is discussed and reported by experts in these Task Forces. The *Co-ordination Committee for Monitoring of Target Sectors* (CCDM) approves these reports.
The emissions of the large industrial point sources are registered individually, based on detailed information of each individual plant. The emissions of the *Small and Medium-sized Enterprises* (SME) as well as non-industrial diffuse sources, are calculated collectively with statistical activity data and emission factors. The data collection process for emissions of large industrial point sources has been changed substantially since 1995 (see *Box.1.1* and *Figure 1.2*).

[1] From January 2002, the Ministry introduced a single integral inspectorate for Housing, Spatial Planning and the Environment in which the former 'Inspectorate HIMH' has been integrated.

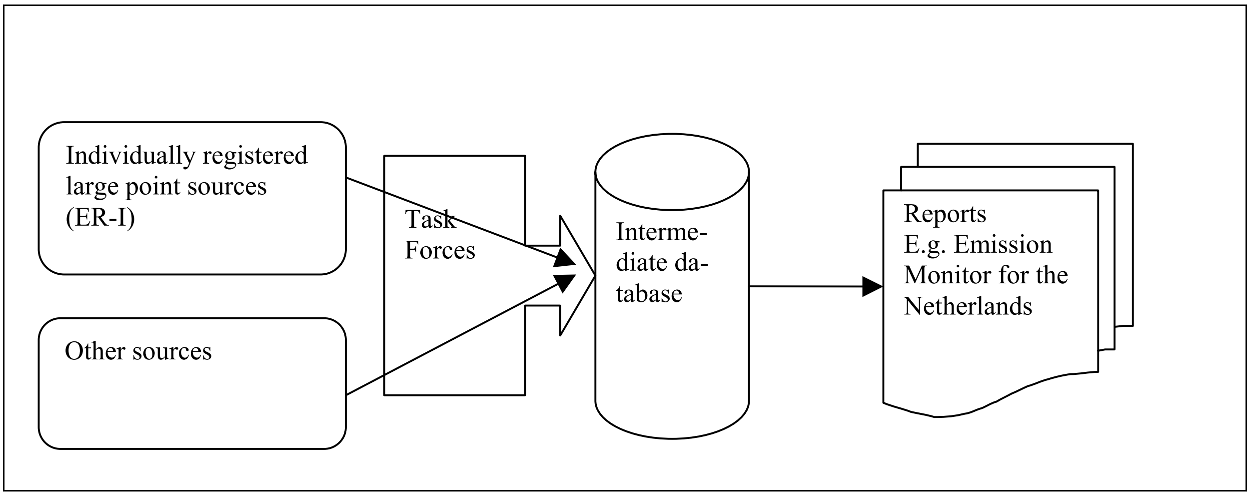


Figure 1.1. Main elements in the Pollutant Emission Register (PER)

This resulted in a reduced number of individual sources in the PER database: about 700 in 1990 and 550 in 1995. For the year 1999 (the first year the companies were obliged to report in the MJV) the ER-I database contains the smallest number of companies: 192. Since then this numbers has increased to 316 in 2000, 381 in 2001 and 424 in 2002 (the latter to be used for the NIR 2005). As explained in *Box 1.1*, in the transition period of companies to another reporting system and another reporting format, the quality of the emission data relevant for the NIR/CRF has also temporarily deteriorated. In section 1.6 we summarise actions that started to improve data quality again.

	before 1995	1995	1999	2000	2001	2002*
MJV reporting companies	0	0	57	140	204	200
Additonal BEES A	200	200	80	70	60	60
Additional ER-I selection	500	350	55	65	75	122
Regional PER	0	0	0	41	42	42
Total included in the ER-I database	700	550	192	316	381	424

A part of the companies with BEES reporting requirements are included in the MJV reporting firms

Number of companies left after quality check in FOI database and included individually in the PER

*: 2002 refers to the year in which the emissions occurred. The data will be used in the 2005 NIR.

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) .

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 been changed since 1995 (see *Figure 1.2*). Before 1995, the ‘ER-I’ data collection for air emissions of about 700 large companies was initiated by the Ministry of VROM, with TNO assisting (on request), the companies in estimating their annual emissions. The activity data and emissions of these large industrial point sources were collected, checked and processed by TNO. These 700 point sources included 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 for more and more companies. For the 1998 PER, 265 companies reported their emissions in the format of the annual environmental reports. These were processed by TNO and included in the ER-I database.

Annual environmental reports were collected for the 1999 emissions and those for subsequent years. After approval by the provinces, these were processed and included in a database by the *Facilitating Organisation for Industry* (FOI). For the 1999 PER onwards, a group of about 250 companies were obliged to report their emissions in the format of the *annual environmental reports* (MJVs). Another 45 companies reported their emissions in a voluntary MJV. Subsequently, this administrative FOI database was checked for consistency and transformed by TNO to be included in the PER. Due to poor quality, only 57 of the companies were processed by TNO and included in the ER-I database for the year 1999. The emissions of the remaining companies were not registered individually but were used as part of the supplementary estimate, resulting in a smaller detailed dataset for individually registered companies. The PER dataset was extended as previously with reported information on fuel consumption and emissions from all companies required to do so under the *‘BEES A’ regulation* (large combustion plants). In addition, TNO collected data from 55 industries according to the ‘old’ method. In line with the year 1998, the voluntarily submitted MJVs were also included in the ER-I. In total, the individual data set holds emissions for 192 companies.

The PER 2000 dataset includes the individual registered emissions based on the MJVs reported by 140 companies (out of the 220 that are obliged to report). Emission data from a regional PER (from the province Noord-Brabant) are also included. Together with the data collected for the 70 BEES A companies and additional 65 industries for which TNO collected data using the reports (in MJV format) that companies provided to FOI related to their environmental convenants, the individual data set holds emissions for 316 companies.

The PER 2001 includes an increased number of the individually registered emissions based on the MJVs: 204. Additional emission data from the regional PER (42), BEES A (60) and additional companies (60) are also included again in the database. So the individual data set holds emissions for 381 companies. This data set was used to recalculate the CRF data for 2001 in this submission and was also used to compile the CRF data for the year 2002.

The PER 2002 includes a further increased number of individually registered emissions (424 companies). These data will be used in the next NIR (2005).

1.2.2 The National Inventory Report and CRF files

The Minister of Housing, Spatial Planning and the Environmental is responsible for the annual reporting to the UNFCCC Secretariat as well as to the European Commission. The *Climate Change and Industry Division* of the Ministry of VROM (VROM/DGM/KVI) is responsible for organising the reporting process. *Figure 1.3* presents this process, the relation with the PER and the responsibilities. The *Co-ordination Committee for Target Sector Monitoring* (CCDM) under auspices of the VROM Inspectorate is responsible for the data collection in the PER process, resulting in an intermediate database, hosted by TNO.

On behalf of the *Climate Change and Industry Division*, Novem is involved in the extraction of the data from the PER, the collection of additional data and the presentation of data in the CRF. The NIR report, also containing a selection of CRF tables, is primarily drafted by RIVM, with contributions by CBS, TNO and Novem. This year organisations and individuals could make, for the second time, comments to the draft NIR. This process was organised by Novem and RIVM, using the site www.greenhousegases.nl, developed to improve the transparency of the National System (see *Section 1.6.2*).

More than 150 selected persons within the Netherlands were informed by mail and per e-mail that the draft NIR was available for public review. In addition, about 100 experts from UNFCCC, IPCC and EU working groups received an e-mail that they could comment to the draft. Six persons provided comments, which is much less than last year, mostly on the LUCF chapter.

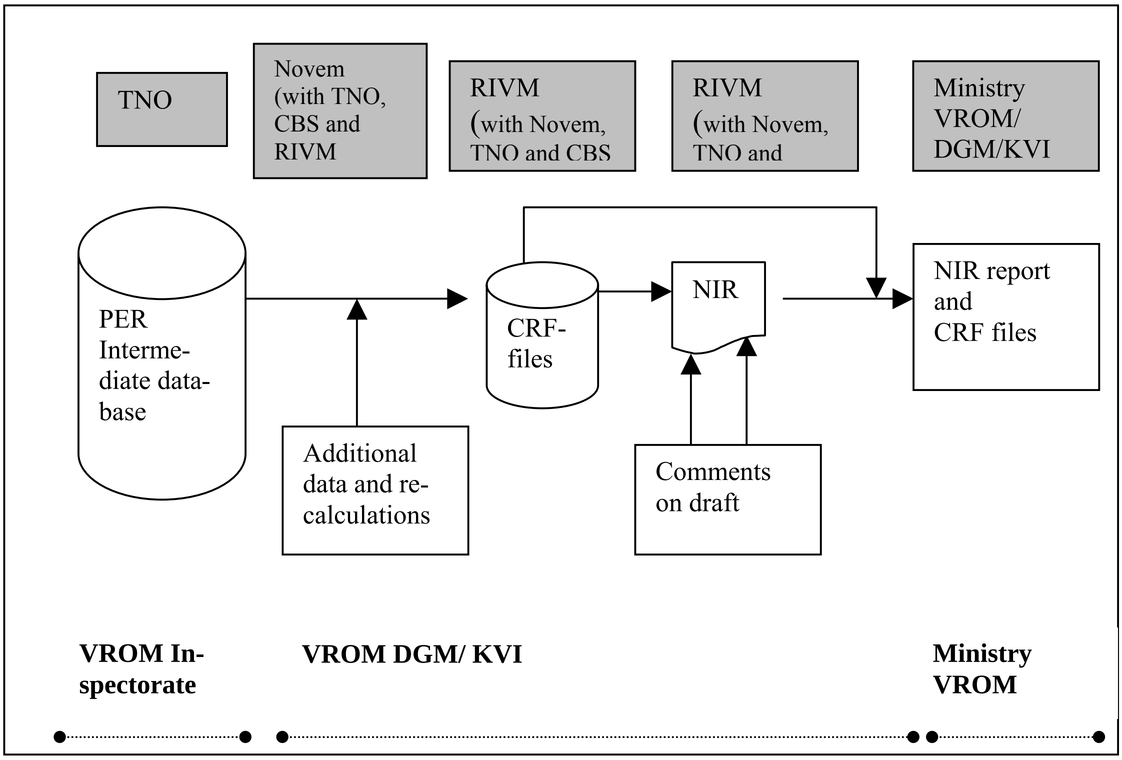


Figure 1.3. NIR and CRF preparation process; relation with Pollutant Emission Register (PER) and responsibilities

1.3 Brief description of the process of inventory preparation

Data collected in the National Inventory Report are based on the PER. In this annual Emission Inventory System, in year *t* emissions have been calculated for year *t-1* and emissions of the last year but one (*t-1*) are improved. In the case of methodological changes, emissions are also recalculated for *t-3* as well as for 1990 and 1995. This means that in 2003 emissions were (re)calculated for 1990, 1995, 2000, 2001 and 2002.
The data from the PER have to be 'translated' to the Common Report Format (CRF). Additional information and calculations are also necessary to fill the CRF files. Several institutes are involved in this process. Especially experts participating in the Task Force ENINA provide additional information to do recalculations or to improve the data consistency in the CRF files.
A Greenhouse Gas Inventory Improvement Programme was started in 2000. This programme is guided by the *Working Group Emission Monitoring of Greenhouse Gases* (WEB), which directs future actions aimed at improving the monitoring of greenhouse gas emissions, relevant to reporting to the UNFCC in all aspects. In *Section 1.6.2* we summarise the main actions presented in more detail in *Section 10.4*. Some actions already resulted in improved data; others are related to future improvements. One of the actions is aimed at improving the process of data collection and calculations by the use of protocols, which should be included in the PER system from 2003 onwards.
In the reviews of the National Inventory Report, including CRF files, suggestions were made to improve the quality. *Section 10.4* describes the Netherlands' response to the issues raised in those reviews.

1.4 Brief general description of methodologies and data sources used

The general methodology for calculating emissions to air and water in the Netherlands' *Pollutant Emission Register* (PER) – or *Emission Registration* ('ER' in Dutch) – 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 Spakman *et al.* (1997) [in Dutch], of which an electronic update has been

published in Dutch in 2003 and in English (Spakman *et al.,* (2003). For methane and nitrous oxide these methods were based on background documents [in English] prepared by Van Amstel *et al*. (1993) and Kroeze (1994). Other documents in English providing descriptions of emission calculation methodology are the proceedings of workshops on greenhouse gas emissions and sinks in the Netherlands held in 1999 (Van Amstel *et al*., 2000a,b) [in English]. These and other key reports documenting the methodologies and data sources used in the Netherlands are listed in *Annex 6* and are electronically available in pdf format on the website, www.greenhousegases.nl.
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*).
Several specific features of the Netherlands country-specific methodology are summarised below, while *Table 1.2* shows the CRF Summary 3 table for the methods and emission factors used. Major methodological changes compared to the previous report show:

- Error corrections in CO_2 emissions in the energy sector (1990, and 1995-2001) due to in depth reanalysis of data used for previous submissions in relation to reinterpretations of the energy statistics;
- Recalculation of the emissions from traffic and transport (all gasses) based on updated emission factors;
- Revision of HFC emissions for the years 2000 and 2001 based on improved analysis of data;
- Revision of PFC and SF_6 emissions for the years 1990-2001 based on improved data from the industry;.
- Recalculation of the CH_4 emissions from landfills based on improved calculation parameter;
- Error correction of NO_2 emissions from agricultural soils for the years 1990 to 1995 based on revised data for manure applied to soil;
- CH_4, N_2O emissions from *international bunkers (international transport)* are now included in the inventory for the years 1990-2002.

Table 1.2. CRF Summary table 3 with methods and emission factors applied

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO2		CH4		N2O	
	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	CS/T2	PS, CS	CS/T2	PS, CS	CS/T1	PS, D
2. Manufacturing Industries and Construction	CS/T2	PS, CS	CS/T2	PS, CS	CS/T1	PS, D
3. Transport	CS/T2(Box 2)	CS	CS/T3(road);T1(non-r)	CS (road	CS/T3(road);T1(rest)	CS(road)/D(rest)
4. Other Sectors	CS/T2	CS	CS/T2	CS	CS/T1	D
5. Other	CS/T2	CS	CS	CS	NE	
B. Fugitive Emissions from Fuels						
1. Solid Fuels	IE		IE		IE	
2. Oil and Natural Gas	CS/T3;>97:T1	CS	CS/T1	CS	CS/T1	CS
2. Industrial Processes						
A. Mineral Products	CS/T2(clinker)	PS, CS	CS	PS, CS	NO	
B. Chemical Industry	CS/IE	PS, CS	CS	PS, CS	CS/T2	PS
C. Metal Production	CS/IE	PS, CS	NE		NO	
D. Other Production	NO					
E. Production of Halocarbons and SF6						
F. Consumption of Halocarbons and SF6						
G. Other	CS	PS, CS	CS	PS, CS	NO	
3. Solvent and Other Product Use	**CS**	**CS**			**CS**	**CS**
4. Agriculture						
A. Enteric Fermentation			cattle 90: T2; rest: T1	cattle: CS; rest: D		
B. Manure Management			CS/T2	CS (=D,corrected)	CS	CS
C. Rice Cultivation			NO			
D. Agricultural Soils	NE		IE	CS	CS/T1b(D&I)	CS
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	T1	CS				
B. Forest and Grassland Conversion	NE		NE		NE	
C. Abandonment of Managed Lands	NE					
D. CO2 Emissions and Removals from Soil	NE					
E. Other	NO		NO		NO	
6. Waste						
A. Solid Waste Disposal on Land	NE		M, CS/T2	CS		
B. Wastewater Handling			CS/T2	CS	CS/T2	CS
C. Waste Incineration	NO (IE)		NO (IE)		NO (IE)	
D. Other	CS	CS	CS	CS	CS	CS
7. Other (please specify)						
Solvents/polluted surface water	NA		CS	CS	CS/T1b	CS
GREENHOUSE GAS SOURCE AND SINK CATEGORIES	**HFCs**		**PFCs**		**SF6**	
	Method applied (1)	Emission factor (2)	Method applied (1)	Emission factor (2)	Method applied (1)	Emission factor (2)
2. Industrial Processes						
A. Mineral Products						
B. Chemical Industry	CS/T2	PS	NO		NO	
C. Metal Production			CS/T2&T3b	PS	NO	
D. Other Production						
E. Production of Halocarbons and SF6	CS/T2	PS	NO		NO	
F. Consumption of Halocarbons and SF6	M,CS/T2	CS	T2&T3b	D	T2&T3b	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.

1.4.1 Carbon dioxide emissions

Carbon dioxide emissions arise mainly from the combustion of fuel and are calculated on the basis of detailed energy statistics and carbon content of the energy carriers. However, about 75% of emissions from public electricity production, refineries, large industries and waste incineration are directly reported by individual companies. This part of the PER is called 'ER-I'. For these sectors, the remainder of the emissions is calculated on the basis of calculated remaining fuel consumption (difference in national energy statistics for the sector and energy consumption reported by these large companies) and standard emission factors.
For the calculation of the *carbon storage* in the *IPCC Reference Approach* for CO_2, carbon storage fractions in products like plastics and bitumen were taken from an analysis of petrochemical products, half products and feedstock use (of energy carriers) by Gielen (1996). This reference calculation is also used to calculate the remainder of feedstock emissions, where total CO_2 from feedstocks reported by the chemical industry is less than the reference value calculated with the Tier 1 method in the *CO_2 Reference Approach*. In addition, fossil-based CO_2 emissions from *waste incineration* (e.g. plastics) are calculated from the total amount of waste incinerated, split into 8 waste types, each with a specific carbon content and fraction of fossil C in total C, based on an analysis by De Jager and Blok (1993). In recent years this amounted to about 2 Mton. The fuel use related to *statistical differences* is included as a source of CO_2 for 1991-1994, since it was assumed that the associated fuel use is real and not accounted for in individual end-use sectors. More information on the methodology for estimating CO_2 emissions from fossil fuel combustion is provided in *Annex 2.1*.
Finally, a *temperature correction* of fuel use for space heating is applied for (domestic) environmental policy purposes, but only to CO_2 emissions from natural gas consumption. The restriction to natural gas is made because this is by far the dominant fuel type for space heating. A description of this method is provided in *Annex 2.2* and the result of the calculation is presented in *Section 3.1.1*.

1.4.2 CO_2 from sinks

At present, the Netherlands only estimates CO_2 removals for *LUCF category 5A*. For the period 1990-2000 period the data on carbon stock and carbon changes were based on:

- forest area (in ha) ;
- average annual growth by category (in m^3/ha per year);
- harvest by category (in m^3/ha per year).

No correction is made for the amount of fuelwood harvested, since this amount is implicitly included in these three variables. For forest stock the FAO definition is used, but for the wood volume a threshold level of 5 cm diameter is used for UNFCCC reporting. All conversion factors have been checked for replacing IPCC default values by country-specific values. It was decided to use IPCC default values for all variables, except for the conversion ratio from volume (in m^3) to dry matter (tonne dm), for which the Netherlands uses more detailed figures: 0.5 and 0.6 t dm/m^3 for coniferous and broadleaf forest, respectively. See *Annex 3.2* for a detailed description.

1.4.3 Methane

Methane from fuel combustion is estimated using the energy statistics and emission factors from the annual *Emission Monitor*, with figures provided by the *Pollutant Emission Register* (PER). 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). For more details, we refer to the description provided for CO_2. Fugitive methane emissions from oil and gas are estimated for onshore and offshore sites separately.
Methane from agriculture is estimated on the basis of emission factors developed in the methane background document by Van Amstel *et al.* (1993), and agricultural statistics for animal numbers and manure production from *Statistics Netherlands* (CBS). For dairy and non-dairy cattle the emission factors for enteric fermentation are based on an IPCC Tier 2 analysis made for the Netherlands cattle in 1990. For subsequent years, these emission factors are used, however, specific factors are applied to 4 and 3 subcategories within dairy and non-dairy cattle, respectively. The emission factors for the other subsources are based on default IPCC Tier 1 emission factors. For enteric fermentation of sheep and goats

the same emission factor of 8 kg CH_4 per animal is used, which stems from an OECD/IEA/IPCC publication in 1991 as documented in Van Amstel *et al*. (1993). The *Revised 1996 IPCC Guidelines*, however, mention different default emission factors for sheep and goats. The Netherlands uses for both animal categories the same emission factor because sheep and goats roughly consume per animal the equal amount of dry matter. 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 of sheep.
The IPCC Tier 1 methodology is used to calculate CH_4 from manure management systems. Country-specific emission factors for CH_4 are based on default IPCC emission factors (using adjusted IPCC values). The calculation of animal manure production and waste management systems is described in Van der Hoek (2002). The emission factors are multiplied by the amount of annually produced manure per animal category after deducting the amount of manure produced on the pasture. Specific emission factors per m^3 manure are taken from Van Amstel *et al.* (1993). The emission factors for sheep and goats are high compared to the IPCC defaults. With VS = 250 kg/m^3, B_o = 0.18 m^3 CH_4/kg VS and MCF = 0.1 it can be calculated that 1 m^3 manure yields 4.5 m^3 CH_4, which corresponds to 2.979 kg CH_4. In the Netherlands one ewe (= female sheep) (including corresponding young stock) annually produces 2000 kg manure in the meadow and 325 kg manure in the animal house. Combined with animal numbers for ewes this results in 0.21 million kg manure and 0.63 Gg CH_4 (Van der Hoek, 2002). In the Netherlands milking goats (including corresponding young stock) are kept all day in the animal house. One milking goat, including corresponding young stock, annually produces 1300 kg manure. All the milking goats together produce 0.15 million kg manure and an emission of 0.45 Gg CH_4 (Van der Hoek, 2002).
Methane emissions from landfills 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. The integration time for the emission calculation is, for all years, the period from 1945 to the year for which the calculation is made. A small source in the waste sector is wastewater treatment, with very small emissions due the high fraction recovered.
A very small source identified in the Netherlands is degassing of drinking water, reported in Sector 9. 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 as anthropogenic emissions under IPCC category 7. Other 'natural emissions' are methane emissions from wetlands and water.

1.4.4 Nitrous oxide

N_2O emissions from fuel combustion is estimated using the energy statistics and emission factors from the annual *Emission Monitor*, with figures provided by the Emission Registration system (PER). 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); 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*.
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 Netherlands' Emission Registration system (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.
The nitrous oxide emissions from agriculture are based on the methods described in the nitrous oxide background document by Kroeze (1994). The calculation of animal manure production and waste management systems is described in Van der Hoek (2002). Direct N_2O emissions include emissions due to application of synthetic fertilisers, animal wastes (manure) to soil and by N-fixing crops. In addition, direct N_2O emissions in the Netherlands include emissions from animal production of manure on the grasslands (pasture). The subcategory 4D1d 'direct N_2O emissions from crop residues left in the field' and 4D2 'cultivation of histosols' (organic soils) are included in the subsource 4D4 '*Other*' (specified as '*Background agricultural soils'*). The Netherlands reports background emissions from agricultural soils with a magnitude of 4.71 Gg N_2O. This value is the arithmetic difference between the background emissions calculated for around the year 1900 and the present, actual background emissions. These so-called enhanced background emissions are caused by manure and fertiliser application in the last cen-

tury and by lowering the groundwater tables in the past. This subsource reflects that agricultural soil emissions will not stop when agricultural activities are stopped. For more specific information we refer to Kroeze (1994).
Indirect N_2O emissions from atmospheric deposition are not yet estimated. Other indirect N_2O emissions from leaching and run-off are included in *category 7 'Polluted surface water'*.
The latter category 7 *'Polluted surface water'* is a fixed value that comprises leaching and run-off from all anthropogenic activities, including human sewage. Since this figure includes more than only agriculture-related emissions, we do not report these under 4.D but as a separate category '7'. N_2O emissions from human sewage are reported partly under '*Wastewater handling'* (6B) and partly under *category 7* as '*Polluted surface water'*. For more details on the exact definition of these indirect N_2O source terms we refer to Spakman *et al. (*2003) or to 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, 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. In Spakman *et al. (*2003) the methodologies are described in more detail.

1.4.6 Data sources

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

- fossil fuel data: (a) annual inventory reports by individual firms (including biofuel data); (b) national energy statistics from CBS (National Energy Statistics; Energy Monitor); (c) agricultural gas consumption (LEI);
- residential biofuel data: (a) annual survey of residential woodstove and fireplace penetration by the Association for Comfortable Living (in Dutch: *Vereniging Comfortabel Wonen*); (b) a survey in 1996 on wood consumption by residential woodstove and fireplace owners by the Stove and Stack Association (in Dutch: *Vereniging van Haard en Rookkanaal, VHR*).
- transport statistics: monthly statistics for traffic and transportation from CBS;
- industrial production statistics: (a) annual inventory reports by individual firms; (b) national statistics from CBS;
- consumption of HFCs: annual reports by the KPMG accountant firm (only HFC data are used due to inconsistency for PFCs and SF_6 with emissions reported otherwise);
- consumption/emissions of PFCs and SF_6: reported by individual firms;
- anaesthetic gas: data provided by Hoekloos, the major supplier of the gas;
- N_2O containing spray cans: Dutch association of aerosol producers (in Dutch: *Nederlandse Aerosol Vereniging*, NAV);
- animal numbers: agricultural database from CBS/LEI-DLO, with data from the agricultural annual census ;
- manure production and handling: national statistics from CBS/LEI-DLO;
- fertiliser statistics: agricultural statistics from LEI-DLO;
- forest and wood statistics: (a) forest area 1980 and 2000: CBS (1985) and Dirksen *et al.* (2001), respectively, supplemented with agricultural statistics on orchards and nurseries from LEI/CBS (2000); CBS (1985, 1989), Daamen (1998) and Edelenbosch (1996) for the years in between; (b) stem volume, annual growth and fellings: Schoonderwoerd (2000), Stolp (1995) and Daamen (1998);
- 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 the statistical website '*Statline*' of CBS (www.cbs.nl) and at the *Environmental Data* website of CBS/RIVM (www.rivm.nl). However, please note that domestically sometimes different units and definitions are used than used in this report. In particular for CO_2 data are provided with or without temperature correction, with or without organic CO_2 included, with or without LUCF sinks.

1.5 Brief description of key source categories

For identification of so-called 'key sources' according to the *IPCC Good Practice approach* (IPCC, 2000), 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. A number of others could not be clearly identified in the present dataset. Changes in key sources compared to the previous NIR are:

- 1A3-CO_2 Aircraft: now non-key;
- 2-CO_2 Other Industrial: now key;
- 3 CO_2 Miscellaneous: now key; and
- 6B CH_4 Wastewater: now non-key.

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 of which the total adds up to 95% of the national total are 18 sources for annual level assessment and 16 sources for the trend assessment out of a total of 60 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. This has been done using the uncertainty estimates discussed above.

The results of the Tier 1 and Tier 2 levels and trend assessment are summarised in *Table 1.3*. As could be expected, the Tier 2 level and trend assessment increase the importance of small sources that are relatively very uncertain. 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.

Table 1.3.K ey source identification using the IPCC Tier 1 and 2 approach

IPCC	Gas	Source category (key sources = bold)	Key (L/T/Tier)	Tier 1	Tier 2	Method/Tier	Emission factor
		ENERGY SECTOR					
1A1	CO_2	**Emissions from stationary combustion : Energy Industries**	Key (L,T)	L, T	L, T	CS	PS, CS
1A2	CO_2	**Emissions from stationary combustion : Manufacturing Industries and Constr.**	Key (L,T)	L, T	L, T	CS	PS, CS
1A2	CO_2	**Emissions from iron and steel industry**	Key (L1,T1)	L, T			
1A2	CO_2	**Feedstock gas**	Key (L)	L	L	CS, T1	PS, CS
1A2	CO_2	**Feedstock oil**	Key (L,T1)	L, T	L	CS, T1	PS, CS
1A2	CO_2	Feedstock coal	Non-key			CS, T1	PS, CS
1A3	CO_2	**Mobile combustion: road vehicles**	Key (L,T)	L, T	L, T	CS, T2	CS
1A3	CO_2	**Mobile combustion: water-borne navigation**	Key (L2)		L	CS	CS
1A3	CO_2	Mobile comustion: aircraft	Non-key			CS	CS
1A3	CO_2	**Mobile combustion: other**	Key (L,T1)	L, T	L	CS	CS
1A3	CH_4	Mobile combustion: road vehicles	Non-key			CS, T3 (road)	CS
1A3	CH_4	Mobile combustion: other	Non-key			CS	CS
1A3	N_2O	Mobile combustion: road vehicles	Non-key			CS, T3 (road)	CS
1A3	N_2O	Mobile combustion: other	Non-key			CS	CS
1A4	CO_2	**Emissions from stationary combustion : Other Sectors**	Key (L,T1)	L, T	L	CS	PS, CS
1A	CH_4	**Emissions from stationary combustion: non-CO_2**	Key (L2)		L	CS	PS, CS
1A	N_2O	**Emissions from stationary combustion: non-CO_2**	Non-key			CS	PS, D
1B1	CH_4	Coal mining	Not Occuring	NO			
1B1	all	Coke production	Included in 1A2	IE			
1B2	CH_4	Fugitive emissions from oil and gas: gas production	Key (L,T1)	L, T	L	CS	CS
1B2	CH_4	**Fugitive emissions from oil and gas: gas distribution**	Key (L)	L	L	CS, T1	CS
1B2	CH_4	Fugitive emissions from oil and gas operations: other	Non-key			CS	CS
		INDUSTRIAL PROCESSES					
2A	CO_2	Emissions from cement production	Non-key			CS	PS, CS
2	CO_2	**Other industrial: CO_2**	Key (L,T1)	L, T	L	CS	PS, CS
2A	CO_2	Emissions from lime consumption	Included in 2G	IE			
2B	CO_2	Chemical industry: feedstock use / NEU	Included in 1A2	IE			
2C	CO_2	Metal production: steel production	Included in 1A2	IE			
2	CH_4	Other industrial: CH_4	Non-key			CS	PS, CS
2B	N_2O	**Emissions from nitric acid production**	Key (L,T1)	L, T	L	CS, T1	D/PS
2G	N_2O	Other industrial: N_2O	Included in 2B	IE			
2C	F-gas	**PFC emissions from aluminium production**	Key (T1)	T		CS	M, PS
2E	F-gas	**HFC-23 emissions from HCFC-22 manufacture**	Key (T)	T	T	CS	PS
2E	F-gas	HFC by-product emissions from HFC manufacture	Non-key				
2F	F-gas	**Emissions from substitutes for ODS substitutes: HFC**	Key (L2,T1)	T	L	CS, T2	CS
2F	F-gas	PFC emissions from PFC use	Non-key			T2	D
2F	F-gas	**SF_6 emissions from SF_6 use**	Key (L2)		L	T2	PS, CS, D
		SOLVENTS AND OTHER PRODUCT USE					
3	CO_2	**Misc. CO_2**	Key (L)	L	L	CS	CS
3	CH_4	Solvents and other product use	Included in 7	IE			
		AGRICULTURAL SECTOR					
4A	CH_4	**CH_4 emissions from enteric fermentation: cattle**	Key (L,T1)	L, T	L	90:T2; T1	CS
4A	CH_4	CH_4 emissions from enteric fermentation: swine	Non-key			T1	D
4A	CH_4	CH_4 emissions from enteric fermentation: sheep	Non-key			T1	D
4A	CH_4	CH_4 emissions from enteric fermentation: other	Non-key			T1	D
4B	CH_4	**Emissions from manure management : cattle**	Key (L2)		L	CS	CS (=D, corrected)
4B	CH_4	**Emissions from manure management : swine**	Key (L2)		L	CS	CS (=D, corrected)
4B	CH_4	Emissions from manure management : poultry	Non-key			CS	CS (=D, corrected)
4B	CH_4	Emissions from manure management : other	Non-key			CS	CS (=D, corrected)
4B	N_2O	Emissions from manure management	Non-key			CS	CS
4C	CH_4	Rice cultivation	Not Occuring	NO			
4D	N_2O	**Direct N_2O emissions from agricultural soils**	Key (L)	L	L	CS	CS
4D	N_2O	**Indirect N_2O emissions from nitrogen used in agriculture**	Key (L)	L	L	CS	CS
4E	all	Prescribed burning of savannas	Not Occuring	NO			
4F	n-CO_2	Emissions from agricultural residue burning	Not Occuring	NO			
		LUCF					
5	all	LUCF	Partly estimated	PE			
		WASTE SECTOR					
6A	CH_4	**CH_4 emissions from solid waste disposal sites**	Key (L,T)	L, T	L, T	CS (T2)	CS
6B	CH_4	**Emissions from wastewater handling**	Non-key			CS	CS
6B	N_2O	**Emissions from wastewater handling**	Non-key			CS	CS
6C	all	Emissions from waste incineration	Included in 1A1	IE			
		OTHER					
7	CH_4	Misc. CH_4	Non-key			CS	CS
7	N_2O	**Polluted surface water**	Key (L)	L	L	CS	CS
7	N_2O	**Misc. N_2O**	Key (T1,L2)	T	L	CS	CS

Notion keys:

L, T = Level, Trend	CS = country-specific	PART = Partial
T1 = 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.*

1.5.1 Key source identification and methodological choice

The result is a list of about 27 source categories out of a total of 56 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 less source categories are selected. In any case, a few conclusions can already be drawn in connection with the methodology and emission factor type label added to *Table 1.3*. For many of the country-specific methods the associated IPCC Tier still has to be determined, but it seems clear that for CH_4 from national gas distribution and CH_4 from enteric fermentation of cattle for instance, the methods used will probably need to be improved in future. However, a comprehensive analysis still has to be made.

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, it provides clear indications of the increasing importance of some smaller but very uncertain sources, in particular:

- CH_4 from manure management of cattle and swine;
- Indirect N_2O emissions from nitrogen used in agriculture.

1.6 Information on the QA/QC plan

The preparation of the greenhouse gas emission data in the CRF files is highly related to the national *Pollutant Emission Register* (PER), see *Section 1.2*. To meet the UNFCCC and EU requirements additional actions are (still) necessary. In the following section we will present information for both (inter-related) processes in separate sections. One deals with the PER and the other with the NIR and the CRF files.

1.6.1 The Pollutant Emission Register (PER)

Quality Assurance for the Netherlands' PER

The *Pollutant Emission Register* (PER) process has been in existence for many years and deals with over 100 different pollutants from point sources, area sources and diffuse sources, with emissions to air, water and soil. It also includes waste handling data. This emission inventory process is organised as a project with an annual cycle. Required changes and priorities for improvement are discussed prior to the next year of data collection. Each year the Inspectorate of the Ministry of VROM commissions TNO to draft a detailed plan for the compilation of the emission inventory for the forthcoming year (e.g. WEM/CCDM, 2003). This project plan includes responsibilities of the parties involved, members of the Task Forces, the division of tasks, the selection of substances and years, the list of source categories and the time schedule. Each Task Force has the task to define or update a protocol for the monitoring process of their specific Target Sector. This protocol covers the data collection, validation, data storage, data management and data dissemination, and is documented in a report and a meta-information sheet. At the end of the project, the PER Project Group (WEM) reports the necessary improvements identified for next year's emission inventory update.
In 1997 the quality assurance system ISO 9001 was introduced to ascertain the quality of the monitoring process related to the PER. All procedural activities by the Inspectorate, TNO and RIVM are subject to this quality control, as well as the maintenance of the PER database by RIVM. However, the activities of actual data collection and emission calculation by the Task Forces are not yet part of the formal ISO quality assurance programme.

Quality of Annual Environmental Reports (MJVs)

As presented in *Figure 1.2* and *Box 1.1* the *Annual Environmental Reports* (in Dutch: '*MJVs'*) contain the data for the large companies that form input for the PER. The 1999 MJVs were analysed to establish the quality of the data, as it was the first time that the large companies had, by virtue of statutory obligation, prepared this report themselves. Analysis on these MJVs and a trend analysis on emission data for 1998 and 1999 for 171 companies led to doubts about the quality. For example CO_2 emissions for these 171 companies showed reductions of 33% from 1998 to 1999. Additional in-depth research on 57 MJVs was conducted. Some differences between 1998 and 1999 data could be traced back to changes in production of energy use, technical improvements, production disturbance and improved measurements. Also mistakes in units and calculations etc. were shown. Overall the improved data for these companies resulted in a new figure for CO_2 emissions; not a 33% reduction, but 7% (Heslinga, 2001a).
An investigation was also made of the quality of MJVs submitted on 2000 emissions (Heslinga, 2001b). The energy input, specified by fuel type, should be reported in the MJV. It was concluded that only

40% of this detailed information could only be used. Moreover, this information is essential for activity data as well as for the calculation of greenhouse gas emissions. In the MJVs a total of 71 Tg CO_2 emissions is reported. In the quality research it was concluded that the energy input could not be verified for 112 companies responsible for 34 Tg CO_2, in particular, for some large companies that kept their energy details confidential. This is also the situation for NO_x: 36 Gg out of a total of 65 Gg could not be verified. These comments on the 1999 and 2000 data do not necessarily mean that these data are wrong, but that reported emissions could not be cross-checked with underlying fuel consumption data at company level.
The Inspectorate of the Ministry of VROM started improvement actions. In 2001 the different reporting formats for the MJV were condensed to one format, which will be used for the MJV 2002 and 2003. In this format the companies will have to report on several processes. This classification of the processes makes the differences between fuel combustion and non-combustion emissions more transparent. The Ministry of VROM started in 2003 an evaluation for the impact, implementation and target group of obliged MJV (KPMG, 2003). In the same year a pilot was started with the use of an electronic MJV, that voluntary can be used in 2004. If the electronic version (the e-MJV) is used, the company finds the data of last year (2002) for references and major differences between data for that year and the new data are immediately indicated. This e-MJV should result in data with a higher quality in future years.

Documentation of methodologies used in the PER

The methodology for calculating emissions to air and water in the Netherlands' *Pollutant Emission Register* has in the course of time been described in a number of reports, as documented below:

- general methodologies and data in Van der Most *et al.* (1999) [in Dutch];
- the methodology for calculating greenhouse gas emissions in more detail in Spakman *et al.* (2003), an update of the 1997 report [available in Dutch and English];
- specific changes in methods of datasets in the annual reports on emissions and waste, e.g. Koch *et al.* (2002) [in Dutch]. These reports also summarise the quality of national total emissions of several compounds by a qualitative classification based on expert judgement in terms of shares of quality classes A to E in conformity with EMEP/CORINAIR and EPA methods. A summary of these reports is also published in English, e.g. Koch *et al.* (2002);
- a set of source category reports documenting or summarising the methodology used by the Task Forces is posted at a new website (so-called meta-data files) [in Dutch, English translation in preparation] (TNO, 2003).

Finally, since 1994 changes in methodologies, deviating source definitions and changes in source allocations in greenhouse gas emissions, have been reported in the annual National Inventory Reports on greenhouse gas emissions in the Netherlands, prepared and co-ordinated by RIVM for submission to the UNFCCC and the *EU Greenhouse Gas Monitoring Mechanism*.
At the end of 2002 the main data and documentation was to be included in a new website http://dm.milieumonitor.net. This site is in the Dutch language, but also contains the English reports that the CCDM publishes. Also the documentation in the meta-data files (in Dutch) is now generally available on at that site. Please note that all emission data provided on this website are presented according to the national method (including emissions from biomass and natural emissions, and those without LUCF); emissions according to the UNFCCC/IPCC definitions can be found at the website www.greenhousegases.nl.

The Quality Control (QC) activities of the PER

The Quality Control (QC) activities of the Netherlands' PER can be divided in the following phases:

- QC by Task Forces before data delivery to TNO (including QC on ER-I data);
- QC by TNO;
- QC by Task Forces before the trend verification workshop;
- QC by Task Force and RIVM Target Sector co-ordinators at the workshop above;
- QC on the IPCC summary tables included in the annual *Emission Monitor* report.

The data deliveries and feedback to the Task Forces is performed in accordance with the procedure 'Data handling and presentation' from the quality assurance system of the Netherlands Pollutant Emission Register. The Task Forces filled a standard-format database delivered by TNO with emission data for 2000, 2001 and 2002 and for the years 1995 and 1990. After a check on the emission file by the Task Force before submission, TNO performed QC activities such as checks on completeness, consistency and formats. The (corrected) data were processed to a comprehensive draft data file. The Task Forces have access the relevant emissions in the draft data file, which can be consulted on the internet in order to check the TNO data handling. Observed errors and information about how the quality controls are performed by the Task Forces are reported to TNO. All corrections made in the draft data file are documented and accessible on the internet for the Task Forces.
In July 2003 a workshop was held on trend analysis of the emissions to air. 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 for the years 1990, 1995, 2000, 2001 and 2002. 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.

Box 1.2. Results of the trend verification workshop

Forty actions were formulated and discussed prior to and at the workshop. Those most relevant for greenhouse gases are listed below.

Task Force on Energy, Industry and Waste Handling (ENINA):
- TNO action: correction of emissions of F-gases.
- CBS action: check and explain major changes in CO_2 emissions in the chemical industry from 1997 onwards.
- TNO/RIVM/CBS actions: analysis of emissions from waste incineration and review of all CO_2 items for 2001 and 2002.

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

Task Force on Traffic and Transport:
- CBS action: explanation of changes in CO_2 emissions from other transport (all years) .

Task Force on Agriculture:
- No actions: data on N_2O emissions were not available in July; they were checked separately in September.

All Task Forces:
- Action: methodological changes must be documented in meta information documents and sent to TNO.

TNO also made time series of emissions per substance for the individual Target Sectors. The Task Force members, the chairman of the Task Force and the RIVM co-ordinator of the Target Sector examined these time series. During the trend analysis also the Dutch greenhouse gas emissions for the years 1990, 1995 to 2002 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, 1995 to 2002.
Remarkable trend changes observed were noted and discussed at the workshop, resulting in an action list (see *Box 1.2*). 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. Where the Task Force members could explain a large change in the trend, it was removed from the list. Inexplicable trend changes were studied in more detail at emission source level after the workshop. 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 in writing. 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 next year's (2004) inventory compilation.

1.6.2 The National Inventory Report and CRF files

Building a National System

Greenhouse gas emission data in the Netherlands are prepared as part of the *Pollutant Emission Register* (PER) (see *Section 1.2.1).* The UNFCCC, the EU and the Kyoto Protocol added additional requirements to the PER. For example, some additional greenhouse gas sources had to be included and the monitoring had to be brought in line with the UNFCCC, IPCC and EU Monitoring Mechanism requirements. To achieve this around the year 2000 a programme was started to adapt the monitoring of greenhouse gases in the Netherlands and transform this to a National System as in Article 5 of the Kyoto Protocol.
The *Quality Assurance* (QA) process and *Quality Control (QC)* activities are incorporated into the development of a National System. We will summarise the overall inventory improvement programme and three selected issues: the monitoring improvement programme, protocols and process descriptions, and a development project for a QA/QC system. In *Section 10.4* we will present these elements in more detail. We elaborate the following *Quality Control* elements in separate sections:

- the impact of the quality of the annual environmental reports on the quality of the data in the CRF files;
- the relationship between the verification process in the PER and for the CRF data at IPCC source category level;
- the documentation of the process to complete the data in the CRF files.

The responses to the issues raised in UNFCCC reviews on the NIR are described in *Section 10.4*.

Quality Assurance as part of building a National System

The UNFCCC and Kyoto Protocol added additional requirements to the regular emission inventory system (PER). To achieve this in 2000 a programme was started to adapt the monitoring of greenhouse gases in the Netherlands and transforming this to a National System as in Article 5 of the Kyoto Protocol. The programme is being implemented under responsibility of the Netherlands Ministry of Spatial Planning, Housing and the Environment (VROM), who delegated the practical co-ordination to Novem. An interdepartmental committee, the *Working Group Emission Monitoring of Greenhouse Gases* (WEB) was created to direct the actions. Many institutes are involved in these activities. The programme is set up as a temporary special assignment. All improvements and arrangements will eventually become an integral part of the wider system of regular emission monitoring (PER).
This programme consists of three main elements: a monitoring improvement programme, development of monitoring protocols and process descriptions, and a QA/QC system as part of the National System. The monitoring improvement programme deals with methods, activity data and emission factors that are assessed and, where needed, adapted. To this end, a series of studies and activities are being carried out to improve – where necessary – data quality, methodologies, documentation and data compilation procedures. The elaboration and implementation by protocols and process descriptions involves assessing and, where needed, redefining processes, methods, procedures, tasks, roles and responsibilities with regard to inventories of greenhouse gases. These different aspects are being laid down in transparent descriptions and procedures in so-called ‘protocols’ per gas and sector, and in process descriptions for other relevant tasks in the National System.
In 2001, a three-phase project was started to adapt the QA/QC system for use in the Netherlands greenhouse gas monitoring and NIR/CRF process. The first phase (finished in 2002) included an assessment of the present situation as compared to the UNFCCC/IPCCC requirements. The second phase involves the elaboration and description of relevant processes and procedures, including adaptation of the present situation. This work is interrelated with the elaboration of the protocols and is co-ordinated by Novem with involvement from the Ministry of VROM and the PER. The third phase comprises the formal and legal arrangements, needed for the structural embedding of the QA/QC procedures. This will be done in 2003/2004, together with the legal embedding of the protocols in the PER.

Quality of Annual Environmental Reports (MJVs) and CRF files

For the years 1990 and 1995 onwards, CRF files include sectoral background data (i.e. emissions per fuel type) for '*Fuel combustion'* (1A). This includes *'Energy Industries'* (1A1) and *'Manufacturing Industries'* (1A2). However, these data are only presented for the three specific fuel types if individual companies (in the MJV) had reported CO_2 and related fossil fuel consumption per fuel type with a proper match. If this specification was not reported or did not properly match, fuel consumption and CO_2 emissions were allocated in the CRF *Sectoral Background Tables* under '*Other fuels'*. This fraction of national total CO_2 emissions increases from about 11% of fossil-fuel related emissions in 1990 to 15% in 1995-1999, and to 41% in 2000; i.e. this percentage of national CO_2 emissions could not be allocated to a specific fuel type in either energy sector or manufacturing industry sector. For these no correct and meaningful so-called '*Implied Emission Factors'* could be provided in the CRF.
The following three groups of economic sectors account for almost all of the unspecified emissions in 2000, each contributing about one-third:

- refineries and iron and steel production, of which *all* CO_2 emissions in 1999 could not - or could not properly - be associated with reported fossil fuel consumption;
- public electricity production and
- the chemical industry.

In 2001 the percentage of the national CO_2 emissions from fossil fuel consumption, '*Other fuels'* decreased to 21%. This is caused by improved quality of the MJVs in the public electricity production sector.
The present procedure to allocate process emissions was elaborated. This resulted in revised data, as corrections for double counting were necessary. Please refer to the relevant sections in *Chapters 3 and 9* for more details.

QA and verification of the CRF data at IPCC source category level

A distinct difference with the national annual emissions report (Van Harmelen *et al.,* 2002) is that for international reporting according to the IPCC format, the sectoral emission sources of most so-called Target Sectors are split into fuel combustion and non-combustion emissions. Therefore, the data were checked at the reporting format level for outliers in two ways: (a) the levels for 2000 and 2001 were compared with the table published previously; (b) annual trends for 1999/2000 and 2000/2001 were calculated as percentages.
The NIR co-ordinator summarised relatively large differences and contacted the relevant sectoral experts of RIVM in the Task Forces to check the correctness of the source allocation and the plausibility of the difference for all flagged items. This resulted in a confirmation or correction (of the IPCC source allocation, for example) and in explanations in terms of either a deliberate recalculation or a probable cause in case of large annual change). This has been done for the greenhouse gases CO_2, CH_4 and N_2O, as well as for the four precursor gases.
Finally, in preparing the CRF data set, similar trend and level 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 the six greenhouse gases;
- annual changes in activity data;
- annual changes in implied emission factors for CO_2, CH_4 and N_2O;
- level values of implied emission factors, in particular, of CO_2 from combustion.

The agency responsible for the data entry checks all flagged items for correctness of the figures and the plausibility of the difference. Again, remaining flagged items are communicated with the relevant RIVM sectoral expert in the Task Forces to explain the marked items. The explanations of both checks are used to document the differences with the previous release of the CRF in the recalculation tables and to explain unusual trends in the NIR. These activities have been documented since 2001 (see, for example, Coenen and Olivier, 2004).

Documentation of completing CRF files

The PER database does not contain all information necessary to fill the CRF files. In general, additional data are needed for the following three groups:

- *IPCC Reference Approach* for CO_2 from fuel combustion, derived from the national energy statistics; complemented with data on the carbon content of crude oil, natural gas liquids and other refinery inputs;
- Improved allocation of emissions due to a more detailed linking table for the years 1990, 1995 and 2000 onwards;
- documentation on recalculations as described in the *UNFCCC guidelines* and the *IPCC Good Practice* report, respectively;
  - additional activity data for the agricultural sector, the waste sector and fuel combustion;
  - data related to *Land Use Change and Forestry* (LUCF: sinks).

Changes in the data reported in the previous NIR have to be reported in the CRF Recalculation Tables 9a/b (see *Annex 7.2*). All activities and data sources to complete the 2003 CRF files have been documented in Coenen and Olivier (2004).

1.7 General uncertainty evaluation

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). However, since key source identification can be done using many more criteria, important for meeting the National System requirements, the information presented in this section should only be considered as a first step in this process.

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 emissions data for 1990 (1995 for F-gasses) and 2002 were taken from the preliminary submission to the EU and allocated to the IPCC source category list, i.e. where these emissions could be separated for these source categories. However, the IPCC list was slightly adjusted. In view of the importance for the Netherlands of CO_2 from feedstocks and the relatively high uncertainty in these emissions, we separated CO_2 from non-energy use and CO_2 from fuel combustion.
The following information sources were used for estimating the uncertainty in activity data and emission factors (Olivier and Brandes, 2004):

- estimates used for reporting uncertainty in greenhouse gases emissions in the Netherlands 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 data quality (Boonekamp *et al.*, 2001).

These were supplemented with expert judgement of RIVM emission experts. Next, the uncertainty in the emissions in 1990 and 2002 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 are to 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 2%, 17%, 34% and 21% for CO_2, CH_4, N_2O and F-gases, respectively, and in an overall uncertainty of 4%. However, these figures do not include the correlation between source categories (e.g. energy amounts for feedstocks and fuel combustion, cattle numbers for enteric fermentation and animal manure production) or a correction for not-reported sources. Therefore, the actual uncertainty of total *annual* emissions per compound and of the total will be somewhat higher; it is currently estimated by RIVM at:

CO_2	±3%	HFCs	±50%
CH_4	±25%	PFCs	±50%
N_2O	±50%	SF_6	±50%

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 (using the column 'Combined Uncertainty as % of total national emissions in 2002' in *Table 1.7)* the top 10 sources contributing the most to total *annual uncertainty* in 2002 are:

IPCC	IPCC Source category	Uncertainty (as % of total national emissions in 2002)
4D	Direct N_2O emissions from agricultural soils	1.5%
4D	Indirect N_2O emissions from nitrogen used in agriculture	1.4%
2X	N_2O Emissions from nitric acid production	1.3%
6A	CH_4 emissions from solid waste disposal sites	1.1%
7X	N_2O Emissions from polluted surface water	1.1%
1A	CO_2 Emissions from stationary combustion: energy industries	1.1%
1A	CO_2 Emissions from feedstock oil	1.0%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	0.6%
1A	CO_2 Emissions from mobile combustion: other	0.6%
1A	CO_2 Emissions from stationary combustion: other sectors	0.6%

Table A1.4 of *Annex 1* summarises the estimate of the *trend uncertainty 1990-2002* 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 for 1990-2002 (1995 for F-gases) of ±4% points. This means that the increase in total CO_2-eq. emissions between 1990 and 2002, 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 ±3%, ±6%, ±11% and ±9% points, respectively. More details on the level and trend uncertainty assessment can be found in *Annex 1* on key sources.

Table 1.4. 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. 2002	AD unc	EF unc	EM unc
1A	Emissions from stationary combustion : Energy Industries	CO_2	51 305	63 780	3%	2%	4%
1A	Emissions from stationary combustion : Manufacturing Industries and Construction	CO_2	28 015	21 062	3%	1%	3%
1A	Emissions from stationary combustion : Other Sectors	CO_2	34 913	37 203	3%	1%	3%
1A	Mobile combustion: road vehicles	CO_2	25 374	32 747	2%	2%	3%
1A	Mobile combustion: water-borne navigation	CO_2	877	923	100%	2%	100%
1A	Mobile combustion: aircraft	CO_2	492	225	50%	2%	50%
1A	Mobile combustion: other	CO_2	2 655	2 356	50%	2%	50%
1A	Feedstock oil	CO_2	2 549	3 856	20%	50%	54%
1A	Feedstock gas	CO_2	4 805	4 817	5%	10%	11%
1A	Feedstock coal	CO_2	569	408	5%	10%	11%
1A	Emissions from iron and steel industry	CO_2	6 255	5 648	3%	3%	4%
2X	Emissions from cement production	CO_2	400	437	5%	10%	11%
2X	Other industrial: CO_2	CO_2	1 181	1 989	20%	5%	21%
7X	Misc. CO_2	CO_2	1 189	1 203	20%	50%	54%
	Total CO_2		**160 578**	**176 654**			**0%**
							-> 3%
1A	Emissions from stationary combustion: non-CO_2	CH_4	561	585	3%	50%	50%
1A	Mobile combustion: road vehicles	CH_4	153	77	5%	60%	60%
1A	Mobile combustion: other	CH_4	8	7	50%	100%	112%
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	2 097	1 221	1%	25%	25%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	1 524	1 224	5%	50%	50%
1B	Fugitive emissions from oil and gas operations: other	CH_4	133	78	20%	50%	54%
2X	Other industrial: CH_4	CH_4	69	47	10%	50%	51%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	CH_4	7 678	5 766	5%	20%	21%
4A	CH_4 emissions from enteric fermentation in domestic livestock: sheep	CH_4	286	199	5%	30%	30%
4A	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	438	367	5%	50%	50%
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	37	89	5%	30%	30%
4B	Emissions from manure management : cattle	CH_4	905	774	10%	100%	100%
4B	Emissions from manure management : swine	CH_4	1 033	775	10%	100%	100%
4B	Emissions from manure management : poultry	CH_4	216	177	10%	100%	100%
4B	Emissions from manure management : other	CH_4	19	24	10%	100%	100%
6A	CH_4 emissions from solid waste disposal sites	CH_4	12 011	7 253	15%	30%	34%
6B	Emissions from wastewater handling	CH_4	138	15	20%	25%	32%
7X	Misc. CH_4	CH_4	43	38	20%	25%	32%
	Total CH4		**27 348**	**18 715**			**0%**
							-> 25%
1A	Emissions from stationary combustion: non-CO_2	N_2O	209	210	2%	50%	50%
1A	Mobile combustion: road vehicles	N_2O	276	476	5%	50%	50%
1A	Mobile combustion: other	N_2O	33	28	50%	100%	112%
2X	Emissions from nitric acid production	N_2O	6 314	5 498	10%	50%	51%
4B	Emissions from manure management	N_2O	205	183	10%	100%	100%
4D	Direct N_2O emissions from agricultural soils	N_2O	5 124	5 158	10%	60%	61%
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	1 460	1 460	50%	200%	206%
6B	Emissions from wastewater handling	N_2O	126	187	20%	50%	54%
7X	Polluted surface water	N_2O	1 178	1 178	50%	200%	206%
7X	Misc. N_2O	N_2O	1 468	902	50%	50%	71%
	Total N_2O		**16 392**	**15 280**			**0%**
							-> 50%
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	5 759	685	15%	25%	29%
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	424	790	10%	50%	51%
2X	HFC by-product emissions from HFC manufacture	HFC	12	98	10%	50%	51%
2X	PFC emissions from aluminium production	PFC	1 799	1 041	5%	20%	21%
2X	PFC emissions from PFC use	PFC	37	160	5%	25%	25%
2X	SF_6 emissions from SF_6 use	SF_6	301	344	100%	25%	103%
	Total F-gases		**8 332**	**3 116**			**0%**
		-> 50% for HFCs ,PFCs and SF6					
	Total Netherlands (CO2-eq.)		**212651**	**213765**			**0%**
							-> 5%

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 Emissions from stationary combustion : energy industries	1.3%
6A	CH_4 emissions from solid waste disposal sites	1.0%
1A	CO_2 Emissions from mobile combustion: other	0.8%
1A	CO_2 Emissions from stationary combustion : other sectors	0.7%
1A	CO_2 Emissions from mobile combustion: water-borne navigation	0.6%
2X	HFC-23 emissions from HCFC-22 manufacture	0.6%
1A	CO_2 Emissions from feedstock oil	0.6%
4D	Indirect N_2O emissions from nitrogen used in agriculture	0.5%
1A	CO_2 Emissions from mobile combustion: road vehicles	0.4%
1A	CO_2 Emissions from stationary combustion : manufacturing industries	0.4%

If we compare this list with the 10 largest contributors to annual uncertainty, we can conclude that except for CO_2 from inland shipping, CO_2 from stationary combustion from manufacturing industries and construction, N_2O from polluted surface water, CH_4 from enteric fermentation of cattle and HFC from HCFC-22 manufacture, all others (7) are included both lists.
Because of the problems identified with annual environmental reports (see *Box 1.1*) an extra uncertainty in national CO_2 emissions was estimated for 2000 at 2% (Heslinga, 2001b). This will also be the case with 2001 and 2002 emissions. In addition, delays in compiling statistics for the last but one calendar year, notably for energy consumption, have caused extra uncertainty for some sectors due to the use of *estimated* data for the 4^{th} quarter of 2002. For the same reason the other greenhouse gas emissions are also more uncertain in 2002, but this extra uncertainty has not been quantified.

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) sector to sector and substance to substance are independent (non-correlated). 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 not normal; 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 expert judgement of representativeness for the circumstances of the particular source category in the Netherlands. Sometimes, however, only limited reference to actual Netherlands data was possible to support these estimates. 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 in the Dutch circumstances the errors made 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 comparisons presented in *Table 1.5* and *Table 1.6*, 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 1.5. 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 1.6. 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).

Furthermore, in using the uncertainty estimates presented in *Table 1.4* and *Table A1.4* we have neglected the uncertainty introduced by the emissions from the sources of the ER-I (individually reporting firms), of which the uncertainty is actually unknown. These sources in the Emission Registration account for about half of the total CO_2 emissions in the Netherlands (see *Figure A2.1*). However, as described in *Annex 2.1*, total CO_2 emissions per industrial subsector do not deviate from the reference calculation by more than 5% (in practice, the group total may show much less deviation). For 2000 and 2001, as cited above, an extra uncertainty in national CO_2 emissions was estimated at 2%. This is in addition to the extra uncertainty introduced in the last year's emission estimates, due to the use of partially estimated statistics as basis for the inventory.
In the assessments made above only random errors have been estimated, assuming that the calculation methodology used 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 Netherlands' *Reduction Programme on Other Greenhouse Gases* (ROB). Results of these studies can be found in, for example, Berdowski *et al.* (2001), Roemer and Tarasova (2002) and Roemer *et al.* (2003).
The inventory improvement programme for some of these sources of bringing the methodology in compliance to *IPCC Good Practice Guidance*, for example indirect emissions of N_2O, may result in adjustments of a few percent (i.e. several Tg [= Mton] of CO_2-eq.) The impact of these methodological changes on emissions is not included in the uncertainty estimates presented here.

1.8 General assessment of the completeness

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

- Indirect N_2O emissions from *atmospheric deposition* (category 4D) are not estimated/reported due to historical reasons;
- CO_2 emissions from *agricultural soils* (category 4D) are not estimated/reported due to historical reasons;
- In addition, it has been observed that *CH_4 and N_2O from horse manure* (category 4B) is missing; this is because no manure production estimates from horses have been made to date and no emission factors for this source category have been defined;
- CH_4 emissions from soils decreased in the last 40 years due to drainage and 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 decrease of total methane from soils acts in fact as methane sink;

- Emissions/sinks for LUCF subcategories 5A to 5E, except for the CO_2 sink in category 5A2. New datasets are being compiled but are still under discussion, so no data for these subcategories have been included in this submission;
- CH_4 and N_2O emissions from *industrial* wastewater treatment (6B) and *from large-scale compost production* from organic waste (6D) (DHV, 2000);
- Emissions of precursors from *international bunkers (international transport)* have not yet been estimated/reported; as of this year also the (small) CH_4 and N_2O emissions from bunkers are reported.

The incorporation of these sources into the national greenhouse gas inventory is part of the inventory improvement programme. For some of these sources, for example indirect emissions of N_2O, bringing the methodology in compliance to *IPCC Good Practice Guidance* may result in adjustments of several Tg (i.e. Mton) of CO_2-eq. More information on the completeness is provided in *Annex 5*.

2. TRENDS IN GREENHOUSE GAS EMISSIONS

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 1990-2002. 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 2002 the same as in the base year 1990 (1995 for fluorinated gases). The 2002 emissions would be 3%-points more when corrected for temperature (the mild winter). Without policy measures the emissions in 2000 would have been more than 10% higher (RIVM, 2003a).

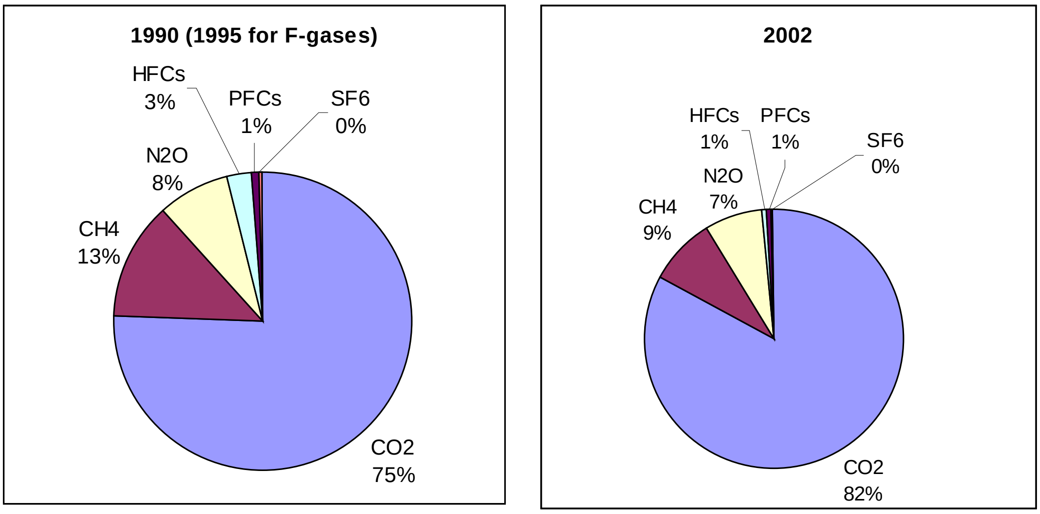


Figure 2.1. Shares of greenhouse gases in total emissions in 1990 (left) and 2002 (right)

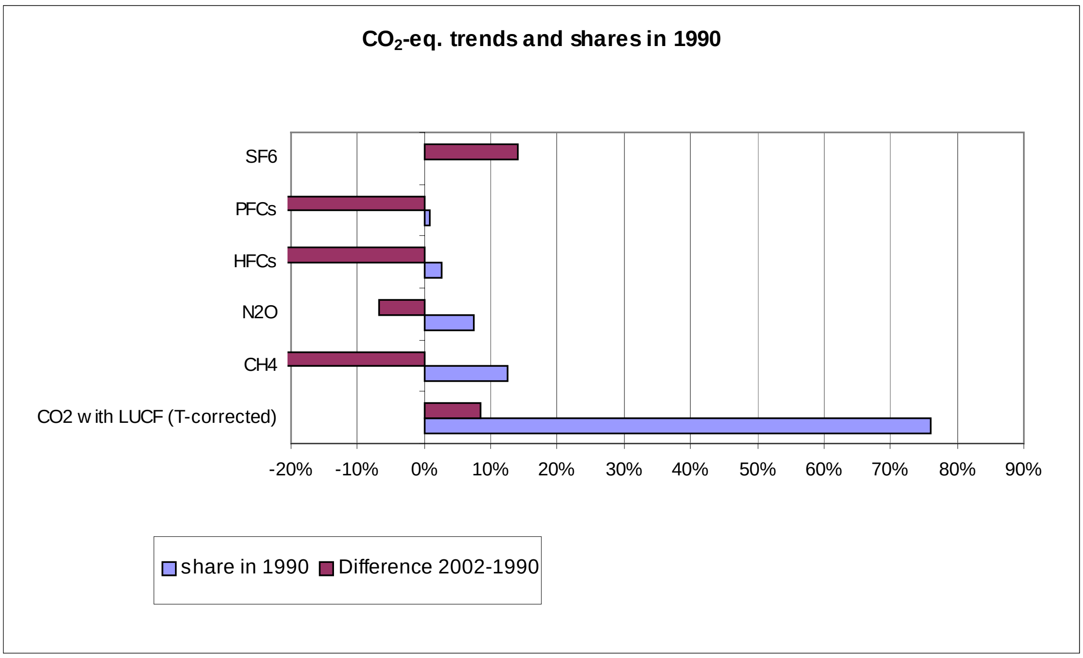


Figure 2.2. Shares and trends in greenhouse gas emissions per gas 1990-2002 (1995-2002 F-gases) and CO_2 also with temperature correction

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[2]. Using temperature-corrected CO_2 emissions in 1990 and 2002, the structural anthropogenic trend of total greenhouse gas emissions in the past 11 years is estimated to be a 1%-point higher than the actual trend of 1% increase (*Table 2.2*).

CO_2 emissions increased by about 10% from 1990 to 2002, mainly due to the increase in the emissions in the energy (24%) and transport sectors (23%). 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.

Table 2.1. Total greenhouse gas emissions in CO_2-eq. and indexed 1990-2002 (no temperature correction)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002 [1)]
Nat. Emissions (Tg CO_2-eq)													
CO_2 with LUCF	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
CO_2 excluding LUCF	***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
CH_4	***27.3***	27.8	26.9	26.5	25.9	25.0	24.8	23.2	22.4	21.4	20.3	19.9	18.7
N_2O	***16.4***	16.7	17.6	18.4	18.0	18.1	17.8	17.7	17.5	17.3	16.6	15.8	15.3
HFCs	4.4	3.5	4.4	5.0	6.5	***6.0***	7.7	8.3	9.4	4.9	3.9	1.5	1.6
PFCs	2.4	2.4	2.1	2.1	1.9	***1.8***	2.0	2.2	1.7	1.5	1.6	1.5	1.2
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	0.3
Total [group of six] [*212.5* [5) 2)]]	**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**
Index (1990=100)													
Index CO_2 [2)]	100	104.4	103.6	104.7	105.3	108.1	113.2	103.7	107.5	104.3	106.4	110.4	110.1
Index CH_4	100	101.8	98.5	96.8	94.7	91.4	90.7	84.9	82.0	78.3	74.4	72.9	68.4
Index N_2O	100	101.6	107.6	112.0	109.6	110.4	108.6	108.2	107.0	105.4	101.0	96.5	93.2
Total [group of three]	**100**	**103.9**	**103.3**	**104.4**	**104.4**	**105.9**	**109.7**	**101.4**	**104.0**	**100.8**	**101.6**	**104.2**	**103.1**
Index HFCs	100	77.9	100.3	112.8	146.4	135.8	173.2	187.4	211.2	111.1	87.5	34.0	35.5
Index PFCs	100	100.1	86.0	86.7	77.1	76.0	83.4	89.6	71.9	60.9	65.3	61.3	49.7
Index SF_6	100	61.6	65.8	69.0	88.0	138.6	143.7	158.7	151.3	145.9	154.2	163.9	158.1
Index [group of six] [2)]	**100**	**103.2**	**103.0**	**104.2**	**104.8**	**106.3**	**110.9**	**103.3**	**105.9**	**100.7**	**101.0**	**102.3**	**101.1**
Index (1995 = 100)													
Index HFCs	73.6	57.4	73.9	83.0	107.8	100	127.5	138.0	155.5	81.8	64.5	25.0	26.1
Index PFCs	131.6	131.8	113.2	114.1	101.5	100	109.7	117.9	94.6	80.1	85.9	80.7	65.4
Index SF_6	72.1	44.5	47.5	49.8	63.5	100	103.7	114.5	109.2	105.2	111.2	118.3	114.0
Index [group of new gases]	**86.6**	**73.6**	**81.8**	**88.8**	**104.7**	**100**	**122.6**	**132.6**	**140.1**	**82.3**	**71.0**	**41.0**	**38.2**
Index ('90; new gases '95) [3) 5)]													
Index [group of 6 composite] [2)]	**98.8**	**102.0**	**101.8**	**102.9**	**103.5**	**105.1**	**109.6**	**102.0**	**104.7**	**99.5**	**99.8**	**101.1**	**99.9**
International Bunker CO_2 [4)]	39.8	41.3	42.4	44.3	42.9	44.3	45.5	48.5	49.6	51.2	53.5	57.6	57.4
Index bunkers CO_2 (1990 = 100)	100.0	103.8	106.6	111.3	107.7	111.4	114.3	121.8	124.6	128.8	134.5	144.8	144.4

[1)] Data for 2002 are of a lower quality than of previous years. In particular, this *'t-1'* dataset is of a relatively low quality in this submission (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, shaded/bold-italic figures): 212.5Tg CO_2-eq.

[2] 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 1% increase in total actual greenhouse gas emissions.

Table 2.2. Total greenhouse gases emissions with temperature correction, in CO_2-eq. and indexed 1990-2002

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Emissions (Tg CO_2-eq)													
CO_2 with LUCF (T-corrected)	165.4	166.6	169.3	167.8	171.3	174.6	175.8	167.4	174.7	171.2	174.7	178.0	179.5
CO_2 excluding LUCF (T-corrected)	166.8	168.1	170.8	169.6	173.2	175.9	177.2	168.6	176.1	172.4	176.1	179.4	181.0
Total [group of six] [1)]	**217.6**	**218.6**	**222.0**	**221.7**	**225.6**	**227.1**	**229.8**	**220.4**	**227.5**	**217.8**	**218.8**	**218.5**	**218.1**
Index (1990 = 100)													
Index CO_2 excluding LUCF (T-corrected)	100	100.8	102.4	101.7	103.8	105.4	106.2	101.1	105.6	103.4	105.6	107.6	108.5
Total [group of three] 1)	**100**	**101.0**	**102.3**	**101.8**	**103.1**	**104.0**	**104.4**	**99.5**	**102.6**	**100.3**	**101.2**	**102.2**	**102.1**
Index ('90; F-gases '95)													
Index [group of six composite] [1)]	**99.5**	**100.0**	**101.5**	**101.4**	**103.2**	**103.8**	**105.1**	**100.8**	**104.0**	**99.6**	**100.0**	**99.9**	**99.7**

[1)] Excluding LUCF.

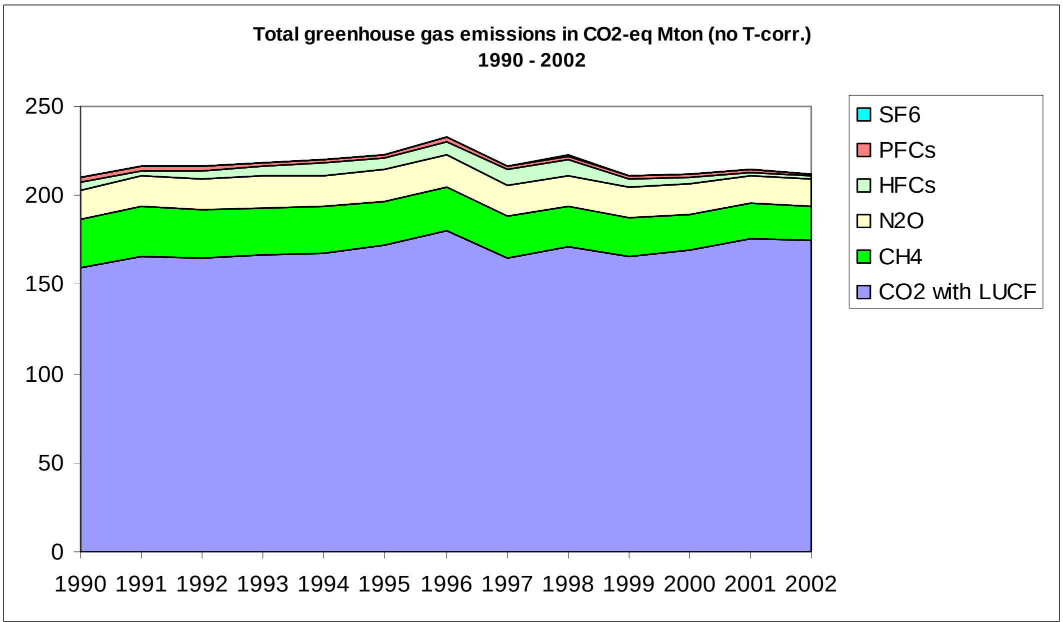


Figure 2.3. Trend in greenhouse gas emissions per gas 1990-2002 (no temperature correction)

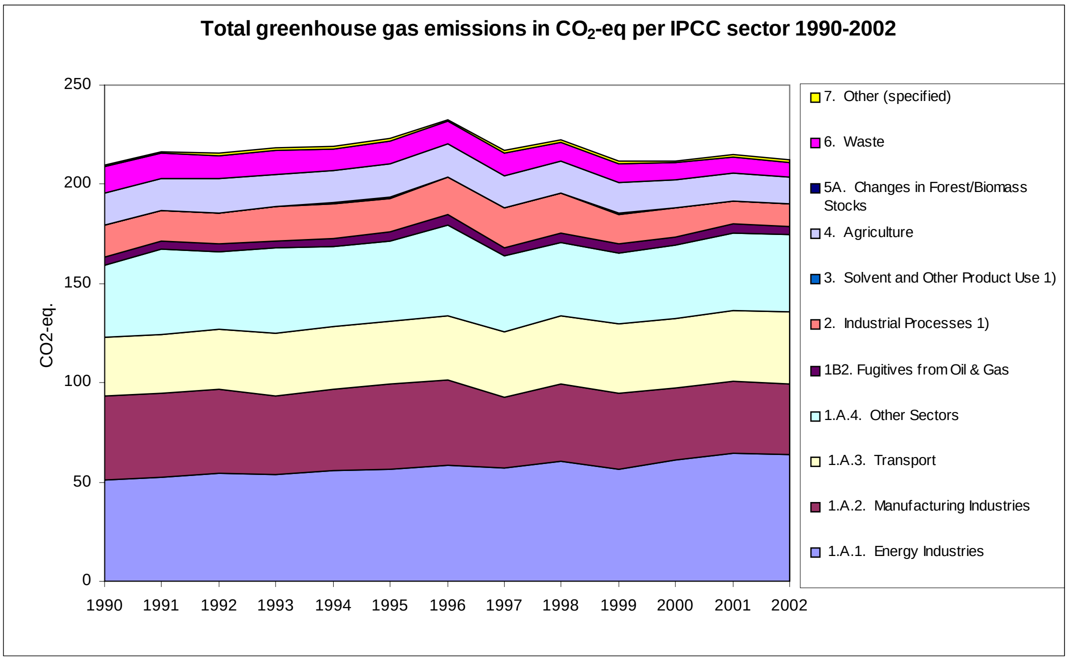


Figure 2.4. Trend in CO_2-eq. emissions per sector 1990-2002 (no temperature correction)

CH_4 emissions decreased by 32% in 2002 compared to the 1990 level, mainly due the decrease in the waste sector (-40%), the agricultural sector (-23%) and fugitive emissions from oil and gas (-33%). N_2O emissions decreased by about 7% in 2002 compared to 1990, mainly due to the decrease in the emissions from industrial processes (-17%), which compensated increases of emissions from fossil fuel combustion of 38% (mainly from transport).
Of the fluorinated greenhouse gases, for which 1995 is the reference year, emissions of HFCs and PFCs decreased in 2002 by about 75% and 35% respectively, while SF_6 emissions increased by 14%. Total emissions of all F-gases decreased by about 60% compared to the 1995 level.

The uncertainty in the *trend* of CO_2-equivalent emissions of the six greenhouse gases together is about ± 4%-point 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 ±3%, ±6%, ±11% and ±8% points, respectively (*Figure 2.5*). However, it should be kept in mind that the 2002 emissions, include additional uncertainty as explained in *Section 1.7*. For CO_2 the estimate of uncertainty in *annual* emissions is ±3%. The uncertainty in *annual* emissions of N_2O and CH_4 is estimated at ±50% and ±25%, respectively, and for HFCs, PFCs and SF_6 ±50% (see *Section 1.7*).

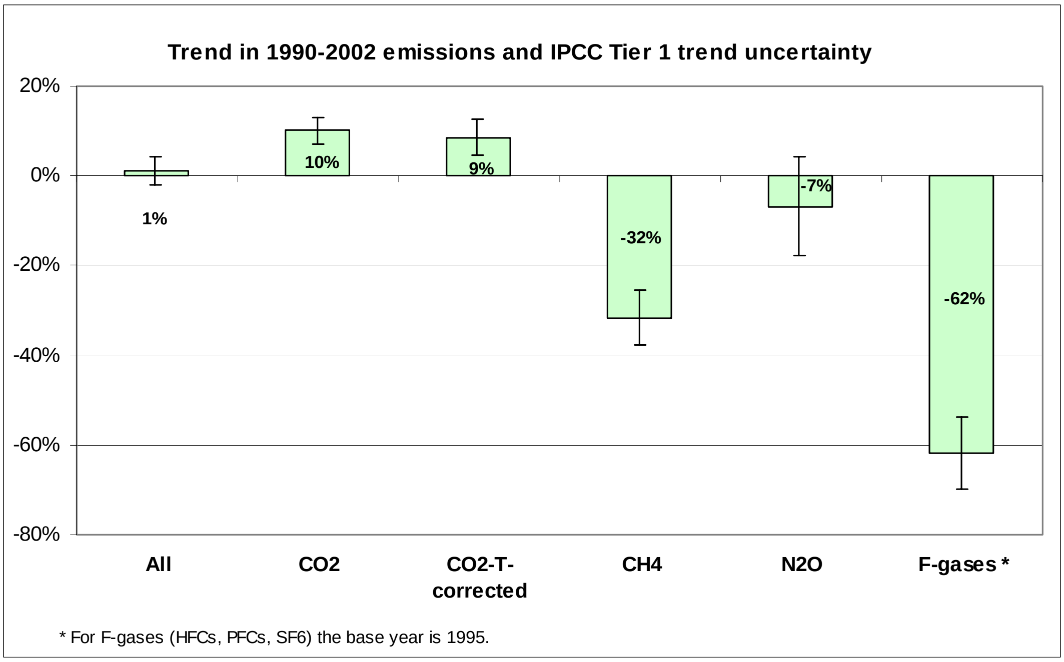


Figure 2.5. Trends in greenhouse gas emissions per gas 1990-2001 (1995-2001 for F-gases) and their uncertainty according to the IPCC Tier 1 trend uncertainty analysis, and, shows CO_2 with temperature correction)

2.2 Emission trends by gas

In *Table 2.3* and *Figure 2.6* the actual trend in actual CO_2 emissions is presented per source category. In 2002, total actual national CO_2 emissions increased since 1990 by 10%[3]. The largest increase in emissions (7 Tg) occurred in the transport sector. 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 small decrease in fossil-fuel related emissions of 4% in industry (1A2) appears to be caused by a decrease of feedstock emissions.

[3] This translates to an increase of 11.5% with both years temperature-corrected and an increase of 8.2% with only 2002 emissions temperature-corrected (i.e. compared to the base year level).

With a temperature correction, the 1990-2002 increase of CO_2 emissions is 1.5% points higher 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[4]. For more details refer to *Section 3.2.4*.

Table 2.3. CO_2 emissions and sinks per IPCC sector 1990-2002 (no temperature correction) (Tg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
TOTAL NET NAT. EMISSIONS Incl. LUCF	**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**
TOTAL NET NAT. EMISSIONS Excl. LUCF	**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**
1. All Energy (combustion and fugitive)	**158.1**	**166.1**	**165.1**	**167.2**	**168.0**	**170.9**	**179.1**	**163.6**	**171.0**	**165.3**	**169.5**	**175.7**	**174.7**
A Fuel combustion total	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
1a Electricity and heat production	40.3	41.6	43.3	43.2	44.8	44.5	45.8	45.1	47.9	44.5	49.0	51.7	51.9
1bc Other transformation	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
2 Industry	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
3 Transport	29.4	29.4	30.6	31.2	31.3	32.1	32.6	33.1	34.2	35.0	35.2	35.5	36.3
4a Commercial/Institutional	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
4b Residential	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
4c Agriculture/Forestry/Fishing	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
5 Other	0.0	1.1	0.0	1.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B Fugitive fuel emissions	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.0	1.6	1.5	1.6	1.7	1.6
2 Crude oil and natural gas	**0.3**	**0.4**	**0.5**	**0.6**	**0.7**	**0.8**	**1.0**	**1.0**	**1.6**	**1.5**	**1.6**	**1.7**	**1.6**
2. Industrial processes (ISIC)	**1.6**	**1.5**	**1.3**	**1.2**	**1.4**	**1.4**	**1.4**	**1.4**	**1.3**	**1.3**	**1.2**	**1.4**	**2.0**
3. Solvent and other product use	**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**
5. Land-use change and forestry	**-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**
6. Waste	**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**
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**
Memo item, not included in national total:													
International bunkers	**39.8**	**41.3**	**42.4**	**44.3**	**42.9**	**44.3**	**45.4**	**48.4**	**49.5**	**51.2**	**53.5**	**57.6**	**57.4**
CO_2 Marine	35.3	36.3	36.5	37.8	36.1	36.6	37.2	39.5	39.8	41.1	43.4	47.7	47.1
CO_2 Aviation	4.5	5.0	5.9	6.5	6.7	7.7	8.2	8.9	9.7	10.1	10.1	9.9	10.3

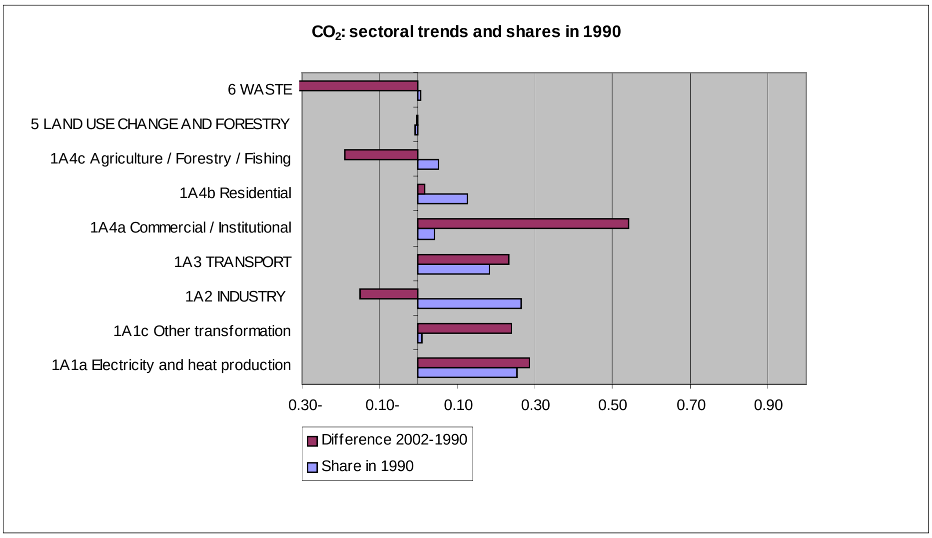


Figure 2.6. CO_2 emission shares and trends per IPCC sector, 1990-2002

[4] Actual CO_2 emissions increased by 13% in the period 1990-1996, while from 1996 till 2001 the CO_2 emissions decreased by about 3%. Temperature-corrected, these changes are 20% and 6% respectively.

In 2002, total CO_2 emissions decreased by -0.2% (0.4 Mton) compared to 2001, whereas the 2001 emissions showed a trend of +3.7% or +6.4 Mton (according to the data for 2001 provided in the previous NIR 2003, the change in 2001 was estimated at +3.5% or +6 Mton). This was mainly caused by the increased energy use in the energy, service and transport sectors. The emissions from industrial processes increased by 0.6 Mton.
In *Table 2.4* and *Figure 2.7* the trend in methane emissions is presented per source category. In 2002, total CH_4 emissions decreased by 32% compared to the 1990 level. Sectors that contributed most to the decrease were the waste sector (-40%), the agricultural sector (-23%) and energy (-29%) with 4.8, 2.5 and 1.3 Mton CO_2 respectively.

Table 2.4. CH_4 emissions per IPCC sector 1990-2002 (Gg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
TOTAL NET NATIONAL EMISSIONS	**1302**	**1326**	**1283**	**1261**	**1233**	**1190**	**1181**	**1105**	**1068**	**1020**	**968**	**949**	**891**
1. All Energy (combustion and fugitive)	**213.2**	**225.0**	**208.2**	**205.5**	**210.7**	**207.0**	**225.6**	**186.0**	**177.7**	**177.4**	**164.6**	**166.8**	**152.0**
A Fuel combustion total	34.4	35.8	36.0	34.3	33.5	36.6	37.3	29.6	31.1	33.1	33.6	32.7	31.9
1 Energy	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
2 Industry	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
3 Transport	7.7	6.8	6.6	6.3	6.1	5.9	5.5	5.2	5.0	4.8	4.4	4.1	4.0
4 a Commercial/Institutional	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
4 b Residential	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
4 c Agriculture/Forestry/Fishing	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
B Fugitive fuel emissions	178.8	189.3	172.3	171.2	177.2	170.3	188.3	156.5	146.6	144.3	131.0	134.1	120.1
2 Crude oil and natural gas	178.8	189.3	172.3	171.2	177.2	170.3	188.3	156.5	146.6	144.3	131.0	134.1	120.1
2. Industrial processes	**3.3**	**3.5**	**3.7**	**4.9**	**5.3**	**2.6**	**5.7**	**2.7**	**2.4**	**2.7**	**1.5**	**2.4**	**2.2**
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**
4. Agriculture	**505.3**	**517.1**	**505.8**	**497.8**	**483.1**	**477.0**	**463.6**	**445.8**	**434.7**	**425.0**	**410.5**	**409.7**	**389.1**
A Enteric fermentation	401.9	411.6	401.2	392.7	381.7	376.7	365.9	352.6	341.4	333.9	319.4	321.5	305.8
B Manure management	103.5	105.5	104.6	105.1	101.5	100.3	97.7	93.2	93.3	91.1	91.1	88.1	83.3
5. Land-use change and forestry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**578.5**	**578.3**	**562.8**	**550.8**	**531.9**	**501.5**	**484.5**	**468.6**	**451.6**	**413.1**	**389.8**	**368.1**	**346.1**
A Solid waste disposal on land	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
B Waste water handling	6.6	6.0	2.4	6.3	5.1	1.5	1.3	0.8	3.8	1.8	0.8	0.7	0.7
7. Other	**2.1**	**2.0**	**2.0**	**1.9**	**2.0**	**2.1**	**2.0**	**2.0**	**1.9**	**1.9**	**1.9**	**1.9**	**1.8**

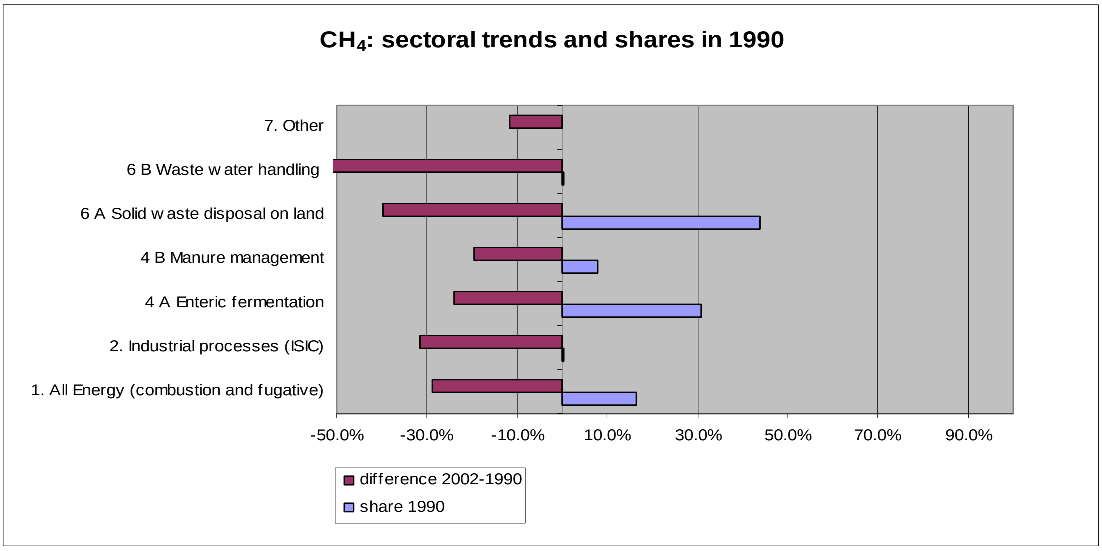


Figure 2.7. CH_4 emission shares and trends per IPCC sector, 1990-2002

In *Table 2.5* and *Figure 2.8* the trend in nitrous oxide emissions is presented per source category. In 2002, total N_2O emissions *decreased* by about 7% compared to 1990, mainly due to the decrease in the emissions from industrial processes of 1.3 Mton CO_2.eq. This compensated increases due to fossil fuel combustion (mainly from transport) of 0.2 Mton CO_2-eq., respectively (see *Table 2.7* and *Figure 2.10*).

Table 2.5. N_2O emissions per IPCC sector, 1990-2002 (Gg)

IPCC sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
TOTAL NET NATIONAL EMISSIONS	**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**
1. All Energy (combustion and fugitive)	**1.7**	**1.8**	**2.0**	**2.1**	**2.3**	**2.4**	**2.1**	**2.3**	**2.4**	**2.3**	**2.3**	**2.2**	**2.3**
A Fuel combustion total	1.7	1.8	2.0	2.1	1.9	2.4	2.1	2.3	2.4	2.3	2.3	2.2	2.3
1 Energy transformation	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
2 Industry	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
3 Transport	1.0	1.1	1.3	1.5	1.5	1.7	1.7	1.7	1.7	1.7	1.7	1.6	1.6
4 Small combustion	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
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
B Fugitive fuel emissions	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2. Industrial processes	**24.4**	**24.7**	**24.9**	**26.7**	**25.5**	**24.2**	**24.2**	**24.2**	**24.1**	**23.2**	**23.0**	**21.3**	**20.2**
3. Solvent and other product use	**0.7**	**0.6**	**0.7**	**0.6**	**0.6**	**0.6**	**0.5**	**0.4**	**0.5**	**0.5**	**0.4**	**0.4**	**0.3**
4. Agriculture	**21.9**	**22.4**	**25.1**	**25.6**	**25.3**	**26.9**	**26.4**	**26.0**	**25.2**	**25.2**	**23.2**	**22.6**	**21.9**
5. Land-use change and forestry	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
6. Waste	**0.4**	**0.4**	**0.4**	**0.5**	**0.5**	**0.5**	**0.5**	**0.6**	**0.5**	**0.6**	**0.6**	**0.7**	**0.7**
7. Other	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**

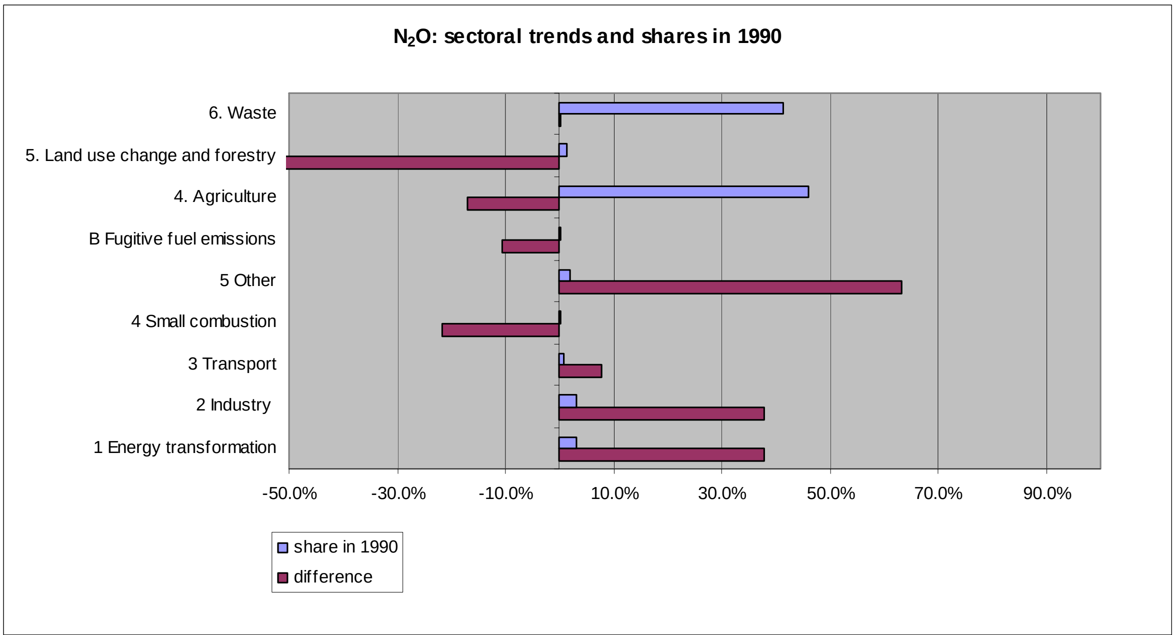


Figure 2.8. N_2O emission shares and trends per IPCC sector, 1990-2002

In *Table 2.6* and *Figure 2.9* the trend in F-gas emissions is presented per source category. In 2002, total emissions of all F-gases decreased by about 60% compared to the 1995 level (a 55% decrease compared to 1990), which is equivalent to 5 Mton CO_2-eq. Emissions of HFCs and PFCs decreased by about 75% and 35% in 2002, respectively, while SF_6 emissions increased by 14%.

Table 2.6. Actual emissions of HFCs, PFCs and SF_6, 1990-2002 (Tg CO_2-eq.)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
HFC total	4.4	3.5	4.4	5.0	6.5	6.0	7.7	8.3	9.4	4.9	3.9	1.5	1.6
PFC total	2.4	2.4	2.1	2.1	1.9	1.8	2.0	2.2	1.7	1.5	1.6	1.5	1.2
SF_6 use	0.2	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3
Total HFC/PFC/SF_6	7.1	6.0	6.7	7.2	8.5	8.2	10.0	10.8	11.4	6.7	5.8	3.3	3.1

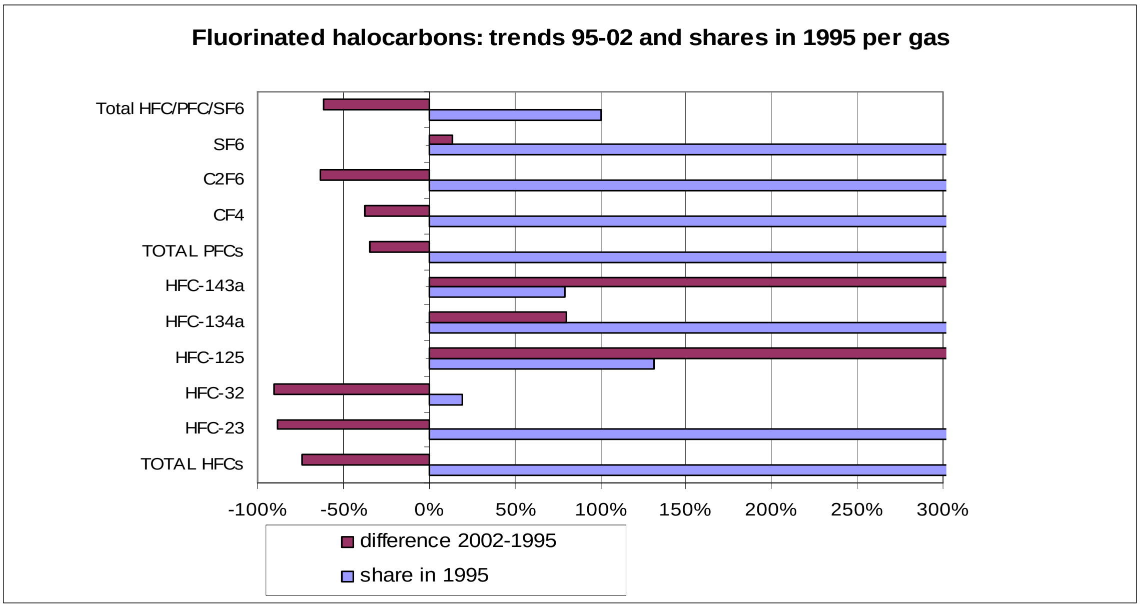


Figure 2.9. Shares and trends in actual emissions of fluorinated gases, 1995-2002

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 75% in 1990 to about 82% in 2002. In contrast, emissions of the other main categories decreased, the largest being those of industrial processes (from 8 to 5% share), waste (from 6 to 4% share) and agriculture (from 8 to 7% in 2002).
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 (23 %) and energy industries (24%). Energy as a whole showed a growth of about 9%. Clear exceptions are the waste sector, industrial processes and agriculture, which showed a decrease in CO_2-eq. emissions of 42%, 30%, and 14% respectively. Emissions from the residential and service sectors increased by 7% but these are substantially influenced by weather effects: when the temperature correction was included, these emissions increased by about 2%.

2.3.1 Energy Sector

The emissions from the energy sector (category 1) 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. Responsible for the increasing trend in this sector are the energy industries and the transport sector, of which CO_2 emissions increased by 24 and 23% since 1990. In contrast, the energy-related CO_2 emissions from manufacturing industries appear to have decreased a few per cent in 2001 and 2002. Actual CO_2 emissions from the other sector (residential, services and agriculture) increased by about 2%.
The relatively strong increases in emissions from the energy sector and the transport sector result in increases of their CO_2 share in the national CO_2-eq. total by 6% and 3%-points, respectively, to 30% and 17% in 2002. The 24% increase of the energy sector emissions is partly mitigated by about 10%-

points due to the strong increase in net import of electricity since 1999 (see *Table 3.7*), which is equivalent to about 4 Mton of CO_2 coming from domestic fossil-fuel generated electricity. We note that fugitive methane emissions from oil and natural gas decreased by 33% since 1990.

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
1A. Energy: fuel combustion	**159.0**	**167.0**	**165.9**	**168.0**	**168.6**	**171.6**	**179.6**	**163.9**	**170.8**	**165.2**	**169.3**	**175.4**	**174.4**
CO_2: 1. Energy industries	51.3	52.2	54.1	53.8	56.0	56.5	58.3	57.2	60.2	56.7	61.2	64.6	63.8
CO_2: 2. Manufacturing industries	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
CO_2: 3. Transport	29.4	29.4	30.6	31.2	31.3	32.1	32.6	33.1	34.2	35.0	35.2	35.5	36.3
CO_2: 4. Other sectors	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
CO_2: 5. Other	0.0	1.1	0.0	1.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CH_4	0.7	0.8	0.8	0.7	0.7	0.8	0.8	0.6	0.7	0.7	0.7	0.7	0.7
N_2O	0.5	0.6	0.6	0.7	0.6	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.7
1B2. Energy: fugitives from oil & gas	**4.1**	**4.4**	**4.1**	**4.2**	**4.6**	**4.4**	**5.0**	**4.3**	**4.6**	**4.5**	**4.3**	**4.5**	**4.2**
CO_2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.0	1.6	1.5	1.6	1.7	1.6
CH_4	3.8	4.0	3.6	3.6	3.7	3.6	4.0	3.3	3.1	3.0	2.8	2.8	2.5
N_2O	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2. Industrial processes [1]	**16.3**	**15.2**	**15.7**	**16.8**	**18.0**	**17.1**	**19.0**	**19.8**	**20.3**	**15.3**	**14.2**	**11.4**	**11.4**
CO_2	1.6	1.5	1.3	1.2	1.4	1.4	1.4	1.4	1.3	1.3	1.2	1.4	2.0
CH_4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
N_2O	7.6	7.7	7.7	8.3	7.9	7.5	7.5	7.5	7.5	7.2	7.1	6.6	6.3
HFCs	4.4	3.5	4.4	5.0	6.5	6.0	7.7	8.3	9.4	4.9	3.9	1.5	1.6
PFCs	2.4	2.4	2.1	2.1	1.9	1.8	2.0	2.2	1.7	1.5	1.6	1.5	1.2
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	0.3
3. Solvent and other product use [1]	**0.2**	**0.3**	**0.3**	**0.2**	**0.2**	**0.2**	**0.1**	**0.1**	**0.2**	**0.2**	**0.1**	**0.1**	**0.1**
CO_2	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
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)
N_2O	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.2	0.2	0.1	0.1	0.1
4. Agriculture	**17.4**	**17.8**	**18.4**	**18.4**	**18.0**	**18.3**	**17.9**	**17.4**	**17.0**	**16.7**	**15.8**	**15.6**	**15.0**
CH_4: Enteric fermentation	8.4	8.6	8.4	8.2	8.0	7.9	7.7	7.4	7.2	7.0	6.7	6.8	6.4
CH_4: Manure management	2.2	2.2	2.2	2.2	2.1	2.1	2.1	2.0	2.0	1.9	1.9	1.9	1.7
N_2O: Manure management	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
N_2O: Agricultural soils	6.6	6.7	7.6	7.7	7.6	8.1	8.0	7.8	7.6	7.6	7.0	6.8	6.6
5A. Changes in forest/biomass stocks	**-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**
CO_2	-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
6. Waste	**13.2**	**12.3**	**12.0**	**11.7**	**11.3**	**11.6**	**11.4**	**11.3**	**9.8**	**9.5**	**8.4**	**8.0**	**7.5**
CO_2	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
CH_4	12.1	12.1	11.8	11.6	11.2	10.5	10.2	9.8	9.5	8.7	8.2	7.7	7.3
N_2O	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2	0.2	0.2	0.2
7. Other (specified)	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**	**1.2**
CH_4: Solvents 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
N_2O: Polluted surface water	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2
NATIONAL TOTAL EMISSIONS [2]	**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**
Memo item, not included in national total:													
International bunkers	**39.8**	**41.3**	**42.4**	**44.3**	**42.9**	**44.3**	**45.5**	**48.5**	**49.6**	**51.2**	**53.5**	**57.6**	**57.4**
Marine	**35.3**	**36.3**	**36.5**	**37.8**	**36.1**	**36.6**	**37.2**	**39.5**	**39.8**	**41.2**	**43.4**	**47.7**	**47.1**
CO_2	35.3	36.3	36.5	37.8	36.1	36.6	37.2	39.5	39.8	41.1	43.4	47.7	47.1
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
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
Aviation	**4.5**	**5.0**	**5.9**	**6.5**	**6.7**	**7.7**	**8.3**	**8.9**	**9.7**	**10.1**	**10.1**	**9.9**	**10.3**
CO_2	4.5	5.0	5.9	6.5	6.7	7.7	8.2	8.9	9.7	10.1	10.1	9.9	10.3
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
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

[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).*

2.3.2 Industrial processes

The greenhouse gas emissions from industrial processes (category 2) have decreased by 30% since 1990. As can be seen in *Table 2.7,* N_2O emissions, mainly from nitric acid manufacture, is the main contributor to this source category. However, 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, are primarily responsible for the decreasing trend in this source category. The F-gas emissions had a share of almost 50% in total source category emissions in 1995; their share is now about 25%, of which HFCs and PFCs form by far the largest part. PFC emissions in the Netherlands stem mainly from aluminium production. CO_2 emissions from industrial processes contribute 18% to the group total and stem only for 1/3 or 1/4 from cement clinker production. A large fraction of cement production in the Netherlands uses imported cement clinker. Emissions of SF_6 contribute about 3% to the group total.

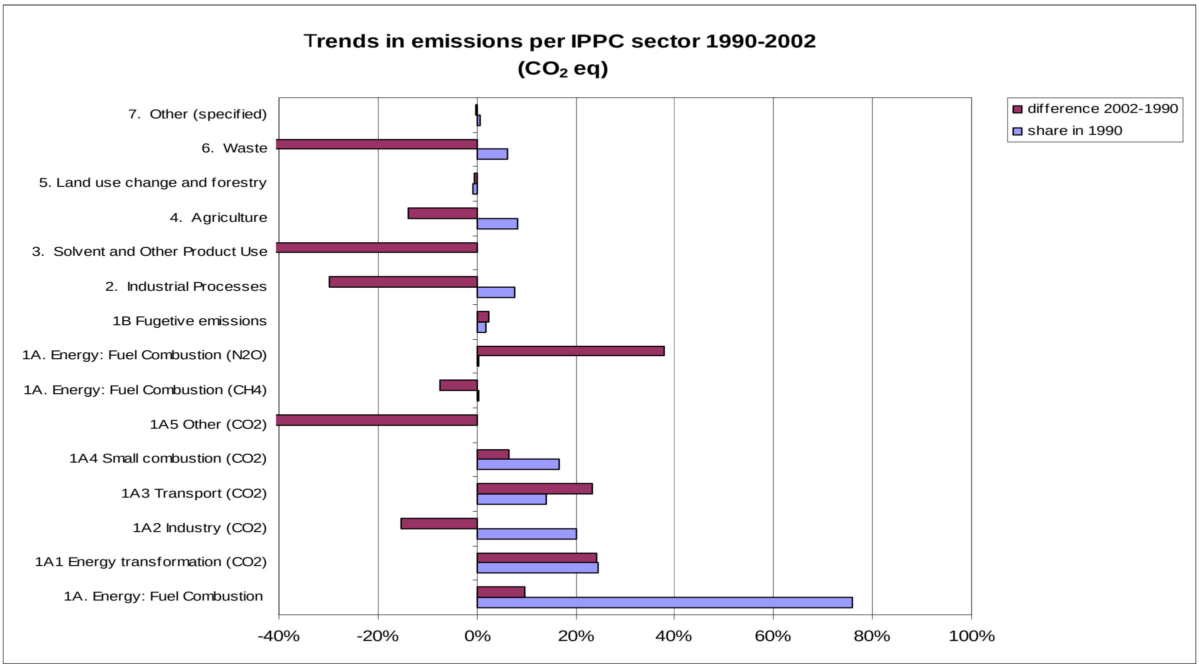


Figure 2.10. Shares and trends of greenhouse gas emissions per sector 1990-2002 (1995-2002 for F-gases), in CO_2-eq. (no temperature correction).

2.3.3 Solvents and other product use

The emissions from '*Solvent and other product use'* (category 3) should be discussed in conjunction with (very small) methane emissions reported under category 7, since the IPCC tables do not allow for methane emissions under category 3. This category contributes very little to the national total: only 0.1%, primarily from N_2O for dispersive uses. We note that the CO_2 emissions related to the use of products from non-energy use of fuels (e.g. lubricants, waxes, etc.) are not reported in this category but are included in the fuel combustion emissions reported under the manufacturing industry (1A2).

2.3.4 Agriculture

The emissions of the agricultural sector (category 4) have decreased by 14% since 1990, mainly through a decrease in CH_4 emissions from enteric fermentation (4A) of 24% by reduced livestock numbers. In its wake, CH_4 from manure management (4B) has also decreased similarly over time. At present, enteric fermentation contributes about 45% to this category's emissions as does N_2O emissions from agricultural soils (4D); N_2O from manure management only contributes 1% to the group total. N_2O from agricultural soils increased until 1995 due to changing practices in animal manure spreading on the fields (incorporation into the soil with the aim of reducing ammonia emissions). The decrease since 1998 is mainly due to a reduction of the use of synthetic fertilisers. At present, due to historical reasons the Netherlands reports no CO_2 emissions from agricultural soils. Indirect N_2O emissions from leaching and run-off of nitrogen from agricultural soils are reported under IPCC category 7, because the Netherlands' method provides only aggregated figures that include industrial sources as well.

2.3.5 Changes in biomass stocks (LUCF)

Of the Land Use Change and Forestry (LUCF) sector (IPCC category 5), the Netherlands presently only reports the net changes of CO_2 due to changes in forests and other biomass stocks (IPCC category 5.A). These result in a sink of about 1% on the national net total emissions. The variation over time is between -1.2 and -1.9 Mton CO_2.

2.3.6 Waste

The emissions from the waste sector (IPCC category 6) have decreased by about 40% since 1990, mainly through decreasing CH_4 emissions – predominantly from landfills – which is the dominating gas (97% percent of total emissions, N_2O emissions contributing the remaining 3%). The fossil-fuel related emissions from waste incineration 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. The reported CO_2 emissions from this sector, presently estimated not to be occurring in the waste category, vary considerably over time (decreased by 0.5 Mton in the 1990-2001 period), but the interannual variation suggests that there figures may not be very reliable.

2.3.7 Other

The Netherlands uses IPCC category 7 to reports its – very minor – CH_4 emissions from solvents and other product use, because the present reporting framework does not allow for CH_4 emissions under IPCC category 3. Total indirect N_2O emissions from leaching and run-off of nitrogen from agricultural soils and industrial sources are reported here, because these aggregated figures also include industrial sources, which make reporting of this total figure in Sector 4 (Agriculture) inappropriate. The latter N_2O emissions are labelled as '*Polluted surface water*' and are kept constant over time under the present methodology.

2.3.8 International transport

Finally, we discuss the trend in emissions from international transport, which is not part of the national total but is reported under the UNFCCC as well. This year the – very minor – CH_4 and N_2O emissions from international bunkers were included in the inventory. Total CO_2 emissions from this source category have increased by 44% or 17.6 Mton since 1990. In particular, marine bunker emissions contributed to this increase (+33% or 12 Mton) due to the marine bunkers large share in this category, but percentage-wise the emissions from international aviation increased much more (+130% or about 6 Mton). Total international transport emissions (road transport, marine and aviation) increased as fraction of the national total greenhouse gas emissions from 19% in 1990 to 27% in 2002.

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 2002 by 40 and 50%, respectively, compared to 1990. For SO_2 this is even 60%, and for NO_x, the 2002 emissions are about 30% 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*).

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, 2002).

Table 2.8. Trend in emissions of ozone and aerosol precursors, 1990-2002

Compound	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Emissions in Gg													
Total NO_x	599.5	586.5	578.8	554.5	529.9	517.8	501.7	470.7	460.8	464.3	447.2	436.2	429.9
Total CO	1130.4	1039.0	985.1	963.9	924.6	851.4	834.6	758.8	746.9	728.2	701.8	675.7	656.5
Total NMVOC	490.5	461.8	437.5	403.6	389.3	361.9	308.2	281.4	298.0	287.0	267.1	251.2	244.3
Total SO_2	203.5	173.4	167.4	160.3	146.2	142.5	135.5	117.7	109.8	104.8	90.8	90.1	85.4
Index (1990 = 100)													
Index total NO_x	100	97.8	96.5	92.5	88.4	86.4	83.7	78.5	76.9	77.4	74.6	72.8	71.7
Index total CO	100	91.9	87.1	85.3	81.8	75.3	73.8	67.1	66.1	64.4	62.1	59.8	58.1
Index total NMVOC	100	94.2	89.2	82.3	79.4	73.8	62.8	57.4	60.8	58.5	54.5	51.2	49.8
Index total SO_2	100	85.2	82.2	78.8	71.8	70.0	66.6	57.8	53.9	51.5	44.6	44.2	42.0

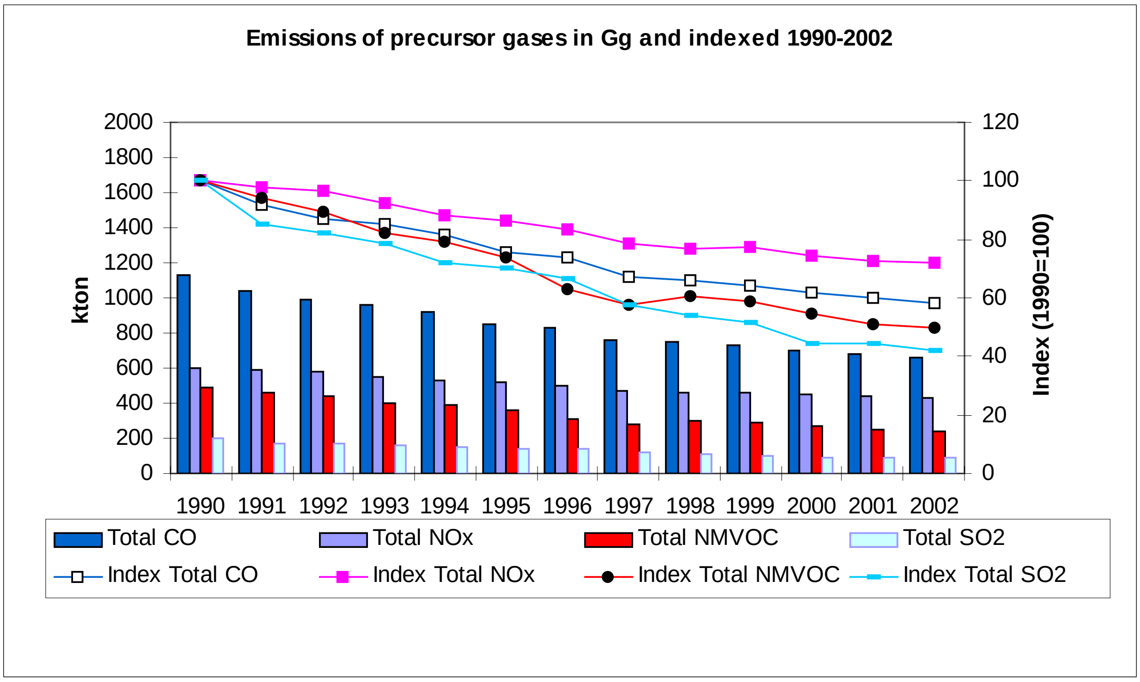


Figure 2.11. Trends in total emissions of NO_x, CO, NMVOC and SO_2, 1990-2002

3. ENERGY [CRF sector 1]

3.1 Overview of sector

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

A. Combustion fuel-related emissions:
- Energy industries (power generation, refineries, etcetera) (1A1)
- Manufacturing industry and construction (1A2)
- Transport (domestic) (1A3)
- Other sectors (residential, services, agriculture, etcetera) (1A4)
- Other fuel use (1A5)

B. Non-combustion fuel-related emissions:
- Solid fuels (1B1)
- Oil and gas (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 industry, 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 so as 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
1A. Energy: Fuel Combustion	159.0	167.0	165.9	168.0	168.6	171.6	179.6	163.9	170.8	165.2	169.3	175.4	174.4
CO2: 1. Energy Industries	51.3	52.2	54.1	53.8	56.0	56.5	58.3	57.2	60.2	56.7	61.2	64.6	63.8
CO2: 2. Manufacturing Industries	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
CO2: 3. Transport	29.4	29.4	30.6	31.2	31.3	32.1	32.6	33.1	34.2	35.0	35.2	35.5	36.3
CO2: 4. Other Sectors	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
CO2: 5. Other [1)]	0.0	1.1	0.0	1.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
CH4	0.7	0.8	0.8	0.7	0.7	0.8	0.8	0.6	0.7	0.7	0.7	0.7	0.7
N2O	0.5	0.6	0.6	0.7	0.6	0.7	0.6	0.7	0.7	0.7	0.7	0.7	0.7
1B2. Energy: Fugitives from Oil & Gas	**4.1**	**4.4**	**4.1**	**4.2**	**4.6**	**4.4**	**5.0**	**4.3**	**4.6**	**4.5**	**4.3**	**4.5**	**4.2**
CO2	0.3	0.5	0.5	0.6	0.7	0.8	1.0	1.0	1.6	1.5	1.6	1.7	1.6
CH4	3.8	4.0	3.6	3.6	3.7	3.6	4.0	3.3	3.1	3.0	2.8	2.8	2.5
N2O	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

[1)] Including emissions related to statistical differences (negative in 1992).

Note: The yellow shading indicate the years for which no recalculations or allocation improvements have been made in the past due to the data limitations.

We recall that the CO_2 emissions reported here are only the fossil-fuel related emissions, since CO_2 emissions from biomass combustion is assumed not to contribute to net CO_2 emissions and are therefore not included in the national total. 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). This not being the case, a correction is made in the CO_2 emissions from sources/sinks reported in the *Land Use Change and Forestry* sector (IPCC category 5). The inventory also provides separate information on CO_2 from organic sources (biomass combustion), which is discussed in *Section 3.1.2*).

The emissions from subcategories 1A1, 1A2 and 1B2 are based mainly on individual company reports (the part of the national pollutant emission register called 'ER-I') (see *Section 1.2*). Due to dataset limitations, the level of detail for these subcategories is often limited, for example, as will be shown in subsequent sections in the limited fuel-specified data for these categories. For other sources, i.e. other industries in the categories 1A1 and 1A2, and for other stationary and mobile sources, emissions are calculated using fuel consumption data and national default emission factors for CO_2 and N_2O, as well as source-specific emission factors for CH_4. Source-specific N_2O emission factors are applied to road transport (see *Section 3.2.3*). More details on the methodologies used are provided in *Annex 2*. The consistency of emissions over time found in these subcategories may also sometimes be limited. Another consequence, shown as yellow shading in the table, is the absence of recalculations or allocation improvements in the years 1991-1994.

Another aspect that limits consistency of fuel combustion emissions over time is the observation that *Statistics Netherlands* (CBS) did not revise the energy balance for the years 1991-1994, with the aim of improving the data and eliminating the statistical differences between apparent consumption, and the sum of sectoral energy consumption by fuel type. This has affected all source categories, so that not revising the energy consumption data for 1991-1994 several inconsistencies in the time series are likely to be caused by this anomaly (see NIR 2002 for more details on sectoral consequences in CO_2 emissions; Olivier *et al.*, 2002).

We recall that the Netherlands report on its CO_2 emissions related to feedstock use of fuels and other non-energy use under fuel combustion from the '*Manufacturing industry'* (1A2), instead of under '*Industrial processes'* (source category 2). These figures also include the CO_2 emissions from non-energy products during their use. The emissions are allocated here instead of under '*Solvents and other product use'*, (source category 3), because they are calculated using the IPCC Tier 1 method for these sources and storage factors that integrate immediate emissions during manufacture and emissions during the use of the products. The same holds for coke input as reducing agent in the iron and steel industry, which according to the *Good Practice Guidance* is also an industrial process source. However, it is also allocated to the manufacturing industry because in the Netherlands all emissions from the steel manufacturing industry are reported at an aggregated level, including emissions due to coke production. Thus the latter is not reported under '*Fugitive emissions from solid fuels*' (1B2) but under '*Fuel Combustion*' (1A).

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'). In addition, natural gas has a very large share in energy consumption and is used for space heating in the other sectors, in industry and power generation. Natural gas production generates related emissions such as methane fugitive emissions and relatively low-level CO_2 emissions from fuel combustion. Furthermore, the Netherlands makes use of the location of Rotterdam harbour at the mouth of the Rhine, for housing many large refineries, which export about half their products to the European market. As a consequence, the Netherlands has a relatively large petrochemical industry and the world's largest supply of marine bunker oils in Rotterdam. Moreover, Schiphol Airport is Western Europe's largest supplier of aviation bunker fuels (jet-fuel). 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, 2001).

In the Netherlands, most domestic commercial shipping enterprises buy their fuels from marine bunkers; therefore their energy consumption is included under '*International bunkers*' and not domestic consumption. This also applies to fisheries, whose current consumption is all allocated to International bunkers (see *Section 3.2.8*).

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 feedstock (non-energy) use of oil and

gas. Feedstock use of coal is not a key source, since it excludes the large amount of coke consumption in the iron & steel industry, of which all CO_2 emissions – including those from coke input – are combined and reported together. CO_2 emissions from oil and gas feedstock, and from the iron and steel industry, are not reported under source category industrial processes (CRF sector 2), but are allocated under fuel combustion by the Netherlands manufacturing industry (1A2) as chemical (1A1c) and iron and steel production (1A1a), respectively.
Of the non-CO_2 combustion sources, only N_2O from road transport appears to be a key source. The summed CH_4 emissions from all combustion sources also represent a key source. Methane from fuel combustion in the residential sector stems predominantly from gas losses during cooking (1A4b), which are also higher in this source category due to biofuel combustion. Of the non-combustion sources, only the CH_4 emissions from gas production and CH_4 emissions from gas distribution are key sources.

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**	**Key (L,T)**
1A2 CO_2	**Emissions from stationary combustion: Manufacturing Industries and Constr.**	**Key (L,T)**
1A2 CO_2	**Emissions from iron and steel industries**	**Key (L1,T1)**
1A2 CO_2	**Feedstock gas**	**Key (L)**
1A2 CO_2	**Feedstock oil**	**Key (L,T1)**
1A2 CO_2	**Feedstock coal**	**Non-key**
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**	**Key (L, T1*)**
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* *
1A3 N_2O	Mobile combustion: other	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 All	Coke production	Included in 1A2
1B2 CO_2	Misc. CO_2, of which 2/3 in category 1B2	Non-key
1B2 CH_4	**Fugitive emissions from oil and gas: gas production**	**Key (L,T1)**
1B2 CH_4	**Fugitive emissions from oil and gas: gas distribution**	**Key (L)**
1B2 CH_4	Fugitive emissions from oil and gas operations: other	Non-key

** Changed compared to the previous NIR.*

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) and feedstock emissions of CO_2 under industrial combustion (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, especially 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 and 2000 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% of total national emissions. Positive figures in the table indicate a 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 1990-2002 increase in CO_2 emissions is 1.5 % less than without this correction.

Table 3.2. Temperature correction for energy and CO_2 emissions per IPCC sector 1990-2002

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Heating-Degree Days (HDD-t) [HDD]		2677	3163	2829	3076	2835	2917	3504	2929	2821	2676	2659	2880	2720
HDD: 30-year moving average (HDD-av)		3211	3198	3203	3177	3156	3140	3124	3135	3133	3118	3098	3076	3068
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**
Space heating natural gas [PJ]														
1A1a	Electricity & heat production	2.8	0.2	2.0	0.5	2.0	1.4	-2.2	1.2	2.4	3.7	3.7	1.5	3.2
1A2a-e	Industry	13.7	0.9	8.0	2.1	7.1	5.1	-5.4	2.9	7.2	10.5	10.5	4.0	7.5
1A4a	Commercial/Institutional	17.9	1.4	16.1	4.3	14.3	9.6	-16.6	9.1	13.5	17.8	21.3	10.8	20.0
1A4b	Residential	52.6	3.2	36.1	9.1	29.8	21.4	-36.1	20.0	27.7	40.9	41.6	18.1	33.6
1A4c	Agriculture/Forestry/Fishing	24.1	1.3	15.0	3.9	13.6	8.8	-15.8	8.8	12.0	17.0	17.1	6.9	12.7
Total correction gas consumption		**111.0**	**7.0**	**77.1**	**19.9**	**66.8**	**46.3**	**-76.1**	**41.9**	**62.8**	**89.8**	**94.1**	**41.4**	**76.9**
CO_2 Emissions [Gg]														
1A1a	Electricity & heat production	160	10	110	30	110	80	-120	60	140	210	210	90	180
1A2a-e	Industry	770	50	450	120	400	290	-300	160	400	590	590	230	420
1A4a	Commercial/Institutional	1000	80	900	240	800	540	-930	510	760	1000	1190	610	1120
1A4b	Residential	2950	180	2020	510	1670	1200	-2020	1120	1550	2290	2330	1010	1880
1A4c	Agriculture/Forestry/Fishing	1350	70	840	220	760	490	-880	490	670	950	960	390	710
Total correction CO_2 emissions		**6230**	**390**	**4320**	**1120**	**3740**	**2600**	**-4250**	**2340**	**3520**	**5040**	**5270**	**2320**	**4310**

Note: HDD = Heating Degree Day; T = Temperature

CO_2 emissions from biomass

In the Netherlands, biomass fuels are used in various subsectors: electric power generation (e.g. waste wood), 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).
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 statistics. 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. However, this information is far from consistent, as up till now there is no well-defined procedure on how to report biomass consumption data in the environmental reports of individual companies. *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 at the beginning of this chapter, 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
1A Fuel combustion	3.4	2.7	2.6	3.3	3.5	3.6	5.3	6.0	5.2	4.9	5.1	6.4	7.2
1A1. Energy industries	1.9	IE	IE	IE	IE	1.9	3.8	4.6	3.7	3.4	3.5	4.7	5.5
1A2 Manufacturing industries	0.1	IE	IE	IE	IE	0.2	0.1	0.1	0.2	0.2	0.2	0.3	0.3
1A3 Transport	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A4 Other sectors:	1.3	1.3	1.2	1.2	1.1	1.1	1.1	1.1	1.1	1.1	1.2	1.2	1.2
a. Commercial/Institutional	0.1	0.1	0.1	0.1	NO	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
b. Residential	1.2	1.2	1.1	1.1	1.1	1.0	1.0	1.0	1.0	0.9	1.0	1.0	1.0
c.Agriculture/Forestry/Fisheries	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A5 Other (not elsewhere)	0.1	1.4	1.4	2.1	2.5	0.3	0.3	0.3	0.2	0.3	0.3	0.3	0.3
Total memo CO_2 from biomass	3.4	2.7	2.6	3.3	3.5	3.6	5.3	6.0	5.2	4.9	5.1	6.4	7.2

Note: IE = Included elsewhere; 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). Therefore the IEFs for combustion of biomass vary significantly over time, but nevertheless they are included in the CRF. In the documentation boxes of the CRF the total amount of biomass consumption which is not included in the Dutch Energy Statistics is documented. This amount is increased in the period 1990 (14.7 PJ) to 2002 (31.6 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.
In 2003, an initiative has been taken to establish a fixed reporting requirement in the annual environmental reporting of individual firms for biomass-related emissions. This will eventually lead to a situation in which each company reports its biomass fuel and the related emissions separately from its fossil-fuel related emissions. In this way, the quality of both the future biomass and fossil-fuel related CO_2 emissions will be improved. Additional research will be required to improve the estimation and allocation of biomass emissions for the whole 1990-2001 period.

3.2 Fuel combustion [CRF category 1A]

The trends per IPCC sector in emissions from fuel combustion have been summarised in *Table 3.4*. Since 1990, CO_2 emissions have increased by about 10%, mainly due to the increase in emissions in the electricity and heat production sector (29%) and transport sector (22%). The largest increase in emissions (11.6 Tg) occurred in the electricity and heat production sector. 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 small decrease of 4% in fossil fuel-related emissions in this industry (1A2) appears to be caused by a decrease of feedstock emissions.
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 3% (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 stationary fuel combustion subsectors and road transport is also estimated to be about 3 to 4%. The uncertainty for other sources is not well known. This applies particular to feedstock use of oil products and other mobile sources (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 3%; the Tier 1 *trend* uncertainty in national total CO_2 emissions 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.

Table 3.4. Emissions and sinks for the energy sector 1990-2002 (CO_2 in Tg; Others in Gg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CO_2													
All Energy (combustion and fugitive)	**158.1**	**166.1**	**165.1**	**167.2**	**168.0**	**170.9**	**179.1**	**163.6**	**171.0**	**165.3**	**169.5**	**175.7**	**174.7**
A. Fuel combustion total	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
1a Electricity and heat production	40.3	41.6	43.3	43.2	44.8	44.5	45.8	45.1	47.9	44.5	49.0	51.7	51.9
1 bc Other transformation	11.0	10.6	10.9	10.6	11.2	12.0	12.6	12.1	12.3	12.1	12.2	13.0	11.9
2 Industry: fuel combustion	33.9	32.9	33.2	31.6	32.2	33.4	34.2	35.5	30.0	28.6	26.3	26.9	26.2
Industry: feedstock emissions	8.3	9.8	9.4	8.3	8.7	9.2	8.8	0.0	9.2	9.6	10.0	9.5	9.6
3 Transport	29.4	29.4	30.6	31.2	31.3	32.1	32.6	33.1	34.2	35.0	35.2	35.5	36.3
4a Commercial/Institutional	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
4b Residential	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
4c Agriculture/Forestry/Fisheries	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
5 Other	0.0	1.1	0.0	1.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
B Fugitive fuel emissions	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.0	1.6	1.5	1.6	1.7	1.6
2 Crude oil and natural gas	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.0	1.6	1.5	1.6	1.7	1.6
CH_4													
All Energy (combustion and fugitive)	**213.2**	**225.0**	**208.2**	**205.5**	**210.7**	**207.0**	**225.6**	**186.0**	**177.7**	**177.4**	**164.6**	**166.8**	**152.0**
A. Fuel combustion total	34.4	35.8	36.0	34.3	33.5	36.6	37.3	29.6	31.1	33.1	33.6	32.7	31.9
1. Energy	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
2 Industry	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
3 Transport	7.7	6.8	6.6	6.3	6.1	5.9	5.5	5.2	5.0	4.8	4.4	4.1	4.0
4a Commercial/Institutional	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
4b Residential	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
4c Agriculture/Forestry/Fisheries	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
B Fugitive fuel emissions	178.8	189.3	172.3	171.2	177.2	170.3	188.3	156.5	146.6	144.3	131.0	134.1	120.1
2 Crude oil and natural gas	178.8	189.3	172.3	171.2	177.2	170.3	188.3	156.5	146.6	144.3	131.0	134.1	120.1
N_2O													
All Energy (combustion and fugitive)	**1.7**	**1.8**	**2.0**	**2.1**	**2.3**	**2.4**	**2.1**	**2.3**	**2.4**	**2.3**	**2.3**	**2.2**	**2.3**
A. Fuel combustion total	1.7	1.8	2.0	2.1	1.9	2.4	2.1	2.3	2.4	2.3	2.3	2.2	2.3
1 Energy	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
2 Industry: fuel combustion	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
3 Transport	1.0	1.1	1.3	1.5	1.5	1.7	1.7	1.7	1.7	1.7	1.7	1.6	1.6
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
4b Residential	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
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
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
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
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

3.2.1 Energy industries (CRF category 1A1)

3.2.1.1 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. The share of CO_2 emission from the energy industries in the national total was 32% in 1990 and 36% in 2002. For CH_4 and N_2O emissions from the energy subsector the share is relatively small and not considered a key source (*Table 3.5*).

Table 3.5. 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**
CO_2													
a. Public Electricity and Heat Production	40.3	41.6	43.3	43.2	44.8	44.8	45.8	45.1	47.9	44.5	49.0	51.7	51.9
b. Petroleum Refining	9.7	0.0	0.0	0.0	0.0	0.0	10.9	10.4	10.2	10.4	10.6	11.2	10.3
c. Manufacture of Solid Fuels/Other	1.3	10.6	10.9	10.6	11.2	11.2	1.7	1.7	2.0	1.7	1.7	1.8	1.7
CH_4													
a. Public Electricity and Heat Production	0.5	2.9	3.4	3.0	3.4	3.4	1.2	1.2	0.9	3.1	3.0	0.8	0.8
b. Petroleum Refining	0.3	0.0	0.0	0.0	0.0	0.0	0.8	0.3	0.1	0.1	0.3	0.0	0.0
c. Manufacture of Solid Fuels/Other	2.5	0.3	0.4	0.4	0.3	0.3	3.7	1.4	3.4	2.8	2.7	4.7	4.1
N_2O													
a. Public Electricity and Heat Production	0.4	0.4	0.4	0.4	0.1	0.1	0.0	0.0	0.4	0.4	0.4	0.3	0.4
b. Petroleum Refining	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
c. Manufacture of Solid Fuels/Other	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0

3.2.1.2 Methodological issues

A country-specific bottom-up (Tier2/Tier 3) method is used for calculating the emissions for fuel combustion in the '*Energy industry*' (1A1). The method is based on the emission data of the large individual point sources provided by the annual environmental reports of large companies and an additional estimation of the rest of the emissions based on the fuel consumption data per sector and country specific emission factors. A detailed description of the methodology for estimating the CO_2 emissions of this key source is provided in Spakman *et al.* (2003). Since the CO_2 emissions from the energy industry are considered to be a key source (see *Section 3.1*), the present Tier 2/3 methodology does comply with the *IPCC Good Practice Guidance* (IPCC, 2000). However, the Netherlands is presently elaborating methods for improving the time-series consistency, transparency and completeness of fuel combustion emissions from notably CO_2 from this sector. E.g. by using sectoral energy statistics for calculation of CO_2 emissions and incorporating individual company data where it improves the quality of the emissions while maintaining the consistency and transparency.

3.2.1.3 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 3.6*. Between 1990 and 2002 total emissions increased by 24%, from 51.3 to 63.8 Tg. A major part of this increase can be attributed to the increase in emissions from electricity production. This 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.

Table 3.6. CO_2 emissions from the energy industry 1990-2002 (Tg)

Source	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Public electricity and heat production	40.3	41.6	43.3	43.2	44.8	44.5	45.8	45.1	47.9	44.5	49.0	51.7	51.9
o.w. Liquid fuels	*0.2*	*IE*	*IE*	*IE*	*IE*	*0.0*	*0.2*	*0.2*	*0.1*	*0.4*	*1.5*	*1.7*	*1.8*
o.w. Solid fuels	*25.4*	*IE*	*IE*	*IE*	*IE*	*27.0*	*26.4*	*24.0*	*26.6*	*22.0*	*2.0*	*24.6*	*21.8*
o.w. Gaseous fuels	*13.8*	*IE*	*IE*	*IE*	*IE*	*16.7*	*18.4*	*19.8*	*18.8*	*21.0*	*8.9*	*21.3*	*21.8*
o.w. Other fuels/Unspecified emissions	*0.9*	*41.6*	*43.3*	*43.2*	*44.8*	*0.8*	*0.8*	*1.0*	*2.4*	*1.1*	*36.6*	*4.0*	*6.5*
Petroleum refining	9.7	IE	IE	IE	IE	10.4	10.9	10.4	10.2	10.4	10.6	11.2	10.3
Other energy industries	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
Total	**51.3**	**52.2**	**54.1**	**53.8**	**56.0**	**56.5**	**58.3**	**57.2**	**60.2**	**56.7**	**61.2**	**64.6**	**63.8**

Note: To reflect the degree of completeness, only emissions reported in the CRF files have been included here.

[1)] The emissions not reported by fuel type have been summed and reported in the CRF under '*Other fuels*', as is total fuel consumption associated with these unspecified emissions. This may explain the absence in this table of the increased liquid fuel emissions in 1999 observed in *Figure 3.1.*

As can be seen from *Table 3.6*, CO_2 emissions increase up to 1998. In 1999, however, the emissions due to public electricity and heat production suddenly drop 5% 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 an enormous 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 3.1*). 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 3.2*).

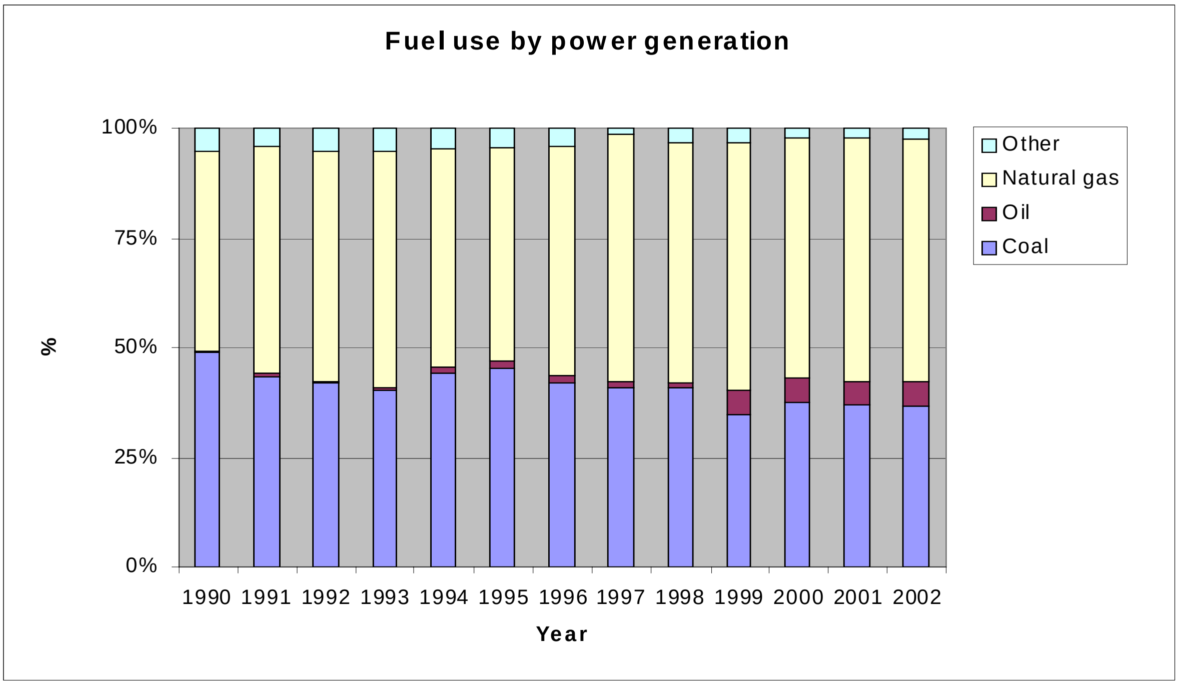


Figure 3.1. Sources of fuel use in power plants 1990-2002 (CBS, several years).

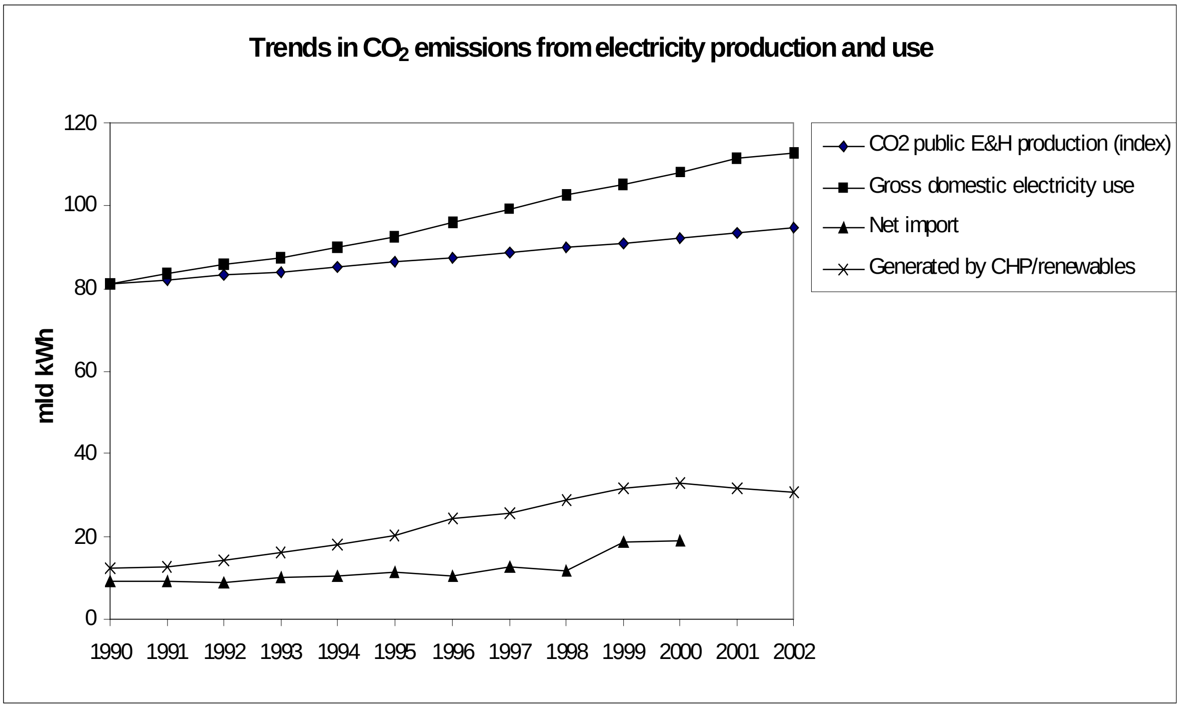


Figure 3.2. Trends in CO_2 emissions from electric power generation 1990-2002.

In cases where CO_2 and related fossil fuel consumption were not reported per fuel type by individual companies or when they did not properly match, fuel consumption and CO_2 emissions have been allocated under *'Other fuels'* in the *CRF Sectoral Background Tables*. Before the data from the national inventory are included in the CRF the IEF for CO_2 is calculated for each relevant record in the database. If the emission divided by the fuel consumption yields a value which differs more than 10% from the Dutch standard emission factor the emissions and fuel data will be allocated to the "other fuel" category in the CRF.
In principle no changes are made to the fuel use data and emissions reported by individual companies. During the preparation of the data for the remaining part of the sectoral combustion emissions fuel use from the national fuel statistics has to be corrected for the fuel use by the individual companies. In case there are flaws in the data from the individual companies (e.g. reflected in unexpected implied emission factors) these are not used to establish the fuel use in the non-individually reporting industry. The fuel use from the national energy statistics is then corrected by a pseudo fuel use in the individual companies calculated from the reported CO_2 emissions by using default national emission factors. The pseudo fuel use is not reported in the CRF. In short: the fuel use as stated in the CRF is not fully correct for the individual firms, but is correct for the remaining not individually registered part.

Table 3.7. Gross production, import, export, and gross consumption of electricity 1990-2002 (1000 mln kWh) Source: CBS, 2001a and www.statline.cbs.nl.

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
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
Fossil fuel, non-CHP	*56.1*	*58.3*	*59.0*	*56.8*	*57.7*	*56.8*	*56.7*	*58.2*	*58.4*	*51.3*	*52.6*	*62.4*	*65,4*
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*
CHP and other	*12.3*	*12.8*	*14.4*	*16.2*	*18.0*	*20.3*	*24.4*	*25.9*	*28.7*	*31.5*	*32.9*	*31.9*	*30,9*
Import	9.7	9.8	8.9	10.6	10.9	12.0	11.3	13.1	12.2	22.4	23.0	17.3*	16.4*
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
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

* 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.

In *Table 3.6*, where these data are presented for the energy sector, it clearly shows that for the public electricity and heat production sector last years the fraction of unspecified fossil-fuel related CO_2 emissions is large thanks to the problems mentioned above. Inspection of the refinery data reveals that the high-unallocated fractions in recent years for the total energy sector also relate to refineries, of which all reported CO_2 emissions since 1999 could not be associated with reported fossil fuel consumption**.**

3.2.2 Manufacturing industries and construction (CRF category 1A2)

3.2.2.1 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 'O*ther*'. It also includes all (process) emissions from metal production, coke production and feedstock emissions.
CO_2 emissions from manufacturing industries (1A2) are key source emissions. In addition, industrial process emissions of CO_2 from the iron and steel industry, and the CO_2 feedstock emissions from gas and oil, are key sources (see *Box 3.1*). The share of the emissions from manufacturing industries and construction in the national CO_2 emission was 26% in 1990 and 20% in 2002. The share of the other greenhouse gas emissions of this category is only very small (*Table 3.8*).

Table 3.8. Emissions from manufacturing industries and construction (1A2) (CO_2 in Tg; others in Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CO_2													
a. Iron and steel [1)]	6.3	IE	IE	IE	IE	6.5	5.6	5.5	6.4	6.5	6.2	6.1	5.6
b. Non-ferrous metals	0.2	IE	IE	IE	IE	0.3	0.3	0.2	0.3	0.3	0.2	0.2	0.6
c. Chemicals [1)]	24.1	IE	IE	IE	IE	24.7	25.4	19.8	21.1	20.2	18.6	19.3	18.9
d. Pulp, paper and print	1.6	IE	IE	IE	IE	2.0	2.0	2.0	2.0	1.6	2.1	2.0	2.0
e. Food processing, beverages & tobacco	4.2	IE	IE	IE	IE	4.5	4.8	3.2	4.4	4.6	4.2	4.2	4.2
f. Other	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
CH_4													
a. Iron and steel	0.6	IE	IE	IE	IE	0.7	0.4	0.1	0.1	0.6	0.8	0.7	0.7
b. Non-ferrous metals	0.0	IE	IE	IE	IE	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
c. Chemicals	1.0	IE	IE	IE	IE	3.0	0.2	0.1	0.9	0.9	1.0	0.6	0.6
d. Pulp, paper and print	0.1	IE	IE	IE	IE	0.3	0.2	0.1	0.0	0.2	0.2	0.1	0.1
e. Food processing, beverages & tobacco	0.5	IE	IE	IE	IE	0.5	0.5	0.2	0.3	0.6	0.5	0.3	0.3
f. Other	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
N_2O													
a. Iron and steel	0.0	IE	IE	IE	IE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b. Non-ferrous metals	0.0	IE	IE	IE	IE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c. Chemicals	0.1	IE	IE	IE	IE	0.1	0.3	0.5	0.1	0.0	0.1	0.1	0.0
d. Pulp, paper and print	0.0	IE	IE	IE	IE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
e. Food processing, beverages & tobacco	0.0	IE	IE	IE	IE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
f. Other	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

[1)] Including non-energy use of fuels e.g. as chemical feedstock.
Note: To reflect the degree of completeness, only emissions reported in the CRF files have been included here: IE = Included Elsewhere (for 1991-1994 no break-up in sub-sectors has been made in the CRF files).

3.2.2.2 Methodological issues

A country-specific bottom-up (Tier 2/Tier 3) method is used for calculating all emissions from the manufacturing industries (1A2), except for the CO_2 emissions from non-energy (feedstock) use of fuels. For these, the IPCC Tier 1 method is, in effect, used for calculating national total feedstock emissions. The method for fuel combustion is based on the emission data of the large individual point sources provided by the annual environmental reports of large companies and an additional estimation of the rest of the emissions based on the fuel consumption data per sector and country-specific emission factors. A detailed description of the methodology for estimating the CO_2 emissions of these key sources is provided in Spakman *et al.* (2003).
Since the CO_2 combustion emissions from manufacturing industries are considered to be a key source (see *Section 3.1*), the present Tier 2/3 methodology complies with the *IPCC Good Practice Guidance* (IPCC, 2000). The CO_2 emissions from non-energy/feedstock use of natural gas and oil products are also considered to be key sources. The present use of the Tier 1 methodology for estimating national total CO_2 emissions from these sources does not fully comply with the *IPCC Good Practice Guidance.*

3.2.2.3 Uncertainty and time-series consistency

The uncertainty of this category is estimated to be 3% in annual CO_2 emissions from combustion. The uncertainty in feedstock-related CO_2 emissions is estimated at about 10% for non-energy use of gas and coal and about 50% for feedstock use of oil products (see *Section 1.7* for more details).
Between 1990 and 2002 the emission of CO_2 due to fossil fuel use by industry decreased from 42.2 to 35.8 Tg (-15%) (*Table 3.10*), and was dominated by the chemical industry. This includes actual emissions of CO_2 from feedstock use of energy carriers of 8.3 and 9.6 Tg respectively. As shown in *Table 3.9* and *Table 3.11* the combustion emissions, also here in other industrial sectors, remained fairly constant in this period. According to national energy statistics between 14 and 19 Tg CO_2 is annually stored in oil products in the 1990-2000 period (*Table 3.12*). Although the growth of industrial produc-

tion in this period was 17% (in monetary units) emissions decreased. The difference 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). In addition, we noted that the trend in energy consumption in the industry, and thus in CO_2 emissions, was influenced by the fraction of fuel used for privately owned cogeneration facilities.

Table 3.9. CO_2 emissions from fuel use in the manufacturing industries and construction (1A2) (unit: Tg)

Sub-sector	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
a. Iron and steel [1]	6.3	IE	IE	IE	IE	6.5	5.6	5.5	6.4	6.5	6.2	6.1	5.6
b. Non-ferrous metals	0.2	IE	IE	IE	IE	0.3	0.3	0.2	0.3	0.3	0.2	0.2	0.6
c. Chemicals [1]	24.1	IE	IE	IE	IE	24.7	25.4	19.8	21.1	20.2	18.6	19.3	18.9
- Fuel combustion (Tier 1)	*15.8*	*IE*	*IE*	*IE*	*IE*	*15.4*	*16.6*	*10.3*	*11.9*	*10.6*	*8.6*	*9.8*	*9.3*
- Feedstocks	*8.3*	*9.8*	*9.4*	*8.3*	*8.7*	*9.2*	*8.8*	*9.5*	*9.2*	*9.6*	*10.0*	*9.5*	*9.6*
d. Pulp, paper and print	1.6	IE	IE	IE	IE	2.0	2.0	2.0	2.0	1.6	2.1	2.0	2.0
e. Food processing [2]	4.2	IE	IE	IE	IE	4.5	4.8	3.2	4.4	4.6	4.2	4.2	4.2
f. Other	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
Total	**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**

[1] Including non-energy use of fuels e.g. chemical feedstock.
[2] Including beverages and tobacco.
Note: IE = Included Elsewhere (for 1991-1994 no breakdown into sub-sectors in the CRF files).

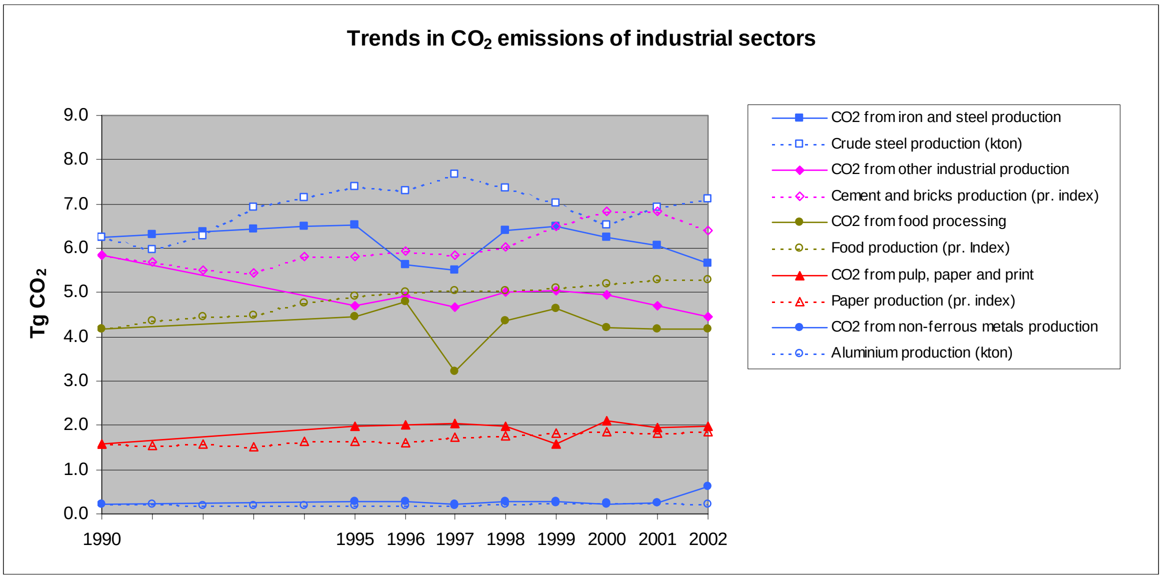


Figure 3.3. Trend analysis of CO_2 emissions in industrial subsectors, excluding the chemical industry, 1990-2002

Trends in subsectors are presented in *Figure 3.3;* here CO_2 emissions trends are compared to trends in underlying production data. Both trends can be concluded to be apparently rather closely related with a few exceptions (iron and steel production in 1996 and 1997; food processing in 1997; paper production in 1999). These exceptions could be either caused by large annual stock changes or by calculation errors. Further study has to disclose the exact nature of these discrepancies.

As mentioned in *Section 3.2.1*, in cases where CO_2 and related fossil fuel consumption were not reported per fuel type by individual companies, or when they did not properly match, fuel consumption and CO_2 emissions were allocated in the *CRF Sectoral Background Tables* under *'Other fuels'*. In *Table 3.10*, where these data are presented for the total industrial sector, the fraction of unspecified fossil-fuel related emissions was clearly shown to be about 27% in 1990, but increased to about 67% in 1997. Inspection of the subsectoral data reveals that high fractions in recent years relate to the iron and steel industry, of which not all CO_2 emissions are related to fuel consumption, and the chemical industry, where about 50% of reported CO_2 emissions were not or not properly associated with reported fossil fuel consumption. In 1990, these fractions were only 5% and 31%, respectively.

Table 3.10. CO_2 emissions by fuel type in the manufacturing industries and construction (1A2) (unit: Tg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Total industrial combustion	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
o.w. Liquid fuels	7.7	IE	IE	IE	IE	7.4	7.6	4.6	3.1	4.7	3.5	0.4	0.5
o.w. Solid fuels	5.0	IE	IE	IE	IE	5.2	1.2	0.7	0.8	1.6	0.7	0.5	0.5
o.w. Gaseous fuels	18.1	IE	IE	IE	IE	18.5	18.2	6.6	17.7	15.8	9.2	13.9	16.8
o.w. Other fuels [1)]	11.4	42.7	42.5	39.9	41.0	11.5	15.9	23.6	17.6	16.1	22.9	21.7	17.9
Fraction unspecified	*27%*	*100%*	*100%*	*100%*	*100%*	*27%*	*37%*	*67%*	*45%*	*42%*	*63%*	*60%*	*50%*

[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).

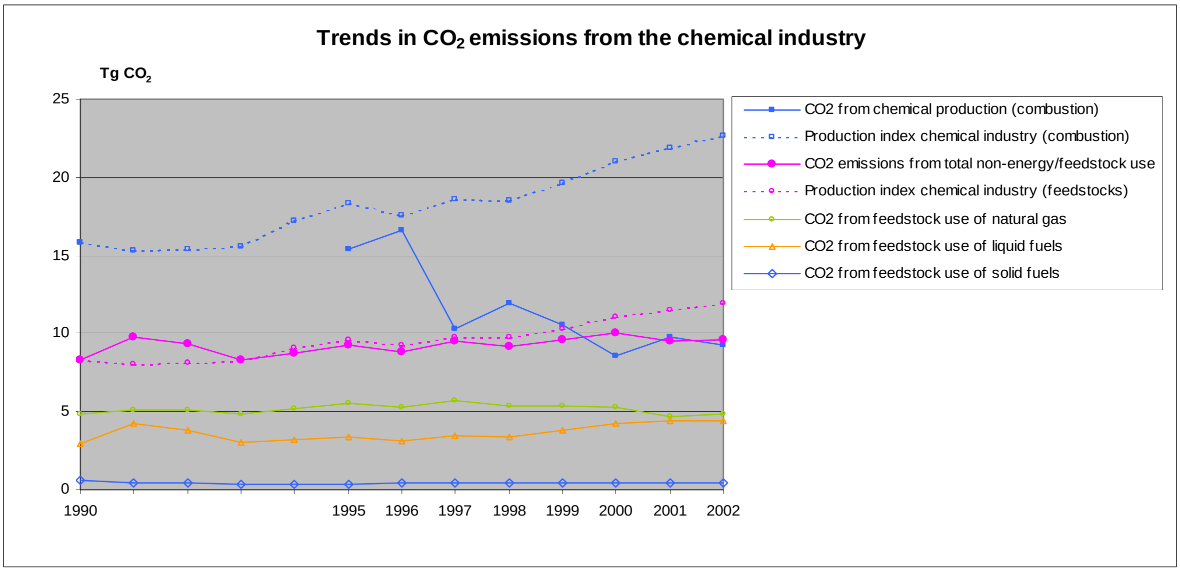


Figure 3.4. Trend analysis of CO_2 emissions in the chemical industry 1990-2002 (separate feedstock and combustion emissions based on IPCC Tier 1 analysis of feedstock-related emissions included in the sectoral total).

The Netherlands' industry has a relative large number of petrochemical plants, which shows up in actual CO_2 emissions associated with non-energy use of oil products and natural gas. *Tables 3 .11* and *3.12* demonstrate the CO_2 emitted and stored in feedstock products, as included in the *IPCC Reference Approach* calculation for CO_2. We stress, however, that the amounts actually included in the sectoral approach, which are to a large extent based on reports by individual companies, may differ substantially. According to the *Reference Approach* calculation the feedstock emissions can vary substantially from year to year.

In *Figure 3.4* trends of CO_2 emissions in the chemical industry are presented from combustion and non-energy use – derived using the IPCC Tier 1 analysis of feedstock-related emissions included in the sectoral total – and compared with trends in production data. We can conclude that the trends in feedstock emissions will follow the production index rather closely, but that the trend in emissions from fuel combustion, although showing a large interannual variation, is generally decreasing. This suggests that in the chemical industry too, energy conservation is a major factor in explaining the trend in its CO_2 emissions. Note that just as in *Figure 3.3* combustion emissions show a substantial drop in 1997, which could be caused either by large sectoral changes or by calculation errors. Further study has to disclose, here too, the exact nature of this discrepancy.

Table 3.11. Trends in CO_2 emitted by feedstock use of energy carriers according to the IPCC Reference Approach [1)] (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Liquids	2.9	4.2	3.8	3.1	3.2	3.3	3.1	3.4	3.4	3.8	4.3	4.4	4.4
Solids [2)]	0.6	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Gaseous	4.8	5.1	5.1	4.9	5.2	5.5	5.3	5.7	5.4	5.3	5.3	4.7	4.8
Total	**8.3**	**9.8**	**9.4**	**8.3**	**8.7**	**9.2**	**8.8**	**9.5**	**9.2**	**9.6**	**10.0**	**9.5**	**9.6**

1) Using country-specific carbon storage factors.

2) Due to change in definition of feedstock and energetic use of coke and coal in iron and steel production; data for 1999-2001 have been recalculated according to the old definition.

Table 3.12. Trend in CO_2 storage in feedstocks according to the default IPCC Reference Approach [1)] (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Liquid	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
Solid Fuels	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**

1) Using country-specific carbon storage factors.

3.2.2.4 Source-specific recalculations

As mentioned above, the incomplete reporting of activity data by individual companies introduced additional uncertainties in the calculation of total sectoral emissions, in particular of CO_2. In response to the observed intransparent and incomplete reporting an in-depth analysis of available energy statistics was made for the largest energy-consuming industries which report their CO_2 emissions through their Annual Environmental Report (MJV). This analysis showed that for one particular chemical industry approximately 85% of their reported CO_2 emissions are actually related to fuel use. However, these emissions are allocated in the PER as process emissions (i.e. from non-combustion activities because no corresponding fuel consumption was provided in the MJV). According to the adopted methodology for calculating total combustion emissions from the subsector, the latter resulted in an estimate of non-individually reported fuel consumption in the total chemical industry that was too high (by the corresponding amount).

Therefore a major revision of CO_2 emissions in the chemical industry was made for one individual company, where it was concluded that the processing of the incomplete reporting in these MJVs resulted in a double counting for the emissions of fuel use in this industry by about 2.5 Tg (85% of the emissions of this particular individual company) for the years 1997-2001. Another correction was made of the gas consumption in the chemical industry in 2000 and 2001, which was found to be in error when performing the re-analysis mentioned above. This resulted in a decrease of about 1.2 Tg CO_2 for the year 2000 and a similar reduction for the year 2001. Finally, a minor change was made in CO_2 emissions from other industries for 1990 and 1995-2001, due to a revision of gas consumption statistics. In *Table 3.13* we show the effects of these revisions on CO_2 emissions from the manufacturing industry, compared to the emissions reported in the previous NIR.

Table 3.13. Effects of recalculation of CO_2 emissions from manufacturing industries 1990-2001 (in Tg)

Source	Submission	1990					1995	1996	1997	1998	1999	2000	2001
Total	NIR 2004	42.2	42.7	42.5	39.9	41.0	42.6	43.0	35.5	39.2	38.2	36.3	36.4
(1A2)	NIR 2003	41.9	42.7	42.5	39.9	41.0	42.6	43.0	38.9	42.4	42.3	39.7	40.2
	Difference	***0.3***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***-3.4***	***-3.3***	***-4.1***	***-3.4***	***-3.8***
of which:													
- Chemical	NIR 2004	24.1	NA	NA	NA	NA	24.7	25.4	19.8	21.1	20.2	18.6	19.3
Industry	NIR 2003	23.9	IE	IE	IE	IE	24.7	25.4	23.3	24.6	24.5	22.0	22.4
(1A2c)	***Difference***	***0.3***	***NA***	***NA***	***NA***	***NA***	***0.0***	***0.0***	***-3.4***	***-3.4***	***-4.3***	***-3.4***	***-3.1***

3.2.2.5 Source-specific planned improvements

The Netherlands is presently elaborating methods for improving the time-series consistency, transparency and completeness of fuel combustion emissions from notably CO_2 from both the Energy and Manufacturing Industry sector (1A1 and 1A2) (for more details see *Section 10.4.7*). E.g. by using sectoral energy statistics for calculation of CO_2 emissions from stationary fuel combustion and incorporating individual company data where it improves the quality of the emissions while maintaining the consistency and transparency. This would include a recalculation of the CO_2 emissions from non-energy use of fuels, distinguishing prompt inadvertent emissions during manufacture of products and emissions from the domestic use of non-energy-use products. When adopted, this will be part of a project scheduled in the second half of 2004 to improve the transparency, consistency over time, completeness and accuracy of the CO_2 emissions for key emission sources in the Netherlands' inventory.

3.2.3 Transport (CRF category 1A3)

3.2.3.1 Source category description

The transport sector comprises road traffic; mobile off-road equipment such as tractors, and road and building construction equipment; rail transport; ships and aircraft. The latter two can be separated into domestic (inland) transport and international transport (bunkers). Pipeline transport (excluding natural gas) is also included in this sector. The transportation sector, dominated by road transport, has some particular features that warrant special attention:

- Allocation to transport or other sectors. This refers in particular to off-road mobile equipment;
- Allocation to domestic or international transport. This concerns shipping and aviation;
- 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 '*Verification'*.

General trend

The greenhouse gas emissions from the transport sector are summarised in *Table 3.14*. Obviously, CO_2 emissions from road transport are the dominant source category here, whereas most nitrous oxide emissions also belong in this subcategory. In *Box 3.2* all CO_2 emissions as well as the N_2O emissions from road transport seem to be key sources.

Table 3.14. 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
CO_2													
a. Civil aviation	0.5	0.3	0.2	0.1	0.2	0.3	0.3	0.3	0.4	0.4	0.3	0.2	0.2
b. Road transport	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
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
d. Navigation	0.9	0.8	1.0	1.0	0.8	0.9	0.8	0.8	0.8	0.8	1.0	1.0	0.9
e. Other 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
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
b. Road transport	7.3	6.4	6.2	6.0	5.7	5.5	5.1	4.8	4.6	4.4	4.0	3.8	3.7
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
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
e. Other transport	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													
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
b. Road transport	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
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
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
e. Other transport	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

By far the largest contributor to this sector is road transport, which accounted for 86% in 1990 (*Table 3.15*). Next are off-road vehicles, contributing about 9% in 1990. These off-road vehicles are used in agriculture, and for building and road construction. Since 1990 CO_2 emissions from total transport have increased by 25%. This increase is predominantly caused by an increase in energy consumption by road transport; here fuel consumption increased by 29% in this period.

Table 3.15. CO_2 emissions from transport in 1990 and 2002 by transport mode (Tg)

Transport mode	Emissions 1990 (Tg)	Share in 1990	Emissions 2002 (Tg)	Share in 2002	Increase 2002/1990 (Tg)	
b. Road transportation	25.4	86%	32.7	90%	7.4	29%
e. Other transportation (off-road)	2.3	9%	2.2	6%	0.0	-2%
d. Domestic shipping	0.9	3%	0.9	3%	0.0	5%
a. Domestic aviation	0.5	2%	0.2	1%	-0.3	54%
c. Railways	0.1	0%	0.1	0%	0.0	26%
Total	**29.1**		**36.3**		**7.1**	**25%**

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 54% in 2002 (*Figure 3.5*).

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, which is equivalent to about 20% of total national greenhouse gas emissions in 1990 and increases to around 30% 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 3.32* (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**	**Key (L,T1)**
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

** Changed compared to the previous NIR.*

Allocation of emissions

Road transport

For national policy purposes, air pollution from road transport is, in general, calculated from statistics on vehicle-km. However, fuel consumption that is based on vehicle-km is smaller 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 (i.e. a correction is made to convert emissions related to vehicle-km to emissions related to energy sales statistics). 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 (i.e. with fuel consumption figures that are somewhat different from energy supply statistics; see *Section 3.2.3.4* for more details).

Shipping

In the Netherlands, the national *Emission Registration* (ER) distinguishes between *inland shipping* and *international shipping,* the former based on fuel sold within the Netherlands and the latter on fuel sold from so-called bunkers. In the Netherlands, most domestic commercial shipping activities buy their fuel from marine bunkers. Therefore their energy consumption is included under 'International bunkers' and not in domestic consumption. International bunkers also include activities from fisheries, which are, at present, all allocated to '*International bunkers'* but should be reported under domestic source category 1A4c '*Commercial/Institutional/Fisheries'*.

Table 3.16. Allocation of non-CO_2 emissions from shipping and aircraft in domestic national inventories and inventories submitted to the UNFCCC

Source/sector	PER	UNFCCC
Shipping emissions (non-CO_2)		
• National inventory	• Inland shipping emissions: Corrected for fuel use abroad	• Ibid.
• International	• International shipping: Only the small part emitted in territorial waters	• All shipping emissions according to bunker fuel sales in the Netherlands [1)]
Aircraft emissions (non-CO_2)		
• National inventory	• Emissions from LTO cycles at Schiphol Airport (other airports are ignored)	• Ibid. - not corrected for the large fraction of LTO cycles related to combustion of bunkered fuel; - not corrected for the small emissions related to domestic cruise flights
• International	• Not recorded	• All international aircraft emissions according to bunker fuel sales in the Netherlands [1)]

[1)] Presently only reported for CO_2, including emissions from national fisheries that should be reported under domestic source category 1A4c '*Commercial/Institutional/Fisheries*'.

In addition, a small number of inland ships also use 'Dutch' fuel in other countries, for example when navigating along international waterways, where the emissions are not included in the ER reports. This minor correction was chosen for placement in reports in the IPCC format (although the guidelines want all emissions from Dutch fuel to be allocated to the Netherlands). Conversely, international ships consume a small part of their bunkered fuel in the Netherlands' territorial waters. The corresponding non-CO_2 emissions are included in the official Netherlands' national inventory along with emissions for all compounds, called the national *Pollutant Emission Register* (PER) (see *Table 3.16).* These (bunker) emissions are, however, excluded from national totals when reporting in the IPCC format. Therefore the emissions for NO_x, and SO_2 of the target group transport as reported in official Netherlands' inventories, are higher than those from the IPCC *1A3 'Transport'* category. For other compounds, however, this difference is rather small.

Air traffic

Domestic fuel sales figures for aircraft from the Netherlands' Energy Statistics were used for calculating CO_2 emissions from domestic air transport. This is different from the emissions recorded in the national Emissions Registration, which accounts only for aircraft emissions associated with the LTO cycles of Schiphol Airport (other airports are ignored). Indeed, by far the most aircraft activities (>90%) are related to Schiphol Airport in the Netherlands.
The national *Pollutant Emission Register* (PER) is used for the inventory of the emissions of non-CO_2 greenhouse gases, (see *Table 3.16*). In the PER system, however, the emphasis is much more on air quality and therefore on local emissions. A good estimate of relevant emissions is reflected in the LTO emissions at Schiphol Airport (Amsterdam), i.e. LTO cycles at other airports are ignored. On the other hand, the main part of these LTO cycles concern the combustion of bunkered fuel, which should be reported - according to the Guidelines - as international emissions. In this report, no attempt has

been made to estimate specific emissions related to all *domestic* flights (including cruise emissions of these flights), since these are almost negligible anyway.

Off-road mobile sources

This category comprises agricultural machinery such as tractors, and road building construction machinery. Emissions of these sources are reported under category *1A3e: 'Other Transport'.*

Description of road transport (CRF 1A3b)

CO_2 emissions

The share of road transport in national CO_2 emissions was 16% in 1990 and 18% in 2002. By far the largest contributor to this source category are passenger cars, which accounted for 64% in 1990. Next are trucks, contributing about 22% in 1990. CO_2 emissions from road transport increased by 29% in the period 1990-2002. This increase is predominantly caused by an increase in energy consumption by passenger cars and vans. Energy use by passenger cars increased by 18% and by vans more than doubled in this period, 1990-2002. 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 54% in 2002 (*Figure 3.5*).

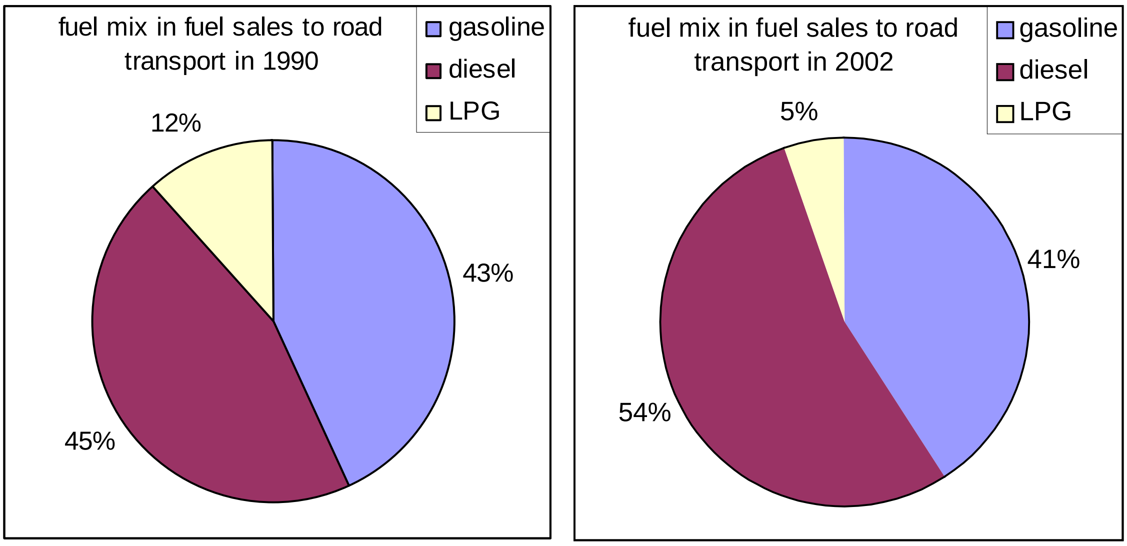


Figure 3.5. Shares of petrol, diesel and LPG in fuel sales to road transport 1990 and 2002.

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 2002: 7.3 to 3.7 Gg (*Table 3.14*). In 2002 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 1990-2002 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 2002. 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 3.17*). The fact that N_2O emissions from transport remained constant between 1999 and 2002, 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 2001. This has been visualised in *Figures 3.6* and *3.7.*

Table 3.17. Trends in N_2O emission factors for passenger cars 1990-2002

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
A. N_2O emission factors (mg/km)													
Gasoline total	9	11	13	14	15	17	16	16	16	15	14	13	13
o.w. gasoline without cat.	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
Share of cars with cat.	22%	32%	41%	47%	53%	58%	64%	68%	73%	77%	80%	83%	83%
Diesel	5	5	5	5	5	5	6	6	7	8	8	9	9
LPG	10	13	15	16	18	19	20	19	18	19	18	17	16
ALL FUELS	9	10	12	13	14	15	15	14	14	14	13	12	12
B. Share of fuels in passenger car km													
Gasoline	64%	64%	66%	68%	67%	68%	68%	68%	68%	68%	67%	67%	67%
Diesel	20%	20%	19%	19%	19%	20%	20%	21%	22%	23%	25%	25%	26%
LPG	16%	16%	15%	14%	13%	12%	12%	11%	10%	9%	8%	8%	7%

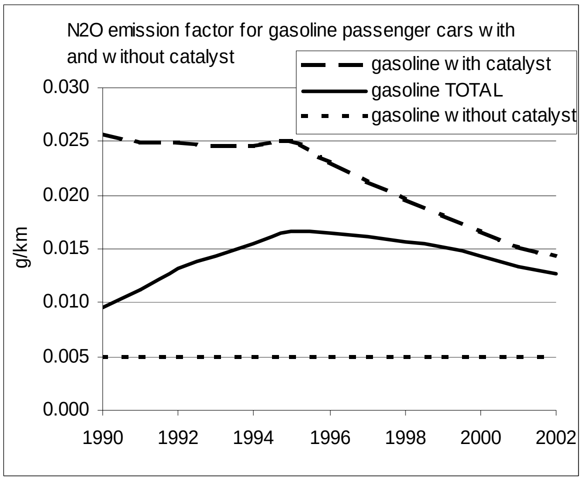


Figure 3.6. Trends in emission factors for N_2O from petrol passenger cars in the Netherlands in 1990-2002 due to increasing numbers of cars equipped with a catalytic converter.

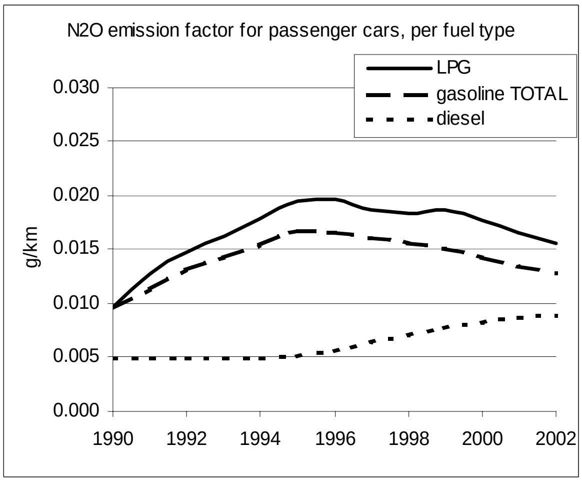


Figure 3.7. Trends in emission factors for N_2O from passenger cars in the Netherlands in 1990-2002 by fuel type.

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

The share of domestic waterborne navigation in national CO_2 emissions was less than 1% in both 1990 and 2002. The share of inland shipping in transport CO_2 emissions was around 3% in 1990 and 2002. Emissions in 2002 were about 0.9 Tg, almost equal to emissions 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 2002. 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 0.5 Tg CO_2 in 1990 and 0.2 Tg in 2001.

Description of other transportation (CRF 1A3e)

The share of other transport, mobile machinery and diesel rail transport, in national CO_2 emissions was around 1 - 1.5% in both 1990 and 2002. CO_2 emissions from this source category remained almost constant since 1990. The share of non-road transport – including domestic waterborne navigation and domestic aviation – in total CH_4 and N_2O emissions by transport is between 5 and 10%. Total N_2O emissions by this source category amounted to around 0.1 Tg in 1990 and have remained almost constant since 1990.

3.2.3.2 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 Spakman *et al.* (2003).
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. Besides, the methodology also distinguishes between three road types and takes cold starts into account.
A country-specific methodology is used for N_2O emissions from road transport. This is equivalent to the IPCC Tier 3 methodology. We calculated N_2O emission 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, motor cycles 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 to be 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 Spakman *et al.* (2003). Deliveries of fuel to internal navigation are excluded from this calculation, which is not in accordance with *IPCC Good Practice*. This is because in the Netherlands also domestic commercial inland ships are allowed

to make use of bunker fuels. This is also the case for national fisheries, but these emissions should be reported under another subcategory (1A4c, '*Commercial/Institutional/Fisheries'*). The result is an underestimation of fuel use and CO_2 emissions by domestic waterborne navigation. For more information on the international transport emissions is provided in *Section 3.2.8.*
Since the CO_2 emissions are considered to be 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 and country-specific emission factors, reported in Spakman *et al.* (2001). Deliveries of bunkers to international aviation are excluded from this calculation. Fuel use by domestic civil aviation in the Netherlands comes to around 0.5 PJ (Brok *et al*., 2000), whereas total fuel deliveries to domestic aviation were about 7 PJ in 1990 and 3 PJ in 2001. From this, one could conclude that military aviation must have a major share in CO_2 emissions by domestic aviation. This conclusion is supported by the fact that according to the Netherlands' Ministry of Defence in 2000 the Dutch military airforce used around 5 PJ of kerosene. However, 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 indeed included in the fuel deliveries to domestic aviation. See *Section 3.2.8* for more information on the international transport (bunker) emissions.

Other transportation (CRF 1A3e)

Information on fuel use by mobile machinery in the Netherlands is obtained via the Agricultural Economics Institute (LEI) and data on fuel use by diesel trains via Dutch Railways. These fuel use data are combined with country-specific emission factors for CO_2, reported in Spakman *et al.* (2003). Since the CO_2 emissions are considered to be a key source (see *Section 3.1*), the present Tier 2 methodology level complies with the *IPCC Good Practice Guidance* (IPCC, 2000).
IPCC Tier 1 methodologies are used for CH_4 and N_2O emissions from other mobile combustion (i.e. non-road). Activity data on fuel deliveries from Statistics Netherlands (CBS) were used. For CH_4, the emission factors are based on total VOC emission factors (g/GJ) from the literature (Klein *et al.*, 2002) and the mass fraction of CH_4 in total VOC from Veldt and Van der Most (1993). For N_2O, the emission factors are equal to the IPCC defaults.

3.2.3.3 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 2-3 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 questionnaire which 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.

Table 3.18. Fuel consumption due to road transport 1990-2002: fuel deliveries versus fuel consumption based on road transport statistics (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2002/1990
A. Deliveries														
Gasoline	152.0	152.4	158.3	167.2	169.8	175.1	177.1	176.5	178.3	180.7	176.0	180.4	183.6	21%
Diesel	159.1	163.2	174.9	176.4	180.4	183.8	192.8	198.4	207.0	219.9	232.5	237.1	245.6	54%
LPG	41.0	39.8	39.0	37.2	35.3	34.1	33.5	33.3	32.8	29.1	25.6	23.5	22.1	-46%
Total	352.1	355.4	372.2	380.8	385.5	393.0	403.4	408.2	418.0	429.6	434.1	441.0	451.3	28%
B. Consumption														
Gasoline	150.9	153.6	161.6	166.4	172.6	175.3	178.3	177.1	180.9	188.3	189.2	188.4	191.8	27%
Diesel	138.8	145.2	152.1	149.2	154.5	160.2	165.9	171.5	184.4	197.9	207.1	213.8	221.3	59%
LPG	35.6	36.1	34.1	30.6	30.9	27.7	26.7	26.5	25.5	23.5	21.3	20.9	20.3	-43%
Total	325.4	334.8	347.8	346.3	357.9	363.2	370.9	375.1	390.8	409.7	417.6	423.0	433.4	33%
Difference														
[B-A)/A]														
Gasoline	-1%	1%	2%	0%	2%	0%	1%	0%	1%	4%	7%	4%	4%	
Diesel	-15%	-12%	-15%	-18%	-17%	-15%	-16%	-16%	-12%	-11%	-12%	-11%	-11%	
LPG	-15%	-10%	-14%	-21%	-14%	-23%	-25%	-26%	-29%	-24%	-20%	-13%	-9%	
Total	-8%	-6%	-7%	-10%	-8%	-8%	-9%	-9%	-7%	-5%	-4%	-4%	-4%	

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; for domestic shipping the estimate is much higher, e.g. about 100% due to the exclusion of commercial inland shipping. However, we observed that fuel deliveries to domestic aviation show large interannual variations in the period 1990-2001 (between 3 and 7 PJ), and no clear trend can be distinguished. One explanation could be a variation in the number of military operations, but information on this subject is kept confidential.
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.

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

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. 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 5-10% (bottom line of the table). This difference is not so much caused by petrol, which shows only differences up to +8, with an average of around 2%, but rather by diesel and LPG figures, which differ annually up to -30%, with an average of about -13 and -19% for diesel and LPG, respectively.
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 passenger car use. As illustrated in *Figure 3.8*, 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.

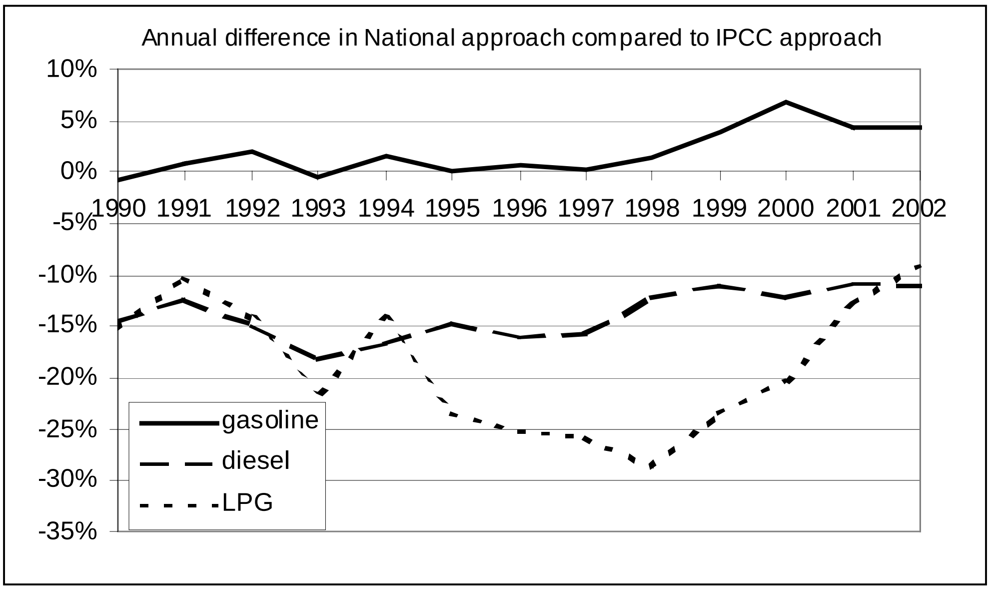


Figure 3.8. Annual differences per fuel type between fuel consumption (PJ) according to the national approach (based on vehicle-km statistics) and the IPCC approach (based on fuel deliveries to fuelling stations).

3.2.3.5 Source-specific recalculations

N_2O emissions from road transport

A decrease of N_2O emission factors of diesel road traffic (not including passenger cars) based on research by TNO by Riemsma *et al.* (2003) has resulted in an adjustment of the time series of N_2O emissions from road transport. TNO has measured real world N_2O emissions of Euro1 and Euro3 heavy-duty vehicles with exhaust control such as SCR[5]. This revealed that these heavy-duty vehicles emit less than 10 mg N_2O per kilometre. The IPCC default factor, which was previously used, is 30 mg/km. *Table 3.19* shows the effects of the correction on N_2O emissions by road transportation on the time series.

Table 3.19. Effect of recalculation of N_2O emissions (Gg) from road transport (category 1A3b) due to correction in $_{N2O}$ emission factors of heavy duty vehicles

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
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
NIR 2003	1.1	1.3	1.5	1.6	1.7	1.8	1.9	1.9	1.9	1.9	1.9	1.9
Difference	***-0.2***	***-0.3***	***-0.3***	***-0.2***	***-0.2***	***-0.2***	***-0.3***	***-0.3***	***-0.3***	***-0.3***	***-0.3***	***-0.4***

CO_2 emissions from other transport

The calculation of fuel consumption by off-road engines has been corrected for several years. The basis for the statistical correction was an adjusted interpretation of the attribution of energy consumption to the different sub-sectors including off-road machinery. This has resulted in an increase of CO_2 emissions by the other transport sector compared to NIR 2003. The effects on CO_2 emissions by other transport due to this correction are shown in *Table 3.20.*

Table 3.20. 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
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
NIR 2003	2.3	2.3	2.3	2.2	2.3	2.4	2.3	2.3	2.3	2.4	2.3	2.3
Difference	***0.3***	***0.2***	***0.2***	***0.3***	***0.1***	***-0.1***	***0.0***	***0.0***	***0.3***	***0.2***	***0.0***	***-0.1***

[5] SCR, Selective Catalytic Reduction

3.2.3.6 Source-specific planned improvements

The exclusion of domestic commercial ships in the calculation of domestic waterborne navigation emissions results in an underestimation of fuel use and emissions by domestic waterborne navigation. The same holds for national fisheries, which are at present included in the international bunker emissions instead of in domestic source category 1A4c '*Commercial/Institutional/Fisheries'*. Also, at present no non-CO_2 emissions are being calculated for international transport. Actions have been started in 2003 to revise and to expand this calculation, respectively, in accordance with *IPCC Good Practice*.

3.2.4 Other sectors (CRF category 1A4)

3.2.4.1 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 greenhouses), forestry and fisheries (1A4c).

Table 3.21. 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
CO_2													
a. Commercial/Institutional	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
b. Residential	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
c. Agriculture/Forestry/Fishery	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
CH_4													
a. Commercial/Institutional	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
b. Residential	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
c. Agriculture/Forestry/Fishery	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
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
b. Residential	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
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

Only stationary emissions are included in this source category. Emissions from mobile machinery are located in the transport category '*Other transportation'* (off-road vehicles, 1A3e). Emissions by national fisheries are also not reported here (under 1A4c), but under '*International bunkers'*. By far, most of the energy is used for room and water heating; some energy is used for cooling. The major fuel used in these sectors is natural gas.
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. However, we also need to recall that consistency over time of fuel combustion emissions for the years 1991-1994 is limited due to revision of the energy balances for other years in order to eliminate the statistical differences between apparent consumption and the sum of sectoral energy consumption. This has affected all source categories and thus may cause some inconsistencies in the time series (see previous NIR 2002 for more details on sectoral consequences in CO_2 emissions; Olivier *et al.*, 2002).
Nevertheless, from the table can be observed that CO_2 emissions from the service sectors increased substantially over time while emissions from agriculture decreased 1990. Looking at the trend of

methane and nitrous oxide emissions, which primarily originate from the residential sector, we see that these emissions are fairly constant over time, except for some anomalies for methane for specific years.

Box 3.3. Sub-sources of 'Other sectors' and identification as key source or non-key source (IPCC method 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

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 losses 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 2002, 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%).

3.2.4.2 Methodological issues

For calculation of greenhouse gas emissions country-specific methodologies, which are equivalent to the IPCC 1A4 Tier 1 method, are used. The emission factors are based on country-specific data. Since the emissions are considered to be a key source for CO_2 (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 Spakman *et al.* (2003).

3.2.4.3 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 three 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 3% 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* for more details). However, we stress that in the uncertainty estimate for fuel consumption data, the same figure of 3% is used as for other stationary combustion sources (energy and industrial sectors). In practice, the uncertainty of statistics for the '*Other sectors'* is likely higher due to the residual character of the data for this sector: consumption per fuel type is 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 assumed to be the energy consumption in the commercial and non-commercial service sectors.
From this process, it is clear that, in practice, the uncertainty in energy statistics for these three subsectors will likely be higher than 3%, in particular for the service sectors. Here we should recall that the consistency of fuel data for the years 1991-1994 over time is limited. In fact, the changes in the energy consumption data due to the revision of the energy balances for other years - in order to eliminate the statistical differences - may serve as an indication of the generic data quality of the 'final' data for 1990 to 2000. In *Table 3.22* we show the effect of these revisions on CO_2 emissions, as presented in the previous NIR. If these changes are indeed indicative for the data quality, 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.

Table 3.22. Indication of uncertainties: effect of recalculating CO_2 emissions from the other sectors due to the revision in 2002 of the energy balances to eliminate statistical differences (Tg)

	Source category		1990	1995	1996	1997	1998	1999	Changes up to (%)
1A4a	Commercial/Institutional	new	6.4	9.2	9.0	7.6	7.7	6.6	
1A4a	Commercial/Institutional	old	7.1	9.4	10.9	8.6	9.2	8.5	
1A4a	*Commercial/Institutional*	***diff.***	***-0.7***	***-0.2***	***-1.9***	***-1.0***	***-1.5***	***-1.8***	***20%***
1A4b	Residential	new	19.8	21.2	24.8	20.8	18.8	19.3	
1A4b	Residential	old	19.8	20.6	24.0	20.1	19.1	19.1	
1A4b	*Residential*	***diff.***	***0.0***	***0.6***	***0.8***	***0.6***	***-0.3***	***0.2***	***3%***
1A4c	Agriculture/Forestry/Fisheries	new	8.4	8.1	8.9	7.5	7.5	7.1	
1A4c	Agriculture/Forestry/Fisheries	old	7.4	8.9	10.3	7.7	7.5	7.8	
1A4c	*Agriculture/Forestry/Fisheries*	***diff.***	***1.0***	***-0.8***	***-1.4***	***-0.2***	***0.0***	***-0.7***	***15%***
1A4	Total Other sectors	new	34.6	38.5	42.7	35.9	34	33	
1A4	Total Other sectors	old	34.3	38.9	45.2	36.4	35.8	35.4	
1A4	*Total Other sectors*	***diff.***	***0.3***	***-0.4***	***-2.5***	***-0.5***	***-1.8***	***-2.4***	***7%***

Source: NIR 2002 (Olivier *et al.*, 2002)

Time series consistency

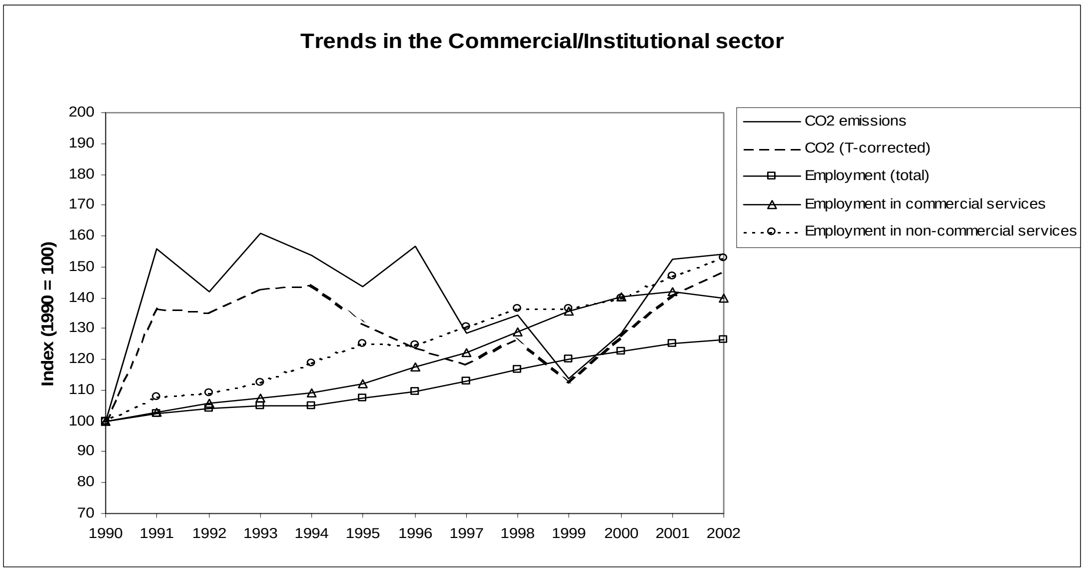
Keeping the qualification of the uncertainty in emissions in mind, we will look at the consistency of the emission trends. The 1990-2001 trend of CO_2 emissions shows an increase of 2 Tg or 6%. The main contributor to this increase was the service sector, with an increase of about 3 Tg, which is equivalent to about 50%. Half of this increase was compensated by a 17% decrease in the agricultural sector. Methane emissions follow similar trends.
To be able to analyse the effect over time of the trend in *anthropogenic* activities and implemented policies, a temperature correction term has been calculated for all CO_2 emissions from gas combustion that tries to filter out the interannual changes due to variation of weather. Resulting emissions trends for the '*Other sectors'* with this correction incorporated are presented in *Table 3.23*. This method is discussed in more detail in *Section 3.1.1*, where also the time series with the CO_2 correction terms is also presented. This temperature correction method aims at compensating for anomalous mild or cold years by using heating-degree days as input for the calculation. In the next section, this correction is to be considered as a *proxy* for the weather influence, since it is a simple method and space heating behaviour of the public will be influenced by more factors than only the average outside temperature.

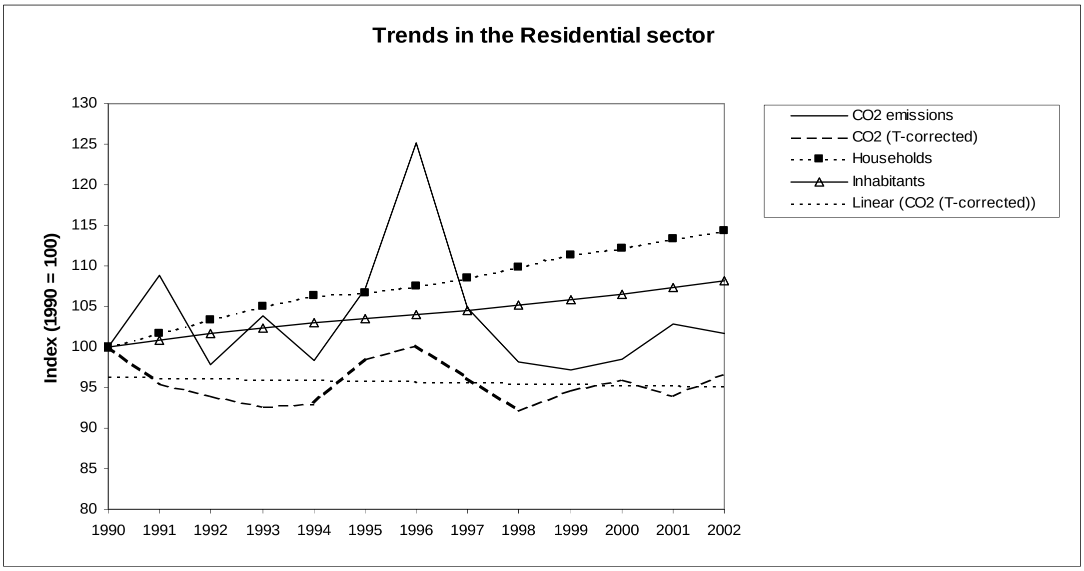
Table 3.23. Temperature-corrected CO_2 emissions from Other sectors (1A4) (in Tg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Residential sector	22.8	21.8	21.5	21.1	21.2	22.5	22.9	22.0	21.1	21.6	21.9	21.5	22.1
Commercial/Institutional	7.6	10.4	10.3	10.9	10.9	10.0	9.4	9.0	9.6	8.5	9.7	10.7	11.3
Agricultural and forestry	9.8	8.5	9.3	9.0	9.5	8.6	8.0	8.0	8.2	8.0	8.1	7.3	7.5
Total	**40.2**	**40.7**	**41.1**	**41.0**	**41.7**	**41.1**	**40.3**	**38.9**	**38.9**	**38.2**	**39.7**	**39.4**	**40.9**

Figure 3.9 compares the actual trend data for CO_2 of the three subsectors with temperature-corrected emissions and basic activity indicator trends of the residential, service and agricultural sectors. From these graphs we can draw the following conclusions:

- The temperature correction is indeed a *proxy* for the weather influence, since it shows that although the largest interannual variation is removed by the correction, the resulting time series is still not very smooth. This is in particular not the case for the residential sector, where the primary data quality is assumed to be rather good. The year 1996 clearly shows as a particular cold year, whereas other years are relatively warm (see *Section 3.1.1* for details).





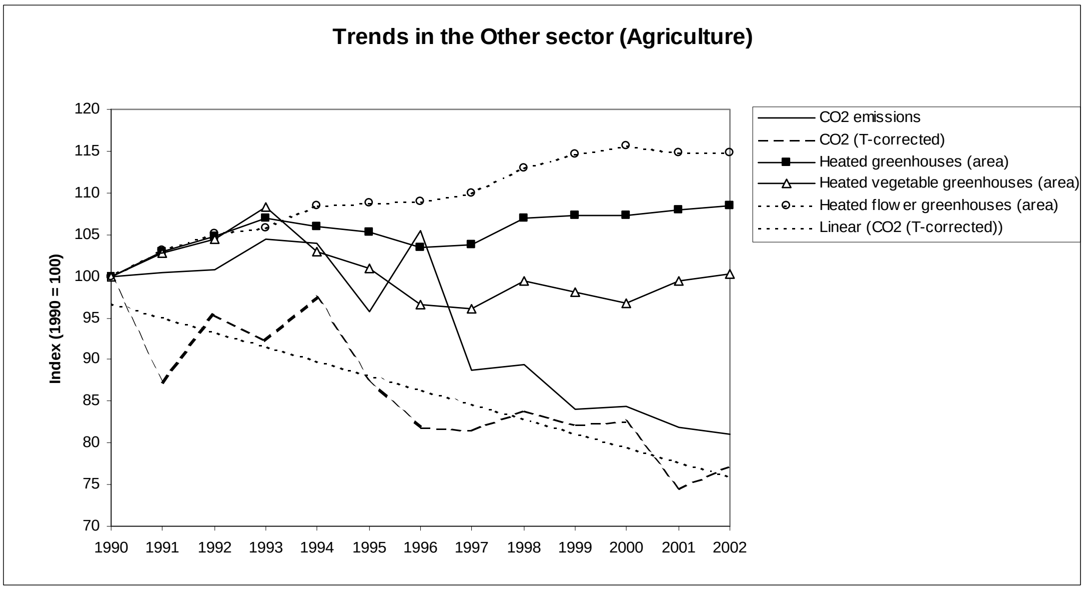


Figure 3.9. Trend analysis of CO_2 emissions from the 'Other sectors' (1A4): residential (top); commercial/institutional services (middle); agriculture (bottom)

- In the residential sector CO_2 emissions increased by 3% since 1990, but when accounting of a temperature correction, the structural, anthropogenic trend shows a decrease of 6% in this period. This can be compared with the increase in households of 13% since 1990. The number of residential dwellings increased similarly by 14% in the period, 1990-2000 (data for 2001 are not available yet), but their energy use has decreased by 4% 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).
- 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 40% in this period. The much higher emissions in the 1991-1994 period, both with and without temperature correction, may be a consequence of the generic uncertainty in this particular source category as discussed above combined with an artefact for these years due to not revision of the energy balances for these years. Therefore 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 40% of the emissions. As can be seen from *Tables 3.21* and *3.22* the preliminary estimate for 2001 shows a considerable extra increase for this sector of about 10% (about 1 Mton), but the trend indicator data do not confirm this.
- In the agricultural sector CO_2 emissions decreased by 17% since 1990, but taking into account a temperature correction; the structural, anthropogenic trends show a decrease of even 25% 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. This 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 should note, however, that included in the CO_2 emissions from the agricultural sector is fuel consumption for privately owned co-generation facilities, which may also provide electricity to the public grid.

3.2.4.4 Source specific recalculations

Although the recalculation of CO_2 emissions due to the elimination of statistical differences in the national energy balances as discussed in *Section 3.2.5.1* was done in previous years, one issue was not yet correctly dealt with. The statistical difference of natural gas (measurement difference) in the previous inventories started from the assumption that the difference was due to an uncertainty in the volume of gas distribution; therefore, the corresponding emissions were subtracted from the CO_2 emissions of the *'Other sectors'*. A new analysis of Statistics Netherlands showed that the uncertainty of this so-called measurement difference between gas supplied and gas sold to consumers must be attributed mainly to uncertainties in the measurement of the gas production volume in the gas production sector. Therefore, the extra amount of gas which was allocated to this measurement difference has been added to the *'Other sectors'*, resulting in an increase of corresponding emissions of the commercial sector for all years including the base year 1990. Another minor change was made in CO_2 emissions from residential sectors for 1990 and 1995-2001, due to a revision of the gas consumption statistics for private consumers (so-called BAK data; see previous section).Resulting emissions and a comparison with emissions previously reported are presented in *Table 3.24*.

Table 3.24. Effects of recalculation of CO_2 emissions of the other sectors (1A4) 1990-2001 (in Tg).

	Source		**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**
1A4a	Commercial	NIR2004	6.6	10.3	9.4	10.6	10.1	9.5	10.4	8.5	8.9	7.5	8.5	10.1
		NIR2003	5.9	10.3	9.4	10.6	10.1	8.6	9.1	7.6	7.7	6.7	7.9	8.8
		Difference	***0.7***	***0.0***	***0.0***	***0.0***	***0.0***	***0.8***	***1.3***	***0.9***	***1.2***	***0.8***	***0.6***	***1.3***
1A4b	Residential	NIR2004	19.9	21.6	19.5	20.6	19.6	21.3	24.9	20.8	19.5	19.3	19.6	20.4
		NIR2003	19.8	21.6	19.5	20.6	19.6	21.2	24.8	20.8	18.8	19.3	19.6	20.4
		Difference	***0.1***	***0.0***	***0.0***	***0.0***	***0.0***	***0.1***	***0.1***	***0.1***	***0.7***	***0.1***	***0.0***	***0.1***
1A4c	Agriculture	NIR2004	8.4	8.5	8.5	8.8	8.8	8.1	8.9	7.5	7.5	7.1	7.1	6.9
		NIR2003	8.4	8.5	8.5	8.8	8.8	8.1	8.9	7.5	7.5	7.1	7.1	7.0
		Difference	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***-0.1***
1A4	Total	NIR2004	34.9	40.4	37.3	40.1	38.5	38.8	44.1	36.8	35.9	33.9	35.2	37.4
		NIR2003	34.2	40.4	37.3	40.1	38.5	37.9	42.7	35.9	34.0	33.1	34.5	36.1
		Difference	***0.7***	***0.0***	***0.0***	***0.0***	***0.0***	***0.9***	***1.4***	***0.9***	***1.9***	***0.9***	***0.6***	***1.3***

3.2.5 Others (CRF category 1A5)

3.2.5.1 Source category description

There are two methods to collect information on the national energy use. One method is the national energy consumption, which is the sum of indigenous production plus import minus export minus bunkers plus/minus stock change. The other method is a bottom-up summing of all sectoral energy demands. In theory both methods should result in the same value, but as statistical observations are never 100% accurate, in practice, there is often a (small) difference between the two methods. The fuel use related to these *statistical differences* was included in the national inventory reports as a source of CO_2, since it is assumed that the associated fuel use is real and not accounted for in individual end use sectors. Usually, the statistical differences between supply and demand were smaller than 2%, but became much larger in the second half of the 1990s. Therefore the Energy Statistics Division of Statistics Netherlands (CBS) started a project to eliminate this statistical difference which resulted in 2001 in a total revision of the national energy balances for all years from 1990 onwards, except for 1991-1994. So, no more CO_2 emissions related to statistical differences are reported in the inventory other than for the years 1991-1994 (*Table 3.25*).

At present, there are no plans to revise the energy balances for the years 1991-1994 to eliminate the statistical differences since the CO_2 emissions related to the statistical differences for these years are relatively small compared to more recent years. Furthermore, revision of the energy balances of these years is expected to be much more difficult than the revisions made due to a major change in the sector classification in Dutch statistics since 1993.

Table 3.25. CO_2 emissions related to statistical differences 1991-1994

Fuel type	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
A. Energy (PJ)													
Coal		0	-4	9	-9								
Oil		25	15	26	24								
Natural gas		-14	-20	-20	-8								
B. CO_2 emissions (Tg)													
Coal		0.0	-0.4	0.8	-0.8								
Oil		1.8	1.1	1.9	1.8								
Natural gas		-0.8	-1.1	-1.1	-0.4								
Total	**0.0**	**1.0**	**-0.4**	**1.6**	**0.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Source: CBS, 1990-1999 (NEH/Energy Monitor).

3.2.6 Comparison of the 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 can be 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*.
In *Table 3.26* the results of the *Reference Approach* calculation are presented for 1990-2002 and compared with the official national total emissions reported as fuel combustion (source category 1A). The annual difference varies between -1.9% for 1992 and +5.8% for 1997, with an average of 0.8%. At present, the difference in 1990 is 1.1%. The 1990-2002 trend differs only slightly: 9.6% for the *National Approach* (NA) (= sum of sectoral emissions in source category 1A) and 10% for the *Reference Approach*. The *Reference Approach* (based on national energy balance data) shows a 10% increase in emissions from liquid fuels and a 15% increase from gaseous fuels; CO_2 emissions from solid fuels decreased in this period by 3%.

Table 3.26. Comparison of CO_2 emissions: Reference Approach (RA) versus National Approach (Tg)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Reference Approach													
Liquid fuels	52.3	51.4	52.4	53.5	54.3	54.6	55.4	54.9	55.4	56.3	56.6	58.4	58.3
Solid fuels	34.7	32.1	31.3	32.8	33.2	35.9	34.4	33.6	34.1	30.4	31.9	33.7	33.8
Gaseous fuels	72.5	80.2	77.7	80.1	77.9	79.6	88.9	83.5	82.9	80.6	81.7	83.9	83.5
Total RA	**159.6**	**163.7**	**161.4**	**166.4**	**165.3**	**170.1**	**178.7**	**172.0**	**172.4**	**167.3**	**170.1**	**175.9**	**175.6**
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**	**173.0**
Difference	*1.1%*	*-1.2%*	*-1.9%*	*-0.1%*	*-1.2%*	*0.0%*	*0.3%*	*5.8%*	*1.8%*	*2.1%*	*1.3%*	*1.1%*	*1.5%*

We stress that the results of the *IPCC Reference Approach* for the carbon content of crude oil input figures are considered as being rather sensitive in the Netherlands due to its relatively high amounts of crude oil refined and oil products exported. In general, there are several reasons for differences in the two approaches, some are country-specific other are inherent to the comparison method itself (see *Annex 4*). We recall that for the 1991-1994 period the National Approach still includes CO_2 emissions associated with statistical differences; in this period the differences between the RA and the NA are negative. The large discrepancy of more than 5% in 1997 is even higher than the 4.2% reported in the NIR 2003. This increased difference is mainly caused by changes due to recalculation in the manufacturing industry (see *Section 3.2.2*). Also a study to improve the CO_2 emission estimates from non-energy use (Neelis, 2003) provides indications for the relative weakness of the 1997 data. More specific research is needed to explain the differences between RA and NA, especially for the year 1997.

3.2.7 Feedstocks and non-energy use of fuels

3.2.7.1 Source category description

Emissions from the use of feedstocks are all allocated under categories 1A2 '*Manufacturing Industry and Construction*'. Most feedstocks are used in the iron and steel industry and in the chemical industry. The feedstock CO_2 emissions of oil and gas are considered as a key source for CO_2 emissions. The share of these CO_2 emissions in the national total was about 5% in 1990 and 7% in 2002 (see *Table 3.27*).
A fraction of energy carriers is stored in such products as plastics or asphalt. The non-stored fraction of the carbon in the energy carrier or product is oxidised, resulting in carbon dioxide emissions, either during the use of the energy carriers in industrial production (e.g. fertiliser production), during product use (e.g. solvents, lubricants) or in both (e.g. monomers). *Table 3.27* summarises the breakdown of these non-combustion emissions included as such in the PER. For a discussion on the time-series consistency we refer to *Section 3.4.7.3*.

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). The total CO_2 emissions related to the fossil-carbon content in the waste combusted in these facilities of about 1 Tg CO_2. However, these emissions are presently reviewed in order to clarify or remove the apparent inconsistencies in the present time series (see also *Section 8.5* on *Other waste*).

Table 3.27. Allocation of CO_2 related to non-energy use (NEU) of energy carriers (production and product use) reported under category 1A (in Tg)

Allocation	1990	1995	1996	1997	1998	1999	2000	2001	2002
Total of which:	**10.3**	**9.9**	**15.2**	**13.2**	**14.3**	**16.8**	**15.4**	**16.1**	**15.5**
- Prompt process emissions [1)]	***8.2***	***7.1***	***13.1***	***10.5***	***11.4***	***13.6***	***11.7***	***12.2***	***11.8***
o.w. ER-I-Iron and Steel [1A2a]	1.2	1.1	3.6	3.5	5.0	6.5	5.2	5.4	5.0
o.w. supplemental estimate [2)] [1A2a]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o.w. ER-I-Chemicals [1A2c]	2.0	3.6	6.2	3.7	3.6	3.1	2.9	3.9	0.0
o.w. supplemental estimate [2)] [1A2c]	1.0	0.5	0.0	0.1	0.0	0.9	1.2	0.2	2.6
o.w. ER-I-Other [1A-other]	0.2	0.0	0.5	0.0	0.1	0.1	0.1	0.2	0.0
o.w. supplemental estimate [2)] [1A-other]	3.8	1.9	2.9	3.2	2.6	3.0	2.4	2.5	4.2
- Use of non-energy products [1)]	***2.1***	***2.8***	***2.1***	***2.7***	***2.8***	***3.2***	***3.7***	***3.9***	***3.6***
o.w. chemical feedstock prod. [1A2c]	2.1	2.5	1.9	2.6	2.5	2.9	3.4	3.5	3.4
o.w. other products [1A2d/f]	0.1	0.3	0.1	0.2	0.3	0.3	0.3	0.3	0.3

[1)] The Netherlands reports these emissions under fuel combustion by manufacturing industries (1A2), with a few negligible exceptions.

[2)] Only supplementary estimates of emissions are made per industrial sector (fertiliser manufacture, organic basic chemicals, inorganic basic chemicals, other basic chemicals and five other small sectors) if the sum of the ER-I returns is lower than the top-down totals calculated according to the method described here (= total, cf. the IPCC Tier 1 method). If the ER-I returns are higher they are not corrected (i.e. not adjusted downwards).

3.2.7.2 Methodological issues

Country-specific methodologies are used for the emissions from feedstocks use and feedstock-product use with country-specific emission factors (see *Annex 2.1*). A full description of the methodology is provided in Spakman *et al*. (2003). In the sectoral approach the Netherlands uses the following data sources to estimate these emissions:

- prompt (i.e. direct or actual) CO_2 emissions *during use of chemical feedstocks* in the manufacturing industry (so-called process emissions). This is the sum of fuel-related non-combustion emissions reported by large companies in their annual environmental report and registered in the ER-I and a supplemental emission estimate to determine the CO_2 process emissions for the non-ER-I companies in the sector based on non-energy use of specific fuels in specific sectors which are known to give raise to inadvertent process emissions;
- CO_2 emissions during *product use of chemical feedstock products* (so-called indirect emissions). The emissions the Netherlands presently reports comprise the use of domestically produced non-energy-use products, both domestically used and the usage abroad of exported products. These emissions are calculated based on non-energy use of specific fuels in specific sectors, using the national storage factors from the IPCC Tier 1 approach to correct for long-term storage and subtracting the prompt emissions occurred during product manufacture that have been already been estimated above. These emissions may take place in other sectors then where they were manufactured, but they are allocated to the corresponding manufacturing industry.

Supplementary estimates of emissions are made per industrial sector: fertiliser manufacture, organic basic chemicals, inorganic basic chemicals, other basic chemicals and five other small sectors.
The allocation to the fuel combustion from the manufacturing industries (source category 1A2) is used since supplemental estimates are based on subsectoral non-energy use statistics in the energy balance and since in the reporting guidelines a comparison is demanded between total fuel combustion emissions of CO_2 in IPCC sector 1A and the IPCC Reference Approach for CO_2 that includes both CO_2

emissions from the production and the use of feedstock products. As mentioned in *Section 3.2.2.5* (and *Section 10.4.7*), the Netherlands has concrete plans to improve both method and data for calculating CO_2 emissions from this source category.

3.2.7.3 Uncertainty and time-series consistency

The uncertainty of CO_2 emissions from non-energy use of natural gas and coal (products) is estimated to be about 10% of annual emissions. The uncertainty of CO_2 emissions from use as chemical feedstock of oil products is estimated to be 50% in annual emissions (see *Section 1.7* for more details).
The industry in the Netherlands has a relatively large petrochemical industry, which shows up in actual CO_2 emissions associated with non-energy use of oil products and natural gas. For information please see *Tables 3 .28* and 3*.29* the CO_2 emitted and stored in feedstock products, as included in the *IPCC Reference Approach* calculation for CO_2. We stress, however, that the amounts included in the sectoral approach, which are to a large extent based on reports by individual companies, may differ substantially, as a comparison of the totals presented in *Table 3.27* and *Table 3.28* shows. We note that a part of the large interannual changes presented in *Table 3.27* are sometimes explained by varying allocation of fuel-related CO_2 emissions to combustion and non-combustion sources, e.g. in the iron and steel industry (see *Table 3.10*). However, also according to the *Reference Approach* calculation the feedstock emissions can vary substantially from year to year.

Table 3.28. Trends in CO_2 emitted by feedstock use of energy carriers (production and product use) according to the IPCC Reference Approach (Gg)*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Liquids	2 947	4 207	3 835	3 065	3 182	3 344	3 073	3 425	3404	3 796	4 251	4 432	4 410
Solids**	569	416	417	372	383	386	433	417	408	449	466	435	410
Gaseous	4 803	5 144	5 102	4 866	5 172	5 510	5 283	5 667	5 390	5 345	5 287	4 664	4 817
Total	**8 319**	**9 767**	**9 353**	**8 303**	**8 737**	**9 240**	**8 789**	**9 510**	**9 203**	**9 590**	**10004**	**9 531**	**9 638**

* Using country-specific carbon storage factors.

** Due to change in definition of feedstock and energetic use of coke and coal in iron and steel production, data for 1994 and 1999-2002 have been recalculated according to the old definition.

Table 3.29. Trend in CO_2 storage in feedstocks according to the default IPCC Reference Approach (Gg)*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Liquid	13 141	18 036	16 790	14 265	14 536	13 916	12 563	14 242	13 857	15 801	17 769	19 006	18 701
Solid fuels	610	544	550	702	558	601	632	576	594	157	224	321	410
Gaseous	534	572	567	541	575	612	587	630	599	594	587	518	535
Total	**14 285**	**19 152**	**17 907**	**15 508**	**15 669**	**15 129**	**13 781**	**15 448**	**15 050**	**16 552**	**18 580**	**19 845**	**19 646**

* Using country-specific carbon storage factors.

Between 1990 and 2002 the emission of CO_2 due to fossil fuel use by industry decreased from 42.9 to 35.8 Tg (-15%) (*Table 3.10*), which is dominated by the chemical industry. This includes actual and product related emissions of CO_2 from feedstock use of energy carriers of 10.3 to 15.5 Tg, respectively (*Table 3.27*).

3.2.8 International bunker fuels

3.2.8.1 Source category description

In *Table 3.30* both energy consumption and CO_2 emissions from international air transport and international shipping are presented per fuel type. In 2002, bunker emissions of CO_2 were about 17.6 Tg or 45% higher than in 1990. In particular, international aviation showed a very high growth of about 120%, whereas international shipping increased by 35%. Due to the much higher growth of international air traffic, its share in international bunker emissions increased from about 4% in 1990 to about 18% in 2002.

Table 3.30. International bunkers: energy consumption (PJ) and related CO_2 emissions (Tg) 1990-2002

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Energy consumption													
Marine bunkers	463	476	478	495	474	481	488	518	522	539	569	625	617
- heavy fuel oil	370	396	398	411	386	377	393	429	429	448	475	524	523
- petrol	89	80	80	84	88	100	90	84	88	86	88	94	89
- lubricant	4	ND	ND	ND	ND	4	5	5	5	5	6	7	5
Aviation bunkers	62	68	81	89	92	105	113	122	133	138	138	135	141
- jet fuel (kerosene)	62	68	81	89	92	105	113	122	133	138	138	135	141
- aviation petrol	0	0	0	0	0	0	0	0	0	0	0	0	0
Total bunkers	524	544	559	584	566	586	601	640	655	677	707	760	758
Emissions													
Marine bunkers	**35.3**	**36.3**	**36.5**	**37.8**	**36.1**	**36.6**	**37.2**	**39.5**	**39.8**	**41.1**	**43.4**	**47.7**	**47.1**
- heavy fuel oil	28.5	30.5	30.7	31.7	29.7	29.0	30.3	33.0	33.0	34.5	36.6	40.3	40.3
- petrol	6.5	5.8	5.8	6.1	6.4	7.3	6.6	6.1	6.4	6.3	6.4	6.9	6.5
- lubricant	0.3	ND	ND	ND	ND	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.4
Aviation bunkers	**4.5**	**5.0**	**5.9**	**6.5**	**6.7**	**7.7**	**8.2**	**8.9**	**9.7**	**10.1**	**10.1**	**9.9**	**10.3**
- jet fuel (kerosene)	4.5	5.0	5.9	6.5	6.7	7.7	8.2	8.9	9.7	10.1	10.1	9.9	10.3
- 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
Total bunkers	**39.8**	**41.3**	**42.4**	**44.3**	**42.9**	**44.3**	**45.4**	**48.4**	**49.5**	**51.2**	**53.5**	**57.6**	**57.4**

Source: CBS, 1990-2003 (NEH/Energy Monitor, Table 1.1; revised data).
N.B. Aviation petrol is included under jet fuel; ND = No data.

3.2.8.2 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 the *Revised IPCC Guidelines* prescribe that emissions from combustion of fuels delivered to both domestic inland shipping and fishing boats have to be considered as national emissions. In a subsequent submission this non-compliance will be eliminated. At present, a few points of total marine and aviation emissions of CO_2 are reported as domestic and included in national total greenhouse gas emissions (*Table 3.31*).
Table 3.32 presents the trend in greenhouse gas emissions from international bunkers for CO_2, CH_4 and N_2O. This year it is for the first time that non-CO_2-emissions (N_2O and CH_4) for international transport are being calculated. 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 3.31. Allocation of marine and aviation fuel consumption: domestic vs. international (from CRF Documentation box)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Marine fuel consumption:													
- Domestic	3%	2%	3%	3%	2%	3%	2%	2%	2%	2%	2%	2%	2%
- International	97%	98%	97%	97%	98%	97%	98%	98%	98%	98%	98%	98%	98%
Aviation fuel consumption:													
- Domestic	10%	6%	3%	2%	3%	4%	3%	3%	4%	4%	3%	2%	2%
- International	90%	94%	97%	98%	97%	96%	97%	97%	96%	96%	97%	98%	98%

3.2.8.3 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).

3.2.8.4 Source-specific planned improvements

The inclusion of commercial ships with national destinations and national fishing boats in bunker fuel use and international bunker emissions results in an overestimation of international transport emissions. In 2003 actions were started to correct the calculation for these two sources to get in accordance with *IPCC Good Practice*. The results of these improvements are expected to be reported in the next submission (see *Section 10.4.7*).

Table 3.32 Trend in greenhouse gas emissions (Tg; Others in Gg) from international bunkers 1990-2002

	Implied EF [1)]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CO_2	(kg/GJ)													
Marine		**35.3**	**36.3**	**36.5**	**37.8**	**36.1**	**36.6**	**37.2**	**39.5**	**39.8**	**41.1**	**43.4**	**47.7**	**47.1**
Gas/Diesel Oil	73.0	6.5	5.8	5.8	6.1	6.4	7.3	6.6	6.1	6.4	6.3	6.4	6.9	6.5
Residual Fuel Oil	77.0	28.5	30.5	30.7	31.7	29.7	29.0	30.3	33.0	33.0	34.5	36.6	40.3	40.3
Lubricants	73.0	0.3	NO	NO	NO	NO	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.4
Aviation		**4.5**	**5.0**	**5.9**	**6.5**	**6.7**	**7.7**	**8.2**	**8.9**	**9.7**	**10.1**	**10.1**	**9.9**	**10.3**
Jet Kerosene	73.0	4.5	5.0	5.9	6.5	6.7	7.7	8.2	8.9	9.7	10.1	10.1	9.9	10.3
Total bunkers		**39.8**	**41.3**	**42.4**	**44.3**	**42.9**	**44.3**	**45.4**	**48.4**	**49.5**	**51.2**	**53.5**	**57.6**	**57.4**
CH_4	(kg/TJ)													
Marine		**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.14**	**0.15**	**0.16**	**0.16**	**0.16**	**0.17**	**0.19**	**0.19**
Gas/Diesel Oil	0.30	0.03	0..02	0.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Residual Fuel Oil	0.30	0.11	0.12	0.12	0.12	0.12	0.11	0.12	0.13	0.13	0.13	0.14	0.16	0.16
Lubricants	0.29	0.00	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aviation		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Jet Kerosene	0.00	0.00	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		**0.14**	**0.14**	**0.14**	**0.15**	**0.14**	**0.14**	**0.15**	**0.16**	**0.16**	**0.16**	**0.17**	**0.19**	**0.19**
N_2O	(kg/TJ)													
Marine		**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.04**	**0.05**	**0.05**	**0.05**
Gas/Diesel Oil	0.08	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Residual Fuel Oil	0.08	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04
Lubricants	0.08	0.00	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Aviation		**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
Jet Kerosene	0.10	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Total bunkers		**0.04**	**0.04**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.05**	**0.06**	**0.06**	**0.06**	**0.06**	**0.06**

NO = Not Occurring
Implied emission factors: CO_2 in kg/GJ, CH_4 and N_2O in kg/TJ.

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

3.3.1 Source category description

Fugitive emissions in this source category originate from the production of oil and gas, the transmission and distribution of gas and from oil refining (*Table 3.33*). Methane emissions from gas production and from gas distribution are key sources according to *Box 3.4*. Emissions from oil production and refineries have been identified as non-key sources.
In the Netherlands there are no fugitive emissions from solid fuels because coal mining and handling activities [1B1] take no longer place anymore since the last mine closed in the early 1970s. In addition, we recall that emissions from coke production are included in fuel combustion emissions from the iron and steel industry (1A2a), since these are reported in an integrated and aggregated way (see *Section 3.2.2*).

Table 3.33 Fugitive emissions from oil and gas (CO_2 in Tg; others in Gg)

Gas/subsource	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CO_2													
a. Oil	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
b. Natural Gas	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.1	0.2	0.2	0.3
c. Venting	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	0.0	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. Oil	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
b. Natural Gas	178.5	189.0	172.0	171.0	177.0	170.1	188.1	156.1	146.3	144.0	130.9	134.1	120.1
c. Venting	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	0.0	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													
c. Venting/flaring		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		0.0	0.0	0.0	0.0	0.0	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)

1B2	CO_2	Misc. CO_2, of which 2/3 part in 1B2	Non-key
1B1	CH_4	Coal mining	Not occurring
1B1	All	Coke production	Included in 1A2
1B2	**CH_4**	**Fugitive emissions from oil and gas: gas production**	**Key (L,T1)**
1B2	**CH_4**	**Fugitive emissions from oil and gas: gas distribution**	**Key (L)**
1B2	CH_4	Fugitive emissions from oil and gas operations: other	Non-key

Fugitive emissions from oil and natural gas [1B2]

The CO_2 emissions from category 1B2 comprise non-combustion emissions from refineries, flaring and venting emissions from oil and gas production and compressor emissions from gas transport and distribution networks. The increasing trend is due to a large increase in non-combustion emission as reported by refineries, which have by far the largest share in this subcategory. However, this does not necessarily correspond to a large rise in CO_2 emissions since the separation of combustion from process emissions as officially reported by refineries, varies substantially over time.
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 share of these sources in the CH_4 emissions of the national greenhouse gas was about 1-2% between 1990-2002. For the other emissions these categories have a small share in the national total and are no key-sources.
Only for 1994 are some N_2O emissions reported here. This is probably due to an incorrect source allocation or some other error in the ER-I emissions.

3.3.2 Methodological issues

Country-specific top-down emission estimates comparable with the IPCC Tier 1 method are used for the emission estimation of fugitive CH_4 emissions from oil and gas. The emission factors for CH_4 from gas flaring and venting are country-specific; mean values from a study that combined available literature data and a few measurements. The present method does not fully comply with the *IPCC Good Practice Guidance*; the data for production of oil and gas can not be divided into the IPCC categories of exploring, production/processing, venting and flaring. Thus, only totals for the production of oil and gas are available as presented in the CRF under the category 1B2b *'Production/processing of gas'*. A full description of the methodology is provided in Spakman *et al.* (2003).

The present Tier 1 method for gas distribution reflects interannual changes in domestic gas consumption – due to its use as activity data – which are not real variations in gas leakage emissions. Since CH_4 emissions from gas production and gas distribution are considered to be key sources (see *Box 3.4*), the present Tier 1 methodology does not comply with the *IPCC Good Practice Guidance* (IPCC, 2000). Note that CO_2 emissions from fugitive sources are not a key source.

Fugitive emissions from refineries in category 1B2 are provided by the annual environmental reports of the Dutch companies. However, as mentioned above, the separation between combustion and process emissions, as reported by refineries, varies substantially over time.

3.3.3 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 3.34.* As discussed above, the sharp increase in non-combustion emissions from refineries are probably due to inconsistent reported splits in combustion and non-combustion emissions from refineries. In the period 1990-2002 the estimated emission of CH_4 decreased from 179 to 118 Gg per year (-34%).

Table 3.34. CH_4 emissions from production of oil and gas, and the transmission and distribution of gas 1990-2002 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Production/processing	100	101	90	86	102	97	104	87	81	82	70	70	58
Transmission	6	7	7	7	6	4	7	5	2	3	3	3	4
Distribution	73	81	75	78	69	70	78	65	62	59	58	61	58
Total	179	**189**	**172**	**171**	**177**	170	188	156	146	144	131	134	120

Note: For 1991-1994 these data differ from the figures in the CRF files, which are old, original submissions to the emission registration system for these reporting years. The CH_4 emissions in the CRF reported in the CRF for subcategory 1B are listed in *Table 3.33* and include for 1991-1994 refineries reported under 1B2d *'Other'* and under 1B2a *'Oil'* for other years

Table 3.35. Activity data of production, transmission and distribution of oil and natural gas, 1990-2002 (source: EZ, 2002; Gasunie, 2001 and 2002)

Source	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
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
Gas production	PJ	2 292	2 608	2 628	2 659	2 482	2 478	2 839	2 590	2 529	2 280	2 144	2 287	2 255
Gas transmission	PJ	2 292	2 608	2 652	2 738	2 598	2 630	2 968	2 660	2 527	2 385	2 310	2 554	2 507
Gas distribution	PJ	657	759	731	784	717	757	879	762	763	725	715	756	719

This substantial emission reduction is not the result of a decrease in activity data: both amounts of gas distribution and gas transmission have increased, while gas production decreased only slightly, although there was a movement towards more offshore production of gas and less onshore production (*Table 3.35*). Emission reductions are mainly the result of the implementation of cost-effective measures to prevent venting of natural gas during production (NOGEPA, 1996, 1999; NAM, 1999a, 1999b). 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 is assumed to decrease because of the gradual replacement of old cast iron pipes by modern materials. *Figure 3.10* shows the trends of the production and transmission of natural gas and related CH_4 emissions (including emissions from oil). The peak emissions in 1996 are due to the relatively cold winter, in which gas consumption and production was much higher than in other years.

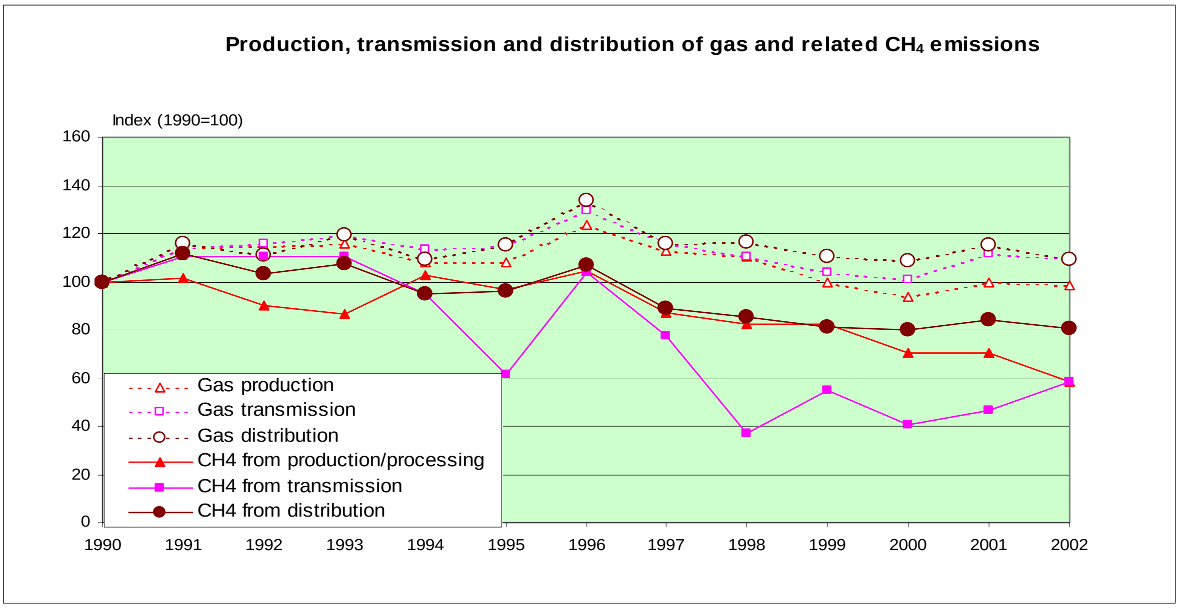


Figure 3.10. Trends in production, transmission and distribution of natural gas and oil and related CH_4 emissions in the period 1990-2002.

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 bottom-up (Tier 3) emission inventory of this source category for recent years. Work is in progress but results are not yet ready to use for this inventory. However, until now no acceptable method for recalculation of the CO_2 and CH_4 emissions for earlier years could be found, because statistical data for venting and flaring are not systematically collected in the Netherlands.
Moreover for emission source ‘distribution of natural gas’ efforts have been made to comply with the methods recommended by IPCC Good Practice. This resulted in the agreement that for future years the association of energy companies, EnergieNed, will annually collect data on the length of distribution network and the amount of leaks of each material. For recalculation purposes of historical data, the total length of the distribution network for 1990-2002 was provided by Gastec (Gastec, 2003) (*Table 3.36*).

Table 3.36. Development of the natural gas distribution pipeline network (in 1000 km) (source: Gastec, 2003)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Length of network	99.9	101.2	102.6	103.0	103.3	103.6	103.9	104.9	105.2	105.5	105.9	106.3	106.7

Still one important ingredient for changing to a method complying with the *IPCC Guidelines* is not dealt with and that is a country-specific measurement program from emissions in the distribution net. Measurements of the Dutch situation are not available and costly to perform. There are some measurements performed in other countries but not largely available and according to EnergieNed the available data are too old and not representative for Dutch circumstances of gas distribution.

4. INDUSTRIAL PROCESSES [CRF sector 2]

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 (thus 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 flue gas desulphurisation which we report under category 2G. The sector Industrial Processes consists of the following subsectors:

- Mineral products (2A)
- Chemical industry (2B)
- Metal production (2C)
- Other production (i.e. Pulp & paper and Food & drinks) (2D)
- Production of halocarbons and SF_6 (2E)
- Consumption of halocarbons and SF_6 (2F)
- Other industrial (2G).

The trends in greenhouse gas emissions from industrial processes are summarised in Table *4.1*. No greenhouse gas emissions are reported for the '*Other production*' subsector (2D). Also no CO_2 emissions are reported for the chemical industry (2B) because all feedstock emissions are reported in the energy sector (1A2). Essentially the same holds for metal production (2C), of which CO_2 from the use of coke as reducing agent is also reported in the energy sector (see *Section 3.2.2*). In addition, no methane emissions from metal production are reported.
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 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 is used at one production facility of Gas Insulated Switchgear (GIS).

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.

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	Emissions from cement production	Non-key
2G	CO_2	Other industrial: CO_2	Key (L, T1)
2A	CO_2	Emissions from lime consumption	Included in 2G
2B	CO_2	Chemical industry: feedstock use / non-energy use	Included in 1A2
2C	CO_2	Metal production: steel production; aluminium production	Included in 1A2
2G	CH_4	Other industrial: CH_4	Non-key
2B	**N_2O**	**Emissions from nitric acid production**	**Key (L,T1)**
2B	N_2O	Other: N_2O	Included in 2B
2C	**F-gas**	**PFC emissions from aluminium production**	**Key (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 (L2,T1)**
2F	F-gas	PFC emissions from PFC use	Non-key
2F	**F-gas**	**SF_6 emissions from SF_6 use**	**Key (L2)**

We recall that for 1991-1994 no recalculations or allocation improvements have been made in past years for most source categories that are based on individual company reports (the part of the national pollutant emission register called 'ER-I') (see *Section 1.2*). As a consequence, consistency over time of CO_2 and CH_4 emissions at subcategory level is limited. These areas have been indicated shaded (in yellow colour) in the table, where most subcategory emissions are reported under '*Other*' (2G).
In *Box 4.1* specific sources in this category are listed and characterised as key or non-key source. The N_2O emission from nitric acid production is 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 2.3% (and 2.9% in the base year 1990). Of the F-gases, both by-product sources and the use of HFCs and of SF_6 are identified as key sources.

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
CO_2													
2A. Mineral products	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
2B. Chemical industry	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	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 [1)]	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2G. Other	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
CH_4													
2A. Mineral products	0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2B. Chemical industry	3.0	0.0	0.0	0.0	0.0	2.5	5.2	2.5	2.2	2.5	1.4	2.0	2.1
2C. Metal production	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
2D. Other production	-	-	-	-	-	-	-	-	-	-	-	-	-
2G. Other	0.0	3.5	3.7	4.9	5.3	0.0	0.1	0.1	0.1	0.0	0.0	0.2	0.0
N_2O													
2B. Chemical industry	24.4	24.7	24.9	26.7	25.5	24.2	24.2	24.2	24.1	23.2	23.0	21.2	20.2
B2. Nitric acid production	20.4	20.7	20.9	22.7	21.5	20.3	20.2	20.2	20.1	19.1	19.0	17.2	17.7
B3. Adipic acid production	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	3.9	4.0	4.0	4.0	4.1	4.0	4.0	2.5
HFCs													
2E. By-product HCFC prod													
HFC-23	379	295	378	423	537	492	589	573	666	294	207	38	59
2F. From 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
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
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	54.7
HFC-134a	NO	NO	18	12	31	3	46	85	14	37	0	1	3
HFC-152a	NO	NO	10	29	24	18	25	NO	NO	0	22	7	2
HFC-143a	NO	NO	NO	3	6	NO	28	NO	18	17	50	8	5
HFC unspecified	NO	NO	NO	7	20	NO	18	198	129	68	46	17	15
PFCs													
2C. By-product aluminium prod													
CF_4	301	301	258	260	228	223	247	261	195	154	160	155	140
C_2F_6	48	48	41	41	38	38	39	40	39	35	38	34	14
2F. From use													
PFC unspecified	2	3	3	3	4	4	6	12	13	17	22	19	19

SF_6													
2F. From use													
SF_6	9	6	6	6	8	13	13	14	14	13	14	15	14

[1)] Pulp & paper and Food & drinks.

In the next sections a description of these subcategories and their source categories will be given, per main category, except for the minor sources listed in *Table 4.1*:

- CH_4 emissions from mineral products (2A) (only 0.1 Gg);
- CH_4 emissions from the chemical industry (2B) (only about 2 Gg);
- CO_2 emissions from metal production (2C) (only 0.02 Tg or smaller);
- CH_4 emissions from other industries (2G) (about 5 Gg).

Because of competitiveness, the AD and EFs are considered as confidential, if the number of companies within a source category is three or less.

4.2 Mineral products (2A)

4.2.1 Source category description

The subsector '*Mineral products'* (2A) consists of the sources specified as non-key source in *Box 4.1*. Its share of CO_2 emissions in the national greenhouse gas total was 0.5% in 1990 and 0.5% in the last reported year.

4.2.2 Methodological issues

For both source categories for CO_2 country-specific methodologies are used. The CO_2 emissions from the source category '*Cement clinker production'* are based on (measured) data reported by producing companies. We note that CO_2 emissions from cement production are correlated to clinker production, not cement production. The Netherlands import 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.
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 the methodology is provided in Spakman *et al.* (2003).

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 (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 and lime use. The emissions remained rather constant in this period, because no measures were taken to control these emissions.

Table 4.2. Emissions of CO_2 from mineral products (2A) 1990-2002 (Tg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2A1. Cement clinker production	0.4	0.4	0.4	0.4	0.5	0.3	0.3	0.4	0.4	0.5	0.4	0.5	0.6
2A. Other	0.7	0.3	0.4	0.7	0.6	0.8	0.6	0.7	0.6	0.5	0.4	0.5	0.9
Total	**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**

4.3 Chemical industry (2B)

4.3.1 Source category description

The subsector '*Chemical industry'* (2B) consists of the sources specified as key or non-key source in *Box 4.1*. Its share of N_2O emissions in the national N_2O total was 46% in 1990 and 41% at present (2.9% 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 some other industrial process sources of N_2O were identified and included in this subsector (caprolactam production, others).
We recall that all CO_2 emissions due to non-energy use are reported under category 1A 'Fuel combustion', subsector 1A2c '*Chemical industry'*.

4.3.2 Methodological issues

For source category '*Nitric acid production'* the IPCC Tier 2 method for N_2O is used. The emission factors are based on plant specific measured data. Since the emissions are considered to be a key source for N_2O, the present methodology does comply with the *IPCC Good Practice Guidance* (IPCC, 2000). A full description of the methodology is provided in Spakman *et al.* (2003). The N_2O emission from the '*Other chemical industry'* (mainly caprolactam) is based on data reported by the manufacturing industry. These data are also included in the Netherlands' *Pollutant Emission Register* (PER).
Since the CO_2 emissions from non-energy/feedstock use of fuels by the chemical industry are included in subsector 1A2a, no methodological tier assessment for CO_2 emissions is applicable here.

4.3.3 Uncertainties and time-series consistency

The uncertainty in N_2O emissions from nitric acid production is estimated to be about 50% in annual emissions (see *Section 1.7* for more details). This estimate was made before recalculation was made based on measurement data instead of using the default IPCC emission factor.
In *Table 4.3* an overview is presented of the trend in N_2O emissions from the chemical industry in the period 1990-2002. The emissions 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 emission in 2002 decreased with 6% compared to 2001.

Table 4.3. N_2O emissions from chemical industry processes (2B) 1990-2002 (Gg N_2O)

Source	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
2B2. Nitric acid production	20.4	20.7	20.9	22.7	21.5	20.3	20.2	20.2	20.1	19.1	19.0	17.2	16.2
2B5. Other chemical industry	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
Total	**24.4**	**24.7**	**24.9**	**26.7**	**25.5**	**24.3**	**24.2**	**24.2**	**24.1**	**23.1**	**23.0**	**21.2**	**20.2**

4.4 Metal production (2C)

4.4.1 Source category description

The subsector '*Metal production'* (2C) consists of the source categories specified as key or non-key source in *Box 4.1*. The CO_2 emission from steel production is included in 1A2a. 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.
We recall that all CO_2 emissions due to non-energy use in the iron and steel industry and in primary aluminium production are reported under category 1A '*Fuel combustion'*, subsectors 1A2a 'Iron and steel' and 1A2b '*Non-ferrous metals'*, respectively.

4.4.2 Methodological issues

For one of the two producers of primary aluminium for PFCs the IPCC Tier 3b method is used during the period 1990-2001, while for 2002 the Tier 2 method is used. The other producer is using the Tier 2 method. 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 Spakman *et al.* (2003).
Since the CO_2 emissions from non-energy/feedstock use of fuels by the iron and steel industry and in primary aluminium production are included in subsector 1A2, no methodological tier assessment for CO_2 emissions is applicable here.

4.4.3 Uncertainties and time-series consistency

The uncertainty in PFC emissions from aluminium production is estimated to be about 20% in annual emissions (see *Section 1.7* for more details). In *Table 4.4* an overview of the trend in PFC emissions from primary aluminium industry during the period 1990-2002 is given.

PFC emissions from aluminium production decreased by about 30% during the period 1995-2001. Switching from side feeding to point feeding 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.

Table 4.4. Actual PFC emissions per compound from aluminium production (2C) 1990-2002 (Gg CO_2-eq.)

Compound	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CF_4 (PFC-14)	1 957	1 957	1 677	1 690	1 482	1 450	1 606	1 697	1 269	1 000	1 043	1006	911
C_2F_6 (PFC-116)	442	442	377	377	350	350	359	368	356	326	348	316	130
PFC total	**2 398**	**2 398**	**2 054**	**2 067**	**1 832**	**1 799**	**1 964**	**2 065**	**1 625**	**1 326**	**1 390**	**1322**	**1041**

4.5 Production of halocarbons and SF_6 (2E)

4.5.1 Source category description

The subsector '*Production of halocarbons and SF_6*' (2E) consists of one source: HCFC-22 manufacture, identified as key source in *Box 4.1*. In addition, under this subsector some *handling* emissions of HFCs are reported. However, these emissions are discussed in the next section on the *consumption* of halocarbons (and included in the emissions tables). 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 22% (0.3% in the national total greenhouse gas emissions) in 2002.

4.5.2 Methodological issues

For source category '*HFC-23 emissions from HCFC-22 manufacture*' the IPCC Tier 2 method for HFC-23 is used. Since the emissions are considered to be a key source for F-gases, the present methodology does comply with the *IPCC Good Practice Guidance* (IPCC, 2000). A full description of the methodology is provided in Spakman *et al.* (2003).

4.5.3 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). In *Table 4.6* an overview of the trend in HFC-23 emissions from the HCFC-22 production is presented for the 1990-2002 period.

Table 4.5. Actual HFC-23 emissions from HCFC-22 production (2E) 1990-2002 (Gg CO_2-eq.)

Compound	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
HFC-23	4 432	3452	4423	4947	6278	5759	6887	6709	7791	3440	2421	450	685
HFC total	**4 432**	**3452**	**4447**	**4998**	**6407**	**5771**	**7110**	**7416**	**8310**	**3825**	**2838**	**641**	**782**

Note: Including handling emissions of HFCs

Due to an increase of production in the 1995-1998 period, the emissions of HFC-23 from the HCFC-22 manufacture increased by 35%. In the 1998-2000 period, the emission of HFC-23 from the HCFC-22 manufacture decreased by 69% because a thermal afterburner was installed. 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 afterburner. Of a lower operation time of the thermal afterburner (93,6% in 2002 compared to 95% in 2001) The emission increased by 52% in 2002.

4.6 Consumption of halocarbons and SF_6 (2F)

4.6.1 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). These consumption emissions include some *handling* emissions of HFCs at the site of the halocarbon manufacture, which have been reported in the CRF under 2E3 *'Other'*. 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	IPCC Tier 2
	2F8 Sound-proof windows	country-specific
	2F8 Electron microscopes	country-specific

4.6.2 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). Since HFC emissions and SF_6 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).

4.6.3 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 4.6,* whereas *potential emissions* (or so-called *apparent consumption*) are shown in *Table 4.7.* 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 4.6*). The sometimes large interannual variation of consumption and emissions of some sources can be explained by the variation in production/handling levels of specific industries and service sectors. In the period 1995-2002 the actual emissions of SF_6 remained almost constant.

Table 4.6. Actual emissions per compound from the use of HFCs, PFCs and SF_6 (2F) 1990-2002 (*Gg CO_2-eq.).*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
HFC-134a	0	0	0	0	80	232	505	783	905	946	822	571	423
HFC-143a	0	0	0	0	0	6	26	48	68	73	106	143	178
HFC-125	0	0	0	0	0	7	25	43	57	60	87	119	153
HFC-152a	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
Other HFC's [1)]	0	0	0	0	0	2	9	16	21	18	25	32	36
HFC Total	0	0	0	0	80	248	565	891	1 051	1 097	1 040	865	790
PFC use [2)]	18	21	24	28	32	37	50	100	113	145	187	160	160
SF_6 use	217	134	143	150	191	301	312	345	329	317	335	356	344
Total HFC/PFC/SF_6	**236**	**155**	**167**	**178**	**303**	**586**	**928**	**1 335**	**1 492**	**1 559**	**1 563**	**1 381**	**1 293**

Note: Excluding handling emissions of HFCs reported under CRF subcategory 2E
[1)] Average GWP of other HFCs: 3000.
[2)] Average GWP of other PFCs: 8400.

Table 4.7. Potential emissions per compound from the use of HFCs, PFCs and SF_6 1990-2002 (Gg CO_2-eq.).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
HFC-134a	0	0	0	0	356	590	1 187	1 398	1 365	1 386	1 011	702	689
HFC-143a	0	0	0	0	0	129	315	350	456	642	828	828	828
HFC-125	0	0	0	0	0	140	286	274	333	543	655	753	840
HFC (unspecified)	0	0	0	0	0	45	120	96	123	45	249	99	99
HFC total	0	0	0	0	356	904	1 908	2 118	2 277	2 616	2 744	2 383	2 456
PFC use	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
Total HFC/PFC/SF_6 [1)]	**0**	**0**	**0**	**0**	**356**	**904**	**1 908**	**2 118**	**2 277**	**2 616**	**2 744**	**2 383**	**2 456**

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.

4.6.4 Source-specific recalculations

Actual emissions of PFCs and SF_6 for 1990 onwards have been recalculated due to more detailed information on the use of PFCs and SF_6 in the semiconductor manufacturing and SF_6 in soundproof windows (see *Table 4.8*). Also actual emissions of HFCs for 1994 onwards have been revised slightly due to more detailed information on the use of HFCs in stationary refrigeration and mobile air-conditioning.

Table 4.8. Effects of recalculation of HFC, PFC and SF_6 emissions (2F) 1990-2001 (in Gg).

		1990	1991	1992	1993	1994	1995 *	1996	1997	1998	1999	2000	2001
HFCs	NIR2004	0	0	0	0	80	248	565	891	1 051	1 097	1 040	865
	NIR2003					124	259	788	1597	1570	1457	1453	1135
	Difference	**0**	**0**	**0**	**0**	**-44**	**-11**	**-223**	**-706**	**-519**	**-360**	**-413**	**-270**
PFCs	NIR2004	18	21	24	28	32	37	50	100	113	145	187	160
	NIR2003	34	39	44	51	59	68	78	89	103	118	136	136
	Difference	**-16**	**-18**	**-20**	**-23**	**-27**	**-31**	**-28**	**11**	**10**	**27**	**51**	**24**
SF_6	NIR2004	217	134	143	150	191	301	312	345	329	317	335	356
	NIR2003	187	100	106	110	148	275	285	311	295	265	269	296
	Difference	**30**	**34**	**37**	**40**	**43**	**26**	**27**	**34**	**34**	**52**	**66**	**60**

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

4.7 Other industrial processes (2G)

4.7.1 Source category description

The subsector '*Other industrial processes'* (2G) consists of CO_2 from flue gas desulphurisation and other sources and is according to *Box 4.1* no key source.

4.7.2 Methodological issues

For this source category country-specific methodologies are used. Since the emissions are considered to be no key source for CO_2, the present methodology does comply with the *IPCC Good Practice Guidance* (IPCC, 2000). A full description of the methodology is provided in Spakman *et al.* (2003).

4.7.3 Uncertainties and time-series consistency

The uncertainty in CO_2 emissions of other production is estimated to be about 20% in annual greenhouse gas emissions (see *Section 1.7* for more details).
In *Table 4.9* an overview of the trend in CO_2 emissions of the source categories from this sub-sector is provided.

Table 4.9. Emissions of CO_2 from 'Other industrial processes' (2G) 1990-2002(Tg)

Subcategory	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Flue gas desulphurisation	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3
Other sources	0.4	0.2	0.4	0.0	0.1	0.0	0.4	0.4	0.0	0.1	0.0	0.0	0.0
Total	**0.6**	**0.4**	**0.6**	**0.2**	**0.4**	**0.3**	**0.8**	**0.7**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**

The emissions in the subcategory *'Other sources'* vary considerably over the years because the emissions in this category largely depend on the quality of the environmental reports of individual companies.

5. SOLVENT AND OTHER PRODUCT USE [CRF sector 3]

5.1 Overview of sector

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).
In this sector The Netherlands reports some N_2O emissions originating from the use of N_2O as anaesthesia and as a propelling agent in aerosol tins, such as those used for whipped cream. Some very minor CO_2 emissions as mentioned in individual company reports and classified as non-combustion sources are also reported.

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
CO_2													
3A. Paint application	-	-	-	-	-	-	-	-	-	-	-	-	-
3B. Degreasing and dry cleaning	-	-	-	-	-	-	-	-	-	-	-	-	-
3C. Chemical products, manuf. & proc.	-	-	-	-	-	-	-	-	-	-	-	-	-
3D. Other [1)]	0	0.1	0.1	0	0	0	0	0	0	0	0	0	0
CH_4													
Included in category 7 [2)]	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	0.6	0.6	0.6	0.6	0.6	0.7	0.6	0.5	0.5	0.4	0.4	0.3
- Use of N_2O for anaesthesia	0.65	0.50	0.50	0.50	0.50	0.50	0.50	0.42	0.37	0.36	0.31	0.28	0.20
- N_2O from aerosol cans	0.08	0.10	0.10	0.10	0.10	0.10	0.15	0.14	0.15	0.15	0.13	0.12	0.09

[1)] Some minor sources were originally allocated to this category. As mentioned in *Chapter 1*, the allocation of emissions for the years 1991-1994 has not been changed/improved over time.

[2)] Methane emissions from solvents and other products, although very small, have been reported under IPCC sector 7 ('*Other*'), since CRF emission tables for category 3 erroneously do not allow for methane to be reported here.

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 (0.0% and 0.1% in 1990, respectively, and now even less). The most important sub-source in category 3 is, relatively speaking, 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)

3D.	CO_2	Misc. CO_2: minor component in category 3	Non-Key
3D.	*CH_4*	*Solvents and other product use*	*Included in 7*
3D.	N_2O	Misc. N_2O; component in category 3:	Non-Key

5.1.1 Source category description

This source category comprises all non-industrial, non-combustion sources except for the use of F-gases, all reported under IPCC category 2F. Source category 3 '*Solvents and other product use*' consists of the following subsources, all classified under subcategory 3D '*Other*':

- CO_2 from miscellaneous non-industrial, non-combustion sources;
- Use of N_2O for anaesthesia;
- N_2O from aerosol tins.

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 7 *'Other'*. This is because CRF emission tables for category 3 erroneously do not allow for methane to be reported here. We recall that all CO_2 emissions due to non-energy use are reported under category 1A '*Fuel combustion*', subcategory 1A2a '*Chemical industry*', including the emissions during the use of the (final) products.

5.1.2 Methodological issues

Country-specific methodologies for the N_2O sources in this sector 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 Spakman *et al.* (2003).
Since CH_4 emissions from solvent and other product use are not reported here – but in Sector 7 *'Other'* – no methodological tier assessment for CH_4 emissions is applicable.

5.1.3 Uncertainties and time-series consistency

The uncertainty of N_2O and CO_2 emissions is not explicitly estimated for this category but is expected to be fairly low. 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).
The trend in emissions of this category is summarised in *Table 5.1,* where it is shown that the CO_2 emissions reported for 1991 and 1992 only do not constitute a consistent trend. This is due to incomplete or changed reporting by individual firms in the past years and the exclusion of the years 1991-1994 in recalculations performed in recent years. However, these emissions are only very minor. 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.

6. AGRICULTURE [CRF sector 4]

6.1 Sector overview

The agricultural sector in the Netherlands comprises three subcategories:

- enteric fermentation by ruminants: 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); emissions from animal waste dropped on the soil during grazing on grasslands are reported under subcategory 4D.
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 direct soil emissions of N_2O (4D1) the largest source of nitrous oxide reported under the IPCC sector 'Agriculture'. In fact, both total direct and indirect N_2O emissions from agricultural soils (subcategory 4D) rank among the top 5 key-level sources.
The subcategories 4D3 and 4D4 require some explanation. Historically, the Netherlands does not use subcategory 4D3 to estimate indirect N_2O emissions. Indirect emissions from atmospheric deposition are not estimated. Indirect N_2O emissions from leaching and run-off of nitrogen are reported as a fixed value of 3.8 Gg N_2O under IPCC sector *7,* 'Other sources', as *'Polluted surface water'*, since this value also includes nitrogen from non-agricultural sources. Three-quarters of these emissions, however, stem from agricultural sources. This is discussed in more detail in *Chapter 9.*

Table 6.1. Trend in greenhouse gas emissions from agriculture (category 4) (CO_2 in T; others in Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CO_2													
4D Agricultural soils	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CH_4													
4A Enteric fermentation	402	412	401	393	382	377	366	353	341	334	319	322	306
4B Manure management	104	106	105	105	102	100	98	93	93	91	91	88	83
4G Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
N_2O													
4B Manure management	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
4D Agricultural soils	21.0	21.7	24.4	24.8	24.5	26.1	25.7	25.3	24.6	24.6	22.6	22.0	21.4
4D1 Direct soil emissions	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
a. Synthetic fertilisers	*6.9*	*6.7*	*6.6*	*6.6*	*6.3*	*6.8*	*6.5*	*6.7*	*6.8*	*6.5*	*5.7*	*5.0*	*5.0*
b. Animal wastes applied to soils	*5.6*	*6.2*	*9.2*	*9.6*	*9.0*	*10.9*	*10.7*	*10.1*	*9.8*	*10.5*	*9.5*	*9.5*	*8.9*
c. N-fixing crops	*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*
d. Crop residue [1)]	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*
e. Cultivation of histosoils [1)]	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*
4D2 Animal production	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
4D3 Indirect emissions	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE
a. Atmospheric deposition	*NE*	*NE*	*NE*	*NE*	*NE*	*NE*	*NE*	*NE*	*NE*	*NE*	*NE*	*NE*	*NE*
b. Nitrogen leaching &run-off	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*	*IE*
4D4 Other [2)]	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
4G Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

[1)] Included in 4D4. The notation key 'NE' was inadvertently used for crop residues in the CRF files.
[2)] Background agricultural soils emissions, due to past nitrogen loading of the soils and lowering of ground water tables.

The subcategory 4D1d ‘direct N_2O emissions from crop residues left in the field’ and subcategory 4D1e ‘N_2O emissions from cultivation of histosols (organic soils)’ are not estimated separately. They are included in 4D4 *‘Other’* as *‘Background emissions from agricultural soils’*. These (enhanced) background emissions result from previous application of manure and fertilisers on agricultural soils and from lowering the groundwater tables in the last century. The *‘Background emissions from agricultural soils’* were calculated using a country-specific method and have been reported as a fixed value of 4.7 Gg N_2O under 4D4. The subsource background agricultural soils is the arithmetic difference between the actual and the natural background emissions from one or two centuries ago (Kroeze, 1994).
As mentioned above, methane from enteric fermentation (4A) – in particular from cattle – and direct and indirect N_2O emissions from agricultural soils (4D) are major sources. Their individual share in national total greenhouse gas emissions is about 3%. From *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 (level) key sources.

Box 6.1. Key source identification in the agricultural sector 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	Non-key
4A	CH_4	CH_4 emissions from enteric fermentation: sheep	Non-key
4A	CH_4	CH_4 emissions from enteric fermentation: other	Non-key
4B	**CH_4**	**Emissions from manure management: cattle**	**Key (L2)**
4B	**CH_4**	**Emissions from manure management: swine**	**Key (L2) ***
4B	CH_4	Emissions from manure management: poultry	Non-key
4B	CH_4	Emissions from manure management: other	Non-key
4B	N_2O	Emissions from manure management	Non-key
4C	CH_4	Rice cultivation	Not Occurring
4D	**N_2O**	**Direct N_2O emissions from agricultural soils**	**Key (L)**
4D	**N_2O**	**Indirect N_2O emissions from nitrogen used in agriculture**	**Key (L)**
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 [CRF category 4A]

6.2.1 Source category description

Source category enteric fermentation consists of the sub-sources specified in Box 6.1. Buffalo, camels and llamas, mules and donkeys do not occur in the Netherlands. Enteric fermentation emission from poultry is not estimated by lack of data on CH_4 emissions by this animal category. Neither do the IPCC Guidelines provide a default emission factor for this animal category and the Netherlands noticed that most/all other countries also do not estimate emissions from poultry. A major level and trend key source is enteric fermentation by cattle. Its share of CH_4 in the national total was 31% in 1990 and is currently 36%.

6.2.2 Methodological issues

IPCC methodologies are used for estimating methane emissions from source category enteric fermentation. For key subsource cattle the emission factors for cattle are based on a country-specific IPCC Tier 2 analysis made for Dutch cattle in 1990. The emission factors, calculated for only 1990, were used for subsequent years. However, specific factors are applied to 4 and 3 subcategories of dairy and non-dairy cattle, respectively. Due to changing animal numbers for the subsequent years, the implied emission factor for Dairy cattle and Non-dairy cattle varies over the years (see *Table 6.4*).

The emission factors for the other sub-sources are based on default IPCC Tier 1 emission factors. The Netherlands uses for enteric fermentation of goats the same emission factor as for sheep viz. 8 kg CH_4 per animal. This is documented in Van Amstel *et al*. (1993) and this stems from an OECD publication in 1991. The Revised IPCC Guidelines, published in 1996, mention different default emission factors for sheep and goats. The Netherlands however uses for both animal categories the same emission factor because sheep and goats roughly consume per animal the equal amount of dry matter. 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 of sheep.
Since the CH_4 emissions from cattle are considered to be a key source (see *Section 1.5*), the present methodology (using emission factors calculated for 1990 also for years succeeding 1990) does not fully comply with the *IPCC Good Practice Guidance* (IPCC, 2000). For a brief description of the methodology and data sources used see *Annex 3.1*. A full description of the methodology is provided in Spakman *et al.* (2003) (and more detailed data sources in Van Amstel *et al.* (1993)).

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.* The annual emission by dairy and non-dairy cattle is determined on the basis of the number of cattle in that year and emission factors (amount of CH_4 per animal per year). Since 1990, the numbers of dairy and non-dairy cattle in the Netherlands have decreased from 3.61 to 2.76 million animals (-24%) and from 1.32 to 1.14 million animals (-14%), respectively (*Table 6.3).* It is obvious that this smaller number of cattle represents the main cause of the decrease in the CH_4 emissions. Livestock cattle numbers are influenced mainly by the EU policy on milk quota and the Dutch manure policy. Milk production per cow increases autonomously and as a consequence – when milk quota remain the same – dairy cattle numbers will be reduced. Manure policy regulates livestock numbers by regulating the amount of manure production and manure application.

Table 6.2. CH_4 emissions due to enteric fermentation (4A) 1990-2002 (Gg)

Animal type	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Cattle	365.6	374.8	362.3	352.8	343.4	339.3	328.5	315.2	307.0	299.0	285.7	287.8	274.6
- Dairy cattle	*290.8*	*291.0*	*280.0*	*271.0*	*263.9*	*265.5*	*262.3*	*252.1*	*247.8*	*241.6*	*230.5*	*234.1*	*225.0*
- Non-dairy cattle	*74.9*	*83.8*	*82.3*	*81.8*	*79.6*	*73.8*	*66.1*	*63.0*	*59.2*	*57.4*	*55.3*	*53.7*	*49.6*
Sheep	13.6	15.1	15.6	15.3	14.1	13.4	13.0	11.7	11.2	11.2	10.5	10.3	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
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
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
Poultry	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Total	401.9	411.6	401.2	392.7	381.7	376.7	365.9	352.6	341.4	333.9	319.4	321.5	305.8

Table 6.3. Number of animals 1990-2002 (1000 head) (CBS/RIVM, 2002)

Animal type	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Cattle	4 926	5 062	4 920	4 797	4 716	4 654	4 551	4 411	4 283	4 206	4 070	4 047	3 897
- Dairy cattle	*3 607*	*3 627*	*3 490*	*3 360*	*3 277*	*3 298*	*3 276*	*3 150*	*3 061*	*2 972*	*2 840*	*2 896*	*2 754*
- Non-dairy cattle	*1 319*	*1 435*	*1 429*	*1 436*	*1 439*	*1 356*	*1 275*	*1 261*	*1 222*	*1 233*	*1 231*	*1 151*	*1 144*
Sheep	1 702	1 882	1 952	1 916	1 766	1 674	1 627	1 465	1 394	1 401	1 308	1 296	1 186
Goats	61	70	63	57	64	76	102	119	132	153	179	221	255
Horses	70	77	86	92	97	100	107	112	114	115	118	120	121
Pigs	13 915	13 217	14 160	14 964	14 565	14 397	14 419	15 189	13 446	13 567	13 118	13 073	11 648

Figure 6.1 shows the trend of the number of cattle and their methane emission due to enteric fermentation. There is a close relationship between the trends of the number of cattle and the emission of

CH_4 due to enteric fermentation. The rest of the difference in the cattle trend can be explained by the shift in shares of the subtypes considered in the emission calculation, each with a different emission factor *(*see *Table 6.4)*.

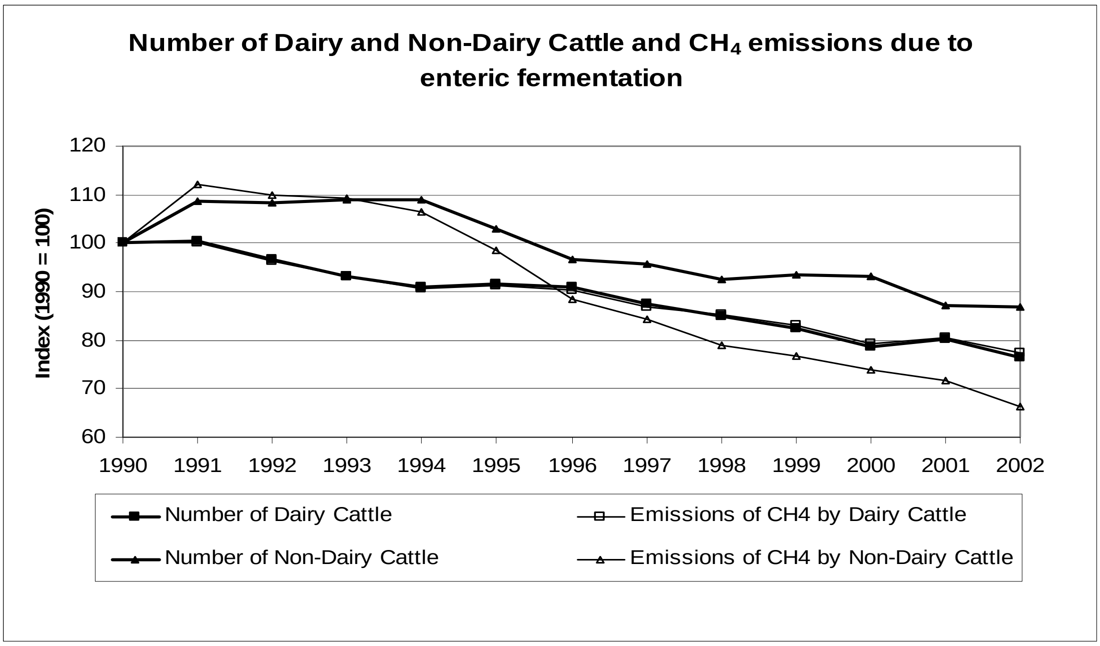


Figure 6.1. Number of cattle and CH_4 emissions due to enteric fermentation from cattle

Table 6.4. Subtypes of dairy and non-dairy cattle (1000 head) and resulting trend in Implied Emission Factors (IEF)

Animal (sub)type	CH_4 EF [1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Dairy cattle														
< 1 yr	49.25	806	820	774	737	735	740	760	698	658	634	600	644	574
> 1 yr young female	62.80	880	908	893	836	803	808	805	822	757	714	699	669	648
female	102.13	1878	1852	1775	1747	1698	1708	1665	1591	1611	1588	1504	1546	1486
> 1 yr male	93.22	43	48	48	41	41	42	46	40	36	36	37	38	46
IEF Dairy cattle		80.6	80.2	80.2	80.6	80.5	80.5	80.0	80.0	80.9	81.3	81.2	81.2	81.7
Non-dairy cattle														
Veal calves	17.65	602	622	638	656	690	669	678	704	711	753	783	712	752
Steers	87.01	598	674	646	624	603	541	451	412	366	328	285	277	241
Female > 1 yr [2]	102.13	120	139	146	156	146	146	146	145	145	153	163	162	151
IEF Non-dairy cattle		56.8	58.4	57.6	56.0	55.3	54.4	51.9	50.0	48.5	46.6	44.9	46.2	41,5

[1] Emission factor for CH_4 from enteric fermentation in kg CH_4 per head per year. Source: Van Amstel *et al.* (1993).
[2] Suckling cows.

6.2.4 Source-specific planned improvements

The present methodologies used to estimate the CH_4 emissions from enteric fermentation from cattle do not fully comply with *IPCC Good Practice Guidance* (IPCC, 2000). For this reason actions are taken in the Netherlands to investigate the need and possibilities to revise and extend calculations in order to be in accordance with *IPCC Good Practice Guidance* (IPCC, 2000).

6.3 Manure management [CRF category 4B]

6.3.1 Source category description

Source category manure management consists of the subsources specified in *Box 6.1*. Emissions from manure management from buffalo, camels and llamas, mules and donkeys do not occur in the Netherlands. Emissions from manure management of horses are not estimated in the Netherlands. A majority of registered horses is kept on horse riding schools and the horse manure is composted and used as substrate for mushroom production with minimal emissions to the air. At present a study is carried out to evaluate the fraction of horses which are presently not accounted for in the national statistics, which are based on an annual survey of agricultural livestock.
A major level and trend key source is manure management of cattle and swine.
The share of CH_4 in the national total was 8% in 1990 and is now 9%. The share of N_2O in the national total is about 1%. Major level trend and key sources are cattle and swine manure management systems. No sub-sources are distinguished for N_2O emissions by manure management. Manure management is not a level or trend key source of N_2O emissions.

6.3.2 Methodological issues

The IPCC Tier 1 methodology is used to calculate CH_4 from manure management systems. The country-specific emission factors for CH_4 are based on default IPCC emission factors (using adjusted IPCC values). For sheep and goats emission factors are high compared to the IPCC defaults. An explanation is given in *Annex 3.1*.
The emission factors are multiplied by the amount of annually produced manure per animal category after deducting the amount of manure produced on the pasture. The amount of annually produced manure per animal category has varied during the past years, as has the number of animals in the different animal categories. Since the emissions are considered to be a key source for CH_4 (see *Section 1.5*), the present Tier 1 methodology does not fully comply with the *IPCC Good Practice Guidance* (IPCC, 2000).
Since the N_2O emission from manure management are not a key source (see *Box 6.1*), the present country-specific Tier 1 methodology complies with the *IPCC Good Practice Guidance* (IPCC, 2000). For a brief description of the methodology and data sources used, see *Annex 3.1*. A full description of the methodology is provided in Spakman *et al.* (2003) (and more detailed data sources in Van Amstel *et al.* (1993)).

6.3.3 Uncertainty and time-series consistency

The uncertainty of CH_4 emissions from manure management from cattle is estimated at about 100% in annual emissions. The uncertainty of CH_4 emissions from manure management from swine is estimated to be 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 6.5*. In the period 1990-2002, the emission of CH_4 decreased from 103.5 to 83.3 Gg (-20%). The trend in emissions of N_2O due to manure management decreased from 0.68 to 0.59 Gg (-13%) between 1990 and 2002 *(Table 6.6*). As can be seen from *Table 6.5*, the decrease in CH_4 is mainly due to the decrease in emissions from manure management of swine (-12.3 Gg), dairy cattle (-3.0 Gg), and non-dairy cattle (-3.3 Gg).
As described in the previous section, the number of dairy cattle in the Netherlands in the 1990-2002 period has decreased by 24%. This decrease is reflected in the amount of stable manure and the related emissions of CH_4 and N_2O (*Table 6.5 and 6.6*). Livestock numbers of cattle are influenced mainly by the EU policy on milk quota and by the Dutch manure policy. Milk production per cow increases autonomously and as a consequence – when milk quota remains the same – dairy cattle numbers will be reduced. Manure policy regulates livestock numbers by regulating the amount of manure production and manure application to the pasture.

Table 6.5. Trend in CH_4 emissions from manure management (4B) 1990-2002 (Gg)

Animal type	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Cattle	43.1	44.7	43.7	43.0	42.1	41.5	39.7	38.5	37.7	37.1	38.5	38.4	36.8
- Dairy cattle	25.9	25.8	24.8	24.2	23.5	23.6	23.3	22.3	22.1	21.7	23.4	23.8	22.9
- Non-dairy cattle	17.2	18.9	18.9	18.8	18.6	17.8	16.5	16.2	15.5	15.4	15.1	14.7	13.9
Sheep	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.6	0.6
Goats	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.5	0.6
Swine	49.2	49.3	49.2	51.0	49.3	48.6	47.7	45.2	45.6	44.1	42.5	40.3	36.9
Poultry	10.3	10.4	10.6	10.2	9.2	9.4	9.4	8.5	9.1	8.9	9.0	8.3	8.4
Total	**103.5**	**105.5**	**104.6**	**105.1**	**101.5**	**100.3**	**97.7**	**93.2**	**93.3**	**91.1**	**91.1**	**88.1**	**83.3**

Table 6.6. Trend in N_2O emissions from manure management (4B) 1990-2002 (Gg)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Total 4B	0.68	0.71	0.71	0.74	0.72	0.74	0.72	0.69	0.67	0.65	0.62	0.63	0.59

Table 6.7 shows a decline in the number of fattening pigs and sows of 21% between 1990 and 2002. However, for swine, the 25% decrease in the CH_4 emissions from manure management is related to the decrease of the amount of manure produced per swine. During the last few years the annual amount of manure per swine has decreased by approximately 9% as a result of changes in agricultural practice in the Netherlands. These changes originated from the Dutch manure policy, forcing farmers to export their surpluses of manure to other farms. To save on expenses for storage, transport and spreading of animal manure on the land, the water content of the manure was kept as low as possible (*Table 6.7* and *Figure 6.2*). 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 and the animals had to stay on the pig farms. For that reason the annual census of 1997 gives high pig numbers. Later in the year the pigs in classical swine fever areas were destructed and there was no replacement in 1997. So the annual manure production in 1997 (based on the average number of swine) was lower than in normal years.

Table 6.7. Number of swine and manure from swine 1990-2002 (CBS/RIVM, 2002)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Number of swine[1)] (mln)													
Fattening pigs	7.0	7.0	7.1	7.5	7.3	7.1	7.1	7.4	6.6	6.8	6.5	6.2	5.6
Sows	1.7	1.7	1.7	1.8	1.7	1.7	1.7	1.8	1.8	1.6	1.5	1.4	1.3
Total	8.7	8.8	8.9	9.3	9.0	8.8	8.8	9.2	8.4	8.3	8.0	7.6	6.9
Manure production by swine (mln m^3)													
Total	16.4	16.4	16.3	17.0	16.4	16.1	15.8	15.0	15.2	14.7	14.1	13.4	12.3

1) When piglets are included the number of swine is considerably higher (cf. *Table 6.3*). Since the manure produced by piglets is attributed to the sows, piglets are not relevant for the calculation of the amount of manure.

6.3.4 Source-specific planned improvements

The present methodologies used to estimate the CH_4 emissions from manure management from swine and cattle do not fully comply with *IPCC Good Practice Guidance* (IPCC, 2000). For this reason actions are taken in the Netherlands to investigate the need and possibilities to revise and extend calculations to be in accordance with *IPCC Good Practice Guidance* (IPCC, 2000).

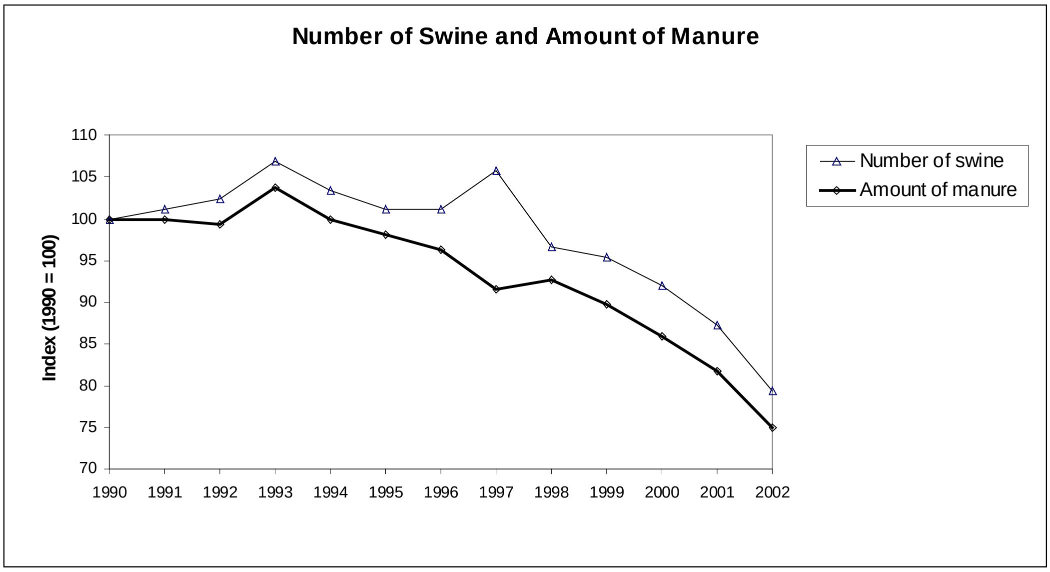


Figure 6.2. Trend in the number of swine and the amount of resultant manure between 1990 and 2002

6.4 Agricultural soils [CRF category 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 (4D1);
- animal production (4D2);
- indirect emissions from nitrogen leaching and run-off (4D3) and
- other emissions (background emissions from agricultural soils) (4D4).

Direct N_2O emissions include emissions due to application of synthetic fertilisers, animal wastes (manure) to soil and by N-fixing crops. Furthermore, in the Netherlands direct N_2O emissions include emissions from animal production (subcategory 4D2) of manure on the grasslands (pasture). The subcategory 4D1d 'direct N_2O emissions from crop residues left in the field' and subcategory 4D1e 'N_2O emissions from cultivation of histosols (organic soils)' are not estimated seperately. They are included in 4D4 *'Other'* as *'Background emissions from agricultural soils'*.
Indirect N_2O emissions from *atmospheric deposition* (another part of category 4D3) have not yet been estimated. Indirect N_2O emissions from leaching and run-off are included elsewhere (under IPCC sub category of sector 7 *'Polluted surface water*').
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). They are not reported as anthropogenic emissions under IPCC category 7.
Major level- and trend-key sources of N_2O emissions by agricultural soils are direct emissions from agricultural soils and indirect N_2O emissions from nitrogen used in agriculture. The share of direct N_2O emissionn from agricultural soils in national greenhouse gas emissions is about 4%. The most important subsources of agricultural soils are direct emissions caused by application of synthetic fertilisers and animal wastes (manure) to soil and background emissions.

6.4.2 Methodological issues

Country-specific methodologies and country-specific emission factors are used for direct N_2O emissions from agricultural soils, which are equivalent to a mixture of the IPCC Tier 1a and Tier 1b methods. The subcategory 4D1d 'direct N_2O emissions from crop residues left in the field' and subcategory 4D1e 'N_2O emissions from cultivation of histosols (organic soils)' are not estimated seperately. They

are included in 4D4 *'Other'* as *'Background emissions from agricultural soils'.* These (enhanced) background emissions result from previous application of manure and fertilisers on agricultural soils and from lowering the groundwater tables in the last century. The *'Background emissions from agricultural soils'* were calculated using a country-specific method and have been reported as a fixed value of 4.7 Gg N_2O under 4D4. The subsource background agricultural soils is the arithmetic difference between the actual and the natural background emissions from one or two centuries ago (Kroeze, 1994). Since the emissions are a key source (see *Box 6.1*), the present methodology does not fully comply with the *IPCC Good Practice Guidance* (IPCC, 2000).
The Netherlands does not use the IPCC method to estimate indirect N_2O emissions. Indirect N_2O emisions resulting from atmospheric deposition are not estimated, and leaching and run-off emissions are included elsewhere (under IPCC sub category of sector 7 *'Polluted surface water'*) and calculated as a fixed figure that comprises leaching and run-off from agricultural activities (3/4) and other nitrogen sources (1/4), including human sewage. Since this figure includes more than only agriculture-related emissions, the Netherlands does not report them under 4D but as a separate category in IPCC sector '7'. N_2O emissions from human sewage are reported partly under subcategory 6B, *'Wastewater handling'*, and partly under a subcategory of sector 7 *'Polluted surface water'.* Since the emissions are a key source (see *Box 6.1*), the present methodology does not fully comply with the *IPCC Good Practice Guidance* (IPCC, 2000).
For a brief description of the methodology and data sources used see *Annex 3.1*. A full description of the methodology is provided in Van Amstel *et al.* (1993), Kroeze (1994) and Van der Hoek (2002).

6.4.3 Uncertainty and time-series consistency

The uncertainty in direct N_2O emissions from agricultural soils is estimated to be about 60% in annual emissions. The uncertainty in indirect N_2O emissions from nitrogen used in agriculture is estimated to be more than a factor of 2 in annual emissions.
The trend in N_2O emissions from agricultural soils is summarised in *Table 6.8.* Between 1990 and 1995 N_2O emissions increased about 20%. This increase is almost completely due to the increase in the emissions related to the application of animal manure to agricultural soils. Between 1990 and 1995 the application method has changed considerably. 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 incorporation of manure *into* the soil (sod injection and ploughing in). Due to these new incorporation methods, the local concentration of nitrogen in the upper layer of the soil is higher, which leads to changes in the microbial environment, in microbial processes and, ultimately, to an increase of N_2O emissions per amount of manure applied. From 1995 onwards all manure was incorporated into the soil explaining the increase in N_2O emissions between 1990 and 1995.

Table 6.8. N_2O Emissions from agricultural soils (4D) 1990-2002 (Gg N_2O)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
4D1 Direct soil emissions	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
a. Synthetic fertilisers	6.9	6.7	6.6	6.6	6.3	6.8	6.5	6.7	6.8	6.5	5.7	5.0	5.0
b. Animal wastes applied to soils	5.6	6.2	9.2	9.6	10.0	10.9	10.7	10.2	9.8	10.5	9.5	9.5	8.9
c. N-fixing Crops	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
4D2 Animal production	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
4D3 Indirect emissions	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE	NE/IE
4D4 Background agricultural soils	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7	4.7
Total	**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**

Notes: This tabel excludes emissions from animal housing included in IPCC category *4.B* Manure management (see *Table 6.6*). 4D3 NE/IE = Not Estimated (atmospheric deposition) / Included Elsewhere (leaching and run-off).

Table 6.9. Additional information on nitrogen flows related to direct soil emissions

Nitrogen flows (ton N/year)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Use of synthetic fertilisers	404	389	381	379	362	395	379	390	392	373	330	290	290
N input from manure applied to soils	327	344	370	375	370	357	349	331	319	335	303	303	283
As % of total in AWMS	78%	79%	86%	84%	87%	83%	83%	83%	82%	89%	85%	84%	84%
Dry pulses and soybeans produced 1)	15	14	14	14	14	13	13	13	13	13	13	13	13

1) In kiloton N/year.

Between 1995 and 2002 N_2O emissions decreased about 18%. In 1999 emissions of manure application were higher than in 1998. Due to the rainy weather in the second half of 1998 part of the manure could not be applied in 1998, so part of the manure application was postponed to 1999. Consequently, the emissions in 1999 were relatively high. The decrease of the N_2O emission since 1995 is 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. In 2002 emissions reached the 1990 level. Table 6.9 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 and a small portion of the manure is exported abroad. It is shown that the amount of nitrogen in manure and fertilser applied to agricultural soils decreased with 13 and 28% respectively.

6.4.4 Source-specific recalculations

In 2002 a recalculation was carried out on N_2O emissions between 1990 and subsequent years from animal waste (manure) applied to soils. This recalculation was in response to recalculated ammonia emissions (Van der Hoek, 2002). For the years 1990-1995 the new calculated ammonia emissions for manure application were higher than the previous figures and as a consequence the N input from manure to soils decreased. The lower N input resulted in lower N_2O emissions in this period. In the previous NIR 2003 the figures for N_2O emissions in *Table 6.8* were already corrected for this lower nitrogen input to soils. However, figures in CRF tables were inadvertently not corrected at that time, but will be corrected this year.

6.4.5 Source-specific planned improvements

The present methodologies used to estimate the direct and indirect N_2O emissions from agricultural soils do not fully comply with *IPCC Good Practice Guidance* (IPCC, 2000). For this reason action has been taken in the Netherlands to revise and extend calculations to be in accordance with *IPCC Good Practice Guidance* (IPCC, 2000).

7. LUCF [CRF sector 5]

7.1 Overview of sector

The IPCC source/sink category 5 '*Land Use Change and Forestry*' (LUCF) consists of the sub-sources specified in *Box 7.1*. The figures about total forested area in 1990 ranges from 3300 km^2 (RIVM/CBS, 2003) to 3410 km^2 (Daamen, 2002), which is about 8% of the total land use. By 2000 the forested area had increased to 3600 km^2 ((RIVM/CBS, 2003). A revision of the 1990 forested area figure is foreseen (using 1:10.000 maps). The existing stock is estimated at around 56 million m^3 roundwood, with an annual growth of approximately 2.5 million m^3. The annual amount of harvested wood is around 1.5 million m^3 with a net harvest of 1.1 million m^3 (Dirkse *et al*, 2003). Approximately 70% comes from thinning and 30% from logging (RIVM/CBS, 2002) In the last 15 years the forests have become more mature, better structured and mixed. Around 45% of all forests are unmixed.
The Netherlands only reports data for temperate forests in category 5A (point 2, box 7.1); the Netherlands has no tropical nor boreal forests or tundra. Data for changes in grasslands (point 4, box 7.1) are not estimated. New data are being evaluated for changes in grasslands (5A4) and the other sub-categories 5B to 5E, the results are still under discussion. Therefore CO_2 sinks data are only related to forestry and other woody biomass stocks (Table 5A).

Box 7.1. Summary of sub-sources/sinks in Land-Use Change and Forestry (LUCF) (IPCC category 5)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O
A. Changes in Forest and Other Woody Biomass Stocks	**-1,413.26**	**NA**	**NA**
1. Tropical Forests	NO		
2. Temperate Forests	-1,413.26		
3. Boreal Forests	NO		
4. Grasslands/Tundra	NE		
5. Other *(please specify)*	0.00		
Harvested Wood (1)	NE		
B. Forest and Grassland Conversion (2)	**NE**	**NE**	**NE**
1. Tropical Forests	NO	NO	NO
2. Temperate Forests	NE	NE	NE
3. Boreal Forests	NO	NO	NO
4. Grasslands/Tundra	NE	NE	NE
5. Other *(please specify)*	0.00	0.00	0.00
C. Abandonment of Managed Lands	**NE**	**NA**	**NA**
1. Tropical Forests	NO		
2. Temperate Forests	NE		
3. Boreal Forests	NO		
4. Grasslands/Tundra	NE		
5. Other *(please specify)*	0.00		
D. CO_2 Emissions and Removals from Soil	**NE**	**NA**	**NA**
Cultivation of Mineral Soils	NE		
Cultivation of Organic Soils	NE		
Liming of Agricultural Soils	NE		
Forest Soils	NE		
Other *(please specify)*(3)	0.00		
E. Other *(please specify)*	**NE**	**NE**	**NE**

(1) According to the IPCC Guidelines, the harvested wood should be reported under *'Changes in Forest and Other Woody Biomass Stocks'* (Volume 3. Reference Manual, p. 5.17).

(2) Includes only the emissions of CO_2 from *'Forest and Grassland Conversion'*. Associated removals should be reported under section D.

(3) Includes emissions from soils not reported under sections A, B and C.

7.2 CO_2 from changes in forestry and other woody biomass stock [5A]

7.2.1 Source category description

The Netherlands has only temperate forests and grasslands, no tropical or boreal forests, or tundra. At present, the Netherlands has no data to report for grasslands in category 5A4 (neither is harvested wood, a memo item only). Data for changes in grasslands and harvested wood are not reported. The share of this CO_2 sink, as calculated according to the *UNFCCC Guidelines* – which are different from the Kyoto Protocol (see *Section 1.1.2*) – in the net national total was 0.7% in 1990 and 0.6% in the last reported year.

7.2.2 Methodological issues

For the period, 1990-2000/2001, the data on carbon stock (C) and changes in forestry are based on three elements:

- forest stock (in ha);
- average annual growth by category (in m^3 per ha per year);
- harvest by category (in m^3 per ha per year).

The forest stocks were based on various data sources on forest area (divided into coniferous and broadleaved forests) and other forested area (divided into coniferous and broadleaved forests smaller than 0.5 ha, line plantations, solitaires, orchards and nurseries). The development of forests in the Netherlands has been monitored at about around 2,500 permanent measuring stations, one-fifth of which are visited annually. The growth increment and harvest were also based on different data sources. The amount of fuelwood consumed is implicitly included in these variables, so including them separately would result in double counting.

The carbon emission factors used are 0.25 and 0.30 ton C/m^3 for coniferous and broadleaved forests, respectively. Other characteristics of this source are illustrated by the implied carbon uptake factors presented in *Table 7.1*. More details are provided in Spakman *et al.* (2003) and in *Annex 3.2.* The latter also explains the deviations of the Netherlands' definition of forest area compared to the FAO definition of TFBTA2000.

Table 7.1. Implied carbon uptake factors (in ton C/k ha) in changes in forest and other woody biomass stocks (IPCC category 5A2)

Implied carbon uptake factor	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Coniferous forest	2.51	2.40	2.34	2.32	2.31	2.37	2.33	2.37	2.37	2.35	2.33	2.33	2.33
Broadleaved forest	2.54	2.56	2.55	2.63	2.69	2.78	2.80	2.85	2.86	2.85	2.84	2.84	2.84

Discussion took place on the update to 2001 of data for forest biomass stocks, and of carbon stocks of soils and emissions of CO_2 from agricultural soils in the Netherlands. However, for 2001 no comparable data were available because of the discontinuation of the old monitoring network and the transition to a new monitoring network '*Meetnet Functievervulling'* (see *Section 7.2.4* for more information). Therefore it was decided to use the data for 2000 as an estimate for 2001. Also for the update to 2002 was decided to use the data for 2000 as an estimate for 2002.

Finally, we stress that the present calculation of the CO_2 sinks for this subcategory is based on the *UNFCCC Guidelines*; a calculation according to *Kyoto Protocol Guidelines* has not yet been done.

7.2.3 Uncertainty and time-series consistency

The total annual increment is about 900 to 1000 Gg C, with exception of 1992, when the increment is 877. The carbon uptake increment in that year is only 3217 Gg CO_2 (see *Table 7.2*). The areas of biomass increase slowly by 19 kha in 1990-2001. About three-quarters of the growth took place in

broadleaved forestland area that increased from 151 kha in 1990 through 156 kha in 1995 to 164 ha in 2001. The coniferous forest area increased from 190 kha in 1990 through 195 kha in 1995 to 196 kha in 2001.
On average, trees in the Netherlands are getting older and heavier. A slow reduction in growth rates (due to maturing forests) since 1990, has been slightly overcompensated by planting fast-growing species like poplar and Douglas fir. The average annual growth rate for broadleaved forest increased from 5.11 ton dry matter per ha in the year 1990 to 5.68 in 2000/2001. Part of the volume increment of biomass is reduced due to fellings. During 1990-1994 the fellings reduced slightly, but from 1995 onwards yearly about 2200 km^2 wood was removed every year. The resulting carbon release is clearly presented in *Table 7.2.*

Table 7.2. CO_2 emissions/removals from changes in forest and other woody biomass stocks (IPCC category 5A)

Gg CO_2	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001[3]**	**2002[3]**
Carbon uptake increm.[1)]	3302	3340	3217	3516	3569	3402	3574	3522	3600	3410	3593	3593	3593
Carbon release [2)]	-1880	-1812	-1730	-1710	-1640	-2170	-2176	-2342	-2220	-2174	-2180	-2180	-2180
Net CO_2 removals	**1422**	**1528**	**1487**	**1806**	**1929**	**1232**	**1398**	**1180**	**1380**	**1236**	**1413**	**1413**	**1413**

[1)] Forest and non-forest trees.
[2)] Biomass consumption from stocks.
[3)] Same estimate as for 2000.

The uncertainty in the resulting sink estimates has not yet been assessed. However, the changes over time, as apparent from the CRF files and the summary data in Table 7.2 indicate the accuracy of the estimate within the constraints of the definition of the source category considered here, i.e. only for 5A2. Apparently, the interannual changes may be as large as 0.5 Mton (see 1994/1995 change) for an average sink of about 1.5 Mton.
According to the dataset used in the 1990-2000 period the total forest area increased by 5% (from 341 kha to 360 kha); in particular, broadleaved forest areas by 8%. These figures are exclude non-forest trees. The Netherlands therefore recently revised its quantitative forest policy into one with a more general objective of expanding the total forested area (LNV, 2001).

7.2.4 Planned improvements

As discussed above, comparable data are for 2001 and subsequent years not available because of the discontinuation of the old monitoring network and the transition to a new monitoring network, '*Meetnet Functievervulling'* (in Dutch). This new sampling network will provide data on forest area, standing volume and annual volume increment, subdivided into tree species. However, new data on harvest will not be available before the completion of the second four years of the sampling cycle (at the earliest in 2008).
The literature for quantitative data on carbon stocks and CO_2 emissions from agricultural soils, forest soils and other soils in natural areas in the Netherlands was reviewed in 2002 by Kuikman *et al*., (2002). To estimate and improve the calculation of the CO_2 emissions from soils due to change in carbon stocks, a computer model was recommended, that parameterises five arable crops, collectively forming 84% of the area use for arable farming and grass. For agricultural soils the data in the study are based on the main crops in the Netherlands, i.e. grassland and cropland for maize, potato, beets and grains. A special item formed the organic soils in low-lying areas that have been drained. Three databases and approaches listed below are options to assess soil carbon stocks. These are:

- based on the topographic soil map coupled with the soils information system;
- based on the Netherlands' soil monitoring program;
- based on the monitoring soils in forest and nature ecosystem.

In 2003 a group of consultants carried out a study aiming at identifying current gaps that the Netherlands is facing in comparison to requirements as set by the Marrakesh accords (Nabuurs *et al*., 2003). This includes the subcategories of sources/sinks not yet reported: LUCF subcategories 5B-5E and 5A4, and CO_2 from agricultural soils (category 4D). They concluded that current LULUCF greenhouse gas reporting by the Netherlands is incomplete. The few sections that are included are done at lower Tiers.

No actual data then for the year 2000 are collected. The concluded that data available on areas of land use and land cover are well available, although consistent time series may be a problem due to differences in classifications. Data on practices in agriculture are also very good. Emission factors may not be available at all for many required emission factors for specific Dutch conditions. Currently there is no system or database that will delivers all data. There is a lack of data on changes in soil carbon stocks. The consistency and frequency between different databases may not be required and lead to inaccuracies and also data on the 1990 situation are not available in a consistent manner. For reporting under Tier 1, activity data are available for the larger part and defaults emission factors can be applied. For reporting under Tier 2 much more country specific emission factors are required, and for reporting under Tier 3 the emission factors are often missing.

A decision will be made in 2004 to what extent data can and will be used for reporting on the Source/Sink category in future editions of the Netherlands' greenhouse gas inventory for reporting under the *UN Framework Convention on Climate Change* (UNFCCC) and the *Kyoto Protocol*.

8. WASTE [CRF sector 6]

8.1 Overview of sector

The waste sector comprises four source categories:

- solid waste disposal (i.e. landfills) (6A);
- wastewater handling (6B);
- waste incineration (6C);
- other waste (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*). 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*. It can also be observed from this table that the CO_2 emissions from '*other waste*' (6D) vary substantially over time. This is discussed in more detail in *Section 8.5.*
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 from wastewater handling are (trend) key sources. Methane from landfills is also a large *level* key source.

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
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
6C. Waste incineration [1)]	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
6D. Other	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
CH_4													
6A. Solid waste disposal	572	572	561	545	527	500	483	468	448	411	389	367	345
6B. Waste water handling	6.6	6.0	2.4	6.3	5.1	1.5	1.3	0.8	3.8	1.8	0.8	0.7	0.7
6C. Waste incineration [1)]	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
6D. 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
N_2O													
6B. Waste water handling	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.6	0.5	0.6	0.6	0.6	0.6
6C. Waste incineration [1)]	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	0.0	IE
6D. Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1

[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).

Box 8.1. Key source identification in the waste sector using the IPCC Tier 1 and 2 approach (L = Level, T = Trend)

6D	CO_2	Misc. CO_2, of which 1/3 in category 6D	Non-Key
6A	**CH_4**	**CH_4 emissions from solid waste disposal sites**	**Key (L,T)**
6B	CH_4	Emissions from wastewater handling	*Non-Key* *
6B	N_2O	Emissions from wastewater handling	Non-Key
6C	All	Emissions from waste incineration	Included in 1A1

** Changed 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 2002.

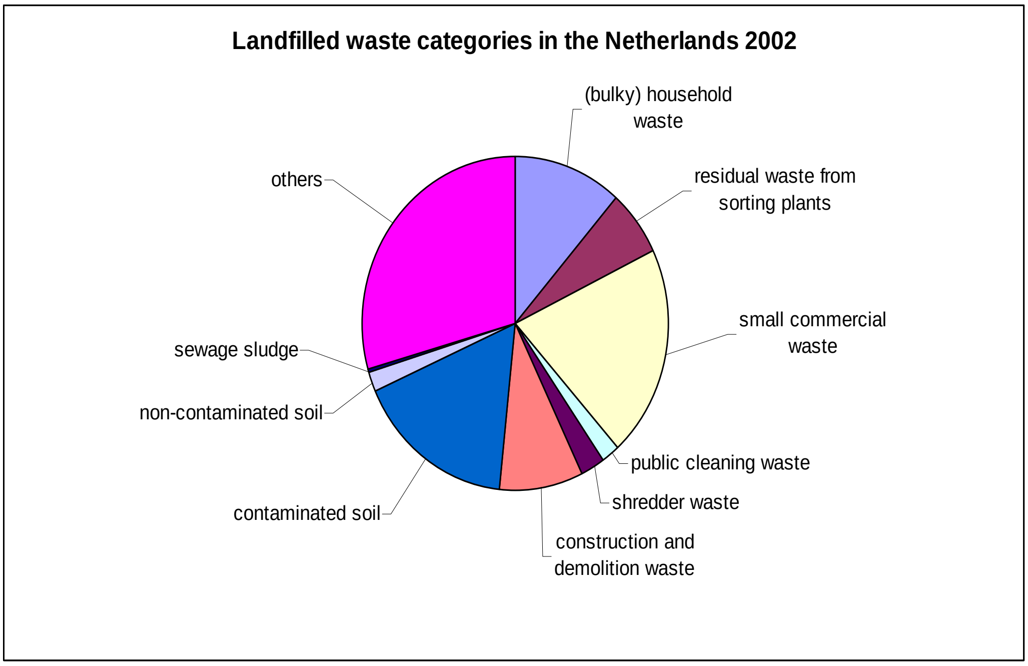


Figure 8.1. Landfilled waste categories in the Netherlands (2002).

In 2002 there were some 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 *Section 8.2.2 ~~,~~ and 8.2.3*).

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:

- 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 methane in landfill gas: 60%;
- 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 are 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.

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
Waste generation rate (kg/cap/day)	8.90	8.87	8.87	8.65	8.63	8.99	9.14	9.14	9.90	9.97	10.17	9.90	9.82
Fraction MSW disposed to SWDS	0.29	0.24	0.24	0.23	0.19	0.16	0.13	0.11	0.10	0.10	0.08	0.08	0.08
Fraction DOC in MSW	0.13	0.13	0.13	0.13	0.13	0.13	0.12	0.12	0.11	0.11	0.12	0.12	0.12
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	0.13
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
CH4 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
Number of SWDS recovering CH_4	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	47	51
Waste incineration (Tg)	3.9	4.1	4.0	3.8	4.4	4.7	5.6	6.7	7.7	7.1	7.2	7.6	7.6

Notes: ND = No Data. Waste generation rate refers to total waste, including MSW.

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
Paper and paperboard	ND	ND	ND	ND	ND	16.6	ND	ND	11.2	11.1	13.1	11.4	11.0
Food and garden waste	ND	ND	ND	ND	ND	21.6	ND	ND	24.7	24.2	26.0	26.8	26.6
Plastics	ND	ND	ND	ND	ND	6.9	ND	ND	8.5	8.5	8.5	8.5	8.5
Glass	ND	ND	ND	ND	ND	2.1	ND	ND	1.5	1.5	1.5	1.5	1.5
Textiles	ND	ND	ND	ND	ND	1.0	ND	ND	1.1	1.1	1.1	1.1	1.1
Other:													
- Metals	*ND*	*ND*	*ND*	*ND*	*ND*	*2.5*	*ND*	*ND*	*3.0*	*2.9*	*3.6*	*2.9*	*3.1*
- Building wastes and ashes	*ND*	*ND*	*ND*	*ND*	*ND*	*32.5*	*ND*	*ND*	*35.9*	*37.7*	*32.5*	*35.2*	*35.4*
- Wood	*ND*	*ND*	*ND*	*ND*	*ND*	*6.5*	*ND*	*ND*	*4.6*	*4.8*	*5.3*	*5.3*	*5.4*
- Other	*ND*	*ND*	*ND*	*ND*	*ND*	*10.2*	*ND*	*ND*	*8.9*	*7.8*	*6.9*	*6.7*	*6.7*

ND = No Data

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, and,
- methane recovery from landfills: VVAV

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 1990-2002 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 2002 (*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 8.4. Net methane emissions and methane recovered from solid waste disposal sites 1990-2002(unit: Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CH_4 emissions (net)	572	572	560	545	527	500	483	468	448	411	389	367	345
CH_4 recovered/flared	26	35	45	55	64	74	69	59	54	66	66	67	69
% of gross emissions	5%	6%	8%	10%	12%	15%	14%	13%	12%	16%	17%	18%	20%

Table 8.5. Waste disposal (excluding discharge into surface water)(Tg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Incinerated	3.9	4.1	4.0	3.8	4.4	4.7	5.6	6.7	7.7	7.1	7.2	7.6	7.6
Reused/recycled	30.5	32.6	33.3	33.2	34.8	38.0	39.3	40.0	43.0	43.5	45.4	45.5	45.5
Landfilled	14.0	11.7	11.8	11.1	9.2	8.1	6.7	5.7	5.5	5.5	4.8	4.7	4.7

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 1990-2002, where the amount of waste disposed in landfills decreased substantially.

~~8.2.4~~ Source-specific recalculations

An in-depth analysis was made by AOO of all available data and the calculation procedure for estimating net methane emissions from landfills. Compared to NIR 2003 both the calculated formation of methane and the amount of methane recovered have been updated (*Table 8.6*). The formation of methane was recalculated by using the methane generation constant *k* as described in *Section 8.2.2* and applied to the appropriate amounts landfilled, i.e. to the waste amounts of the year to which the k factor corresponds, and by using revised DOC values from 1998 onwards. The amount of recovered methane has been revised for recent years based on new volume data for gas recovery from the VVAV and due to the a new conversion factor used for converting from volume to mass units.

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
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
- Recovered/flared	25.89	35.5	45.0	54.6	64.2	73.8	69.1	59.3	53.7	66.2	65.7	66.5
- 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**
NIR2003												
- Gross emissions	589.0	593.1	587.2	580.5	572.9	558.0	548.9	536.0	520.5	504.3	489.8	475.6
- Recovered/flared	27	37	47	58	68	78	73	73	76	76	86	86
- Net emissions	**562.0**	**556.1**	**540.2**	**522.5**	**504.9**	**480.0**	**475.9**	**463.0**	**444.5**	**428.3**	**403.8**	**389.6**
Difference												
- Gross emissions	*8.8*	*14.6*	*18.3*	*18.7*	*18.1*	*15.8*	*3.5*	*-9.0*	*-19.1*	*-26.7*	*-35.1*	*-41.6*
- Recovered/flared	*-1.1*	*-1.5*	*-2.0*	*-3.4*	*-3.8*	*-4.2*	*-3.9*	*-13.7*	*-22.3*	*-9.8*	*-20.3*	*-19.5*
- Net emissions	***9.9***	***16.2***	***20.3***	***22.0***	***21.9***	***20.1***	***7.4***	***4.8***	***3.2***	***-16.9***	***-14.7***	***-22.1***

8.3 Wastewater handling (6B)

8.3.1 Source category description

CH_4 emission from wastewater handling (category 6B) is identified as a key source (trend) in *Box 8.1*. Its present share of CH_4 emissions in the national total was 0.1% (0.5% in 1990). N_2O emissions from wastewater treatment or considered to be a non key source have, at present, a share of 1.2% in total emissions (0.8% in 1990).

8.3.2 Methodological issues

Country-specific methodologies are used for CH_4 and N_2O emissions from wastewater handling, which are both equivalent to the IPCC Tier 2 methods. A full description of the methodology is provided in Spakman *et al.* (2003). Since the CH_4 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).

8.3.3 Uncertainties and time-series consistency

In *Table 8.7* gives an overview of the trend in greenhouse gas emissions from 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.

Table 8.7. Wastewater handling emissions of methane (in Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Net CH_4 emissions (Gg)	6.6	6.0	2.4	6.3	5.1	1.5	1.3	0.8	3.8	1.8	0.8	0.7	0.7
CH_4 recovered and/or flared (Gg)	27.6	32.6	33.3	32.7	NE	37.8	37.3	39.5	34.3	37.9	36.6	39.5	39.5
Recovery/flared (% of gross emiss.)	81%	84%	93%	84%	NE	96%	97%	98%	90%	95%	98%	98%	98%

Table 8.8. Wastewater handling: composition (unit: Gg DOC/yr [1])

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Wastewater	933	940	948	960	970	921	921	916	930	915	921	937	937
Sludge	254	263	248	246	251	269	283	270	279	282	281	299	299
Total	1 187	1 203	1 196	1 206	1 221	1 190	1 204	1 186	1 209	1 197	1 202	1 236	1 236

[1] DOC: Degradable Organic Component

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 CO_2 emissions from *waste incineration* (e.g. plastics) are calculated from the total amount of waste incinerated. These are split into eight waste types, each with a specific carbon content and fraction of fossil C in total C based on an analysis by De Jager and Blok (1993).
The CH_4 and N_2O emissions from these sources are also included in the ER-I dataset. For N_2O an emission factor of 20 g/ton waste is applied. A more detailed description of the methodology is provided in Spakman *et al.* (2003).

8.4.3 Uncertainties and time-series consistency

The source category '*Waste incineration*' is included in category 1A1 (Energy industries) as part of the sub-source '*Public Electricity and Heat Production'*, see *Section 3.2.1*. The emissions from this source are not specified separately.

8.5 Other waste handling (6D)

8.5.1 Source category description

This source category consists of emissions from ambiguous sub-sources, with CO_2 emissions varying between 0.1 and 1.2 Tg and, incidentally, some CH_4 emissions (in 1996) (see *Table 8.1*). This source category is not considered as a key source.

8.5.2 Methodological issues

Country-specific methodologies for this source category are used. The estimations are based on environmental reports from individual companies. As the set of individual companies differs per year, it may happen that for some years a very plant-specific emission is reported that does not occur in the emissions dataset of other years. 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

In the Dutch PER the waste sector uses ambiguous source descriptions and these change over time. Therefore the allocation of these sources is subject to interpretation. In the NIR 2004 the allocations for the years 1990, and 1995-1999 are based on the source descriptions for 2000, so that the trend in 6D remains unsatisfactory, also after recalculations performed as described below. A revised dataset will been compiled in 2004 by the Task Force ENINA.

8.5.4 Source-specific recalculations

The non-CO_2 emissions from combustion of biogas at wastewater treatment facilities, previously allocated in the category (6D), are now allocated the emissions under category 1A4 (*Fuel combustion - Other sectors)* because this combustion is partly used for heat or power generation at the plant. In addition, part of the CO_2 emissions (in 6D) in the years 1998 to 2001 which could not be accounted for in the energy statistics were removed. These actions changed the CO_2 emissions in category 6D as shown in *Table 8.9*. However, further study of the data reported under 6D will be done in 2004 in order to achieve a consistent times series the complete 1990-12002 period.

Table 8.9. 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
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
NIR2003	0.9	0.0	0.0	0.0	0.0	0.9	1.1	1.2	0.5	1.0	0.4	0.4
Difference	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***0.0***	***-0.4***	***-0.4***	***-0.4***	***-0.4***

9. OTHER [CRF sector 7]

9.1 Overview of sector

The Netherlands uses this source category to report all sources that cannot be properly allocated to one of the subcategories of the standard IPCC source sectors 1 to 6, either because of the definition of the source does not match with the IPCC classification or because the CRF (following IPCC recommendations) erroneously does not permit to report emissions of specific gases under these sectors. *Table 9.1* lists both the sources reported here as well as their emission trends. It shows that the N_2O emissions reported under this category are assumed to remain constant over time.

Table 9.1. Trend in emissions from the other sector (category 7) (CO_2 in Tg; others in Gg)

Gas/subsource	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
CO_2													
a. Solvents and other product use	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
CH_4													
a. Solvents and other product use	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
b. Degassing drinking water [1)]	2.0	2.0	2.0	1.9	2.0	2.0	2.0	1.9	1.9	1.9	1.9	1.8	1.8
N_2O													
c. Polluted surface water	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8	3.8

[1)] From ground water.

From *Box 9.1*, in which the key and non-key sources of this sector are presented based on level, trend or both, we can conclude that N_2O from polluted surface water is a (level) key source.

Box 9.1. Key source identification in the 'Other' source sector 7 using the IPCC Tier 1 and 2 approach (L = Level, T = Trend)

7	CH_4	Misc. CH_4	Non-key
7	CO_2	Misc. CO_2	Non-key
7	**N_2O**	**Misc. N_2O**	**Key (T1, L2) ***
7	**N_2O**	**Polluted surface water**	**Key (L)**

* Changed compared to the previous NIR.

9.1.1 Source category description

Miscellaneous non-industrial CO_2 sources

The small CO_2 emissions labelled in *Table 9.1* as '*Solvents and other product use*' consist of emissions from fireworks. These emissions are reported here for historical reasons.

Miscellaneous non-industrial CH_4 sources

Some minor sources of CH_4 emissions from non-industrial, non-combustion sources have been included in the Netherlands' inventory, but these are reported in category 7 '*Other*' instead of in category 3, since the CRF table for that category erroneously do not allow for methane to be reported. These sources are:

- emissions from fireworks (also a negligible source of N_2O);
- emissions from paints and lacquers and from food storage/warehouses;
- degassing of drinking water;
- burning of candles.

The latter is a new source introduced in the Dutch Emission inventory in 2002. Activity data were based on an amount of candle burning of 2.2 kg per person per year (Van Harmelen *et al.*, 2002).

CH_4 emissions from (agricultural) soils decreased in last 40 years due to drainage and lowering of water tables 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 total, although they act as a methane sink. Therefore, they are not reported as anthropogenic emissions under IPCC category 7.

Miscellaneous N_2O sources
In addition, one source of N_2O is reported under this source sector 7: '*Polluted surface water'*. This comprises the indirect N_2O emissions from leaching and run-off, which are calculated as a fixed value that comprises leaching and run-off from agricultural activities (3/4) and from other nitrogen sources (1/4), including human sewage. More details on this source can be found in Spakman *et al.* (2003) and Kroeze (1994). Since this figure includes more than only agriculture related emissions we do not report these under 4.D but as a separate source in category '7' (see also *Section 6.4*). Total N_2O emissions from leaching and run off are 3.8 Gg N_2O. The N_2O emissions stemming from agriculture are thus 3/4 * 3.8 = 2.85 Gg N_2O; the other part stems from NO_x emissions from transport and stationary combustion sources.

9.1.2 Methodological issues

Nitrous oxide emissions from polluted surface water, comprising indirect N_2O emissions from leaching and run-off, is identified as a (level) key source and the methodological aspects are addressed in *Sections 9.1.1* and *6.4*. The Netherlands does not use the IPCC method to estimate these indirect N_2O emissions from leaching and run-off; N_2O emissions from atmospheric deposition emissions are not estimated. Since the emissions are a key source (see *Box 9.1*), the present methodology does not fully comply with the *IPCC Good Practice Guidance* (IPCC, 2000).
For other sources reported here also country-specific methodologies are used. The estimations are based on statistics from suppliers of products. Methane from food storage/warehouses is also reported in annual environmental reports from individual companies. Since these emissions are not considered to be key sources (see *Section 1.5*), the present methodology level does comply with the *IPCC Good Practice Guidance* (IPCC, 2000).

9.1.3 Uncertainties and time-series consistency

The uncertainty of N_2O emissions from polluted surface water is estimated to be 200% in annual emissions (see *Section 1.7* for more details). The uncertainty of N_2O is expected to be rather large due to inherent uncertainty in the emission factors, and because of the correlation with the N_2O emissions from other sources. The uncertainty of the other sources is estimated to be in the range 25-50% (*Section 1.7*).
It is expected that the N_2O emissions from polluted surface water will, in practice, vary from year by year, but because no detailed data are available the emissions from this source are kept constant (see *Table 9.1*). It can be observed in *Table 9.1* that CO_2 and CH_4 emissions from the solvent use subcategory can vary substantially over time. This may be attributed partly to changes in the groups of individual firms reporting in every year.

9.1.4 Source-specific planned improvements

The present methodology used to estimate indirect N_2O emissions from agricultural soils, here reported as *N_2O from polluted surface water*, does not fully comply with *IPCC Good Practice Guidance* (IPCC, 2000). For this reason actions are underway to revise and expand calculations to be in accordance with *IPCC Good Practice Guidance*.

10. RECALCULATIONS AND IMPROVEMENTS

In this chapter we outline the key differences compared with the previous submission reported by Olivier *et al.* (2003). Because most changes are only minor and, since recalculations have not been performed for all the years prior to 1999 but mostly only to 1990 and 1995, emission figures have, in general, remained unchanged for the years 1991-1994 compared to the previous submission. The minor alterations that have been made are explained in the following sections.

10.1 Explanation and justification for recalculations

This section will elaborate the relevant changes in emission figures compared to the last NIR. A distinction is made between:

1. *Methodological changes:* new data based on revised or new estimation methods; improved emission factors are also included under methodological changes;
2. *Allocation:* changes in allocation of emissions to the different sectors (only affect the totals per sector);
3. *Error corrections:* repair of incorrect data transfer from the PER to the CRF.

This year recalculations or methodological changes were made for the years 1990, 1995, 2000, 2001 and (new) 2002. This means that for 1991-1994 and 1996-1999 no recalculations have been made, except in the cases explicitly mentioned below.

10.1.1 Methodological changes

The following methodological changes were made for greenhouse gases:

- Recalculation of the emissions from traffic and transport (all gases, all years) based on updated emission factors and recalculated gas oil data for other mobile sources (category 1A3);
- Revision of HFC emissions for the years 2000-2002 based on improved analysis of data (category 2);
- Revision of PFC and SF_6 emissions for the years 1990-2001 based on improved data from the industry (category 2).
- Recalculation of the CH_4 emissions from landfills based on improved calculation parameter, activity data and recovery rate (category 6A);
- CH_4, N_2O emissions from *international bunkers (international transport)* are now included in the inventory for the years 1990, 1995 to 2002 (category Memo Items).

For precursor only one change was made (other than resulting from the above mentioned actions);

- Recalculation of the emission factor for SO_2 for chemical fuel gas used in the electricity production for the years 2000 and 2001 (category 1A1).

10.1.2 Source allocation

In this submission the source allocation was improved in the following case:

- *Fugitive emissions*: The fugitive emissions of CH_4 (1B2) were reallocated for 1991-1994 over the subcategories of 1B2 instead of lumping the total under ‘Other, non-specified’ in 1B2;
- *Waste*: The emissions from combustion of biogas at wastewater treatment facilities were previously allocated in the category (6D). Because this combustion is partly used for heat or power generation at the plant we now allocated the emissions under category 1A4.

10.1.3 Error corrections

During the compilation of the inventory for 2002 errors were detected in the emission calculations for previous years. These actions also led to changes in emissions per category and in national total emissions. The most obvious error corrections were:

- Recalculation of the natural gas use and thus emissions in category 1A4 (1990, 1995-2001) based on revised fuel use statistics for the residential sector;
- Recalculation of the natural gas use and thus emissions in chemical industry category 1A2c (1990 and, in particular, 1997-2001) based on in-depth analysis of fuel data of about 1 Tg CO_2 and identification of a double-counting error for 1997-2001 of about 2.5 Tg CO_2;
- Recalculation of the gas oil use and thus emissions in refinery category 1A1b (1995-2001), based on in-depth analysis of fuel data;
- Removal of part of the CO_2 emissions (in other waste, 6D) in the years 1998 to 2001 which could not be accounted for in the energy statistics;
- Error correction in calculation of CO_2 and N_2O emissions from the residential sector (in Memo Item and category 1A, respectively) for fire places, using non-fossil fuels e.g. wood and of N_2O from aerosols for the total period 1990-2001;
- Error correction of NO_2 emissions from agricultural soils (4D) for the years 1990 to 1995 based on revised data for manure applied to soil.

10.2 Implications for emission levels

This section outlines the implications of the different improvements, as described in *Section 10.1,* for the emission levels over time. *Table 10.3* elaborates the differences between the submissions from last year and the current NIR on level of the different greenhouse gases. More detailed explanations are elaborated in the sectoral *Chapters 3 to 9*.

Table 10.1. Differences between NIR 2003 and NIR 2004 for 1990-2001 due to recalculations

Gas	Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CO_2 [Tg]	NIR 2003	**157.8**	166.0	164.2	166.1	166.8	171.2	178.9	167.5	172.4	169.5	172.4	178.4
Incl. LUCF	NIR 2004	**159.2**	166.2	164.8	166.4	167.0	172.0	180.2	165.0	171.0	166.0	169.3	175.6
	Difference	***0.8%***	*0.1%*	*0.3%*	*0.2%*	*0.1%*	*0.5%*	*0.7%*	*-1.5%*	*-0.8%*	*-2.0%*	*-1.8%*	*-1.6%*
CO_2 [Tg]	NIR 2003	**159.3**	167.5	165.7	167.9	168.8	172.4	180.3	168.7	173.8	170.7	173.8	179.9
Excl.LUCF	NIR 2004	**160.6**	167.8	166.3	168.2	168.9	173.2	181.6	166.2	172.4	167.3	170.7	177.1
	Difference	*0.8%*	*0.1%*	*0.3%*	*0.2%*	*0.1%*	*0.5%*	*0.7%*	*-1.4%*	*-0.8%*	*-2.0%*	*-1.8%*	*-1.6%*
CH_4 [Gg]	NIR 2003	**1292**	1309	1253	1226	1203	1170	1174	1100	1065	1037	983	973
	NIR 2004	**1302**	1325	1273	1248	1224	1190	1181	1105	1068	1020	968	949
	Difference	***0.8%***	*1.2%*	*1.6%*	*1.8%*	*1.8%*	*1.7%*	*0.7%*	*0.4%*	*0.3%*	*-1.7%*	*-1.5%*	*-2.5%*
N_2O [Gg]	NIR 2003	**53.4**	54.2	57.9	60.2	59.1	58.6	57.9	57.4	56.9	56.0	53.7	51.8
	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
	Difference	***-0.9%***	*-0.9%*	*-1.7%*	*-1.6%*	*-1.8%*	*-0.4%*	*-0.8%*	*-0.2%*	*-0.5%*	*-0.5%*	*-0.6%*	*-1.6%*
PFCs [Mg]	NIR 2003	353	354	304	307	273	**269**	295	312	246	203	214	205
	NIR 2004	351	352	302	304	270	**265**	292	313	247	207	220	208
	Difference	*-0.5%*	*-0.6%*	*-0.8%*	*-0.9%*	*-1.2%*	***-1.4%***	*-1.1%*	*0.4%*	*0.5%*	*1.5%*	*2.8%*	*1.5%*
HFCs [Mg]	NIR 2003	379	295	406	474	680	**700**	1113	1496	1585	1196	1053	704
	NIR 2004	379	295	406	474	680	**700**	1113	1496	1585	1215	1056	649
	Difference	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	***0.0%***	*0.0%*	*0.0%*	*0.0%*	*1.6%*	*0.3%*	*-7.8%*
SF_6 [Mg]	NIR 2003	7.8	4.2	4.5	4.6	6.2	**11.5**	11.9	13.0	12.3	11.1	11.2	12.4
	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
	Difference	*16.3%*	*33.4%*	*34.5%*	*36.3%*	*29.2%*	***9.4%***	*9.7%*	*10.7%*	*11.6%*	*19.6%*	*24.8%*	*20.3%*
Total	NIR 2003	208.6	216.3	215.2	217.8	218.9	222.1	231.5	219.1	223.8	215.2	215.4	218.3
[Tg CO_2-eq.]	NIR 2004	210.0	216.7	215.9	218.2	219.2	223.3	232.8	216.8	222.4	211.4	212.0	214.7

Incl. LUCF	*Difference*	*0.7%*	*0.2%*	*0.3%*	*0.2%*	*0.1%*	*0.5%*	*0.6%*	*-1.1%*	*-0.6%*	*-1.8%*	*-1.6%*	*-1.6%*
Total.	NIR 2003	210.0	217.8	216.7	219.6	220.9	223.3	232.9	220.3	225.2	216.4	216.8	219.7
[Tg CO_2-eq]	NIR 2004	211.4	218.2	217.4	220.0	221.2	224.5	234.2	218.0	223.8	212.7	213.4	216.1
Excl.LUCF	*Difference*	*0.7%*	*0.2%*	*0.3%*	*0.2%*	*0.1%*	*0.5%*	*0.6%*	*-1.1%*	*-0.6%*	*-1.7%*	*-1.6%*	*-1.6%*

Note: base year values are indicated in bold.

10.2.1 Recalculation of base year and (now final) year 2000

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

The total CO_2-eq. emissions in the base year 1990 increased by 1.4 Tg CO_2-eq or 0.7 % compared to last submission. This increase can be explained by the following most relevant changes (all in CO_2 equivalent):

- For CO_2: + 0.7 Tg in the category *Other sectors* (1A4) due to recalculations of natural gas use based on new statistics; and + 0.3 Tg in the category *Manufacturing industry* (1A2) due to error correction on the basis of detailed analysis of inventory data an energy statistics; and +0.3 Tg in *Transport* (3) due to recalculation (see *Sections 3.2.2.4, 3.2.2.5* and *3.2.2.5* for more information);
- For the other gases the changes are very small; the largest: 0.01 Tg for CH_4 in Waste (6) due to recalculation of emissions from landfills.

The changes for F-gases in 1995 (the base year for the F-gas emissions) due to recalculations amount to +0.06 Tg CO_2-eq.: +0.02 Tg for PFCs and +0.03 Tg for SF_6 emissions.

Year 2001: Full recalculation on final statistics

The data for 2001 are now based on the final 2001 energy and production statistics, which implicitly leads to changes in almost all emission data, related to these statistics. The decrease in the total CO_2-eq. emissions for 2001 was -3.5 Tg CO_2-eq. or -1.6 % compared to last submission.
The main changes are (all in CO_2 equivalent):

- For CO_2: -3.7 Tg in *Manufacturing industry* (1A2) due to removal of double counting of the emissions from a major chemical plant. During detailed analysis of fuel data this major error was detected (see *Section 3.2.2.4* for more information);
- For CO_2: +1.3 Tg in the category *Other sectors* (1A4) due to recalculations of natural gas use based on new statistics (see *Section 3.2.2.4* for more information);
- For CO_2: In the sectors *Energy* (1A1) and *Transport* (1A3) and *Waste* (6D) the emissions decreased (-0.1, -0.1 and -0.4 Tg). In the industrial processes the emissions increased + 0.2 Tg. These changes were based on final statistical data. In the waste sector an error correction lead to a decrease of 0.4 Tg.
- For CH_4: -0.5 Tg mainly due the final statistics for the emissions from *Landfills* (6A);
- For N_2O: -0.001 Tg mainly due the an decrease in the energy sector and *Agricultural soils* (4D);
- For HFCs, PFCs and SF_6: -0.07, +0.03 Tg and -0.06 Tg, respectively due to recalculations based on new data from the industry.

10.2.2 Recalculation of other years/gases

Years 1991-1994

The decrease in the total CO_2-eq. emissions in 1991 to 1994 compared to the last submission amounts to 0.5, 0.7, 0.4 and 0.3 Tg CO_2-eq or 0.2, 0.3, 0.3 and 0.1%, respectively. As can be concluded from *Table 10.1,* the gases CO_2 and CH_4 account almost completely for these changes. The increase in the emissions for these gasses (in *Transport* and *Waste*) is partly counterbalanced by a decrease in N_2O emissions (from *Agricultural soils* and *Transport*).

Year 1995

The increase in the total CO_2-eq. emissions in 1995 was 1.2 Tg CO_2-eq or 0.5%, compared to the last submission: CO_2 emissions increased by 0.9 Tg due to recalculation in *Energy* (1A.4 *Other sectors*) based on new natural gas statistics. The remaining part of the increase was due to the recalculated CH_4 emissions from *Waste* (6A). Other gasses did only change slightly as a result of the actions mentioned earlier.

Years 1996-2000

The changes in the total CO_2-eq. emissions in 1996 to 1999 compared to last submission amounts to 1.3, -2.3, -1.3, -3.8 and -3.4 Tg CO_2-eq or 0.6%, -1.1%, -0.6%, -1.7% and -1.6%, respectively. The main changes are (all in CO_2 equivalent):

- For CO_2: -3.3 Tg for 1997-2000 in *Manufacturing industry* (1A2) due to removal of double counting of the emissions from a major chemical plant. During detailed analysis of fuel data this major error was detected;
- For CO_2*:* +0.9 to 1.3 Tg in the category *Other sectors* (1A4) due to recalculations of natural gas use based on new statistics (1996-2000);
- For CH_4 : mainly due to recalculations for *Waste* (6A);
- For N_2O : small changes mainly due to recalculation of the *Transport* (1A3) emissions;
- For HFCs, PFCs and SF_6: slight increase due to recalculations.

10.3 Implications for emission trends, including time-series consistency

The recalculations, in general, account for an improvement in the overall emission trend. Data for all greenhouse gases for the years 1990, and 1995 to 2001 are now consistent in methodology and allocation. The differences in national total emissions per compound are presented in *Table 10.1* for each year in the period 1990 to 2000. The change in the 1990-2001 trend for the greenhouse gas emissions compared to the previous submission is presented in *Table 10.2*. From this table it can be concluded that due to recalculations the trend in the total national emissions decreased by 1.5% compared to the NIR 2003. The largest relative changes in emission trends are observed for CH_4 and SF_6.

Table 10.2. Differences between NIR 2003 and NIR 2004 for the emission trends 1990-2001

Gas	**Trend (absolute)**			**Trend (percentage)**		
[Gg CO_2-eq.]	**NIR 2003**	**NIR 2004**	*Difference*	**NIR 2003**	**NIR 2004**	*Difference*
CO_2 [1)]	19,163	16,485	*-2,678*	11.9%	10.3%	*-1.7%*
CH_4	-6,705	-7,423	*-718*	-24.7%	-27.1%	*-2.4%*
N_2O	-729	-578	*151*	-4.4%	-3.5%	*0.9%*
HFCs	-2,848	-2,925	*-77*	-64.3%	-66.0%	*-1.7%*
PFCs	-975	-934	*41*	-40.1%	-38.7%	*1.4%*
SF_6	109	139	*30*	58.4%	63.9%	*5.5%*
Total [1)]	8,016	4,764	*-3,251*	3.8%	2.3%	*-1.5%*

[1)] Excluding LUCF.

The trends for all gases for all years on a more detailed level can be found in the CRF file for 2002 (CRF Tables 10), which are also reproduced in *Annex 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. The years 1991-1994 were not recalculated completely (i.e. either not or only partially for 1A.3, 1A.4 and 4D and 6A); especially the CO_2 emissions do not match the overall trend.

10.4 Recalculations, response to the review process and planned improvements

10.4.1 Revised source allocations

For domestic purposes, emissions in the Netherlands are grouped by 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 (so-called reporting codes (in Dutch: 'rap-codes') have received an additional attribute 'IPCC subsector'. In the year 2001 the reporting codes used in past years, were revised in order to improve the link between Netherlands' emissions sources and IPCC subsectors. Based on these new reporting codes, improvements of the related reporting code have been made to the IPCC sector correspondence table. This was done to achieve the best possible compliance with source category definitions in the *Revised 1996 IPCC Guidelines* within the constraints of lowest subsource categories currently identified (reporting codes) in the Netherlands' *Pollutant Emission Register* (Coenen and Olivier, 2002).

All emission data in this submission for the years 1990, 1995, 2000, 2001 and 2002 were submitted to the Netherlands' Emission Registration system using the updated source codes, resulting in a totally comparable source allocation in the CRF for these years. Especially for CO_2 (and related combustion emissions), this resulted in reallocations between and within categories 1, 2 and 6, mainly due to improved identification of combustion, process and biomass emissions in the inventory data (see also *Section 10.1*).

The historic inventory datasets used for reporting data for the 1991-1994 and 1996-1999 period were only partly revised and thus, the overall source allocation did not change for these years.

10.4.2 Completeness of sources

The Netherlands greenhouse gas emission inventory includes all sources identified by the *Revised IPCC Guidelines (IPCC, 1997) except* for the following:

- Indirect N_2O emissions from *atmospheric deposition* (category 4D) are not estimated/reported due to historic reasons;
- CO_2 emissions from *agricultural soils* (category 4D) are not estimated/reported due to historic reasons;
- In addition, it has been observed that *CH_4 and N_2O from horse manure* (category 4B) is missing; this is because no manure production estimates from horses have been made to date and no emission factors for this source category have been defined;
- CH_4 emissions from *soils* deceased in the last 40 years due to drainage and 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, total methane from soils acts in fact a methane sink;
- Emissions/sinks for *LUCF subcategories 5A to 5E*, except for the CO_2 sink in category 5A2. New datasets are being compiled but are still under discussion, so no data for these subcategories have been included in this submission;
- CH_4 and N_2O emissions from *industrial* wastewater treatment (6B) and from *large-scale compost production* from organic waste (6D) (DHV, 2000).

Most of these sources are planned to be included in the next submission (see *par. 10.4.7*). This year the – very minor – CH_4 and N_2O emissions from *international bunkers* were included in the inventory for the complete 1990- 2002 period. A survey made to check for possibly unidentified sources of non-CO_2 emissions in the Netherlands showed that some other minor sources of PFCs and SF_6 are also not included in the present greenhouse gas inventory (DHV, 2000). These may be included later provided that they will be monitored regularly.

10.4.3 Changes in CRF files compared to the previous submission

The tables included in the *Annex 7* represent the *printed summary version* of the 2003 Netherlands' annual submission of the CRF files of its greenhouse gas emission inventory in accordance with the UNFCCC and the European Union's *Greenhouse Gas Monitoring Mechanism.* These include:

- IPCC Summary Tables 7A for the base years 1990 and 1995, and for the last two years (2001 and 2002) (CRF Summaries 1);
- Trend Tables 10 for each gas individually and for all gases and source in CO_2-eq. (included in the file *Netherlands - submission 2004 v 1.0 - 2002.xls*);
- Trend Tables 10 for precursor gases (included in the file *Netherlands - submission 2004 v1.0 - 2002.xls*);
- Recalculation Tables and Explanation Table 8.a and 8.b for base years 1990-2001.

Completeness Table 9 for 1990 has been included in *Annex 5*. The largest changes are (see copy of recalculation checklist below):

- Data for 2000 and 2001 were updated (2001 data were partially based on estimated activity data in the previous submission);
- Data for 2002 have been added (figures for 2002 are partially based on estimated activity data);
- Data for 1990-2000 were updated according to the latest data and methodology. See also *Sections 10.1* to *10.4*), including changes announced in the previous three 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 recalculations

We have summarised the recalculations (derived from the CRF status reports on recalculations) below for your information. All recalculation were explained in table 8 of the CRF.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
CO_2												
Energy	X	X	X	X	X	X	X	X	X	X	X	X
Ind.Processes												X
Solvent Use												X
LUCF												
Agriculture												X
Waste							X		X	X	X	X
CH_4												
Energy	X	X	X	X	X	X	X	X	X	X	X	X
Ind.Processes												X
Solvent Use												X
LUCF												
Agriculture						X		X				X
Waste	X	X	X	X	X	X	X	X	X	X	X	X
N_2O												
Energy	X	X	X	X	X	X	X	X	X	X	X	X
Ind.Processes												X
Solvent Use		X	X		X	X	X	X				X
LUCF												
Agriculture	X	X		X	X							X
Waste						X	X	X			X	X
HFCs									X	X	X	X
PFCs	X	X	X	X	X	X	X	X	X	X	X	X
SF_6	X	X	X	X	X	X	X	X	X	X	X	X

10.4.4 Completeness of the CRF files

As mentioned above, the CRF files for 1990 and 1995-2002 now also include sectoral background data for *1A1 Fuel combustion,* including *1A1: Energy industries* and *1A2: Manufacturing industries,* i.e., to the extent that emissions were reported in the various industry sectors in the national Emission Registration system per fuel type (solid, liquid and gaseous fossil fuels).

Derived gases (coke oven gas, blast furnace gas etc.) were included under ‘Solid fuels’. Emissions from LPG (except for Transport) were included in ‘Liquid fuels’. The emissions not reported by fuel type are summed and reported under ‘Other fuels’, as is total fuel consumption associated with these unspecified emissions. This fraction increases from about 11% of fossil-fuel related emissions in 1990 to 15% in 1996-1997, and to 34% in 2000; i.e. this percentage of CO_2 emissions could not be allocated to a specific fuel type.

In general, completeness of the CRF tables is limited by the present level of detail of ER-I data storage, in particular, for IPCC categories 1A1, 1A2 and 2 (see *Table 10.5*). These are the sectors that are largely reported by individual firms for which the level of detail, completeness and quality varies considerably (see *Section 1.6* on Quality Assurance). For example, in cases where point sources are reported differently, inconsistent fuel consumption figures are associated with emissions of CO_2, CH_4 and N_2O, respectively. In those cases it was decided to use the fuel data for CO_2 in the CRF tables, since CO_2 is, by far, the most important gas of the three. As a consequence, however, the implied emission factors for CH_4 and N_2O in these cases will show another value than could be calculated from the original reported activity data.

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 currently individual consumption figures are available and which are now used for estimating actual emissions (so-called Confidential Business Information). This replaces the use of aggregated figures from the annual report by KPMG on consumption of CFCs, halons, HCFCs, HFCs, PFCs and SF_6. Some of these entries are therefore labelled ‘C’, but please note that as a result of the CRF structure, most of the summed figures for potential emissions of PFCs and SF_6 show ‘0.0’ or ‘value’. Please also note that the Netherlands introduced the species ‘HFC unspecified’ and ‘PFC unspecified’ in the F-gas tables, accompanied by an average GWP value. One should pay attention to this when extracting CRF data for other calculation.

Table 10.5 provides a summary of the completeness of the CRF files per IPCC source category. Where 'IEF' is included, both emissions and activity data were provided in the sectoral background tables. In some cases confidentiality (‘C’) prohibited this. Compared to the previous submission, completeness of sectoral background tables has improved substantially, as was noted above. The still limited completeness for the years 1991-1994 in subcategories 1A and 1B is mainly due to fact that (recalculated and updated) data for these sectors are not yet available in the required format.

10.4.5 Response to the issues raised in external reviews

Although the contents of the PER as a whole has not been subjected to regular external reviews, in recent years a number a reviews have been conducted on the greenhouse gas emission data and the PER as National System for compiling the national greenhouse gas inventory. For example:

- In 1999 Utrecht University on request of RIVM reviewed the quality of annual carbon dioxide emissions of the PER and trend assessments made by RIVM for its annual evaluation of emission trends within the framework of the *Environmental Balance* (Turkenburg and Van der Sluijs, 1999). As a result of these reviews of analyses made for the *Environmental Balance*, it was concluded that more attention should be given to: a) documentation of methodologies; b) documentation of data quality including uncertainty estimates and c) a wider consultation of experts to analyse the uncertainty in the data.
- On request of the UNFCCC secretariat, a consultant described and evaluated the quality of the Netherlands’ present National System for compiling the National Greenhouse Gas Emission Inventory (Mareckova, 2000).

Table 10.3a. Summary of completeness of the Common Reporting Format files 1990-2002.

GREENHOUSE GAS CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
1. Energy													
A. Fuel Combustion													
1. Energy Industries	IEF [1]	EM	EM	EM	EM	IEF [1]	IEF [1]	IEF [1]	IEF [1]	IEF [1]	IEF [1]	IEF [1]	IEF [1]
2. Manufacturing Industries and Construction	IEF [1]	EM	EM	EM	EM	IEF [1]	IEF [1]	IEF [1]	IEF [1]	IEF [1]	IEF [1]	IEF [1]	IEF [1]
3. Transport	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF
4. Other Sectors	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF
5. Other	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
B. Fugitive Emissions from Fuels													
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	IEF [2]	EM	EM	EM	EM	IEF [2]	IEF [2]	IEF [2]	IEF [2]	IEF [2]	IEF [2]	IEF [2]	IEF [2]
2. Industrial Processes													
A. Mineral Products													
1. Cement Production	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF
3. Limestone and Dolomite Use	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
B. Chemical Industry													
2. Nitric Acid Production	C	C	C	C	C	C	C	C	C	C	C	C	C
C. Metal Production													
1. Iron and Steel Production	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE
3. Aluminium Production	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]
D. Other Production	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
E. Production of Halocarbons and SF_6													
1. By-product Emissions HCFC-22 production	C	C	C	C	C	C	C	C	C	C	C	C	C
F. Consumption of Halocarbons and SF_6													
1 Refrigeration	C	C	C	C	C	C	C	C	C	C	C	C	C
2 Foam Blowing	C	C	C	C	C	C	C	C	C	C	C	C	C
8 Other	EM [4]	EM [4]	EM [4]	EM [4]	EM [4]	EM [4]	EM [4]	EM [4]	EM [4]	EM [4]	EM [4]	EM [4]	EM [4]
G. Other	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
3. Solvent and Other Product Use	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF
4. Agriculture													
A. Enteric Fermentation	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF
B. Manure Management	IEF [5]	IEF [5]	IEF [5]	IEF [5]	IEF [5]	IEF [5]	IEF [5]	IEF [5]	IEF [5]	IEF [5]	IEF [5]	IEF [5]	IEF [5]
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils													
Synthetic Fertilizers	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF
Animal Wastes Applied to Soils	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF
N-fixing Crops	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF
Crop Residue	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Cultivation of Histosols	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]
Animal Production	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF
Atmospheric Deposition	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Nitrogen Leaching and Run-off	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]	IE [6]
Background agricultural soils	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
E. Prescribed Burning of Savannas	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
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry													
A. Changes in Forest and Other Woody Biomass Stocks	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF
B. Forest and Grassland Conversion	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]
C. Abandonment of Managed Lands	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]
D. CO_2 Emissions and Removals from Soil	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]
E. Other	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]	NE [7]
6. Waste													
A. Solid Waste Disposal on Land	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF
B. Wastewater Handling													
Wastewater/Sludge	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
N_2O from human sewage	IE [8]	IE [8]	IE [8]	IE [8]	IE [8]	IE [8]	IE [8]	IE [8]	IE [8]	IE [8]	IE [8]	IE [8]	IE [8]
C. Waste Incineration	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE
D. Other	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
7. Other													
Solvents and other product use	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
Polluted surface water	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
International Bunkers													
Aviation	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]
Marine	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]	IEF [9]
Multilateral Operations	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

For notes see next page.

Table 10.3b. Summary of completeness of Common Reporting Format files 1990-2002: Industrial processes

SPECIFICATION OF INDUSTRIAL PROCESSES:	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
2. Industrial Processes													
A. Mineral Products													
1. Cement Production	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
3. Limestone and Dolomite Use	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
4. Soda Ash	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Glass Production	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
B. Chemical Industry													
1. Ammonia Production [3]	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Nitric Acid Production	C	C	C	C	C	C	C	C	C	C	C	C	C
3. Adipic Acid Production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Carbide Production	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
5. Other *(please specify)*	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
C. Metal Production													
1. Iron and Steel Production	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE	AD/IE
3. Aluminium Production	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]	IEF [3]
D. Other Production													
1. Pulp and Paper	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Food and Drink	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
E. Production of Halocarbons and SF_6													
1. By-product Emissions HCFC-22 production	C	C	C	C	C	C	C	C	C	C	C	C	C
F. Consumption of Halocarbons and SF_6													
1 Refrigeration	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM
2 Foam Blowing	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM
3 Fire Extinguishers [10]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4 Aerosols [10]	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
5 Solvents [10]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6 Semiconductors [10]	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE
7 Electric Equipment [10]	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE	C/IE
8 Other (please specify)	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM	AD/EM
G. Other	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM

Abbreviations:

IEF = Implied Emission Factor; EM = Emissions (no IEF)
EM = Emissions, no activity data, though not confidential
NO = Not Occurring; NE = Not Estimated; IE = Included Elsewhere
C = Confidential Business Information (only emissions)

Notes:

1) Implied emission factors of CO_2 for solid, liquid and gaseous fossil fuel use are now in line with underlying fuel consumption due to allocation under 'other fuels' where CO_2 and related fuel consumption did not properly match. However, this approach did not simultaneously improve the IEFs for CH_4 and N_2O. Due to limited data quality and completeness of point-source data, about 10 to 35% of fossil fuel consumption is not reported as gas, oil or coal, but is included under 'other fuels'.
2) Only IEFs for CH_4; Not for flaring/venting separately.
3) IEFs for PFCs; other process emissions are included elsewhere.
4) Activity data are included when not considered confidential.
5) No split of amount of manure per type for animal waste management system.
6) Included under 'Background agricultural soils'.
7) Not yet estimated. See *Section 2.5* for improvement activities.
8) Included under categories *Wastewater/Sludge treatment* (6B) and *7 Polluted surface water* (7)
9) For CO_2, CH_4 and N_2O (no precursor emissions were estimated).
10) IE refers to category 2F8 (others). Notation keys filled in CRF Table 2(II)Fs2.

N.B. N_2O from crop residues (4D3) are included in 'Background from agricultural soils' (4D). In the CRF files, and thus in this table which is copied from the CRF, accidentally the wrong notation key 'NE' has been used.

In addition, this year, for the second time, organisations and individuals could make comments to the draft NIR. This process was organised by Novem and RIVM, using the site www.greenhousegases.nl, developed to improve the transparency of the National System (see *Section 1.6.2*). Six persons provided comments, which is much less than last year, mostly on the LUCF chapter. All comments were evaluated whether (a) they should result in modifications of the draft report, (b) be listed for further discussion or (c) be rejected. The comments did contribute to elimination of errors and further clarification of descriptions and explanations.

10.4.6 Response to the issues raised in UNFCCC reviews

The Netherlands greenhouse gas inventory were subject to the following reviews by the Climate Secretariat: (a) Desk Review and Centralised Review of the NIR 2000 and (b) Country section of Synthesis & Assessment report on the NIR's of 2001 and 2002. In 2003 a Centralised Review of the NIR 2003 was conducted. In general the findings of the different UNFCCC reviews are well observed and described. The Netherlands response to the general remarks is as recorded below.

- *The Netherlands' use of the category Other in the CRF to group existing IPCC categories*
  Some of the emission figures in the Dutch inventory can not be allocated to the specific (industrial) activities as asked for in the CRF. This is especially the case for those figures not reported by individual firms. Furthermore some of the requested data originate in the Netherlands from one or two individual companies. In those cases we prefer to include the emission under the category "other" rather than to mark the emissions as "C" and provide no data.
  We have planned to improve the specific allocation of fuel combustion emissions in the next submission based on a total recalculation based on fuel statistics for the total time series.

- *Inconsistency in time series*
  There are apparent gaps in the data for the years 1991–1994 (see the comments under the Energy and Industrial Process sections below) 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 further improve consistency for the years 1991–1994. Some of the apparent inconsistencies in time series are due to (a) limited recalculations (only for 1990, 1995 and the last three years) because of the limitation in the annual PER project of the years considered in the update; and (b) to different source allocations used for different years (in particular 1991-1994) because of a different national source coding system for these years. Therefore, with the current PER practices, consistency over the complete time period can not be guaranteed for all sources. However, as explained in *Section 10.4.7*, this aspect is part of the improvement programme.

- *Missing notation keys and other documentation in CRF tables*
  In this submission we did include additional notation keys.

- *Incompleteness of CRF*
  Two potentially significant subcategories in the Agricultural Soils category (N_2O emissions from crop residues and indirect N_2O from atmospheric deposition) and categories 5.B to 5.D of the LUCF sector are not reported in the inventory. See *Section 6.4.4* on the actions planned to resolve this issue.

- *Additional info in NIR*
  The review reports make recommendations on the inclusion in the NIR of information provided in other Dutch reports cited. In general, this raises the question on how extensive the explanations in the NIR should be, given that the report needs to be submitted annually. In this report we have added an annex with references to other reports 'that should be considered as part of the NIR', which are also publicly available through the internet, as are the NIR and the corresponding CRF files.

- *Comparison of activity data with international statistics*
  In comparing Netherlands' activity data with international data, we stress that, in general, statistical data published by international organisations like UN, IEA and FAO, though essentially officially submitted national data, are ultimately the responsibility of these organisations. Any discrepancies found could be due to various reasons, e.g. (a) apparent errors in one of the national submissions; (b) errors in data processing by the international statistical agency; (c) errors arising from data conversions prior or after submission; (d) differences in activity definitions; (e) differences in datasets compared due to revisions in subsequent editions; and (f) modifications or estimates made by the international statistical agency, when inconsistencies or omissions were found

in the dataset and national agencies did not conclusively respond to requests for clarifications. However, it is still important to check discrepancies found to see if errors have been made in the emission compilation or reporting process.

In the NIR/CRF 2004 the following specific changes were made in the CRF tables (see also *Section 10.4.3*) partly in response to the reviews and partly as a result of the national improvement programme:

- CRF tables improved by replacing 0 by notation keys NE, NA, NO, IE, C, where applicable;
- Correction of typing/unit errors as observed;
- In the 2003 submission the fuel split was made uniform for the years 1990, 1995 to 2002;
- A physical link between the CRF files and the tables of the NIR was established to make sure that the data in both are equal.

10.4.7 Planned improvements

The UNFCCC Guidelines for reporting the emissions and the Guidelines for National Systems for annual emission monitoring under the Kyoto Protocol have added additional requirements to the present *Pollutant Emission Register* (PER) of the Netherlands. In 2000 a programme was started to adapt the monitoring procedures of greenhouse gases in the Netherlands to meet these requirements. The European Union imposed similar requirements and is also a Party to the Convention and the Protocol, which require that the EU Member States' National Systems to be operational as early as possible and in any case by 31 December 2005 at the latest.
The national system improvement programme is being implemented under the responsibility of the Netherlands Ministry of Spatial Planning, Housing and the Environment (VROM), who delegated the practical co-ordination to Novem. To comply with the EU requirements, VROM has set the (internal) deadline for the Netherlands National System to be operational by 1 January 2005.
An interdepartmental committee, the *Working Group on Emission Monitoring of Greenhouse Gases* (WEB) was created to direct the actions. Several institutes and ministries are involved in these activities. The programme has been set up as a temporary special assignment. Ultimately, all improvements and arrangements will become an integral part of the larger system of annual emission monitoring (PER). The WEB has three subgroups: the Project Groups on CO_2, on Non-CO_2 and on Sinks. The subgroup on Non-CO_2 is formed by the Steering Committee of the Netherlands' *Reduction Programme on Other Greenhouse Gases* (ROB). In this section we will summarise the three main elements of this programme and the results of actions so far.

Monitoring improvement programme

In 1999 two workshops were held on the quality of methodology and data used for calculation of greenhouse gas emissions in the Netherlands (Van Amstel *et al*., 2000a,b). The workshop assessed the situation, and the possible and required improvements. A long-list of possible actions was elaborated. Subsequently, the aforementioned working group, WEB, was installed to prioritise the actions and the improvement programme was started. To focus the work further, the WEB initiated three Expert Project Groups focussing on CO_2, non-CO_2 and Sinks, respectively. Both WEB and the Project Groups are composed of persons from the relevant ministries and institutes, who are usually also involved in the Emission Registration project. This ensures inclusion of the appropriate expertise and promotes optimal communication with the parties of the ER project. In this way synergy is created between the improvements initiated by the greenhouse monitoring requirements and other improvements in the annual Dutch PER on the basis of (inter)national agreements as decided by the CCDM (WEM, CCDM 2003).
A series of activities have been concluded the last few years or are planned for the second half of 2004:

- *Uncertainty assessment:* a comparison of Tier 1 and Tier 2 uncertainty analyses of the Netherlands greenhouse gas inventory (Olsthoorn and Pielaat, 2003). This study encountered some problems with regard to disaggregation of data on uncertainties in some categories and had to use

some preliminary calculations. The study concluded that (with a reservation for the preliminary calculations) (see *Section 1.7* for more details):
- the Tier 2 and Tier 1 uncertainty analyses resulted in similar magnitudes of overall uncertainty estimates, both for level and trend uncertainty;
- the model for emission estimates had been thoroughly assessed, indicating some areas of improvement;
- with regard to data in various sectors, the quality of uncertainty data still depends to a large extent on expert estimates.

The on-going monitoring improvement programme will deal with the most important 'weaker' spots. Another Tier 2 uncertainty analysis may be carried out after major revisions of the data.

- *Sinks:* A common understanding on the present and future monitoring systems is researched. A group of consultants finalised a study comparing the present situation on sinks monitoring with the requirements from a national system point of view (Nabuurs *et al*., 2003). Also reporting of a workshop and a study to identify missing sources/sinks and (potential) key sources has been finalised (Kuikman, 2003).

- *CO_2 emission factors for fuel combustion:* A study to evaluate the documentation and validity of the present set of country-specific CO_2 emission factors for fuels was finalised in 2002 (Van Harmelen and Koch, 2002). This study showed that for some sources, national CO_2 emission factors should be changed, but also, that for some fuels data for establishing country-specific national emission factors are lacking, in particular for the road transport fuels (gasoline, diesel, LPG). A recommendation was made to draw up a set of guidelines on the proper application of the set of national emission factors agreed upon and to communicate those broadly, e.g. to the companies that report their emissions individually through the MJV. This is implemented for the PER 2004, as the MJV reporting of emissions will change to a web-based data collecting structure (e-MJV). In 2004 measurements started to determine the country-specific carbon content of road transport fuels.

- *Final recalculations of key sources:*
  To meet the VROM deadline of 1 January 2005, final recalculations of the Netherlands' greenhouse gas inventory are planned for the second half of 2004, which will include all remaining key issues identified by the Netherlands' improvement programme and by the UNFCCC reviews carried out to date. A major part consists of recalculations to improve the quality (transparency, consistency over time, completeness and accuracy) of the CO_2 emissions:
  - *IPCC sector 1A*: The emissions from fuel combustion may be recalculated, if approved and agreed upon (based on the results of a feasibility study which is underway), based on the sectoral energy statistics for the period 1990-2003 and using above mentioned improved emission factors. For stationary combustion sources this will then replace the use of reported emissions from individual industrial companies. The combustion emissions from mobile sources will be updated using corrected data on bunker and domestic shipping and aviation statistics and, if approved, newly established country-specific emission factors for road transport. In parallel with the recalculations for CO_2 the N_2O and CH_4 emissions from stationary combustion may be recalculated.
  - *IPCC sectors 2 and 3:* Recalculation of the CO_2 emissions from non-energy use of fuels, distinguishing prompt inadvertent emissions during manufacture of products and emissions from the domestic use of non-energy-use products. In 2003 a detailed study on CO_2 emissions related to non-energetic use of energy carriers (notably as chemical feedstock) was finalised (Neelis *et al.,* 2003). Results for the 1993-1999 period were obtained with (partly confidential) data provided by Statistics Netherlands (CBS) (2002). It was concluded that it is necessary to revise the emissions related to feedstock since (a) some storage factors are out of date, (b) these factors refer to the use of all domestically produced products, of which a large fraction is exported, and (c) no clear distinction can presently be made in sources to be allocated into the IPCC sectors 1A (combustion), 2 (non-combustion processes during manufacture of products and 3 (product use). Presently, the emissions during product use are allocated to the industry sector (the producers) and not to

users, and all of these emissions are reported under fuel combustion (1A). In addition, export (and import) of these products is not taken into account and the usage emissions are now related to the total amount of these products *produced* in the Netherlands. Moreover, the energy data in the statistics should be rearranged or separate data should be published to make a recalculation possible. The country-specific storage fractions now used will also be updated for future use in the *CO_2 Reference Approach*, as the study by Neelis *et al.* also concluded that the present factors are outdated, and to reflect the new CO_2 from non-energy use emissions that will be reported in IPCC Sectors 1 and 2. So this project will result in a recalculation of the emissions related to feedstock 1990 onwards. The recalculation will deal with the direct (prompt) CO_2 emissions from non-energy use in the industry and with the indirect CO_2 emissions, primarily based on NMVOC emissions from product use.

- *IPCC sector 6C/1A:* Fossil-fuel related CO_2 emissions from *waste incineration* (6C/1A) are being recalculated in the first half of 2004 as part of the ER update in 2004 (improved organic, non-organic split).
- *IPCC sectors 1B and 6:* Besides the above mentioned major recalculations, effecting the emissions in the 1A and 6 sectors, minor recalculations are planned for the CO_2 emissions from venting and flaring (1B), the other CO_2 emissions from industrial processes (related to lime use etc. in *sector 2*), and emissions now allocated to the waste sector (6).

Other major recalculations are scheduled for CH_4 and N_2O emission sources:

- *CH_4 emissions:* Methane emissions from *natural gas distribution* (1B) will be recalculated based on data on the length of the natural gas network and the leak rate per type of material in the network (e.g. cast iron). In addition, the emissions related to *venting* of associated gas (1B) will be revised. Furthermore, emissions from *enteric fermentation by cattle* (4A) will be recalculated based on updated country-specific emission factors, if available (determined by an assessment of recent emissions research in the Netherlands). Emissions from *landfills* (6A) are being recalculated in the first half of 2004 as part of the PER update in 2004. Finally, for the present (non-industrial) *wastewater treatment plants* (6B) recovery/venting of biogas is being recalculated in the first half of 2004 as part of the ER update in 2004, whereas methane emissions from *industrial* WWTPs may be added in the recalculation project later this year, if possible (based on new research).
- *N_2O emissions:* Indirect emissions N_2O from soils (4D) due to *atmospheric deposition* (are not yet included in the inventory. In 2004 these emissions will be calculated based on specific Netherlands activity data in conformity with the recommended *IPCC Good Practice* method.

Protocols and process descriptions

In 2001 a project was started to develop specific monitoring protocols for the greenhouse gas emissions in the Netherlands. As part of the National System, all relevant methodologies, procedures, tasks, responsibilities and such are being described in a transparent way in these protocols. In this project, under co-ordination of Novem, discussions were initiated with key firms, organisations involved in the PER process and other research institutes. In this process the methodologies and procedures for estimating greenhouse gas emission in the Netherlands were (re)assessed and compared with UNFCCC and IPCC requirements. Where relevant these were or are being adapted. Discussions include the feasibility and willingness to provide additional (sometimes confidential) data and, where relevant, the feasibility and costs of changing methodologies.
The project started with the non-CO_2 greenhouse gases, since some of these were not traditionally part of the PER. Meanwhile all key sources, including the CO_2 sources, are described in separate (draft) protocols. For non-key sources a separate combined 'protocol' is elaborated. At present the QA/QC aspects are being worked out and the implementation process of the protocols is started together with the PER project (Task Forces and *Co-ordinating Committee on Target Group Monitoring,* CCDM). Parallel discussions are ongoing, with and within the Ministry of VROM, on the required adaptations in legal and organisational bases. It is planned to finalise this process in 2004, with the aim that in

2005 methods and processes will be as described in these protocols. It should be noted that some of the improvements agreed upon are (or have been) implemented earlier. In 2004 also for sinks protocols will be elaborated.
The report of the 2003 UNFCCC review team stressed the need for the ultimate implementation of the formal QA/QC plan, in order to demonstrate verification of the consistency of the time series, the procedures used to fill gaps in the data, and the quality of the PER data set.

Improvement proposals resulting from compiling the NIR/CRF 2003 submission

During the compilation and checks of the data for the CRF files it was concluded that the data for the *waste sector* (category 6) were not satisfactory. In the next inventory update the CO_2 emissions from waste combustion will be recalculated, of which the results will be included in the NIR 2005.
Furthermore, it has been concluded that the combustion emissions of CO_2 for 1997 in the *Manufacturing industries* (category 1A2) still do not fit well in the expected trend. This holds in particular for the chemical industry and the food industry. Amongst others this may contribute to the observed difference between the reference approach and the national approach for CO_2 which is for 1997 the highest of all years and not yet fully understood (see *Section 3.2.6* and *Annex 4*). This subject will be included in the planned recalculation project scheduled for the second half of 2004, as mentioned above under the inventory improvement programme.

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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, where possible, the national emissions according to the IPCC's potential key source list. This non-combustion category of CO_2 has been added to the list for the Netherlands, with its high share of feedstock/non-energy use of fuels. A number of other potential key sources could not be clearly identified in the present dataset. However, compared with the previous submission, it was now possible to identify the possible key source CO_2 emissions from iron and steel production. 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: 18 sources for annual level assessment and 16 sources for the trend assessment out of a total of 56 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 1.6* and show that a total of 27 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
1A	Emissions from stationary combustion: Energy Industries	CO_2	1	1	1	1
	Emissions from stationary combustion: Manufacturing Industries & Constr.	CO_2	1	1	1	1
	Emissions from iron and steel industry	CO_2	1	1		
	Emissions from stationary combustion: Other Sectors	CO_2	1	1	1	
	Feedstock gas	CO_2	1		1	
	Feedstock oil	CO_2	1	1	1	
	Mobile combustion: road vehicles	CO_2	1	1	1	1
	Mobile combustion: other	CO_2	1	1	1	
1B	Fugitive emissions from oil and gas: gas production	CH_4	1	1	1	
	Fugitive emissions from oil and gas: gas distribution	CH_4	1		1	
2	CO_2 Other industrial *	CO_2	1	1	1	
2	Emissions from nitric acid production	N_2O	1	1	1	
	HFC Emissions from substitutes for ozone depleting substances	HFC		1	1	
	HFC-23 emissions from HCFC-22 manufacture	HFC		1		1
	PFC emissions from aluminium production	PFC		1		
3	CO_2 Miscellaneous *	CO_2	1		1	
4A	CH_4 emissions from enteric fermentation in domestic cattle livestock	CH_4	1	1	1	
4B	Emissions from swine manure management	CH_4			1	
4D	Direct N_2O emissions from agricultural soils	N_2O	1		1	
	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	1		1	
6A	CH_4 emissions from solid waste disposal sites	CH_4	1	1	1	1
7	Miscellaneous N_2O	N_2O		1	1	
	Polluted surface water	N_2O	1		1	
Tier 2 key sources not in Tier 1 key source list:						
1A	Emissions from stationary combustion: non-CO_2	CH_4			1	
1A	Mobile combustion: water-borne navigation	CO_2				
2 F	SF_6 emissions from SF6 use	F-gas			1	
4B	Emissions from cattle manure management	CH^4			1	
Number of sources:		**27**	**18**	**16**	**23**	**5**

* 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, four more sources are added to the list of 23 Tier 1 level and trend key sources:

- CH_4 emissions from stationary combustion;
- CO_2 from mobile combustion: water-borne navigation;
- CH_4 emissions from cattle manure management;
- SF_6 emissions from SF_6 use.

Their share in the national annual total becomes more important when taking their uncertainty into account: 50%, 100%, 100% and 100% respectively (*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 emissions data for key source identification resulted in the following changes compared to the previous NIR:

- 1A3-CO_2 Aircraft: now *non-key*;
- 2-CO_2 Other Industrial: now *key*;
- 3-CO_2 Miscellaneous: now *key*;
- 6B-CH_4 Wastewater: now *non-key*.

Table A1.2. Source ranking using IPCC Tier 1 level assessment 2002 (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.

IPCC	Category	Gas	CO_2-eq 2002	Share	Cum. share
1A	Emissions from stationary combustion : Energy Industries	CO_2	63780	30%	30%
1A	Emissions from stationary combustion : Other Sectors	CO_2	37203	17%	47%
1A	Mobile combustion: road vehicles	CO_2	32747	15%	63%
1A	Emissions from stationary combustion : Manufacturing Industries and Construction	CO_2	21062	10%	72%
6A	CH_4 emissions from solid waste disposal sites	CH_4	7253	3%	76%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	CH_4	5766	3%	79%
1A	Emissions from iron and steel industry	CO_2	5648	3%	81%
2X	Emissions from nitric acid production	N_2O	5498	3%	84%
4D	Direct N_2O emissions from agricultural soils	N_2O	5158	2%	86%
1A	Feedstock gas	CO_2	4817	2%	88%
1A	Feedstock oil	CO_2	3856	2%	90%
1A	Mobile combustion: other	CO_2	2356	1%	91%
2X	Other industrial: CO_2	CO_2	1989	1%	92%
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	1460	1%	93%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	1224	1%	93%
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	1221	1%	94%
7X	Misc. CO_2	CO_2	1203	1%	95%
7X	Polluted surface water	N_2O	1178	1%	95%
2X	PFC emissions from aluminium production	PFC	1041	0%	96%
1A	Mobile combustion: water-borne navigation	CO_2	923	0%	96%
7X	Misc. N_2O	N_2O	902	0%	97%
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	790	0%	97%
4B	Emissions from manure management : swine	CH_4	775	0%	97%
4B	Emissions from manure management : cattle	CH_4	774	0%	98%
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	685	0%	98%
1A	Emissions from stationary combustion: non-CO_2	CH_4	585	0%	98%
1A	Mobile combustion: road vehicles	N_2O	476	0%	98%
2X	Emissions from cement production	CO_2	437	0%	99%
1A	Feedstock coal	CO_2	408	0%	99%
4A	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	367	0%	99%
2X	SF_6 emissions from SF_6 use	SF_6	344	0%	99%
1A	Mobile combustion: aircraft	CO_2	225	0%	99%
1A	Emissions from stationary combustion: non-CO_2	N_2O	210	0%	99%
4A	CH_4 emissions from enteric fermentation in domestic livestock: sheep	CH_4	199	0%	99%
6B	Emissions from wastewater handling	N_2O	187	0%	100%
4B	Emissions from manure management	N_2O	183	0%	100%
4B	Emissions from manure management : poultry	CH_4	177	0%	100%
2X	PFC emissions from PFC use	PFC	160	0%	100%
2X	HFC by-product emissions from HFC manufacture	HFC	98	0%	100%
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	89	0%	100%
1B	Fugitive emissions from oil and gas operations: other	CH_4	78	0%	100%
1A	Mobile combustion: road vehicles	CH_4	77	0%	100%
2X	Other industrial: CH_4	CH_4	47	0%	100%
7X	Misc. CH_4	CH_4	38	0%	100%
1A	Mobile combustion: other	N_2O	28	0%	100%
4B	Emissions from manure management : other	CH_4	24	0%	100%
6B	Emissions from wastewater handling	CH_4	15	0%	100%
1A	Mobile combustion: other	CH_4	7	0%	100%
			213765		
4B	Emissions from agricultural residue burning	n-CO_2	NO		
2	Emissions from lime consumption	CO_2	IE		
2	PFC, HFC, SF_6 emissions from semiconductor manufacturing (GWP)	PFC	IE		
2	Other industrial: N_2O	N_2O	IE		
6C	Emissions from waste incineration	n-CO_2	IE		

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 2002 annual emissions total and to the base year to 2002 trend, respectively. This results in 18 level key sources and 16 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 12 sources are found in both lists. This set forms the most robust list, since it does not include the uncertainty estimate for the emissions. However, the level and trend assessment uses the dataset for the last reported year, 2002, of which the data are preliminary and can, in some cases, change substantially when the final data become available in the next year (= subsequent submission). In *Chapter 10* on recalculations and in the recalculation *Table A7.17* in *Annex 7.2,* examples are provided for 2001.

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 2002	Level assessment 90/95	Level assessment 2001	Trend assessment	% Contr. to trend	Cumulative total
1A	Emissions from stationary combustion : Energy Industries	CO_2	51305	63780	24%	30%	5.7%	25%	25%
1A	Mobile combustion: road vehicles	CO_2	25374	32747	12%	15%	3.4%	15%	39%
1A	Emissions from stationary combustion : Manufacturing Industries and Construction	CO_2	28015	21062	13%	10%	3.3%	14%	54%
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	5759	685	3%	0%	2.4%	10%	64%
6A	CH_4 emissions from solid waste disposal sites	CH_4	12011	7253	6%	3%	2.2%	10%	74%
1A	Emissions from stationary combustion : Other Sectors	CO_2	34913	37203	16%	17%	1.0%	4%	78%
4A	CH4 emissions from enteric fermentation in domestic livestock: cattle	CH_4	7678	5766	4%	3%	0.9%	4%	82%
1A	Feedstock oil	CO_2	2549	3856	1%	2%	0.6%	3%	85%
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	2097	1221	1%	1%	0.4%	2%	86%
2X	Emissions from nitric acid production	N_2O	6314	5498	3%	3%	0.4%	2%	88%
2X	Other industrial: CO_2	CO_2	1181	1989	1%	1%	0.4%	2%	90%
2X	PFC emissions from aluminium production	PFC	1799	1041	1%	0%	0.4%	2%	91%
1A	Emissions from iron and steel industry	CO_2	6255	5648	3%	3%	0.3%	1%	93%
7X	Misc. N_2O	N_2O	1468	902	1%	0%	0.3%	1%	94%
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	424	790	0%	0%	0.2%	1%	95%
1A	Mobile combustion: other	CO_2	2655	2356	1%	1%	0.1%	1%	95%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	1524	1224	1%	1%	0.1%	1%	96%
1A	Mobile combustion: aircraft	CO_2	492	225	0%	0%	0.1%	1%	96%
4B	Emissions from manure management : swine	CH_4	1033	775	0%	0%	0.1%	1%	97%
1A	Mobile combustion: road vehicles	N_2O	276	476	0%	0%	0.1%	0%	97%
1A	Feedstock coal	CO_2	569	408	0%	0%	0.1%	0%	98%
4B	Emissions from manure management : cattle	CH_4	905	774	0%	0%	0.1%	0%	98%
6B	Emissions from wastewater handling	CH_4	138	15	0%	0%	0.1%	0%	98%
2X	PFC emissions from PFC use	PFC	37	160	0%	0%	0.1%	0%	98%
4A	CH_4 emissions from enteric fermentation in domestic livestock: sheep	CH_4	286	199	0%	0%	0.0%	0%	99%
2X	HFC by-product emissions from HFC manufacture	HFC	12	98	0%	0%	0.0%	0%	99%
1A	Mobile combustion: road vehicles	CH_4	153	77	0%	0%	0.0%	0%	99%
4A	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	438	367	0%	0%	0.0%	0%	99%
6B	Emissions from wastewater handling	N_2O	126	187	0%	0%	0.0%	0%	99%
1B	Fugitive emissions from oil and gas operations: other	CH_4	133	78	0%	0%	0.0%	0%	99%
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	37	89	0%	0%	0.0%	0%	99%
2X	SF_6 emissions from SF_6 use	SF_6	301	344	0%	0%	0.0%	0%	100%
1A	Mobile combustion: water-borne navigation	CO_2	877	923	0%	0%	0.0%	0%	100%
4B	Emissions from manure management : poultry	CH_4	216	177	0%	0%	0.0%	0%	100%
2X	Emissions from cement production	CO_2	400	437	0%	0%	0.0%	0%	100%
4B	Emissions from manure management	N_2O	205	183	0%	0%	0.0%	0%	100%
2X	Other industrial: CH_4	CH_4	69	47	0%	0%	0.0%	0%	100%
1A	Emissions from stationary combustion: non-CO_2	CH_4	561	585	0%	0%	0.0%	0%	100%
1A	Feedstock gas	CO_2	4805	4817	2%	2%	0.0%	0%	100%
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	1460	1460	1%	1%	0.0%	0%	100%
4D	Direct N_2O emissions from agricultural soils	N_2O	5124	5158	2%	2%	0.0%	0%	100%
7X	Misc. CO_2	CO_2	1189	1203	1%	1%	0.0%	0%	100%
7X	Polluted surface water	N_2O	1178	1178	1%	1%	0.0%	0%	100%
7X	Misc. CH_4	CH_4	43	38	0%	0%	0.0%	0%	100%
1A	Mobile combustion: other	N_2O	33	28	0%	0%	0.0%	0%	100%
4B	Emissions from manure management : other	CH_4	19	24	0%	0%	0.0%	0%	100%
1A	Mobile combustion: other	CH_4	8	7	0%	0%	0.0%	0%	100%
1A	Emissions from stationary combustion: non-CO_2	N_2O	209	210	0%	0%	0.0%	0%	100%
			212651	**213765**	**100%**	**100%**	**23.0%**	**100%**	

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[6]. 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, that can be summarised as follows:

CO_2-eq.	±3.5%-points of 0.5% increase	N_2O	±11%-points of 7% decrease
CO_2	±3%-points of 10% increase	F-gases	±9%-points of 63% 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 2002 annual emissions total and to the base year to 2002 trend, respectively. Comparison with the Tier 1 assessment presented in *Tables A1.2 and A1.3* shows *more level* key sources (21 instead of 18) and *much lower trend* key sources (5 instead of 16). This is because in the Tier 2 trend contribution calculation, the contribution of the number 1 key source – CO_2 from energy industries – almost doubles, from 25% to 47%, 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, five large but quite uncertain CH_4 and N_2O sources now top the list of level key sources. These are:

- Direct N_2O emissions from agricultural soils;
- N_2O emissions from nitric acid production;
- Indirect N_2O emissions from nitrogen used in agriculture;
- CH_4 emissions from solid waste disposal sites;
- N_2O emissions from polluted surface water.

The uncertainty in these emissions is estimated to be in the range of 30 to 60%, with indirect N_2O emissions and N_2O from polluted surface water having an uncertainty of a factor of 2, which is one or

[6] 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).

two orders of magnitude higher than the 4% uncertainty estimated for CO_2 from the energy industries (*Table 1.7*).

Table A1.4. Tier 1 trend uncertainty assessment 1990-2001 (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)	2002 Emissions	Activity data uncertainty	Emission factor uncertainty	Combined Uncertainty	Combined Uncertainty as % of total national emissions in 2002
1A	Emissions from stationary combustion : Energy Industries	CO_2	51305	63780	3%	2%	4%	1%
1A	Emissions from stationary combustion : Manufacturing Industries and Construction	CO_2	28015	21062	3%	1%	3%	0%
1A	Emissions from stationary combustion : Other Sectors	CO_2	34913	37203	3%	1%	3%	1%
1A	Mobile combustion: road vehicles	CO_2	25374	32747	2%	2%	3%	0%
1A	Mobile combustion: water-borne navigation	CO_2	877	923	100%	2%	100%	0%
1A	Mobile combustion: aircraft	CO_2	492	225	50%	2%	50%	0%
1A	Mobile combustion: other	CO_2	2655	2356	50%	2%	50%	1%
1A	Feedstock oil	CO_2	2549	3856	20%	50%	54%	1%
1A	Feedstock gas	CO_2	4805	4817	5%	10%	11%	0%
1A	Feedstock coal	CO_2	569	408	5%	10%	11%	0%
1A	Emissions from iron and steel industry	CO_2	6255	5648	3%	3%	4%	0%
2X	Emissions from cement production	CO_2	400	437	5%	10%	11%	0%
2X	Other industrial: CO_2	CO_2	1181	1989	20%	5%	21%	0%
7X	Misc. CO_2	CO_2	1189	1203	20%	50%	54%	0%
	TOTAL CO_2	**CO_2**	**160578**	**176654**	**10%**	**(increase)**		
1A	Emissions from stationary combustion: non-CO_2	CH_4	561	585	3%	50%	50%	0%
1A	Mobile combustion: road vehicles	CH_4	153	77	5%	60%	60%	0%
1A	Mobile combustion: other	CH_4	8	7	50%	100%	112%	0%
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	2097	1221	1%	25%	25%	0%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	1524	1224	5%	50%	50%	0%
1B	Fugitive emissions from oil and gas operations: other	CH_4	133	78	20%	50%	54%	0%
2X	Other industrial: CH_4	CH_4	69	47	10%	50%	51%	0%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	CH_4	7678	5766	5%	20%	21%	1%
4A	CH_4 emissions from enteric fermentation in domestic livestock: sheep	CH_4	286	199	5%	30%	30%	0%
4A	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	438	367	5%	50%	50%	0%
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	37	89	5%	30%	30%	0%
4B	Emissions from manure management : cattle	CH_4	905	774	10%	100%	100%	0%
4B	Emissions from manure management : swine	CH_4	1033	775	10%	100%	100%	0%
4B	Emissions from manure management : poultry	CH_4	216	177	10%	100%	100%	0%
4B	Emissions from manure management : other	CH_4	19	24	10%	100%	100%	0%
6A	CH4 emissions from solid waste disposal sites	CH_4	12011	7253	15%	30%	34%	1%
6B	Emissions from wastewater handling	CH_4	138	15	20%	25%	32%	0%
7X	Misc. CH_4	CH_4	43	38	20%	25%	32%	0%
	TOTAL CH_4	**CH_4**	**27348**	**18715**	**-32%**	**(= decrease)**		
1A	Emissions from stationary combustion: non-CO_2	N_2O	209	210	2%	50%	50%	0%
1A	Mobile combustion: road vehicles	N_2O	276	476	5%	50%	50%	0%
1A	Mobile combustion: other	N_2O	33	28	50%	100%	112%	0%
2X	Emissions from nitric acid production	N_2O	6314	5498	10%	50%	51%	1%
4B	Emissions from manure management	N_2O	205	183	10%	100%	100%	0%
4D	Direct N_2O emissions from agricultural soils	N_2O	5124	5158	10%	60%	61%	1%
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	1460	1460	50%	200%	206%	1%
6B	Emissions from wastewater handling	N_2O	126	187	20%	50%	54%	0%
7X	Polluted surface water	N_2O	1178	1178	50%	200%	206%	1%
7X	Misc. N_2O	N_2O	1468	902	50%	50%	71%	0%
	TOTAL N_2O	**N_2O**	**16392**	**15280**	**-7%**	**(= decrease)**		
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	424	790	10%	50%	51%	0%
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	5759	685	15%	25%	29%	0%
2X	HFC by-product emissions from HFC manufacture	HFC	12	98	10%	50%	51%	0%
2X	PFC emissions from aluminium production	PFC	1799	1041	5%	20%	21%	0%
2X	PFC emissions from PFC use	PFC	37	160	5%	25%	25%	0%
2X	SF_6 emissions from SF_6 use	SF_6	301	344	100%	25%	103%	0%
	TOTAL F-gases	F-gases	8332	3116	**-63%**	**(= decrease)**		
	TOTAL CO_2-eq.	**GHG**	**212651**	**213765**	**1%**	**increase**		**3.6%**

Table A1.4 (continued). Tier 1 trend uncertainty assessment 1990-2002 (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	Emission factor quality indicator
1A	Emissions from stationary combustion : Energy Industries	CO_2	4.6%	40%	0.1%	1.7%	1.7%	pm
1A	Emissions from stationary combustion : Manufacturing Industries and Construction	CO_2	-6.1%	13%	-0.1%	0.6%	0.6%	pm
1A	Emissions from stationary combustion : Other Sectors	CO_2	-0.7%	23%	0.0%	1.0%	1.0%	pm
1A	Mobile combustion: road vehicles	CO_2	3.0%	20%	0.1%	0.6%	0.6%	pm
1A	Mobile combustion: water-borne navigation	CO_2	0.0%	1%	0.0%	0.8%	0.8%	pm
1A	Mobile combustion: aircraft	CO_2	-0.2%	0%	0.0%	0.1%	0.1%	pm
1A	Mobile combustion: other	CO_2	-0.4%	1%	0.0%	1.0%	1.0%	pm
1A	Feedstock oil	CO_2	0.7%	2%	0.3%	0.7%	0.8%	pm
1A	Feedstock gas	CO_2	-0.3%	3%	0.0%	0.2%	0.2%	pm
1A	Feedstock coal	CO_2	-0.1%	0%	0.0%	0.0%	0.0%	pm
1A	Emissions from iron and steel industry	CO_2	-0.8%	4%	0.0%	0.1%	0.2%	pm
2X	Emissions from cement production	CO_2	0.0%	0%	0.0%	0.0%	0.0%	pm
2X	Other industrial: CO_2	CO_2	0.4%	1%	0.0%	0.4%	0.4%	pm
7X	Misc. CO_2	CO_2	-0.1%	1%	0.0%	0.2%	0.2%	pm
	TOTAL CO_2	**CO_2**					**3%p. in trend of 10%**	**pm**
1A	Emissions from stationary combustion: non-CO_2	CH_4	0.7%	2%	0.4%	0.1%	0.4%	pm
1A	Mobile combustion: road vehicles	CH_4	-0.1%	0%	-0.1%	0.0%	0.1%	pm
1A	Mobile combustion: other	CH_4	0.0%	0%	0.0%	0.0%	0.0%	pm
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	-0.8%	4%	-0.2%	0.1%	0.2%	pm
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	0.7%	4%	0.3%	0.3%	0.5%	pm
1B	Fugitive emissions from oil and gas operations: other	CH_4	0.0%	0%	0.0%	0.1%	0.1%	pm
2X	Other industrial: CH_4	CH_4	0.0%	0%	0.0%	0.0%	0.0%	pm
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	CH_4	1.9%	21%	0.4%	1.5%	1.5%	pm
4A	CH_4 emissions from enteric fermentation in domestic livestock: sheep	CH_4	0.0%	1%	0.0%	0.1%	0.1%	pm
4A	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	0.2%	1%	0.1%	0.1%	0.2%	pm
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	0.2%	0%	0.1%	0.0%	0.1%	pm
4B	Emissions from manure management : cattle	CH_4	0.6%	3%	0.6%	0.4%	0.7%	pm
4B	Emissions from manure management : swine	CH_4	0.2%	3%	0.2%	0.4%	0.5%	pm
4B	Emissions from manure management : poultry	CH_4	0.1%	1%	0.1%	0.1%	0.1%	pm
4B	Emissions from manure management : other	CH_4	0.0%	0%	0.0%	0.0%	0.0%	pm
6A	CH_4 emissions from solid waste disposal sites	CH_4	-3.5%	27%	-1.1%	5.6%	5.7%	pm
6B	Emissions from wastewater handling	CH_4	-0.3%	0%	-0.1%	0.0%	0.1%	pm
7X	Misc. CH_4	CH_4	0.0%	0%	0.0%	0.0%	0.0%	pm
	TOTAL CH_4	**CH_4**					**6%p. in trend of -32%**	pm
1A	Emissions from stationary combustion: non-CO_2	N_2O	0.1%	1%	0.0%	0.0%	0.1%	pm
1A	Mobile combustion: road vehicles	N_2O	1.3%	3%	0.7%	0.2%	0.7%	pm
1A	Mobile combustion: other	N_2O	0.0%	0%	0.0%	0.1%	0.1%	pm
2X	Emissions from nitric acid production	N_2O	-2.4%	34%	-1.2%	4.7%	4.9%	pm
4B	Emissions from manure management	N_2O	0.0%	1%	0.0%	0.2%	0.2%	pm
4D	Direct N_2O emissions from agricultural soils	N_2O	2.3%	31%	1.4%	4.5%	4.7%	pm
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	0.6%	9%	1.2%	6.3%	6.4%	pm
6B	Emissions from wastewater handling	N_2O	0.4%	1%	0.2%	0.3%	0.4%	pm
7X	Polluted surface water	N_2O	0.5%	7%	1.0%	5.1%	5.2%	pm
7X	Misc. N_2O	N_2O	-2.8%	6%	-1.4%	3.9%	4.1%	pm
	TOTAL N_2O	**N_2O**					**11%p. in trend of -7%**	pm
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	7.6%	9%	3.8%	1.3%	4.0%	pm
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	-17.5%	8%	-4.4%	1.7%	4.7%	pm
2X	HFC by-product emissions from HFC manufacture	HFC	1.1%	1%	0.6%	0.2%	0.6%	pm
2X	PFC emissions from aluminium production	PFC	4.4%	12%	0.9%	0.9%	1.2%	pm
2X	PFC emissions from PFC use	PFC	1.7%	2%	0.4%	0.1%	0.5%	pm
2X	SF_6 emissions from SF_6 use	SF6	2.8%	4%	0.7%	5.8%	5.9%	pm
	TOTAL F-gases	**F-gases**					**9%p. in trend of -63%**	pm
	TOTAL CO_2-eq.	**GHG**					**3.6% p in trend of 0**	pm

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 2002 (amounts in Gg CO_2-eq.)

IPCC	Category	Gas	CO_2-eq 2002	Share	Uncertainty estimate	Level * Uncertainty	Cumulative total
4D	Direct N_2O emissions from agricultural soils	N_2O	5158	2%	61%	1.5%	2%
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	1460	1%	206%	1.4%	3%
2X	Emissions from nitric acid production	N_2O	5498	3%	51%	1.3%	6%
6A	CH_4 emissions from solid waste disposal sites	CH_4	7253	3%	34%	1.1%	9%
7X	Polluted surface water	N_2O	1178	1%	206%	1.1%	10%
1A	Emissions from stationary combustion : Energy Industries	CO_2	63780	30%	4%	1.1%	39%
1A	Feedstock oil	CO_2	3856	2%	54%	1.0%	41%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	CH_4	5766	3%	21%	0.6%	44%
1A	Mobile combustion: other	CO_2	2356	1%	50%	0.6%	45%
1A	Emissions from stationary combustion : Other Sectors	CO_2	37203	17%	3%	0.6%	62%
1A	Mobile combustion: road vehicles	CO_2	32747	15%	3%	0.4%	78%
1A	Mobile combustion: water-borne navigation	CO_2	923	0%	100%	0.4%	78%
4B	Emissions from manure management : swine	CH_4	775	0%	100%	0.4%	79%
4B	Emissions from manure management : cattle	CH_4	774	0%	100%	0.4%	79%
1A	Emissions from stationary combustion : Manufacturing Industries and Constructio	CO_2	21062	10%	3%	0.3%	89%
7X	Misc. CO_2	CO_2	1203	1%	54%	0.3%	89%
7X	Misc. N_2O	N_2O	902	0%	71%	0.3%	90%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	1224	1%	50%	0.3%	90%
1A	Feedstock gas	CO_2	4817	2%	11%	0.3%	93%
2X	Other industrial: CO_2	CO_2	1989	1%	21%	0.2%	94%
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	790	0%	51%	0.2%	94%
2X	SF_6 emissions from SF_6 use	SF_6	344	0%	103%	0.2%	94%
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	1221	1%	25%	0.1%	95%
1A	Emissions from stationary combustion: non-CO_2	CH_4	585	0%	50%	0.1%	95%
1A	Emissions from iron and steel industry	CO_2	5648	3%	4%	0.1%	98%
1A	Mobile combustion: road vehicles	N_2O	476	0%	50%	0.1%	98%
2X	PFC emissions from aluminium production	PFC	1041	0%	21%	0.1%	98%
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	685	0%	29%	0.1%	99%
4A	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	367	0%	50%	0.1%	99%
4B	Emissions from manure management	N_2O	183	0%	100%	0.1%	99%
4B	Emissions from manure management : poultry	CH_4	177	0%	100%	0.1%	99%
1A	Mobile combustion: aircraft	CO_2	225	0%	50%	0.1%	99%
1A	Emissions from stationary combustion: non-CO_2	N_2O	210	0%	50%	0.0%	99%
6B	Emissions from wastewater handling	N_2O	187	0%	54%	0.0%	99%
4A	CH_4 emissions from enteric fermentation in domestic livestock: sheep	CH_4	199	0%	30%	0.0%	99%
2X	HFC by-product emissions from HFC manufacture	HFC	98	0%	51%	0.0%	99%
2X	Emissions from cement production	CO_2	437	0%	11%	0.0%	100%
1A	Mobile combustion: road vehicles	CH_4	77	0%	60%	0.0%	100%
1A	Feedstock coal	CO_2	408	0%	11%	0.0%	100%
1B	Fugitive emissions from oil and gas operations: other	CH_4	78	0%	54%	0.0%	100%
2X	PFC emissions from PFC use	PFC	160	0%	25%	0.0%	100%
1A	Mobile combustion: other	N_2O	28	0%	112%	0.0%	100%
4A	CH4 emissions from enteric fermentation in domestic livestock: other	CH_4	89	0%	30%	0.0%	100%
2X	Other industrial: CH_4	CH_4	47	0%	51%	0.0%	100%
4B	Emissions from manure management : other	CH_4	24	0%	100%	0.0%	100%
7X	Misc. CH_4	CH_4	38	0%	32%	0.0%	100%
1A	Mobile combustion: other	CH_4	7	0%	112%	0.0%	100%
6B	Emissions from wastewater handling	CH_4	15	0%	32%	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 2002	Level assessment 90/95	Level assessment 2002	Trend assessment	% Contr. to trend	Trend * Uncertainty	% Contr. to trend	Cumulative total
1A	Emissions from stationary combustion : Energy Industries	CO_2	51305	63780	24%	30%	5.7%	25%	1.4%	47%	47%
1A	Mobile combustion: road vehicles	CO_2	25374	32747	12%	15%	3.4%	15%	0.5%	17%	64%
1A	Emissions from stationary combustion : Manufacturing Industries and Construction	CO_2	28015	21062	13%	10%	3.3%	14%	0.5%	16%	80%
2X	HFC-23 emissions from HCFC-22 manufacture	HFC	5759	685	3%	0%	2.4%	10%	0.2%	8%	88%
6A	CH4 emissions from solid waste disposal sites	CH_4	12011	7253	6%	3%	2.2%	10%	0.2%	7%	96%
1A	Emissions from stationary combustion : Other Sectors	CO_2	34913	37203	16%	17%	1.0%	4%	0.0%	1%	97%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	CH_4	7678	5766	4%	3%	0.9%	4%	0.0%	1%	98%
1A	Feedstock oil	CO_2	2549	3856	1%	2%	0.6%	3%	0.0%	1%	99%
1B	Fugitive emissions from oil and gas operations: gas production	CH_4	2097	1221	1%	1%	0.4%	2%	0.0%	0%	99%
2X	Emissions from nitric acid production	N_2O	6314	5498	3%	3%	0.4%	2%	0.0%	0%	99%
2X	Other industrial: CO_2	CO_2	1181	1989	1%	1%	0.4%	2%	0.0%	0%	99%
2X	PFC emissions from aluminium production	PFC	1799	1041	1%	0%	0.4%	2%	0.0%	0%	100%
1A	Emissions from iron and steel industry	CO_2	6255	5648	3%	3%	0.3%	1%	0.0%	0%	100%
7X	Misc. N_2O	N_2O	1468	902	1%	0%	0.3%	1%	0.0%	0%	100%
2X	Emissions from substitutes for ozone depleting substances (ODS substitutes): HFC	HFC	424	790	0%	0%	0.2%	1%	0.0%	0%	100%
1A	Mobile combustion: other	CO_2	2655	2356	1%	1%	0.1%	1%	0.0%	0%	100%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH_4	1524	1224	1%	1%	0.1%	1%	0.0%	0%	100%
1A	Mobile combustion: aircraft	CO_2	492	225	0%	0%	0.1%	1%	0.0%	0%	100%
4B	Emissions from manure management : swine	CH_4	1033	775	0%	0%	0.1%	1%	0.0%	0%	100%
1A	Mobile combustion: road vehicles	N_2O	276	476	0%	0%	0.1%	0%	0.0%	0%	100%
1A	Feedstock coal	CO_2	569	408	0%	0%	0.1%	0%	0.0%	0%	100%
4B	Emissions from manure management : cattle	CH_4	905	774	0%	0%	0.1%	0%	0.0%	0%	100%
6B	Emissions from wastewater handling	CH_4	138	15	0%	0%	0.1%	0%	0.0%	0%	100%
2X	PFC emissions from PFC use	PFC	37	160	0%	0%	0.1%	0%	0.0%	0%	100%
4A	CH_4 emissions from enteric fermentation in domestic livestock: sheep	CH_4	286	199	0%	0%	0.0%	0%	0.0%	0%	100%
2X	HFC by-product emissions from HFC manufacture	HFC	12	98	0%	0%	0.0%	0%	0.0%	0%	100%
1A	Mobile combustion: road vehicles	CH_4	153	77	0%	0%	0.0%	0%	0.0%	0%	100%
4A	CH_4 emissions from enteric fermentation in domestic livestock: swine	CH_4	438	367	0%	0%	0.0%	0%	0.0%	0%	100%
6B	Emissions from wastewater handling	N_2O	126	187	0%	0%	0.0%	0%	0.0%	0%	100%
1B	Fugitive emissions from oil and gas operations: other	CH_4	133	78	0%	0%	0.0%	0%	0.0%	0%	100%
4A	CH_4 emissions from enteric fermentation in domestic livestock: other	CH_4	37	89	0%	0%	0.0%	0%	0.0%	0%	100%
2X	SF_6 emissions from SF_6 use	SF6	301	344	0%	0%	0.0%	0%	0.0%	0%	100%
1A	Mobile combustion: water-borne navigation	CO_2	877	923	0%	0%	0.0%	0%	0.0%	0%	100%
4B	Emissions from manure management : poultry	CH_4	216	177	0%	0%	0.0%	0%	0.0%	0%	100%
2X	Emissions from cement production	CO_2	400	437	0%	0%	0.0%	0%	0.0%	0%	100%
4B	Emissions from manure management	N_2O	205	183	0%	0%	0.0%	0%	0.0%	0%	100%
2X	Other industrial: CH_4	CH_4	69	47	0%	0%	0.0%	0%	0.0%	0%	100%
1A	Emissions from stationary combustion: non-CO_2	CH_4	561	585	0%	0%	0.0%	0%	0.0%	0%	100%
1A	Feedstock gas	CO_2	4805	4817	2%	2%	0.0%	0%	0.0%	0%	100%
4D	Indirect N_2O emissions from nitrogen used in agriculture	N_2O	1460	1460	1%	1%	0.0%	0%	0.0%	0%	100%
4D	Direct N_2O emissions from agricultural soils	N_2O	5124	5158	2%	2%	0.0%	0%	0.0%	0%	100%
7X	Misc. CO_2	CO_2	1189	1203	1%	1%	0.0%	0%	0.0%	0%	100%
7X	Polluted surface water	N_2O	1178	1178	1%	1%	0.0%	0%	0.0%	0%	100%
7X	Misc. CH_4	CH_4	43	38	0%	0%	0.0%	0%	0.0%	0%	100%
1A	Mobile combustion: other	N_2O	33	28	0%	0%	0.0%	0%	0.0%	0%	100%
4B	Emissions from manure management : other	CH_4	19	24	0%	0%	0.0%	0%	0.0%	0%	100%
1A	Mobile combustion: other	CH_4	8	7	0%	0%	0.0%	0%	0.0%	0%	100%
1A	Emissions from stationary combustion: non-CO_2	N_2O	209	210	0%	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 final fossil-fuel related CO_2 emissions from fuel combustion (including non-energy use)

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 Spakman *et al.* (1997) [in Dutch] of which an electronic update is available in Dutch and in English (Spakman *et al.* (2003). 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. non-energy/feedstock use of fuels;
4. 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 (see *Figure A2.1*). This part of the PER is called ‘ER-I’. For these sectors, the remainder of the emissions is calculated on the basis of calculated remaining fuel consumption (difference of national energy statistics for the sector and energy consumption reported by these large companies) and standard emission factors. In some cases this may lead to negative corrections, for example in cases where firms include fuel consumption due to cogeneration, whereas this energy consumption in national statistics is not reported under industry but under another category (local cogeneration).

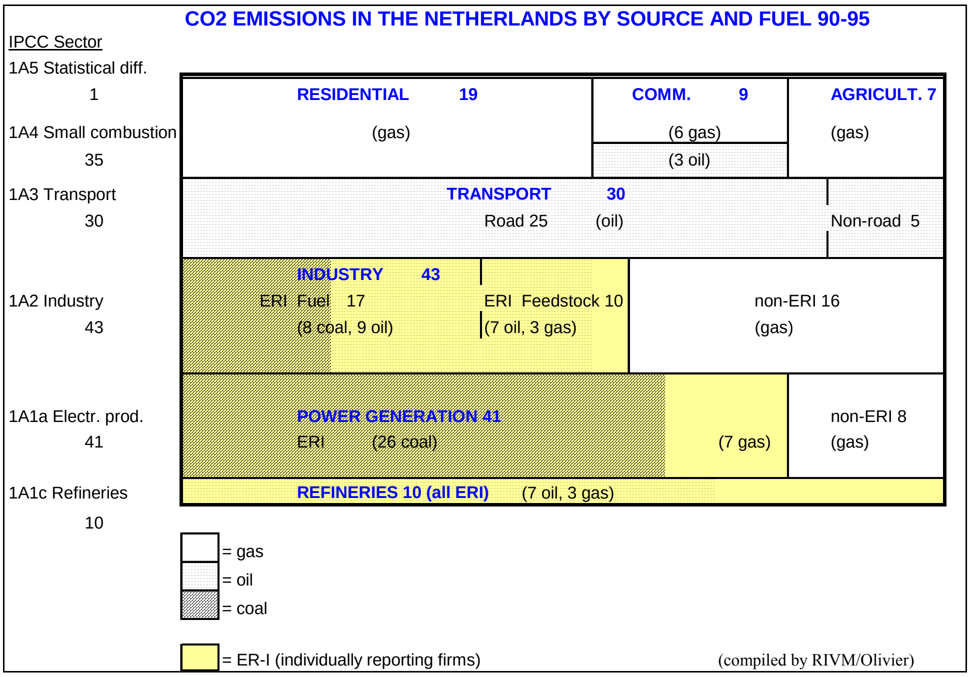


Figure A2.1. Schematic overview of CO_2 emissions from fuel combustion (Tg) (IPCC category 1A), showing the relative shares of subsectors as well as main fuel types and the total contribution of individually reporting firms (ER-I). Data are representative for the period 1990 to 1995 (source: Van Amstel et al., 2000a)

In addition, per economic subsector the total CO_2 emissions reported by these *individual companies* are compared with the amount calculated with the standard Netherlands' emission factors for CO_2 (*Table A2.1*). If the difference is more than 5%, then these large deviations are corrected to a maximum deviation of 5% via modification of the remaining energy consumption used for additional estimate of CO_2 emissions for non-ER-I-reporting firms within the *Target Group*. This procedure is followed because in those cases it is implicitly assumed that the submitted fuel consumption data are incorrect and because the PER is not allowed to revise individually reported emissions figures. This ensures that total CO_2 emissions per industrial sub-sector cannot deviate from the reference calculation by more than 5% (in practice, the group total may show less deviation). Recently, the calculation method of CO_2 emissions for the 100 largest individual industries has been revised (for years 2001 onwards); more details are provided in the meta-data files (e.g. Koch, 2003).
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 used for calculation of sectoral emissions in the Netherlands

	Carbon content (%)	Lower Heating Value (GJ/ton)	Emission factor (gram CO_2/kg or /m^3)	Emission factor (kg CO_2/GJ)
Hard coal				
Residential	90	32.0	3300	103
Metal industry	74	27.0	2720	101
Other activities [1]	69	27.0	2540	94
Coke	84	28.5	3080	103
Petroleum cokes	99	35.2	3630	103
Brown coal	58	21.0	2130	101
Wood, fuelwood		15.5	1610	104
Residential waste		10.5	780	74
Petrol [2]	86	44.0	3180	73 [3]
Diesel [2]	86	42.7	3130	73
Petroleum	87	43.1	3190	73
H.B.O. I	86	42.7	3130	73
H.B.O. II	86	42.7	3130	73
Heavy fuel oil (HFO)	86	41.0	3160	77
Natural gas	58	31.65	1768	56
LPG [2]	82	45.2	3000	66
Coke oven gas		19.7	870	44
Refinery gas: general		38.1	1676	46
Refinery gas: other		31.65	2109	46
Blast furnace gas				200

Source: Spakman *et al.* (2003)

1) Including public power plants.

2) For domestic mobile sources emission factors with 3 digits are used: 72.3 for petrol, 73.3 for diesel and 66.4 for LPG.

3) Should be 72 (rounded), but all emission factors for oil products were set to one single value, except for HFO, in view of the uncertainty in the energy data. See also note 2 on mobile sources.

For the calculation of the *carbon storage* in the *IPCC Reference Approach* for CO_2, carbon storage fractions in products like plastics and bitumen were taken from an analysis of petrochemical products, half products and feedstock use (of energy carriers) by Gielen (1996). The CO_2 emissions reported under combustion by the manufacturing industries include a substantial amount of CO_2 associated with non-stored carbon in non-energy applications of gas, oil products and cokes (of the order of 10 Mton of a total of around 43 Mton). Some 18 Mton is calculated as stored (i.e. not emitted) carbon, with a fixed storage fraction per energy carrier used for non-energy purposes (*Table A2.2*). This reference calculation is also used to calculate the remainder of feedstock emissions in case total CO_2 from feedstocks reported by the chemical industry is less than the reference value. In addition, carbon dioxide emissions are calculated for fossil fuel related carbon (e.g. plastics) in incinerated waste. These account for about 1 Mton of CO_2, annually.

Table A2.2. Carbon storage fractions for energy carriers used as chemical feedstock (constant for all years)

Energy carrier	1990
Naphtha	0.82
Lubricants	0.00
Bitumen	1.00
Coal Oils and Tars (from Coking Coal)	1.00
Natural Gas	0.10
Gas/Diesel Oil	0.82
LPG	0.82
Butane	0.00
Ethane	0.00
Coal/lignite	0.00
Coke	0.00
Aromates/light oils/other oil products	0.82
Other kerosine	0.82
Residual fuel oil	0.82

Source: Gielen (1996).

Note: The fraction used for all oil products is the weighted average of fractions determined for individual oil products (Spakman *et al*., 2003).

Fossil-based CO_2 emissions from *waste incineration* are calculated from the total amount of waste that is incinerated, split into 8 waste types, each with a specific carbon content and fraction of fossil C in total C, based on an analysis by De Jager and Blok (1993). In recent years this amounted about 2 Mton).

The fuel use related to *statistical differences* is still included as a source of CO_2 for 1991-1994, since it was assumed that the associated fuel use is real and not accounted for in individual end-use sectors. Per energy carrier, however, the difference may vary both in sign and size, as is shown in *Table 3.25*. *Statistics Netherlands* (CBS) has revised in the national energy balances the method for establishing the statistical difference between the apparent national energy consumption (indigenous production + import - export - bunkers ± stock change) and the bottom-up sum of all sectoral energy use. The statistical difference was eliminated for all years from 1990 onwards, except for 1991-1994, through incorporation of (formerly remaining) differences into other parts of the energy balance (see Section 3.2.5 for more details). Since the energy balances 1991-1994 have not been revised, it is not possible to provide a consistent time series for this 'source category' for the whole period 1990-2000.

Finally, for domestic environmental policy purposes a *temperature correction* of fuel use for space heating is applied, but only to CO_2 emissions from natural gas consumption. 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.*

Estimating emissions for year 't-1'

The method to calculate preliminary emissions for the year *t-1* is different from those used for older years as described above, due to absence or limited data from individual firms and incomplete energy statistics. For example, for the NIR 2003 in May 2002 combustion emissions for 2001 were calculated using energy statistics for the first three quarters of 2001 supplemented by the statistics of the last quarter of 2000 as a proxy for the unavailable data for the last quarter of 2001. Details on *t-1* emission calculations are provided in the meta-information files (e.g. TNO, 2004).
In some cases this may result in an underestimate of fuel consumption, in other cases, e.g. when the weather in the last quarters of 2000 and in 2001 were markedly different, in an under- or overestimate for the '*Other sectors'*. Although the total number of so-called heating degree days in 2000 and 2001 are almost equal, this is not necessarily also the case for the last quarter of these years.
However, for industrial subsectors the trend in fuel consumption can sometimes be estimated from already available data from annual environmental reports of individual companies (Koch *et al.,* 2002).

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.4.1*).
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.

Table A.4.1. 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.

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.4.3*). Other sectors use fixed application factors provided by the Ministry of Economic Affairs (see *Table A.4.2*) (Wieleman, 1994).

Table A.4.2. 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.4.3. 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
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

Source: EnergieNed, 1995-2003

Example calculation of temperature correction in 1990

As an example in *Table A.4.4* the calculation of the temperature correction of sectoral CO_2 emissions for 1990 has been summarised. In addition, *Table A.4.5* 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.4.4. 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.4.5. Temperature correction of carbon dioxide emissions per sector 1990-2002 (in Gg)

Source category	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
1A1a Energy sector	160	10	110	30	110	80	-120	60	140	210	210	90	180
1A2 Industry	770	50	450	120	400	290	-300	160	400	590	590	230	420
1A4a Commercial and public services	1000	80	900	240	800	540	-930	510	760	1000	1190	610	1120
1A4b Residential sector	2950	180	2020	510	1670	1200	-2020	1120	1550	2290	2330	1010	1880
1A4c Agriculture	1350	70	840	220	760	490	-880	490	670	950	960	390	710
Total CO_2 correction	**6230**	**390**	**4320**	**1120**	**3740**	**2600**	**-4250**	**2340**	**3520**	**5040**	**5270**	**2320**	**4310**
As % of uncorrected national total	3.9%	0.2%	2.6%	0.7%	2.2%	1.5%	-2.4%	1.4%	2.0%	3.0%	3.1%	1.3%	2.4%

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, however, final conclusions have not yet been drawn (Van Amstel *et al.*, 2000a).

ANNEX 3: Other detailed methodological descriptions for individual source or sink categories

3.1 Detailed methodological description for other sources

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 Spakman *et al.* (1997) [in Dutch] of which an electronic update is available in Dutch and in English (Spakman *et al.* (2003). The description provided in this Annex aims at reflecting better the IPCC source structure (IPCC, 1997) and methodological issues discussed in the *IPCC Good Practice Guidance* report (IPCC, 2000).

Carbon dioxide emissions for non-fossil fuel sources

In the Netherlands the non-fossil, non-organic sources of CO_2 are the following:

- Gas flaring and venting at oil and gas production sites (category 1B2);
- Cement clinker production (category 2A);
- Lime production and consumption (category 2A);
- Flue gas desulphurisation (category 2G);
- Waste recycling activities (category 6D);
- Miscellaneous minor sources: fireworks (category 7).

Gas flaring and venting emissions for 1990-1996 are provided through ER-I data; from 1997 emissions are calculated based on oil and gas production data and the emission factors per unit of oil and gas produced stemming from the 1996 dataset. The Netherlands imports a large part of cement clinker used for cement production. Therefore, associated CO_2 emissions are calculated based on domestic clinker production and reported through ER-I data. CO_2 from lime production and use are also included in the ER-I dataset. Emissions from flue gas desulphurisation units installed in public power plants are calculated from gypsum production and a fixed emission factor. More information on the methodologies and datasets used are provided in Spakman *et al.* (2003). Non-combustion emissions are also reported in ER-I from waste recycling. Finally, CO_2 emissions from the use of fireworks are included as a minor miscellaneous source in the Netherlands inventory system, which is reported under category 7.

Methane

Methane emissions from fuel combustion are estimated using the energy statistics and emission factors from the annual *Emission Monitor* with figures provided by the Emission Registration system (PER). The largest fuel combustion subcategory is the residential sector, where emissions from cooking (including startup losses) and biofuel combustion are the largest sources. 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). For more details we refer to the description provided for CO_2. Fugitive methane emissions from oil and gas are estimated for onshore and offshore sites separately.
Methane from agriculture is estimated on the basis of emission factors developed in the methane background document by Van Amstel *et al.* (1993), and agricultural statistics for animal numbers and manure production from *Statistics Netherlands* (CBS). For dairy and non-dairy cattle the emission factors for enteric fermentation are based on an IPCC Tier 2 analysis made for the Netherlands cattle in 1990. For subsequent years, these emission factors are used, however, specific factors are applied to 4 and 3 subcategories within dairy and non-dairy cattle, respectively. The emission factors for the

other sub-sources are based on default IPCC Tier 1 emission factors. For enteric fermentation of sheep and goats the same emission factor of 8 kg CH_4 per animal is used, which stems from an OECD/IEA/IPCC publication in 1991 as documented in Van Amstel *et al*. (1993). The *Revised 1996 IPCC Guidelines*, however, mention different default emission factors for sheep and goats. The Netherlands uses for both animal categories the same emission factor because sheep and goats roughly consume per animal the equal amount of dry matter. 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 of sheep.
The IPCC Tier 1 methodology is used to calculate CH_4 from manure management systems. Country-specific emission factors for CH_4 are based on default IPCC emission factors (using adjusted IPCC values). The calculation of animal manure production and waste management systems is described in Van der Hoek (2002). The emission factors are multiplied by the amount of annually produced manure per animal category after deducting the amount of manure produced on the pasture. Specific emission factors per m^3 manure are taken from Van Amstel *et al.* (1993). The emission factors for sheep and goats are high compared to the IPCC defaults. With VS = 250 kg/m^3, B_o = 0.18 m^3 CH_4/kg VS and MCF = 0.1 it can be calculated that 1 m^3 manure yields 4.5 m^3 CH_4, which corresponds to 2.979 kg CH_4. In the Netherlands one ewe (= female sheep) (including corresponding young stock) annually produces 2000 kg manure in the meadow and 325 kg manure in the animal house. Combined with animal numbers for ewes this results in 0.21 million kg manure and 0.63 Gg CH_4 (Van der Hoek, 2002). In the Netherlands milking goats (including corresponding young stock) are kept all day in the animal house. One milking goat, including corresponding young stock, annually produces 1300 kg manure. All the milking goats together produce 0.15 million kg manure and an emission of 0.45 Gg CH_4 (Van der Hoek, 2002).
Methane emissions from landfills 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. A small source in the waste sector is wastewater treatment. These emissions are very small because of the high fraction recovered (from 80% in 1990 to 98% at present).
A very small source identified in the Netherlands is degassing of drinking water, which are reported in Sector 9. 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 as anthropogenic emissions under IPCC category 7. Other 'natural emissions' are methane emissions from wetlands and water.

Nitrous oxide

Nitrous oxide emissions from fuel combustion are estimated using the energy statistics and emission factors from the annual *Emission Monitor* with figures provided by the Emission Registration system (PER). 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*.

N_2O emissions from the production of chemicals 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.
The nitrous oxide emissions from agriculture are based on the methods described in the nitrous oxide background document by Kroeze (1994). The calculation of animal manure production and waste management systems is described in Van der Hoek (2002). Direct N_2O emissions include emissions due to application of synthetic fertilisers, animal wastes (manure) to soil and by N-fixing crops. In addition, direct N_2O emissions in the Netherlands include emissions from animal production of manure on the grasslands (pasture). The subcategory 4D1d 'direct N_2O emissions from crop residues left in the field' and 4D2 'cultivation of histosols' (organic soils) are included in the subsource 4D4 '*Other*' (specified as '*Background agricultural soils'*). The Netherlands reports background emissions from agricultural soils with a magnitude of 4.71 Gg N_2O. This value is the arithmetic difference between the background emissions calculated for around the year 1900 and the present, actual background emissions. These so-called enhanced background emissions are caused by manure and fertiliser application in the last century and by lowering the groundwater tables in the past. This subsource reflects that agricultural soil emissions will not stop when agricultural activities are stopped. For more specific information we refer to Kroeze (1994).
Indirect N_2O emissions from atmospheric deposition are not yet estimated. Other indirect N_2O emissions from leaching and run-off are included in *category 7 'Polluted surface water'*.
The latter category 7 *'Polluted surface water'* is a fixed value that comprises leaching and run-off from all anthropogenic activities, including human sewage. Since this figure includes more than only agriculture related emissions we do not report these under category 4.D but as a separate category '7'. N_2O emissions from human sewage are reported partly under *category 6B 'Wastewater handling'* and partly under *category 7* as *'Polluted surface water'*. For more details on the exact definition of these indirect N_2O source terms we refer to Spakman *et al.* (2003) or to Kroeze (1994).

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 to calculate emissions for the year *t-1* are different from those for older years which were described above, due to absence or limited data from individual firms and incomplete energy statistics. For example, for the NIR 2003 in May 2002 combustion emissions for 2001 were calculated using energy statistics for the first three quarters of 2001 supplemented by the statistics of the last quarter of 2000 as a proxy for the unavailable data for the last quarter of 2001. Details are provided in the meta-information files (TNO, 2004).
In some cases this may result in an underestimate of fuel consumption, in other cases, e.g. when the weather in the last quarters of 2000 and in 2001 were markedly different, in an under- or overestimate for the '*Other sectors'*. Although the total number of so-called heating-degree days in 2000 and 2001 are almost equal, this is not necessarily also the case for the last quarter of these years.
However, for industrial subsectors the trend in fuel consumption can sometimes be estimated from already available data from annual environmental reports of individual companies (Koch *et al.*, 2002).

3.2 Detailed methodological description of LUCF category 5A

For category 5A (*Changes in forest and other woody biomass stocks)* a complete forestry dataset for the whole period 1990-2000 has been compiled. The method and data sources used to estimate CO_2 removals as described in Spakman *et al.* (1997) have been refined and also completed for years not calculated sofar (i.e. all years except 1990, 1994 and 1995). In this Annex the description of both methodology and data sources is provided, based on a more detailed assessment by Daamen (2002). In addition, we provide some information on LUCF studies that are still in progress.
The Netherlands' forests reported in the CRF under the header '*Temperate, other'* split into coniferous and broadleaf forest are the sum of exploited, non-exploited and other forests. In the CRF the group *non-forest trees* has been specified for trees in line, solitaires, urban parks, fruit trees (orchards) and nurseries. In the Netherlands trees are, on the average, getting older and heavier: the maturing of forests. Also, the total forest area is increasing because of forest expansion. Besides this growth, there are fellings that reduce woody livestock. The overall balance of these processes leads to a sink of carbon dioxide, which varies between 1.2 and 1.9 Tg CO_2 per year in the period 1990-2000. In the Netherlands, the carbon sink in biomass (IPCC category 5A) refers to the net growth of forests and other trees defined as volume increment minus volume of fellings. This is based on three key parameters: forest area (in ha), average annual growth by category (in m^3/ha/year) and harvest by category (in m^3/ha/year). No correction is made for the amount of fuelwood harvested, since this amount is implicitly included in these three variables.

For *forest area* (in ha) in the Netherlands the FAO definition of TFBRA2000 is used (ECE/FAO, 1997), with the following deviations (printed in italics):

- land with tree crown cover of more than *20%* (instead of FAO definition of 10%) *and width of more than 30 m instead of 20 m;*
- including young natural stands and plantations which have yet to reach a crown density of 20% (instead of FAO definition of 10%) are included under forest;
- forest roads, cleared tracts, firebreaks and other small areas within forest are included, *however with a maximum width of 6 m*;
- windbreaks and shelterbelds of trees are included, *however only with a width of more than 30 m;*
- for determining the *wood volume of the forest stock* the Netherlands uses a *threshold of 5 cm diameter minimum* (instead of no threshold); however, this has how negligible effect on the total volume (Daamen, 2002).

We note that this is the definition of what should be reported under the *UN Framework Convention on Climate Change*. The definition of emissions/sinks to be included in the national total under the *Kyoto Protocol* is quite different and is not defined here, nor reported in the NIR.

Dataset for 1990-2000

A. Activity data and volume per hectare

For forest biomass stock an improved dataset was compiled and completed for all years 1990-2000 by Daamen (2002), in which definitions, data sources and assumptions have been documented which are used to estimate the CO_2 removal in source/sink category 5A. For the period 1990-2000 the data on carbon stock and carbon changes are based on:

- forest area (in ha);
- non-forest trees (in ha);
- average annual growth by category (in m^3/ha/year);
- harvest (fellings) by category (in m^3/ha/year).

The 1990-2000 data on ***forest area*** are taken from the following data sources:

- CBS (1985) for the total forest area in 1980;
- Dirksen e*t al*. (2001) for the total forest area in 2000;

- in conjunction with the previous estimates for 1980 and 2000, the following sources were used to estimate the total forest area in 1990: CBS (1985, 1989) for forest area in 1980-1984, Daamen (1998) for forest area in 1997, and Edelenbosch (1996) for forest expansion in the period 1990-1995;
- for the years 1991-1999 a linear interpolation of the 1990 and 2000 estimates was used.

The first results of the 'Monitoring Network Functions' estimate the total forest area in 2000 at 360 kha, an increase of about 6% compared to the 341 kha estimated for 1990. The estimates for the ***other forested area*** are taken from the following data sources:

- Schoonderwoerd (1991) for trees in line plantations with a maximum width of 30 m, with CBS (1985) for stem volume data;
- CBS (1985) for solitary trees;
- LEI/CBS agricultural statistics on orchards and nurseries (LEI/CBS, 2000);
- CBS (1985) for other non-forest areas, e.g. urban parks, defined as areas < 0.5 ha and/or width less than 30 m.

The area for all these categories has been assumed to be constant, except for orchards and nurseries for which annual area statistics are available. Also the stem volume is assumed to be constant for all six subcategories.

The 1990-2000 data on ***stem volume***, used to determine the annual volume increment from growth, and on ***fellings*** are taken from the following data sources:

1. annual HOSP reports for about 280 kha forest land (high forest) with data on stem volume/growth and fellings/harvest from the HOSP project; a compilation is provided in Schoonderwoerd and Daamen (2000) and Stolp (1995);
2. HOSP reports on additional forest land (coppice, new forests planted 1984-1990, amenity plantations etc.) for about 29 kha with data on stem volume/growth from 1992 onwards and fellings/harvest from 1997 onwards ('HOSP-2') provided in Daamen (1998) (TBFRA2000);
3. remaining forest area (land covered with forest with other form of land-use, e.g. recreation, zoo, build up areas) according to the 4th forest statistics and not covered by the previous two inventories (Daamen, 1998).

For the latter category no changes in stem volume and negligible fellings/harvest are assumed. In *Table A3.1* the area of the distinguished subcategories have been summarised. More details can be found in Daamen (2002).

Table A3.1. Forest and non-forest tree area in the Netherlands 1990-2000 (kha)

Forest/tree type	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Forest land											
coniferous	190.4	192.0	192.5	193.0	193.8	194.7	195.3	194.9	195.1	195.3	196.4
broadleaved	151.0	150.9	152.3	153.7	154.8	155.8	157.1	159.4	161.1	162.8	163.6
Total forest land	**341.4**	**342.9**	**344.8**	**346.7**	**348.6**	**350.5**	**352.4**	**354.3**	**356.2**	**358.1**	**360.0**
Non-Forest Trees											
forests<0.5 ha, coniferous	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
forests<0.5 ha broadleaved	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
line plantations	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0	66.0
solitaires	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0
orchards	23.9	23.8	23.6	23.4	23.3	23.1	22.8	22.6	22.3	22.0	21.8
Nurseries	5.1	5.2	5.4	5.5	5.6	5.7	6.0	6.2	6.5	6.7	7.0
Total Non-Forest Trees	**107.0**	**107.0**	**107.0**	**106.9**	**106.9**	**106.8**	**106.8**	**106.8**	**106.8**	**106.7**	**106.7**
Total trees	**448.4**	**449.9**	**451.8**	**453.6**	**455.5**	**457.3**	**459.2**	**461.1**	**463.0**	**464.8**	**466.7**

Source: Daamen, 2002

B. Conversion factors

All conversion factors have been checked for replacing IPCC default values by country-specific values. It was decided to use for all variables IPCC default values, except for the conversion ratio from volume (in m^3) to dry matter (tonne dm), for which the Netherlands uses more detailed figures: 0.5 and 0.6 t dm/m^3 for coniferous and broadleaf forest, respectively. *Table A3.2* summarises all conversion factors used in the calculation for source/sink category 5A. Again more details can be found in Daamen (2002).

Table A3.2. Conversion factors used to estimate CO_2 source/removal IPCC category 5A..for the Netherlands

Factor	Value/unit
Volume addition for branches, tree top and roots (D)	20% of stem volume including bark
Mass density coniferous tree (E_1)	500 kg dm/m^3
Mass density broadleaf tree (E_1)	600 kg dm/m^3
Carbon content (E_2)	0.5 kg C/kg dm

Source: Spakman *et al.* (1997); Daamen (2002)

The net annual CO_2 emissions/removals can now be calculated using the formula:

$$CO_2 \text{ removal in year } t \text{ (kg/year)} = [\ A_t * (B_t - C_t) + (F_t - F_{t-1})\ ] * (1+D/100) * E_1 * E_2 * 44/12$$

where:

A = Forest Area with growth and fellings [kha]
B = Volume increment [m^3/ha/yr], about 8 m^3/ha/yr
C = Fellings [m^3/ha/yr], about 6 and 3-4 m^3/ha/yr for coniferous and broadleaf forests, respectively
D = Volume addition for branches, tree top and roots [%]
E_1 = Mass density [kg dry matter/m^3]
E_2 = Carbon content [kg carbon/kg dry matter]
F = Change in stock of non-growing categories due to changes in area between year *t* and year *t-1*
44/12 = Conversion factor from C to CO_2

The first factor A (forest area with growth and fellings) refers to forests monitored in the HOSP project and the HOSP-2 forest. The remaining forest area according to the 4th forest statistics and the non-forest trees are summarised in factor F. *Table A3.3* summarises the annual growth and fellings used in the calculations.

From 2001 onwards the data source for *annual growth* and *fellings* will be based from a new source: a new monitoring network, in Dutch called '*Meetnet Functievervulling*'. This sampling network will provide new data on forest area, standing volume and annual volume increment, subdivided into tree species. New data on harvest will not be available before the completion of the second four years sampling cycle (at the earliest in 2008).

LUCF studies in progress

The literature for quantitative data on carbon stocks and CO_2 emissions from agricultural soils, forest soils and other soils in natural areas in the Netherlands was reviewed in 2002 by Kuikman *et al.*, (2002). For LUCF subcategories 5B-5E also new datasets are being compiled, of which some information is presented below. However, the results are still under discussion.

Literature has been reviewed for quantitative data on carbon stocks and CO_2 emissions form agricultural soils, forest soils and other nature soils in the Netherlands (Kuikman *et al.*, 2003). To estimate and improve the calculation of the CO_2 emissions from soils due to change of carbon stocks, the use of a computer model was recommended, that parameterises five arable crops, together comprising 84% of the area use for arable farming, and grass). For agricultural soils the data in the study are based on the main crops in the Netherlands, i.e. grassland and cropland with maize, potato, beets and grains. A special item was the organic soils in low areas that have been drained. Three databases and approaches are options to assess soil carbon stocks:

- based on the topographic soil map coupled with the soils information system;
- based on the Netherlands' soil monitoring program;
- based on the monitoring soils in forest and nature ecosystem.

In 2003 a group of consultants carried out a study aiming at identifying current gaps that the Netherlands is facing in comparison to requirements as set by the Marrakesh accords (Nabuurs *et al.*, 2003). This includes the subcategories of sources/sinks not yet reported: LUCF subcategories 5B-5E and 5A4, and CO_2 from agricultural soils (category 4D). They concluded that current LULUCF greenhouse gas reporting by the Netherlands is incomplete. The few sections that are included are done at lower Tiers. No actual data then for the year 2000 are collected. The concluded that data available on areas of land use and land cover are well available, although consistent time series may be a problem due to differences in classifications. Data on practices in agriculture are also very good. Emission factors may not be available at all for many required emission factors for specific Dutch conditions. Currently there is no system or database that will delivers all data. There is a lack of data on changes in soil carbon stocks. The consistency and frequency between different databases may not be required and lead to inaccuracies and also data on the 1990 situation are not available in a consistent manner. For reporting under Tier 1, activity data are available for the larger part and defaults emission factors can be applied. For reporting under Tier 2 much more country specific emission factors are required, and for reporting under Tier 3 the emission factors are often missing.

A decision will be made in 2004 to what extent data can and will be used for reporting on the Source/Sink category in future editions of the Netherlands' greenhouse gas inventory for reporting under the *UN Framework Convention on Climate Change* (UNFCCC) and the *Kyoto Protocol*.

Table A3.3. Annual growth increment and annual fellings forests in the Netherlands, 1990-2000

	Annual growth increment										
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Total growth [m^3/ha]	**7.8**	**7.6**	**7.5**	**7.5**	**7.6**	**7.8**	**7.8**	**7.9**	**7.9**	**7.9**	**7.8**
- coniferous	8.4	8.0	7.8	7.7	7.7	7.9	7.8	7.9	7.9	7.8	7.8
- broadleaf	7.0	7.1	7.1	7.3	7.5	7.7	7.8	7.9	7.9	7.9	7.9
Growth [1000 m^3/yr]											
HOSP	**2303**	**2244**	**2198**	**2211**	**2209**	**2258**	**2245**	**2237**	**2246**	**2227**	**2230**
- coniferous	1453	1397	1356	1343	1326	1354	1332	1336	1331	1310	1310
- broadleaf	850	847	842	868	883	904	913	901	915	917	920
HOSP 2	**120**	**125**	**128**	**137**	**140**	**146**	**147**	**188**	**187**	**185**	**183**
- coniferous	13	13	13	13	13	13	13	17	17	17	17
- broadleaf	107	112	115	124	127	133	134	171	170	168	166
	Annual fellings										
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Fellings [m^3 ha/yr]	**4.8**	**4.6**	**4.3**	**4.2**	**4.0**	**5.3**	**5.3**	**5.6**	**5.3**	**5.2**	**5.2**
- coniferous	6.2	5.7	5.3	5.3	4.7	6.0	6.1	6.8	6.5	6.4	6.3
- broadleaf	3.0	3.0	3.0	2.9	3.1	4.3	4.1	4.2	3.9	3.7	3.7
Fellings [1000 m^3/yr]											
HOSP	**1452**	**1384**	**1303**	**1277**	**1197**	**1568**	**1570**	**1682**	**1591**	**1547**	**1550**
- coniferous	1078	1005	929	919	823	1039	1060	1154	1110	1080	1080
- broadleaf	374	379	374	358	374	529	509	528	481	467	470
HOSP 2 *	**30**	**33**	**36**	**42**	**45**	**48**	**50**	**51**	**48**	**48**	**48**
- coniferous	1	1	1	2	2	3	3	4	2	2	2
- broadleaf	29	32	35	40	43	45	47	47	46	46	46

** Harvest +10%. Harvest is known for this category. The conversion from harvest to fellings (+10%) is based on the ration for HOSP forest.*

Source: Daamen, 2002.

ANNEX 4: CO_2 Reference Approach and comparison with the Sectoral Approach

Comparison of CO_2 emissions in the National Approach and Reference Approach

The *IPCC Reference Approach* (RA) for CO_2 from energy combustion uses apparent consumption data per fuel type to estimate CO_2 emissions from fossil fuel use. This can be used as a means of verification of the sectoral total CO_2 emissions from fuel combustion. For the *Reference Approach,* energy statistics were provided by Statistics Netherlands (CBS); country-specific emission factors (carbon contents) and carbon storage fractions based on a study by Gielen (1996) are used (see *Annex 2*, *Tables A2.1* and *A2.2).*
Table A4.1 presents the results of the 2003 *Reference Approach* calculation for 1990-2002 and compares them with the official national total emissions reported as fuel combustion (source category 1A). The annual difference varies between -1.9% for 1992 and +5.8% for 1997, with an average of 0.8%. The 1990-2001 trend differs only slightly: 9.6% for the *National Approach* (NA) (= sum of sectoral emissions in 1A) and 10.1% for the *Reference Approach*.
The *Reference Approach* data show 12% increase in emissions from liquid fuels (1990-2002) and a 15% increase from gaseous fuels; CO_2 emissions from solid fuels decreased in this period by 3%. The *National Approach* data on the other hand show 16% *decrease* in emissions from liquid fuels (1990-2002) and a 15% increase from gaseous fuels; CO_2 emissions from solid fuels decreased in this period by 27%. These changes are strongly interrelated with the emissions from others that increased by 135%.

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
Refference Approach													
Liquid fuels [3)]	52.3	51.4	52.4	53.5	54.3	54.6	55.4	54.9	55.4	56.3	56.6	58.4	58.3
Solid fuels	34.7	32.1	31.3	32.8	33.2	35.9	34.4	33.6	34.1	30.4	31.9	33.7	33.8
Gaseous fuels	72.5	80.2	77.7	80.1	77.9	79.6	88.9	83.5	82.9	80.6	81.7	83.9	83.5
Others													
Total RA	**159.6**	**163.7**	**161.4**	**166.4**	**165.3**	**170.1**	**178.7**	**172.0**	**172.4**	**167.3**	**170.1**	**175.9**	**175.6**
National Approach													
Liquid fuels [3)]	45.1	27.4	28.7	29.4	29.6	45.1	48.0	45.3	44.7	38.9	39.1	36.7	37.7
Solid fuels	30.5	0.1	0.1	0.0	0.0	32.3	27.7	24.7	27.4	23.6	2.7	25.2	22.4
Gaseous fuels	66.8	20.9	18.8	19.9	18.9	75.1	82.4	64.8	74.6	71.7	54.3	73.7	76.9
Others	15.4	117.3	117.1	117.3	118.7	17.6	20.0	27.8	22.7	29.5	71.8	38.4	36.1
Total NA	**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**
Difference (%)													
Liquid fuels [3)]	16	87	83	82	83	21	15	21	24	45	45	59	55
Solid fuels	14	62266	60766	79498	107201	11	24	36	24	29	1076	34	51
Gaseous fuels	9	284	314	302	311	6	8	29	11	12	50	14	9
Other	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100	-100
Total	**1.1**	**-1.2**	**-1.9**	**-0.1**	**-1.2**	**0.0**	**0.3**	**5.8**	**1.8**	**2.2**	**1.3**	**1.1**	**1.5**

1) Preliminary calculation, using provisional carbon factors for crude oil and natural gas liquids (NGL).
2) Preliminary data.
3) 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

Comparison of RA-NA emissions by fuel type as presented in *Table A4.1* clearly shows that there is reasonable correspondence (with exception for the year 1997 and 2000) for gaseous fuels – i.e. natural gas –. For solid fuels the differences are often the largest, in particular for 2000 where no fuel split disaggregation was possible due to missing data in the *Annual Environmental Reports* (MJVs) of the electric power companies (see *Section 1.6.1* for more details on the data quality for the inventory for 2000). In other years the 20 to 50% of solid fuel emissions missing in the *National Approach* is due to (a) aggregated data for the iron and steel industry and (b) high interannual variation of derived fuels (coke oven gas and blast furnace gas) sold to other sectors (i.e. power plants), which are often not very transparently reported. Liquid fuels are increasing missing since 1998.
Although about 30% of the fuel combustion for the years 2001 and 2002 in the *National Approach* is not attributable to a specific fuel type, the difference between the total national CO_2 emissions from fuel combustion with the *Reference Approach* is in general below 2.5% as discussed above.
Specific reasons for the large discrepancy of 5.8% in 1997 can not be given. However, we do note the relative weakness of data collected from large companies since 1996, as discussed in *Section 1.2,* and the substantial revisions in energy statistics, in particular for 1997, due to the elimination of statistical differences and other improvements, as discussed in *Section 5.1.1* of the NIR 2002 (Olivier *et al.*, 2002).

Causes of differences between the two approaches

In general, the Netherlands *Reference Approach* calculation is very sensitive for the carbon content of crude oil input figures due to the relatively high amounts of crude oil refined and oil products exported. A sensitivity analysis for four sets of carbon contents to crude oil showed that the annual average difference of sectoral and reference calculation could vary between 0.3% and 1.9% (Olivier *et al.*, 2000). Other reasons for differences in the two approaches are:

- differences in exact source and source group definitions for CO_2 emissions from fuel combustion (correction for non-energy use, methodological differences in allocating emissions as domestic or abroad);
- use of different emission factors by the individual reporting firms (ER-I), in particular for solid fuels (notably energy industries and manufacturing industry);
- use of different carbon storage fractions by the individual reporting firms;
- unclear reporting in ER-I of the fraction of organic carbon CO_2 emissions in total reported CO_2 emissions, leading to incorrect interpretations;
- possible double counting due to erroneous supplemental estimates for fossil fuel combustion in cases where ER-I data from individual companies contain only partial or no fuel use data at all related to their reported CO_2 emissions;
- limitations of the comparison approach RA versus total CO_2 reported under category 1A ‘Fuel combustion’ due to the split in reporting of fossil carbon related CO_2 emissions into (in principle) IPCC source sectors 1A, 1B, 2, 3 and 6.

Having said this, reporting by the Netherlands of fossil-fuel related CO_2 emissions in the source categories industrial processes (2), solvents (3) and a large part of waste (6) cannot be a reason for the differences, since these are currently all reported under fuel combustion (1A). Moreover, we note that since the NIR 2002 for the years 1991-1994 only CO2 emissions associated with statistical differences in coal, oil and gas consumption are included in the national total from fuel combustion, whereas for all other years the energy balance does not show statistical differences.

Recalculations and error corrections

Last year an error in the calculation of the *Reference Approach* was detected, as a result of improved quality assurance. This year the data for the *Reference Approach* calculation have not been changed. However, CO_2 emissions in the *National Approach* have been recalculated for all years. For more details on recalculations in sectoral emissions, we refer to *Section 10.1* 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 A4.2*, which shows changes of 0.8, -0.4 and -0.9% in the base year 1990 emissions in the NIR of 2004, 2003 and 2002, respectively. For the years 1997-1999 the figures shows every year a decrease of emissions. The major change is -6.8% in 1997.

Table A4.2. Differences of CO_2 emissions from fuel combustion in the National Approach 1990-2001 due to recalculations (revisions, error corrections and reallocations between source category 1A and other categories)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
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 2004/2003	***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 2003/2002	***-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 2001/2001	***-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		

Reference Approach and comparison with Sectoral Approach

Table A4.3 summarises the reported comparisons between *Reference Approach* and *National Approach* for the last four National Inventory Reports. This shows that recalculations and improvements in both approaches do not have the same impact for each year. For 1990 the change in differences is from -0.6% in the NIR 2001 to 2.0% in the NIR 2003; for 1995 the changes are from 0.1% to 0.5%. The largest changes are for 1997, where in the NIR 2001 a difference of -0.4% was reported, this was 3.5% in the NIR 2002 and currently the difference is 5.8%. For a discussion of the possible causes of this discrepancy we refer to discussion above and in *Section 3.4.6* and *Section 3.2.2*.

Table A4.3. Effect of recalculations on the comparison of CO_2 emissions from fuel combustion in the Reference Approach versus National Approach (in Tg), NIRs 2001-2004

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
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 of greenhouse gas emissions and removals 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*):

- Indirect N_2O emissions from *atmospheric deposition* (category 4D) are not estimated/reported;
- CO_2 emissions from *agricultural soils* (category 4D) are not estimated/reported;
- In addition, it has been observed that *CH_4 and N_2O from manure of horses* (category 4B) is missing; this is due to the fact that until now no manure production estimates from horses are being made and that no emission factors for this source category have been defined;
- CH_4 emissions from soils deceased in last 40 years due to drainage and lowering of water tables; these emissions have been included in the natural total; thus no net (i.e. positive) anthropogenic emissions, on the contrary, this acts in fact a methane sink.
- Precursor (non GHG) emissions from *international bunkers (international transport)* are not estimated/ reported. This year we included the emissions from N_2O and CH_4 from international bunkers in the inventory.
- Emissions/sinks for LUCF subcategories 5A to 5E, except for the CO_2 sink in category 5A2. New datasets are being compiled but are still under discussion, so no data for these subcategories have been included in this submission.

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*.

A survey made to check for *unaccounted sources* of non-CO_2 emissions in the Netherlands showed that the following minor sources are not included in the present greenhouse gas inventory (DHV, 2000):

- CH_4: notably large-scale compost production from organic waste and waste-water treatment;
- N_2O: notably large-scale compost production from organic waste;
- PFCs and SF_6: some minor sources.

These sources may be included in a later stage when it has been decided to monitor them regularly. For some of these sources, for example indirect emissions of N_2O, bringing the methodology in compliance to *IPCC Good Practice Guidance* may result in adjustments of several Tg (i.e. Mton) of CO_2-eq.

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	4. Agriculture	Agricultural Soils	Not estimated/monitored	
	5. Land-Use Change and Forestry	Grassland Conversion	Not estimated/monitored	
		D. CO2 Emissions and Removals	Not estimated/monitored	
CH_4	4. Agriculture	Agricultural Soils		Emissions deceased in last 40 years due to drainage and lowering of water tables; emissions included in natural total; thus no net (positive) anthropogenic emissions
	Various			A recent survey identified some minor sources (notably large-scale compost production from organic waste and waste water treatment); to be included when monitored regularly and when not already included in the present emission inventory.
N_2O	Various			A recent survey identified some minor sources (notably large-scale compost production from organic waste and waste water treatment); to be included when monitored regularly and when not already included in the present emission inventory.
PFCs	2. Industrial Processes			A recent survey identified some minor sources; to be included when monitored regularly and when not already included in the present emission inventory.
SF_6	2. Industrial Processes			A recent survey identified some minor sources ; to be included when monitored regularly and when not already included in the present emission inventory.

Sources and sinks reported elsewhere (IE)[3]				
GHG	**Source/sink category**	**Allocation as per IPCC Guidelines**	**Allocation used by the Party**	**Explanation**
CO_2	Specific source categories (see doc.box)	Detailled source category	Within that source category on less detailed level or under "other"	Detailled source categories not distinguishable in inventory data
	Examples:			
	Fugitive oil &gas	1.B.2.a.ii Oil production	1.B.2.b.i production/processing	
	Industrial processes	2.B.1 Ammonia production	2.G Other	
	Coke production	1.A.1 Energy industries	1.A.2 Manufacturing industries	Source allocated to Target Group Industry
	Off-road vehicles	1.A.4 Small combustion	1.A.3 Transport	Source allocated to Target Group Transport
	Off-road vehicles	1.A.2 Manufacturing Industries	1.A.3 Transport	Source allocated to Target Group Transport
	Waste combustion (fossil fuel related carbon)	1.A.1 Energy industries	6.D Waste / Other	No waste combustion in the Netherlands whitout energy recovery
CH_4	Specific source categories	Detailled source category	Within that source category on less detailed level or under "other"	Detailled source categories not distinguishable in inventory data
	Examples:			
	Fugitive oil &gas	1.B.2.a.ii Oil production	1.B.2.b.i production/processing	
	Industrial processes	2.B.1 Ammonia production	2.B.5 Other	
N_2O	2. Industrial Processes	1.A.2 Manufacturing Industries	2. Industrial Processes	Detailled process emission data (minor ammounts) not distinguishable in inventory data
	4D Indirect Emissions	4.D Nitrogen leaching	4.D others Background	
	6 B Waste water handling	N2O from human sewage	7. Polluted surface water	

Note: The Dutch inventory does not always allow a distinction of the detailed IPCC categories. In these cases the emissions are placed under 'Other' in the relevant (sub)sources category. The source distribution is then 'not attributable to specific source category'.

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

- 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, 2004: *Meta information on PER 2003 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, 2004: *Estimate of annual and trend uncertainty for Dutch sources of greenhouse gas emissions using the IPCC Tier 1 approach.* RIVM, Bilthoven.

Detailed methodology 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.
- Daamen, W.P., 2002: *Forest biomass stocks (IPCC). Part 1: Calculation method Netherlands' National Inventory Reports/National Communications; Part 2: Analysis of the consequences of application of IPCC Guidelines for reporting and recommendation for calculation method Netherlands' National Inventory reports/National Communications for 1990-2000* (in Dutch). Forest Data Foundation (St. Bosdata), Wageningen.

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., 2004: QA/QC activities performed on CRF 2003 datasets compiled for EU and UNFCCC. Memo TNO, Apeldoorn
- Coenen, P.W.H.G. and J.G.J. Olivier, 2004: *Documentation of the activities within the framework of the completion of the CRF for the 2004 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 three years (2000 - 2002)

Annex 7.2 Recalculation tables for base years 1990 and 1995 and for 1996-2001 (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 2000-2002

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]		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	**160 578.35**	**-1 421.91**	**1 302.28**	**52.88**	**0.00**	**4 431.84**	**0.00**	**2 416.48**	**0.00**	**0.01**	**599.49**	**1 130.44**	**490.46**	**203.52**
1. Energy	**158 116.42**		**213.15**	**1.67**							**592.79**	**1 082.93**	**275.19**	**191.95**
A. Fuel Combustion — Reference Approach[2]	159 558.48													
Sectoral Approach[2]	157 808.27		34.38	1.67							592.66	1 076.83	220.25	184.34
1. Energy Industries	51 304.82		3.32	0.47							98.61	14.65	3.57	105.06
2. Manufacturing Industries and Construction	42 192.12		2.91	0.11							77.27	224.44	3.41	44.15
3. Transport	29 398.66		7.68	1.00							375.34	765.00	197.92	30.53
4. Other Sectors	34 911.91		20.37	0.09							41.27	72.04	15.14	4.57
5. Other	0.76		0.11	0.00							0.17	0.70	0.20	0.03
B. Fugitive Emissions from Fuels	308.15		178.77	0.00							0.13	6.10	54.94	7.61
1. Solid Fuels	0.00		0.00	0.00							0.00	0.00	0.00	0.00
2. Oil and Natural Gas	308.15		178.77	0.00							0.13	6.10	54.94	7.61
2. Industrial Processes	**1 580.63**		**3.27**	**24.37**	**0.00**	**4 431.84**	**0.00**	**2 416.48**	**0.00**	**0.01**	**2.71**	**43.31**	**86.43**	**7.39**
A. Mineral Products	1 124.07		0.21	0.00							1.28	3.52	1.04	6.31
B. Chemical Industry	0.00		3.02	24.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	33.11	0.00
C. Metal Production	0.00		0.00	0.00				2 398.10		0.00	0.00	35.11	3.15	0.00
D. Other Production[3]	IE										0.00	0.00	10.76	0.00
E. Production of Halocarbons and SF_6						4 431.84		0.00		0.00				
F. Consumption of Halocarbons and SF_6					0.00	0.00	0.00	18.38	0.00	0.01				
G. Other	456.56		0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.43	4.68	38.36	1.08

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	**0.00**			**0.73**							**NO**	**NO**	**127.12**	**NO**
4. Agriculture	**0.00**	**0.00**	**505.33**	**21.90**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			401.86											
B. Manure Management			103.47	0.66									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	[4] NE	[4] NE	0.00	21.24									0.16	
E. Prescribed Burning of Savannas			NO	NO							0.00	0.00	0.00	
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] **0.00**	[5] **-1 421.91**	**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] -1 421.91												
B. Forest and Grassland Conversion	NE		NE	NE							NE	NE	NE	
C. Abandonment of Managed Lands	[5] NE	[5] 0.00												
D. CO_2 Emissions and Removals from Soil	[5] NE	[5] 0.00												
E. Other	[5] NE	[5] 0.00	NE	NE							NE	NE	NO	NO
6. Waste	**881.09**		**578.48**	**0.40**							**3.91**	**1.93**	**1.56**	**4.17**
A. Solid Waste Disposal on Land	[6] 0.00		571.93									0.00	1.45	
B. Wastewater Handling			6.55	0.40							0.00	0.00	0.00	
C. Waste Incineration	[6] IE		IE	IE							IE	IE	IE	IE
D. Other	881.09		0.00	0.00							3.91	1.93	0.11	4.17
7. Other *(please specify)* ---	**0.21**	**0.00**	**2.05**	**3.81**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.09**	**2.28**	**0.00**	**0.01**
Solvents and other product use	0.21	NO	0.05	0.01	NO	NO	NO	NO	NO	NO	0.09	2.28	NO	0.01
Polluted surface water				3.80										
Degassing drinkwater from ground water			2.00											

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] 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	**173 247.97**	**-1 232.28**	**1 190.24**	**58.39**	**928.40**	**6 018.31**	**#VALUE!**	**1 836.07**	**0.00**	**0.01**	**517.80**	**851.37**	**361.90**	**142.47**
1. Energy	**170 897.05**		**206.97**	**2.38**							**513.61**	**815.43**	**210.05**	**138.85**
A. Fuel Combustion — Reference Approach[2]	170 091.39													
Sectoral Approach[2]	170 087.03		36.65	2.38							513.02	807.48	167.24	128.63
1. Energy Industries	56 516.14		4.88	0.49							81.29	16.38	5.20	68.25
2. Manufacturing Industries and Construction	42 626.88		5.07	0.13							55.06	180.75	3.87	26.78
3. Transport	32 103.17		5.88	1.67							328.79	544.88	144.42	30.55
4. Other Sectors	38 836.89		20.51	0.09							47.46	63.56	13.19	3.02
5. Other	3.94		0.30	0.00							0.43	1.92	0.56	0.04
B. Fugitive Emissions from Fuels	810.02		170.33	0.00							0.59	7.95	42.80	10.22
1. Solid Fuels	0.00		0.00	0.00							0.00	0.00	0.00	0.00
2. Oil and Natural Gas	810.02		170.33	0.00							0.59	7.95	42.80	10.22
2. Industrial Processes	**1 442.31**		**2.63**	**24.17**	**928.40**	**6 018.31**	**#VALUE!**	**1 836.07**	**0.00**	**0.01**	**1.75**	**33.39**	**53.70**	**3.34**
A. Mineral Products	1 113.90		0.10	0.00							1.31	2.45	0.45	2.77
B. Chemical Industry	0.00		2.49	24.17	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	17.89	0.00
C. Metal Production	16.53		0.00	0.00				1 799.10		0.00	0.00	30.32	2.60	0.00
D. Other Production[3]	IE										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	247.55	#VALUE!	36.97	0.00	0.01				
G. Other	311.88		0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.62	25.44	0.57

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)			
3. Solvent and Other Product Use	**0.00**			**0.64**							**NO**	**NO**	**96.23**	**NO**
4. Agriculture	**0.00**	**0.00**	**477.04**	**26.85**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			376.72											
B. Manure Management			100.32	0.74									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	(4) NE	(4) NE	0.00	26.11									0.16	
E. Prescribed Burning of Savannas			NO	NO							0.00	0.00	0.00	
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) **0.00**	(5) **-1 232.28**	**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) -1 232.28												
B. Forest and Grassland Conversion	NE		NE	NE							NE	NE	NE	
C. Abandonment of Managed Lands	(5) NE	(5) 0.00												
D. CO_2 Emissions and Removals from Soil	(5) NE	(5) 0.00												
E. Other	(5) NE	(5) 0.00	NE	NE							NE	NE	NO	NO
6. Waste	**908.26**		**501.53**	**0.54**							**2.37**	**0.40**	**1.76**	**0.27**
A. Solid Waste Disposal on Land	(6) 0.00		500.07									0.00	1.27	
B. Wastewater Handling			1.46	0.50							0.00	0.00	0.00	
C. Waste Incineration	(6) IE		IE	IE							IE	IE	IE	IE
D. Other	908.26		0.00	0.04							2.37	0.40	0.49	0.27
7. Other (please specify)	**0.35**	**0.00**	**2.06**	**3.82**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.08**	**2.15**	**0.00**	**0.02**
Solvents and other product use	0.35	NO	0.06	0.02	NO	NO	NO	NO	NO	NO	0.08	2.15	NO	0.02
Polluted surface water				3.80										
Degassing drinkwater from ground water			2.00											

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	**170 718.50**	**-1 413.26**	**968.44**	**53.39**	**2 744.00**	**3 878.85**	**#VALUE!**	**1 577.56**	**#VALUE!**	**0.01**	**447.19**	**701.76**	**267.08**	**90.81**
1. Energy	**169 480.47**		**164.61**	**2.34**							**445.56**	**658.09**	**158.84**	**88.38**
A. Fuel Combustion — Reference Approach [2]	170 109.51													
Sectoral Approach [2]	167 889.74		33.64	2.34							445.16	653.81	131.57	81.88
1. Energy Industries	61 222.17		5.96	0.49							64.27	27.18	4.51	42.31
2. Manufacturing Industries and Construction	36 278.18		3.19	0.12							33.20	116.78	1.87	13.88
3. Transport	35 212.50		4.36	1.65							303.35	447.42	112.35	23.91
4. Other Sectors	35 176.90		19.88	0.08							43.92	60.64	12.35	1.69
5. Other	0.00		0.27	0.00							0.42	1.79	0.49	0.09
B. Fugitive Emissions from Fuels	1 590.73		130.96	0.00							0.40	4.27	27.27	6.50
1. Solid Fuels	0.00		0.00	0.00							0.00	0.00	0.00	0.00
2. Oil and Natural Gas	1 590.73		130.96	0.00							0.40	4.27	27.27	6.50
2. Industrial Processes	**1 237.61**		**1.54**	**22.97**	**2 744.00**	**3 878.85**	**#VALUE!**	**1 577.56**	**#VALUE!**	**0.01**	**1.55**	**41.58**	**38.91**	**2.42**
A. Mineral Products	857.12		0.14	0.00							0.97	1.56	0.19	2.04
B. Chemical Industry	0.00		1.38	22.97	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.56	0.00
C. Metal Production	0.00		0.00	0.00				1 390.36		0.00	0.00	39.66	1.93	0.00
D. Other Production [3]	IE										0.00	0.00	5.66	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	1 040.42	#VALUE!	187.20	#VALUE!	0.01				
G. Other	380.48		0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.36	18.57	0.37

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	**0.00**			**0.44**							**NO**	**NO**	**68.11**	**NO**
4. Agriculture	**0.00**	**0.00**	**410.53**	**23.20**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			319.43											
B. Manure Management			91.10	0.62									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	[4] NE	[4] NE	0.00	22.58									0.16	
E. Prescribed Burning of Savannas			NO	NO							0.00	0.00	0.00	
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] **0.00**	[5] **-1 413.26**	**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] -1 413.26												
B. Forest and Grassland Conversion	NE		NE	NE							NE	NE	NE	
C. Abandonment of Managed Lands	[5] NE	[5] 0.00												
D. CO_2 Emissions and Removals from Soil	[5] NE	[5] 0.00												
E. Other	[5] NE	[5] 0.00	NE	NE							NE	NE	NO	NO
6. Waste	**0.00**		**389.85**	**0.62**							**0.00**	**0.01**	**1.06**	**0.00**
A. Solid Waste Disposal on Land	[6] 0.00		389.07									0.00	0.99	
B. Wastewater Handling			0.78	0.62							0.00	0.00	0.00	
C. Waste Incineration	[6] IE		IE	IE							IE	IE	IE	IE
D. Other	0.00		0.00	0.00							0.00	0.01	0.07	0.00
7. Other *(please specify)* ---	**0.42**	**0.00**	**1.91**	**3.82**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.08**	**2.08**	**0.00**	**0.02**
Solvents and other product use	0.42	NO	0.03	0.02	NO	NO	NO	NO	NO	NO	0.08	2.08	NO	0.02
Polluted surface water				3.80										
Degassing drinkwater from ground water			1.89											

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] 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	**177 063.16**	**-1 413.26**	**948.82**	**51.02**	**2 382.60**	**1 506.87**	**#VALUE!**	**1 482.26**	**#VALUE!**	**0.01**	**436.21**	**675.72**	**251.23**	**90.06**
1. Energy	**175 707.57**		**166.79**	**2.19**							**434.33**	**628.52**	**153.81**	**87.47**
A. Fuel Combustion — Reference Approach [2]	175 904.01													
Sectoral Approach [2]	174 014.28		32.65	2.19							433.84	623.92	125.53	80.69
1. Energy Industries	64 649.12		5.46	0.37							57.87	24.34	3.95	43.67
2. Manufacturing Industries and Construction	36 443.62		2.24	0.10							35.14	112.93	2.08	13.30
3. Transport	35 505.69		4.14	1.63							294.05	424.02	106.59	21.93
4. Other Sectors	37 415.46		20.55	0.08							46.41	60.77	12.42	1.76
5. Other	0.38		0.27	0.00							0.37	1.86	0.49	0.03
B. Fugitive Emissions from Fuels	1 693.29		134.14	0.00							0.48	4.60	28.28	6.78
1. Solid Fuels	0.00		0.00	0.00							0.00	0.00	0.00	0.00
2. Oil and Natural Gas	1 693.29		134.14	0.00							0.48	4.60	28.28	6.78
2. Industrial Processes	**1 355.15**		**2.37**	**21.30**	**2 382.60**	**1 506.87**	**#VALUE!**	**1 482.26**	**#VALUE!**	**0.01**	**1.43**	**45.12**	**32.46**	**2.53**
A. Mineral Products	958.73		0.13	0.00							1.02	1.41	0.23	2.15
B. Chemical Industry	0.00		2.01	21.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	11.25	0.00
C. Metal Production	0.00		0.00	0.00				1 322.68		0.00	0.00	41.45	1.13	0.00
D. Other Production [3]	IE										0.00	0.00	5.61	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	865.39	#VALUE!	159.58	#VALUE!	0.01				
G. Other	396.42		0.23	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.41	2.25	14.24	0.38
CATEGORIES	**emissions**	**removals**			**P**	**A**	**P**	**A**	**P**	**A**				
	(Gg)				CO2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**0.00**			**0.37**							**NO**	**NO**	**63.75**	NO
4. Agriculture	**0.00**	**0.00**	**409.68**	**22.59**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			321.54											
B. Manure Management			88.14	0.63									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	(4) NE	(4) NE	0.00	21.96									0.16	
E. Prescribed Burning of Savannas			NO	NO							0.00	0.00	0.00	
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) **0.00**	(5) **-1 413.26**	**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) -1 413.26												
B. Forest and Grassland Conversion	NE		NE	NE							NE	NE	NE	
C. Abandonment of Managed Lands	(5) NE	(5) 0.00												
D. CO2 Emissions and Removals from Soil	(5) NE	(5) 0.00												
E. Other	(5) NE	(5) 0.00	NE	NE							NE	NE	NO	NO
6. Waste	**0.00**		**368.14**	**0.75**							**0.37**	**0.11**	**1.05**	**0.04**
A. Solid Waste Disposal on Land	(4) 0.00		367.42									0.00	0.93	
B. Wastewater Handling			0.72	0.60							0.00	0.00	0.00	
C. Waste Incineration	(4) IE		IE	0.00							IE	IE	IE	IE
D. Other	0.00		0.00	0.15							0.37	0.11	0.12	0.04
7. Other (please specify)	**0.44**	**0.00**	**1.85**	**3.82**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.07**	**1.98**	**0.00**	**0.02**
Solvents and other product use	0.44	NO	0.02	0.02	NO	NO	NO	NO	NO	NO	0.07	1.98	NO	0.02
Polluted surface water				3.80										
Degassing drinkwater from ground water			1.83											

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] 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	**176 654.00**	**-1 413.26**	**891.17**	**49.29**	**2 456.40**	**1 572.42**	**#VALUE!**	**1 200.39**	**#VALUE!**	**0.01**	**429.94**	**656.47**	**244.29**	**85.43**
1. Energy	**174 664.26**		**151.98**	**2.30**							**428.03**	**652.90**	**147.48**	**83.25**
A. Fuel Combustion — Reference Approach[2]	175 615.85													
Sectoral Approach[2]	173 024.62		31.85	2.30							427.73	648.62	121.76	77.03
1. Energy Industries	63 779.92		4.91	0.50							58.69	24.06	3.89	41.20
2. Manufacturing Industries and Construction	35 791.09		2.26	0.09							34.14	147.82	1.72	12.54
3. Transport	36 250.61		4.01	1.63							288.35	414.30	103.23	21.52
4. Other Sectors	37 202.99		20.39	0.08							46.16	60.68	12.39	1.73
5. Other	0.00		0.28	0.00							0.40	1.76	0.53	0.03
B. Fugitive Emissions from Fuels	1 639.64		120.12	0.00							0.30	4.27	25.72	6.22
1. Solid Fuels	0.00		0.00	0.00							0.00	0.00	0.00	0.00
2. Oil and Natural Gas	1 639.64		120.12	0.00							0.30	4.27	25.72	6.22
2. Industrial Processes	**1 989.28**		**2.23**	**20.19**	**2 456.40**	**1 572.42**	**#VALUE!**	**1 200.39**	**#VALUE!**	**0.01**	**1.84**	**1.39**	**31.11**	**2.13**
A. Mineral Products	1 431.35		0.11	0.00							0.41	1.24	0.21	2.00
B. Chemical Industry	0.00		2.12	20.19	0.00	0.00	0.00	0.00	0.00	0.00	1.43	0.00	11.53	0.13
C. Metal Production	172.36		0.00	0.00				1 040.81		0.00	0.00	0.15	1.67	0.00
D. Other Production[3]	NE										0.00	0.00	5.38	0.00
E. Production of Halocarbons and SF_6						782.43		0.00		0.00				
F. Consumption of Halocarbons and SF_6					2 456.40	789.99	#VALUE!	159.58	#VALUE!	0.01				
G. Other	385.57		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.32	0.00

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)			
3. Solvent and Other Product Use	**0.00**			**0.29**							**NO**	**NO**	**64.54**	NO
4. Agriculture	**0.00**	**0.00**	**389.07**	**21.94**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			305.78											
B. Manure Management			83.29	0.59									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	[4] NE	[4] NE	0.00	21.35									0.16	
E. Prescribed Burning of Savannas			NO	NO							0.00	0.00	0.00	
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] **0.00**	[5] **-1 413.26**	**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] -1 413.26												
B. Forest and Grassland Conversion	NE		NE	NE							NE	NE	NE	
C. Abandonment of Managed Lands	[5] NE	[5] 0.00												
D. CO_2 Emissions and Removals from Soil	[5] NE	[5] 0.00												
E. Other	[5] NE	[5] 0.00	NE	NE							NE	NE	NO	NO
6. Waste	**0.00**		**346.09**	**0.75**							**0.00**	**0.11**	**0.99**	**0.04**
A. Solid Waste Disposal on Land	[6] 0.00		345.37									0.00	0.88	
B. Wastewater Handling			0.72	0.60							0.00	0.00	0.00	
C. Waste Incineration	[6] IE		IE	IE							IE	IE	IE	IE
D. Other	0.00		0.00	0.15							0.00	0.11	0.12	0.04
7. Other *(please specify)*	**0.47**	**0.00**	**1.81**	**3.82**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.08**	**2.08**	**0.00**	**0.02**
Solvents and other product use	0.47	NO	0.02	0.02	NO	NO	NO	NO	NO	NO	0.08	2.08	NO	0.02
Polluted surface water				3.80										
Degassing drinkwater from ground water			1.79											

7.2 Recalculation and Completeness Tables for 1990 and 1995-2001

This appendix shows information from sheets from the CRF data files of 1990 and for the period 1995-2001.
In principle, all figures for 2001 have been revised, due to best estimates of activity data that were used for 2001 in the previous submission.

Table A.7.6. 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		**159 270.22**	**160 578.35**	**0.82**	**27 139.62**	**27 347.91**	**0.77**	**16 543.95**	**16 392.45**	**-0.92**
1. Energy		**156 808.29**	**158 116.42**	**0.83**	**4 476.50**	**4 476.25**	**-0.01**	**579.78**	**518.17**	**-10.63**
1.A.	Fuel Combustion Activities	156 500.14	157 808.27	0.84	722.29	722.04	-0.04	579.78	518.17	-10.63
1.A.1.	Energy Industries	51 304.82	51 304.82	0.00	69.69	69.69	0.00	144.51	144.51	0.00
1.A.2.	Manufacturing Industries and Construction	41 888.18	42 192.12	0.73	61.06	61.16	0.16	35.60	35.61	0.04
1.A.3.	Transport	29 121.59	29 398.66	0.95	165.39	161.24	-2.51	371.28	309.25	-16.71
1.A.4.	Other Sectors	34 184.78	34 911.91	2.13	20.26	20.37	0.52	28.40	28.80	1.43
1.A.5.	Other	0.76	0.76	0.00	0.68	2.24	230.48	0.00	0.00	0.00
1.B.	Fugitive Emissions from Fuels	308.15	308.15	0.00	3 754.21	3 754.21	0.00	0.00	0.00	0.00
1.B.1.	Solid fuel	IE	IE		0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.	Oil and Natural Gas	308.15	308.15	0.00	3 754.21	3 754.21	0.00	0.00	0.00	0.00
2. Industrial Processes		**1 580.63**	**1 580.63**	**0.00**	**68.58**	**68.58**	**0.00**	**7 554.02**	**7 554.02**	**0.00**
2.A.	Mineral Products	1 124.07	1 124.07	0.00	4.42	4.42	0.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	0.00	0.00	63.49	63.49	0.00	7 554.02	7 554.02	0.00
2.C.	Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	IE	IE							
2.G.	Other	456.56	456.56	0.00	0.67	0.67	0.00	0.00	0.00	0.00
3. Solvent and Other Product Use		**0.00**	**0.00**	**0.00**				**224.75**	**224.75**	**0.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**10 611.93**	**10 611.93**	**0.00**	**6 878.90**	**6 789.00**	**-1.31**
4.A.	Enteric Fermentation				8 439.06	8 439.06	0.00			
4.B.	Manure Management				2 172.87	2 172.87	0.00	204.60	204.60	0.00
4.C.	Rice Cultivation				0.00	0.00	0.00			
4.D.	Agricultural Soils [2]	0.00	NE	-100.00	0.00	0.00	0.00	6 674.30	6 584.40	-1.35
4.E.	Prescribed Burning of Savannas				0.00	0.00	0.00	0.00	0.00	0.00
4.F.	Field Burning of Agricultural Residues				0.00	0.00	0.00	0.00	0.00	0.00
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**	**-1 421.91**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks			0.00						
5.B.	Forest and Grassland Conversion			0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C.	Abandonment of Managed Lands			0.00						
5.D.	CO_2 Emissions and Removals from Soil			0.00						
5.E.	Other			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	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	**881.09**	**881.09**	**0.00**	**11 939.55**	**12 148.09**	**1.75**	**125.53**	**125.53**	**0.00**
6.A. Solid Waste Disposal on Land	0.00	0.00	0.00	11 802.00	12 010.54	1.77			
6.B. Wastewater Handling				137.55	137.55	0.00	125.53	125.53	0.00
6.C. Waste Incineration	IE	IE		IE	IE		IE	IE	
6.D. Other	881.09	881.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Other *(please specify)*	**0.21**	**0.21**	**0.00**	**43.05**	**43.05**	**0.00**	**1 180.98**	**1 180.98**	**0.00**
Solvents and other product use	**0.21**	**0.21**	0.00	1.05	1.05	0.00	2.98	2.98	0.00
Polluted surface water			0.00			0.00	1 178.00	1 178.00	0.00
Degassing drinkwater from ground water			0.00	42.00	42.00	0.00			0.00
Memo Items:									
International Bunkers	**39 764.52**	**39 764.52**	**0.00**	**0.00**	**2.92**	**100.00**	**0.00**	**13.40**	**100.00**
Multilateral Operations	**NE**	**NE**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass	**3 394.49**	**3 392.38**	**-0.06**						

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	**4 431.84**	**4 431.84**	**0.00**	**2 431.74**	**2 416.48**	**-0.63**	**186.90**	**217.32**	**16.28**
2.C.3. Aluminium Production				2 398.10	2 398.10	0.00			0.00
2.E. Production of Halocarbons and SF_6	4 431.84	4 431.84	0.00			0.00			0.00
2.F. Consumption of Halocarbons and SF_6	0.00	0.00	0.00	33.64	18.38	-45.37	186.90	217.32	16.28
Other			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)	208 582.37	209 962.45	0.66
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (3)	210 004.28	211 384.35	0.66

Table A.7.8. CRF Recalculation Explanation Table 8.b for 1990

Specify the		GHG	RECALCULATION DUE TO CHANGES IN:			
			Methods [2]	Emission factors [2]	Activity data [2]	Addition/removal/ replacement of source/sink categories
...						
1.A.2	**Manufacturing Industries and Construction**	All	Improved accuracy		Data adjusted	
1.A.3	**Transport**	All	Improved accuracy		Data adjusted	
1.A.4	**Other sectors**	All	Improved accuracy		Data adjusted	
1.A.5	**Other**	CH4	Recalculation for emisison from combustion of biogas from waste dumps		Data adjusted	
4.D	**Agricultural soils**	N2O	Improved accuracy		*Data adjusted*	
6.A	**Solid Waste Disposal on Land**	CH4	Improved accuracy	Error Correction in calculation formula		
2.F	**Consumption of halocarbons and SF6**	PFCs, SF6	Improved accuracy		Data adjusted	

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	**172 401.55**	**173 247.97**	**0.49**	**24 574.14**	**24 995.05**	**1.71**	**18 177.71**	**18 101.54**	**-0.42**
1. Energy	**170 050.62**	**170 897.05**	**0.50**	**4 347.01**	**4 346.40**	**-0.01**	**819.45**	**736.46**	**-10.13**
1.A. Fuel Combustion Activities	169 240.60	170 087.03	0.50	770.18	769.57	-0.08	819.45	736.46	-10.13
1.A.1. Energy Industries	56 540.17	56 516.14	-0.04	102.60	102.52	-0.08	150.75	150.74	-0.01
1.A.2. Manufacturing Industries and Construction	42 600.62	42 626.88	0.06	106.29	106.53	0.22	39.44	39.46	0.04
1.A.3. Transport	32 163.36	32 103.17	-0.19	126.22	123.41	-2.22	602.19	518.70	-13.86
1.A.4. Other Sectors	37 932.51	38 836.89	2.38	20.46	20.51	0.27	27.07	27.57	1.87
1.A.5. Other	3.94	3.94	0.00	5.48	6.37	16.22	0.00	0.00	0.00
1.B. Fugitive Emissions from Fuels	810.02	810.02	0.00	3 576.83	3 576.83	0.00	0.00	0.00	0.00
1.B.1. Solid fuel	IE	IE		0.00	0.00	0.00	0.00	0.00	0.00
1.B.2. Oil and Natural Gas	810.02	810.02	0.00	3 576.83	3 576.83	0.00	0.00	0.00	0.00
2. Industrial Processes	**1 442.31**	**1 442.31**	**0.00**	**55.30**	**55.30**	**0.00**	**7 493.18**	**7 493.18**	**0.00**
2.A. Mineral Products	1 113.90	1 113.90	0.00	2.17	2.17	0.00	0.00	0.00	0.00
2.B. Chemical Industry	0.00	0.00	0.00	52.28	52.28	0.00	7 493.18	7 493.18	0.00
2.C. Metal Production	16.53	16.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D. Other Production	IE	IE							
2.G. Other	311.88	311.88	0.00	0.84	0.84	0.00	0.00	0.00	0.00
3. Solvent and Other Product Use	**0.00**	**0.00**	**0.00**				**194.47**	**197.57**	**1.59**
4. Agriculture	**0.00**	**0.00**	**0.00**	**10 017.84**	**10 017.84**	**0.00**	**8 323.50**	**8 323.50**	**0.00**
4.A. Enteric Fermentation				7 911.12	7 911.12	0.00			
4.B. Manure Management				2 106.72	2 106.72	0.00	229.40	229.40	0.00
4.C. Rice Cultivation				0.00	0.00	0.00			
4.D. Agricultural Soils [2]	0.00	NE	-100.00	0.00	0.00	0.00	8 094.10	8 094.10	0.00
4.E. Prescribed Burning of Savannas				0.00	0.00	0.00	0.00	0.00	0.00
4.F. Field Burning of Agricultural Residues				0.00	0.00	0.00	0.00	0.00	0.00
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**	**-1 232.28**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A. Changes in Forest and Other Woody Biomass Stocks			0.00						
5.B. Forest and Grassland Conversion			0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C. Abandonment of Managed Lands			0.00						
5.D. CO_2 Emissions and Removals from Soil			0.00						
5.E. Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.10. 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**	**908.26**	**0.00**	**10 110.66**	**10 532.18**	**4.17**	**164.13**	**167.84**	**2.26**
6.A.	Solid Waste Disposal on Land	0.00	0.00	0.00	10 080.00	10 501.52	4.18			
6.B.	Wastewater Handling				30.65	30.65	-0.01	152.55	156.26	2.44
6.C.	Waste Incineration	IE	IE		0.00	0.00	0.00	0.00	0.00	0.00
6.D.	Other	908.26	908.26	0.00	0.01	0.01	0.00	11.58	11.58	0.00
7. Other *(please specify)*		**0.35**	**0.35**	**0.00**	**43.34**	**43.34**	**0.00**	**1 182.98**	**1 182.98**	**0.00**
	Solvents and other product use	0.35	0.35	0.00	1.34	1.34	0.00	4.98	4.98	0.00
	Polluted surface water			0.00			0.00	1 178.00	1 178.00	0.00
	Degassing drinkwater from ground water			0.00	42.00	42.00	0.00			0.00
Memo Items:										
International Bunkers		**44 286.00**	**44 286.00**	**0.00**	**0.00**	**3.03**	**100.00**	**0.00**	**15.18**	**100.00**
Multilateral Operations		**NE**	**NE**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass		**3 597.94**	**3 580.44**	**-0.49**						

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**	**6 018.31**	**0.00**	**1 866.76**	**1 836.07**	**-1.64**	**275.32**	**301.26**	**9.42**
2.C.3.	Aluminium Production				1 799.10	1 799.10	0.00			0.00
2.E.	Production of Halocarbons and SF_6	5 770.76	5 770.76	0.00			0.00			0.00
2F	Consumption of Halocarbons and SF_6	247.55	247.55	0.00	67.66	36.97	-45.36	275.32	301.26	9.42
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**0.00**	**928.40**	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]	222 081.51	223 267.91	0.53
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	223 313.79	224 500.20	0.53

Table A.7.11. 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.1	Energy Industries	All	Improved accuracy		Data adjusted	
1.A.2	Manufacturing Industries and Cons	All	Improved accuracy		Data adjusted	
1.A.3	Transport	All	Improved accuracy		Data adjusted	
1.A.4	Other sectors	All	Improved accuracy		Data adjusted	
1.A.5	Other	CH4	Recalculation for emisison from combustion of biogas from waste dumps		Data adjusted	
3.D	Solvent /Product use	N2O			Error correction	
6.A	Solid Waste Disposal on Land	CH4	Improved accuracy	Error Correction in calculation formula		
6.B	Wastewater handling	CH4/N20	Improved accuracy		Data adjusted	
2.F	Consumption of halocarbons and S	HFCs,PFCs, SF6	Improved accuracy		Data adjusted	
2.F	Consumption of halocarbons and S	HFCs, SF6	Improved accuracy		Data adjusted	

Table A.7.12. 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		**180 304.08**	**181 571.94**	**0.70**	**24 648.11**	**24 809.94**	**0.66**	**17 946.14**	**17 803.62**	**-0.79**
1. Energy		**177 862.12**	**179 129.98**	**0.71**	**4 731.66**	**4 737.97**	**0.13**	**731.56**	**645.77**	**-11.73**
1.A.	Fuel Combustion Activities	176 859.12	178 126.98	0.72	776.57	782.85	0.81	731.56	645.77	-11.73
1.A.1.	Energy Industries	58 337.61	58 337.61	0.00	119.70	119.70	0.00	3.74	3.74	0.00
1.A.2.	Manufacturing Industries and Construction	42 999.94	43 026.06	0.06	38.38	38.48	0.26	86.34	86.41	0.08
1.A.3.	Transport	32 641.71	32 625.56	-0.05	115.36	115.04	-0.28	612.09	525.49	-14.15
1.A.4.	Other Sectors	42 742.16	44 129.02	3.24	23.75	23.98	0.97	29.32	30.13	2.78
1.A.5.	Other	137.70	8.72	-93.67	4.28	5.97	39.29	0.08	0.00	-100.00
1.B.	Fugitive Emissions from Fuels	1 003.00	1 003.00	0.00	3 955.10	3 955.12	0.00	0.00	0.00	0.00
1.B.1.	Solid fuel	IE	IE		0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.	Oil and Natural Gas	1 003.00	1 003.00	0.00	3 955.10	3 955.12	0.00	0.00	0.00	0.00
2. Industrial Processes		**1 385.84**	**1 385.84**	**0.00**	**119.89**	**119.89**	**0.00**	**7 503.29**	**7 503.29**	**0.00**
2.A.	Mineral Products	899.16	899.16	0.00	2.41	2.41	0.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	0.00	0.00	109.20	109.20	0.00	7 503.29	7 503.29	0.00
2.C.	Metal Production	0.03	0.03	0.00	6.30	6.30	0.00	0.00	0.00	0.00
2.D.	Other Production	IE	IE							
2.G.	Other	486.65	486.65	0.00	1.98	1.98	0.00	0.00	0.00	0.00
3. Solvent and Other Product Use		**0.00**	**0.00**	**0.00**				**202.43**	**145.70**	**-28.02**
4. Agriculture		**0.00**	**0.00**	**0.00**	**9 735.08**	**9 735.08**	**0.00**	**8 182.45**	**8 182.45**	**0.00**
4.A.	Enteric Fermentation				7 683.12	7 683.12	0.00			
4.B.	Manure Management				2 051.95	2 051.95	0.00	224.44	224.44	0.00
4.C.	Rice Cultivation				0.00	0.00	0.00			
4.D.	Agricultural Soils[2]	0.00	NE	-100.00	0.00	0.00	0.00	7 958.01	7 958.01	0.00
4.E.	Prescribed Burning of Savannas				NO	NO		0.00	0.00	0.00
4.F.	Field Burning of Agricultural Residues				NO	NO		0.00	0.00	0.00
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**	**-1 397.68**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks			0.00						
5.B.	Forest and Grassland Conversion			0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C.	Abandonment of Managed Lands			0.00						
5.D.	CO_2 Emissions and Removals from Soil			0.00						
5.E.	Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.13. 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**	**1 055.71**	**0.00**	**10 019.48**	**10 175.01**	**1.55**	**148.41**	**148.41**	**0.00**
6.A. Solid Waste Disposal on Land	0.00	0.00	0.00	9 992.90	10 148.43	1.56			
6.B. Wastewater Handling				26.58	26.58	0.00	148.41	148.41	0.00
6.C. Waste Incineration	IE	IE		0.00	0.00	0.00	0.00	0.00	0.00
6.D. Other	1 055.71	1 055.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**42.00**	**42.00**	**0.00**	**1 178.00**	**1 178.00**	**0.00**
Degassing			0.00	42.00	**42.00**	0.00	0.00	**0.00**	0.00
Polluted surface water			0.00	0.00	**0.00**	0.00	1 178.00	**1 178.00**	0.00
			0.00			0.00			0.00
Memo Items:									
International Bunkers	**45 445.00**	**45 445.00**	**0.00**	**0.00**	**3.07**	**100.00**	**0.00**	**15.61**	**100.00**
Multilateral Operations	**NE**	**NE**		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass	**5 207.46**	**5 285.34**	**1.50**						

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**	**7 675.65**	**0.00**	**2 042.11**	**2 014.30**	**-1.36**	**284.87**	**312.40**	**9.66**
2.C.3. Aluminium Production				1 964.30	1 964.30	0.00			0.00
2.E. Production of Halocarbons and SF_6	7 110.50	7 110.50	0.00			0.00			0.00
2.F. Consumption of Halocarbons and SF_6	565.16	565.16	0.00	77.81	50.00	-35.74	284.87	312.40	9.66
Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**0.00**	**1 955.90**	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)	231 502.87	232 789.75	0.56
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry(3)	232 900.54	234 187.43	0.55

Table A.7.14. 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.2	Manufacturing Industries and Co	All	Improved accuracy		Data adjusted	
1.A.3	Transport	All	Improved accuracy		Data adjusted	
1.A.4	Other sectors	All	Improved accuracy		Data adjusted	
1.A.5	Other	CH4	Recalculation for emisison from combustion of biogas from waste dumps		Data adjusted	
6.A	Solid Waste Disposal on Land	CH4	Improved accuracy	Error Correction in calculation formula		
2.F	Consumption of halocarbons and SF6	HFCs,PFCs, SF6	Improved accuracy		Data adjusted	

[1] Enter the identification code of the source/sink category (e.g. 1.B.1) in the first column and the name of the category (e.g. Fugitive Emissions from Solid Fuels) in the second column

Table A.7.15. 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	**168 668.75**	**166 227.69**	**-1.45**	**23 102.39**	**23 206.51**	**0.45**	**17 786.47**	**17 739.84**	**-0.26**
1. Energy	**165 994.83**	**163 553.79**	**-1.47**	**3 903.33**	**3 906.76**	**0.09**	**715.75**	**711.43**	**-0.60**
1.A. Fuel Combustion Activities	164 976.97	162 535.92	-1.48	617.75	621.18	0.56	715.75	711.43	-0.60
1.A.1. Energy Industries	57 180.81	57 180.81	0.00	62.06	62.06	0.00	5.88	5.88	0.00
1.A.2. Manufacturing Industries and Construction	38 867.78	35 485.37	-8.70	20.82	21.02	0.99	64.87	149.62	130.63
1.A.3. Transport	33 067.42	33 062.43	-0.02	108.63	108.90	0.25	619.67	530.06	-14.46
1.A.4. Other Sectors	35 860.96	36 806.08	2.64	20.11	20.19	0.42	25.33	25.86	2.11
1.A.5. Other	0.00	1.23	100.00	3.93	5.12	30.29	0.00	0.00	0.00
1.B. Fugitive Emissions from Fuels	1 017.86	1 017.86	0.00	3 285.58	3 285.58	0.00	0.00	0.00	0.00
1.B.1. Solid fuel	IE	IE		0.00	0.00	0.00	0.00	0.00	0.00
1.B.2. Oil and Natural Gas	1 017.86	1 017.86	0.00	3 285.58	3 285.58	0.00	0.00	0.00	0.00
2. Industrial Processes	**1 428.25**	**1 428.25**	**0.00**	**55.77**	**55.90**	**0.23**	**7 487.48**	**7 487.38**	**0.00**
2.A. Mineral Products	1 083.73	1 083.73	0.00	2.91	2.91	0.00	0.00	0.00	0.00
2.B. Chemical Industry	0.00	0.00	0.00	51.73	51.73	0.00	7 487.38	7 487.38	0.00
2.C. Metal Production	2.50	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D. Other Production	IE	IE							
2.G. Other	342.02	342.02	0.00	1.13	1.26	11.38	0.10	0.00	-100.00
3. Solvent and Other Product Use	**0.00**	**0.00**	**0.00**				**170.85**	**128.65**	**-24.70**
4. Agriculture	**0.00**	**0.00**	**0.00**	**9 361.80**	**9 361.80**	**0.00**	**8 055.66**	**8 055.66**	**0.00**
4.A. Enteric Fermentation				7 405.44	7 405.44	0.00			
4.B. Manure Management				1 956.36	1 956.36	0.00	214.83	214.83	0.00
4.C. Rice Cultivation				0.00	0.00	0.00			
4.D. Agricultural Soils (2)	0.00	NE	-100.00	0.00	0.00	0.00	7 840.83	7 840.83	0.00
4.E. Prescribed Burning of Savannas				0.00	0.00	0.00	0.00	0.00	0.00
4.F. Field Burning of Agricultural Residues				0.00	0.00	0.00	0.00	0.00	0.00
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**	**-1 180.35**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A. Changes in Forest and Other Woody Biomass Stocks			0.00						
5.B. Forest and Grassland Conversion			0.00	0.00	0.00	0.00	**0.00**	0.00	0.00
5.C. Abandonment of Managed Lands			0.00						
5.D. CO_2 Emissions and Removals from Soil			0.00						
5.E. Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.16. 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**	**1 245.20**	**0.00**	**9 739.89**	**9 840.44**	**1.03**	**178.73**	**178.73**	**0.00**
6.A. Solid Waste Disposal on Land	0.00	0.00	0.00	9 723.28	9 823.83	1.03			
6.B. Wastewater Handling				16.62	16.62	0.00	178.73	178.73	0.00
6.C. Waste Incineration	IE	IE		0.00	0.00	0.00	0.00	0.00	0.00
6.D. Other	1 245.20	1 245.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**41.60**	**41.60**	**0.00**	**1 178.00**	**1 178.00**	**0.00**
Solvents and other product use			0.00	0.23	0.23	0.00	0.00	0.00	0.00
Polluted surface water			0.00			0.00	1 178.00	1 178.00	0.00
			0.00			0.00			0.00
Memo Items:									
International Bunkers	**48 509.00**	**48 436.00**	**-0.15**	**0.00**	**3.26**	**100.00**	**0.00**	**16.63**	**100.00**
Multilateral Operations	NE	NE		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass	**6 002.84**	**6 042.21**	**0.66**						

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**	**8 306.57**	**0.00**	**2 153.98**	**2 164.13**	**0.47**	**311.39**	**344.85**	**10.75**
2.C.3. Aluminium Production				2 064.50	2 064.50	0.00			0.00
2.E. Production of Halocarbons and SF_6	7 415.62	7 415.62	0.00			0.00			0.00
2.F. Consumption of Halocarbons and SF_6	890.95	890.95	0.00	89.48	99.63	11.35	311.39	344.85	10.75
Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**0.00**	**2 117.50**	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)	219 148.74	216 808.79	-1.07
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (3)	220 329.09	217 989.14	-1.06

Table A.7.17. 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.2	**Manufacturing Industries and Construct**	All	Improved accuracy		Data adjusted	
1.A.3	**Transport**	All	Improved accuracy		Data adjusted	
1.A.4	**Other sectors**	All	Improved accuracy		Data adjusted	
1.A.5	**Other**	CO2	Improved accuracy		Data adjusted	
1.A.5	**Other**	CH4	Recalculation for emisison from combustion of biogas from waste dumps		Data adjusted	
2G	**Industrial processes other**	N2O, CH4	Improved accuracy		Data adjusted/Error correction	
6.A	**Solid Waste Disposal on Land**	CH4	Improved accuracy	Error Correction in calculation formula		
2.F	**Consumption of halocarbons and SF6**	HFCs,PFCs, SF6	Improved accuracy		Data adjusted	

A.7.18. 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		**173 787.79**	**172 421.22**	**-0.79**	**22 356.89**	**22 434.17**	**0.35**	**17 629.30**	**17 540.37**	**-0.50**
1. Energy		**172 013.75**	**170 997.17**	**-0.59**	**3 725.02**	**3 731.27**	**0.17**	**821.03**	**734.45**	**-10.55**
1.A.	Fuel Combustion Activities	170 460.22	169 443.22	-0.60	647.36	653.61	0.96	821.03	734.45	-10.55
1.A.1.	Energy Industries	60 195.17	60 185.04	-0.02	92.47	92.44	-0.04	142.90	142.90	0.00
1.A.2.	Manufacturing Industries and Construction	42 436.63	39 177.77	-7.68	34.75	36.09	3.85	30.95	31.56	1.98
1.A.3.	Transport	33 785.26	34 154.34	1.09	104.59	104.78	0.18	623.05	534.82	-14.16
1.A.4.	Other Sectors	34 032.22	35 915.13	5.53	410.54	415.43	1.19	24.08	25.13	4.35
1.A.5.	Other	10.94	10.94	0.00	5.01	4.87	-2.77	0.04	0.04	0.00
1.B.	Fugitive Emissions from Fuels	1 553.53	1 553.95	0.03	3 077.66	3 077.66	0.00	0.00	0.00	0.00
1.B.1.	Solid fuel	IE	IE		0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.	Oil and Natural Gas	1 553.53	1 553.95	0.03	3 077.66	3 077.66	0.00	0.00	0.00	0.00
2. Industrial Processes		**1 318.99**	**1 318.99**	**0.00**	**50.48**	**50.48**	**0.00**	**7 471.00**	**7 471.00**	**0.00**
2.A.	Mineral Products	1 025.40	1 025.40	0.00	2.68	2.68	0.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	0.00	0.00	46.72	46.72	0.00	7 471.00	7 471.00	0.00
2.C.	Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	IE	IE							
2.G.	Other	293.59	293.59	0.00	1.08	1.08	0.00	0.00	0.00	0.00
3. Solvent and Other Product Use		**0.00**	**0.00**	**0.00**				**160.30**	**160.30**	**0.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**9 128.91**	**9 128.91**	**0.00**	**7 826.88**	**7 825.95**	**-0.01**
4.A.	Enteric Fermentation				7 169.19	7 169.19	0.00			
4.B.	Manure Management				1 959.72	1 959.72	0.00	208.94	207.70	-0.59
4.C.	Rice Cultivation				0.00	0.00	0.00			
4.D.	Agricultural Soils[2]	0.00	NE	-100.00	0.00	0.00	0.00	7 617.94	7 618.25	0.00
4.E.	Prescribed Burning of Savannas				0.00	0.00	0.00	0.00	0.00	0.00
4.F.	Field Burning of Agricultural Residues				0.00	0.00	0.00	0.00	0.00	0.00
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**	**-1 379.57**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks			0.00						
5.B.	Forest and Grassland Conversion			0.00	0.00	0.00	0.00	**0.00**	**0.00**	0.00
5.C.	Abandonment of Managed Lands			0.00						
5.D.	CO_2 Emissions and Removals from Soil			0.00						
5.E.	Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.19. CRF Recalculation Table 8.a for 1998 (continued)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2 Previous submission	CO_2 Latest submission	CO_2 Difference[1]	CH_4 Previous submission	CH_4 Latest submission	CH_4 Difference[1]	N_2O Previous submission	N_2O Latest submission	N_2O Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste		**454.60**	**104.60**	**-76.99**	**9 411.80**	**9 482.84**	**0.75**	**165.65**	**164.23**	**-0.86**
6.A.	Solid Waste Disposal on Land	0.00	0.00	0.00	9 335.19	9 403.37	0.73			
6.B.	Wastewater Handling				76.61	79.47	3.73	165.65	164.23	-0.86
6.C.	Waste Incineration	IE	IE		0.00	0.00	0.00	0.00	0.00	0.00
6.D.	Other	454.60	104.60	-76.99	0.00	0.00	0.00	0.00	0.00	0.00
7. Other *(please specify)*		**0.46**	**0.46**	**0.00**	**40.67**	**40.67**	**0.00**	**1 184.44**	**1 184.44**	**0.00**
	Solvents and other product use	40.67	40.67	0.00	40.67	40.67	0.00	6.44	6.44	0.00
	Polluted surface water			0.00	0.00	0.00	0.00	1 178.00	1 178.00	0.00
				0.00			0.00			0.00
Memo Items:										
International Bunkers		**49 531.00**	**49 531.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Multilateral Operations		NE	NE		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass		**5 365.77**	**5 247.29**	**-2.21**						

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		HFCs Previous submission	HFCs Latest submission	HFCs Difference[1]	PFCs Previous submission	PFCs Latest submission	PFCs Difference[1]	SF_6 Previous submission	SF_6 Latest submission	SF_6 Difference[1]
		CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
Total Actual Emissions		**9 360.41**	**9 360.41**	**0.00**	**1 727.52**	**1 737.58**	**0.58**	**294.58**	**328.84**	**11.63**
2.C.3.	Aluminium Production				1 624.62	1 624.62	0.00			0.00
2.E.	Production of Halocarbons and SF_6	8 309.72	8 309.72	0.00			0.00			0.00
2.F.	Consumption of Halocarbons and SF_6	1 050.69	1 050.69	0.00	102.90	112.95	9.77	294.58	328.84	11.63
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**0.00**	**2 277.20**	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]	223 776.91	222 443.01	-0.60
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	225 156.48	223 822.58	-0.59

Table A.7.20. 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.1	Energy Industries	CO2 CH4	Improved accuracy		Data adjusted	
1.A.2	Manufacturing Industries and Construction	All	Improved accuracy		Data adjusted	
1.A.3	Transport	All	Improved accuracy		Data adjusted	
1.A.4	Other sectors	All	Improved accuracy		Data adjusted	
1.A.5	Other	CH4	Recalculation for emisison from combustion of biogas from waste dumps		Data adjusted	
4.A	Enteric fermentation	CH4	Improved accuracy		Data adjusted	
6.A	Solid Waste Disposal on Land	CH4	Improved accuracy	Error Correction in calculation formula		
6.B	Wastewater handling	CH4/N20	Improved accuracy		Data adjusted	
2.F	Consumption of halocarbons and SF6	HFCs,PFCs, SF6	Improved accuracy		Data adjusted	

Table A.7.21. 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	**170 685.58**	**167 261.50**	**-2.01**	**21 786.80**	**21 424.24**	**-1.66**	**17 367.35**	**17 277.62**	**-0.52**
1. Energy	**168 347.70**	**165 273.62**	**-1.83**	**3 726.77**	**3 725.46**	**-0.04**	**815.38**	**720.64**	**-11.62**
1.A. Fuel Combustion Activities	166 832.15	163 758.07	-1.84	696.09	694.78	-0.19	815.38	720.64	-11.62
1.A.1. Energy Industries	56 670.61	56 660.42	-0.02	126.09	126.06	-0.03	141.67	141.66	0.00
1.A.2. Manufacturing Industries and Construction	42 299.75	38 175.42	-9.75	63.97	61.31	-4.16	20.73	20.50	-1.12
1.A.3. Transport	34 795.34	34 995.52	0.58	101.15	99.85	-1.28	629.67	534.69	-15.09
1.A.4. Other Sectors	33 066.42	33 926.67	2.60	399.64	401.98	0.58	23.31	23.79	2.06
1.A.5. Other	0.04	0.04	0.00	5.24	5.58	6.51	0.00	0.00	0.00
1.B. Fugitive Emissions from Fuels	1 515.55	1 515.55	0.00	3 030.68	3 030.68	0.00	0.00	0.00	0.00
1.B.1. Solid fuel	IE	IE		0.00	0.00	0.00	0.00	0.00	0.00
1.B.2. Oil and Natural Gas	1 515.55	1 515.55	0.00	3 030.68	3 030.68	0.00	0.00	0.00	0.00
2. Industrial Processes	**1 315.45**	**1 315.45**	**0.00**	**56.91**	**56.91**	**0.00**	**7 201.07**	**7 201.07**	**0.00**
2.A. Mineral Products	974.97	974.97	0.00	2.95	2.95	0.00	0.00	0.00	0.00
2.B. Chemical Industry	0.00	0.00	0.00	53.17	53.17	0.00	7 189.65	7 189.65	0.00
2.C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D. Other Production	IE	IE							
2.G. Other	340.48	340.48	0.00	0.79	0.79	0.00	11.42	11.42	0.00
3. Solvent and Other Product Use	**0.00**	**0.00**	**0.00**				**155.67**	**153.62**	**-1.32**
4. Agriculture	**0.00**	**0.00**	**0.00**	**8 925.21**	**8 925.21**	**0.00**	**7 822.85**	**7 822.85**	**0.00**
4.A. Enteric Fermentation				7 011.69	7 011.69	0.00			
4.B. Manure Management				1 913.52	1 913.52	0.00	202.28	202.28	0.00
4.C. Rice Cultivation				NO	NO				
4.D. Agricultural Soils [2]	0.00	NE	-100.00	IE	IE		7 620.58	7 620.58	0.00
4.E. Prescribed Burning of Savannas				NO	NO		0.00	0.00	0.00
4.F. Field Burning of Agricultural Residues				NO	NO		0.00	0.00	0.00
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**	**-1 235.57**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A. Changes in Forest and Other Woody Biomass Stocks			0.00						
5.B. Forest and Grassland Conversion			0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C. Abandonment of Managed Lands			0.00						
5.D. CO_2 Emissions and Removals from Soil									
5.E. Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.22. 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	**1 021.86**	**671.86**	**-34.25**	**9 037.01**	**8 675.76**	**-4.00**	**186.32**	**193.38**	**3.79**
6.A. Solid Waste Disposal on Land	0.00	0.00	0.00	8 993.65	8 637.71	-3.96			
6.B. Wastewater Handling	0.00	0.00		43.36	38.06	-12.22	175.36	182.43	4.03
6.C. Waste Incineration	IE	IE		IE	IE		IE	IE	
6.D. Other	1 021.86	671.86	-34.25	0.00	0.00	0.00	10.95	10.95	0.00
7. Other *(please specify)*	**0.57**	**0.57**	**0.00**	**40.90**	**40.90**	**0.00**	**1 186.05**	**1 186.05**	**0.00**
Solvents and other product use	0.57	0.57	0.00	0.40	0.40	0.00	8.05	8.05	0.00
Polluted surface water			0.00	40.50	40.50	0.00	1 178.00	1 178.00	0.00
	0.00	0.00	0.00			0.00			0.00
Memo Items:									
International Bunkers	**51 213.63**	**51 213.63**	**0.00**	**NE**	**NE**		**0.00**	**0.00**	**0.00**
Multilateral Operations	**NE**	**NE**		**NE**	**NE**		**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass	**4 976.78**	**4 933.62**	**-0.87**						

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	**4 896.94**	**4 921.92**	**0.51**	**1 444.39**	**1 470.84**	**1.83**	**265.03**	**317.03**	**19.62**
2.C.3. Aluminium Production				1 326.03	1 326.03	0.00			0.00
2.E. Production of Halocarbons and SF_6	3 824.53	3 824.53	0.00			0.00			0.00
2.F. Consumption of Halocarbons and SF_6	1 072.42	1 097.39	2.33	118.36	144.81	22.35	265.03	317.03	19.62
Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**P**	**P**		**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]	215 210.53	211 437.58	-1.75
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	216 446.10	212 673.15	-1.74

Table.A.7.23. 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.1	Energy Industries	CO2 CH4	Improved accuracy		Data adjusted	
1.A.2	Manufacturing Industries and Cons	All	Improved accuracy		Data adjusted	
1.A.3	Transport	All	Improved accuracy		Data adjusted	
1.A.4	Other sectors	All	Improved accuracy		Data adjusted	
1.A.5	Other	CH4	Recalculation for emisison from combustion of biogas from waste dumps		Data adjusted	
3	product use	N2O	Improved accuracy		Data adjusted/error correction	
6.B	Waste water handling	N2O.CH4	Improved accuracy		Data adjusted	
6.D	Waste other	CO2	Improved accuracy		Error correction	
2.F	Consumption of halocarbons and SI	PFCs, SF6	Improved accuracy		Data adjusted	

Table A.7.24. 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	**172 426.78**	**169 305.23**	**-1.81**	**20 647.53**	**20 337.07**	**-1.50**	**16 659.01**	**16 551.76**	**-0.64**
1. Energy	**172 252.02**	**169 480.47**	**-1.61**	**3 458.07**	**3 456.72**	**-0.04**	**830.86**	**724.19**	**-12.84**
1.A. Fuel Combustion Activities	170 661.29	167 889.74	-1.62	707.85	706.50	-0.19	830.86	724.19	-12.84
1.A.1. Energy Industries	61 222.17	61 222.17	0.00	125.11	125.11	0.00	150.71	150.71	0.00
1.A.2. Manufacturing Industries and Construction	39 676.73	36 278.18	-8.57	68.88	66.93	-2.84	36.72	36.67	-0.14
1.A.3. Transport	35 212.50	35 212.50	0.00	91.47	91.46	-0.01	619.03	512.05	-17.28
1.A.4. Other Sectors	34 549.90	35 176.90	1.81	19.80	19.88	0.41	24.40	24.75	1.44
1.A.5. Other	0.00	0.00	0.00	6.66	5.58	-16.19	0.00	0.00	0.00
1.B. Fugitive Emissions from Fuels	1 590.73	1 590.73	0.00	2 750.22	2 750.22	0.00	0.00	0.00	0.00
1.B.1. Solid fuel	IE	IE		0.00	0.00	0.00	0.00	0.00	0.00
1.B.2. Oil and Natural Gas	1 590.73	1 590.73	0.00	2 750.22	2 750.22	0.00	0.00	0.00	0.00
2. Industrial Processes	**1 237.61**	**1 237.61**	**0.00**	**32.35**	**32.35**	**0.00**	**7 120.46**	**7 120.46**	**0.00**
2.A. Mineral Products	857.12	857.12	0.00	3.04	3.04	0.00	0.00	0.00	0.00
2.B. Chemical Industry	0.00	0.00	0.00	28.89	28.89	0.00	7 120.46	7 120.46	0.00
2.C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D. Other Production	IE	IE							
2.G. Other	380.48	380.48	0.00	0.41	0.41	0.00	0.00	0.00	0.00
3. Solvent and Other Product Use	**0.00**	**0.00**	**0.00**				**137.66**	**137.66**	**0.00**
4. Agriculture	**0.00**	**0.00**	**0.00**	**8 621.13**	**8 621.13**	**0.00**	**7 192.00**	**7 192.00**	**0.00**
4.A. Enteric Fermentation				6 708.03	6 708.03	0.00			
4.B. Manure Management				1 913.10	1 913.10	0.00	192.20	192.20	0.00
4.C. Rice Cultivation				NO	NO				
4.D. Agricultural Soils (2)	0.00	NE	-100.00	IE	IE		6 999.80	6 999.80	0.00
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**	**-1 413.26**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A. Changes in Forest and Other Woody Biomass Stocks			0.00						
5.B. Forest and Grassland Conversion			0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C. Abandonment of Managed Lands			0.00						
5.D. CO_2 Emissions and Removals from Soil			0.00						
5.E. Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.25. 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		**350.00**	**0.00**	**-100.00**	**8 495.88**	**8 186.77**	**-3.64**	**194.13**	**193.55**	**-0.30**
6.A.	Solid Waste Disposal on Land	0.00	0.00	0.00	8 479.59	8 170.48	-3.65			
6.B.	Wastewater Handling				16.29	16.29	0.00	194.13	193.55	-0.30
6.C.	Waste Incineration	IE	IE		IE	IE		IE	IE	
6.D.	Other	350.00	0.00	-100.00	0.00	0.00	0.00	0.00	0.00	0.00
7. Other *(please specify)*		**0.42**	**0.42**	**0.00**	**40.11**	**40.11**	**0.00**	**1 183.90**	**1 183.90**	**0.00**
	Solvents and other product use	0.42	0.42	0.00	0.50	0.50	0.00	5.90	5.90	0.00
	Polluted surface water			0.00				1 178.00	1 178.00	0.00
	Degassing drinkwater from ground water			0.00	39.61	39.61	0.00			0.00
Memo Items:										
International Bunkers		**53 500.11**	**53 500.11**	**0.00**	**39.61**	**39.61**	**0.00**	**0.00**	**0.00**	**0.00**
Multilateral Operations		**0.00**	**0.00**	**0.00**	**NE**	**NE**		**NE**	**NE**	
CO_2 Emissions from Biomass		**4 988.57**	**4 988.57**	**0.00**						

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		**3 874.56**	**3 878.85**	**0.11**	**1 526.44**	**1 577.56**	**3.35**	**268.65**	**335.15**	**24.75**
2.C.3.	Aluminium Production				1 390.36	1 390.36	0.00			0.00
2.E.	Production of Halocarbons and SF_6	2 838.43	2 838.43	0.00			0.00			0.00
2.F.	Consumption of Halocarbons and SF_6	1 036.12	1 040.42	0.41	136.08	187.20	37.57	268.65	335.15	24.75
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**0.00**	**2 744.00**	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)	215 402.96	211 985.63	-1.59
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry(3)	216 816.23	213 398.89	-1.58

Table.A.7.26. 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.1	Energy Industries	CO2, CH4, 2O	Improved accuracy		Data adjusted	
1.A.2	Manufacturing Industries and Constructio	All	Improved accuracy		Data adjusted	
1.A.3	Transport	All	Improved accuracy		Data adjusted	
1.A.4	Other sectors	All	Improved accuracy		Data adjusted	
1.A.5	Other	CH4	Recalculation for emisison from combustion of biogas from waste dumps		Data adjusted	
6.B	Waste Water handling	N2O	improved accuracy		Data adjusted	
6.D	Waste other	CO2	Improved accuracy		Error correction	
6.A	Solid Waste Disposal on Land	CH4	Improved accuracy by using updated activity data/methods			

Table A.7.27. CRF Recalculation Table 8.a for 2001

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)
		CO2 equivalent (Gg)		(%)	CO2 equivalent (Gg)		(%)	CO2 equivalent (Gg)		(%)
Total National Emissions and Removals		**179 855.16**	**177 063.16**	**-1.55**	**20 435.10**	**19 925.34**	**-2.49**	**15 815.59**	**15 814.84**	**0.00**
1. Energy		**178 380.82**	**175 707.57**	**-1.50**	**3 547.22**	**3 502.64**	**-1.26**	**835.60**	**678.76**	**-18.77**
1.A.	Fuel Combustion Activities	176 715.04	174 014.28	-1.53	726.21	685.71	-5.58	835.60	678.76	-18.77
1.A.1.	Energy Industries	64 775.57	64 649.12	-0.20	131.55	114.62	-12.87	160.16	116.16	-27.47
1.A.2.	Manufacturing Industries and Construction	40 196.92	36 443.62	-9.34	71.09	47.02	-33.86	37.64	31.66	-15.89
1.A.3.	Transport	35 608.22	35 505.69	-0.29	88.02	87.03	-1.13	612.33	505.07	-17.52
1.A.4.	Other Sectors	36 134.33	37 415.46	3.55	20.42	20.55	0.60	25.48	25.88	1.56
1.A.5.	Other	0.00	0.38	100.00	6.66	5.59	-16.08	0.00	0.00	0.00
1.B.	Fugitive Emissions from Fuels	1 665.79	1 693.29	1.65	2 821.01	2 816.93	-0.14	0.00	0.00	0.00
1.B.1.	Solid fuel	IE	IE		0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.	Oil and Natural Gas	1 665.79	1 693.29	1.65	2 821.01	2 816.93	-0.14	0.00	0.00	0.00
2. Industrial Processes		**1 123.89**	**1 355.15**	**20.58**	**29.77**	**49.68**	**66.89**	**6 563.64**	**6 601.69**	**0.58**
2.A.	Mineral Products	805.23	958.73	19.06	2.68	2.74	2.28	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	0.00	0.00	26.71	42.20	58.00	6 563.64	6 563.02	-0.01
2.C.	Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	IE	IE							
2.G.	Other	318.66	396.42	24.40	0.38	4.74	1 150.94	0.00	38.68	100.00
3. Solvent and Other Product Use		**0.00**	**0.00**	**0.00**				**122.47**	**115.04**	**-6.06**
4. Agriculture		**0.00**	**0.00**	**0.00**	**8 622.39**	**8 603.22**	**-0.22**	**7 167.20**	**7 002.90**	**-2.29**
4.A.	Enteric Fermentation				6 766.41	6 752.34	-0.21			
4.B.	Manure Management				1 855.98	1 850.88	-0.27	189.10	195.30	3.28
4.C.	Rice Cultivation				NO	NO				
4.D.	Agricultural Soils (2)	0.00	NE	-100.00	IE	IE		6 978.10	6 807.60	-2.44
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**	**-1 413.26**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks			0.00						
5.B.	Forest and Grassland Conversion			0.00	0.00	0.00	0.00	0.00	0.00	0.00
5.C.	Abandonment of Managed Lands			0.00						
5.D.	CO2 Emissions and Removals from Soil			0.00						
5.E.	Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.7.28. CRF Recalculation Table 8.a for 2001 (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)
	CO2 equivalent (Gg)		(%)	CO2 equivalent (Gg)		(%)	CO2 equivalent (Gg)		(%)
6. Waste	**350.00**	**0.00**	**-100.00**	**8 196.84**	**7 730.92**	**-5.68**	**193.55**	**232.18**	**19.96**
6.A. Solid Waste Disposal on Land	0.00	0.00	0.00	8 180.55	7 715.87	-5.68			
6.B. Wastewater Handling				16.29	15.05	-7.59	193.55	186.69	-3.54
6.C. Waste Incineration	IE	IE		IE	IE		IE	IE	
6.D. Other	350.00	0.00	-100.00	0.00	0.00	0.00	0.00	45.49	100.00
7. Other (please specify)	**0.44**	**0.44**	**0.00**	**38.88**	**38.88**	**0.00**	**1 184.26**	**1 184.26**	**0.00**
Solvents and other product use	0.44	0.44	0.00	0.46	0.46	0.00	6.26	6.26	0.00
Polluted surface water			0.00				1 178.00	1 178.00	0.00
Degassing drinkwater from ground water			0.00	38.42	38.42	0.00			0.00
Memo Items:									
International Bunkers	**53 500.11**	**53 500.11**	**0.00**	**38.42**	**38.42**	**0.00**	**0.00**	**0.00**	**0.00**
Multilateral Operations	**0.00**	**0.00**	**0.00**	NE	NE		NE	NE	
CO2 Emissions from Biomass	**4 988.57**	**4 988.57**	**0.00**						

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)
	CO2 equivalent (Gg)		(%)	CO2 equivalent (Gg)		(%)	CO2 equivalent (Gg)		(%)
Total Actual Emissions	**1 584.20**	**1 506.87**	**-4.88**	**1 456.38**	**1 482.26**	**1.78**	**296.09**	**356.25**	**20.32**
2.C.3. Aluminium Production				1 320.30	1 322.68	0.18			0.00
2.E. Production of Halocarbons and SF6	641.47	641.47	0.00			0.00			0.00
2.F. Consumption of Halocarbons and SF6	942.73	865.39	-8.20	136.08	159.58	17.27	296.09	356.25	20.32
Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF6	**0.00**	**2 382.60**	100.00	C	C		C	C	

	Previous submission	Latest submission	Difference(1)
	CO2 equivalent (Gg)		(%)
Total CO2 Equivalent Emissions with Land-Use Change and Forestry (3)	218 280.39	214 735.46	-1.62
Total CO2 Equivalent Emissions without Land-Use Change and Forestry (3)	219 693.65	216 148.72	-1.61

Table A.7.29. CRF Recalculation Table 8.a for 2001 (continued)

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]	
...						
ALL	ALL	ALL		All 2001 data are provisional	All 2001 data are provisional	
1.2	All Energy and Industrial sources	All	Due to poor quality of data from individual firms, process and combustion emissions are difficult to separate			
6.D	**Waste other**	CO2	Improved accuracy		Error correction	

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.7.30. 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
	(Gg)													
1. Energy	**158 116**	**158 116**	**166 155**	**164 937**	**166 984**	**167 493**	**170 897**	**179 130**	**163 554**	**170 997**	**165 274**	**169 480**	**175 708**	**174 664**
A. Fuel Combustion (Sectoral Approach)	157 808	157 808	165 695	164 567	166 634	167 303	170 087	178 127	162 536	169 443	163 758	167 890	174 014	173 025
1. Energy Industries	51 305	51 305	52 190	54 130	53 800	55 980	56 516	58 338	57 181	60 185	56 660	61 222	64 649	63 780
2. Manufacturing Industries and Construction	42 192	42 192	42 660	42 510	39 920	40 950	42 627	43 026	35 485	39 178	38 175	36 278	36 444	35 791
3. Transport	29 399	29 399	29 391	30 597	31 209	31 347	32 103	32 626	33 062	34 154	34 996	35 212	35 506	36 251
4. Other Sectors	34 912	34 912	40 384	37 330	40 055	38 466	38 837	44 129	36 806	35 915	33 927	35 177	37 415	37 203
5. Other	1	1	1 070	0	1 650	560	4	9	1	11	0	0	0	0
B. Fugitive Emissions from Fuels	308	308	460	370	350	190	810	1 003	1 018	1 554	1 516	1 591	1 693	1 640
1. Solid Fuels	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Oil and Natural Gas	308	308	460	370	350	190	810	1 003	1 018	1 554	1 516	1 591	1 693	1 640
2. Industrial Processes	**1 581**	**1 581**	**1 500**	**1 270**	**1 210**	**1 440**	**1 442**	**1 386**	**1 428**	**1 319**	**1 315**	**1 238**	**1 355**	**1 989**
A. Mineral Products	1 124	1 124	700	750	1 050	1 050	1 114	899	1 084	1 025	975	857	959	1 431
B. Chemical Industry	0	0	0	0	0	0	0	0	0	0	0	0	0	0
C. Metal Production	0	0	0	0	0	0	17	0	3	0	0	0	0	172
D. Other Production	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	NE
E. Production of Halocarbons and SF_6														
F. Consumption of Halocarbons and SF_6														
G. Other	457	457	800	520	160	390	312	487	342	294	340	380	396	386
3. Solvent and Other Product Use	**0**	**0**	**100**	**100**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
4. Agriculture	**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
B. Manure Management	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
D. Agricultural Soils [2]	0	0	0	0	0	0	0	0	0	0	0	0	0	0
E. Prescribed Burning of Savannas	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
F. Field Burning of Agricultural Residues	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
5. Land-Use Change and Forestry [3]	**-1 422**	**-1 422**	**-1 528**	**-1 487**	**-1 806**	**-1 929**	**-1 232**	**-1 398**	**-1 180**	**-1 380**	**-1 236**	**-1 413**	**-1 413**	**-1 413**
A. Changes in Forest and Other Woody Biomass Stocks	-1 422	-1 422	-1 528	-1 487	-1 806	-1 929	-1 232	-1 398	-1 180	-1 380	-1 236	-1 413	-1 413	-1 413
B. Forest and Grassland Conversion	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
C. Abandonment of Managed Lands	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. CO_2 Emissions and Removals from Soil	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**881**	**881**	**0**	**0**	**0**	**0**	**908**	**1 056**	**1 245**	**105**	**672**	**0**	**0**	**0**
A. Solid Waste Disposal on Land	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
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	881	881	0	0	0	0	908	1 056	1 245	105	672	0	0	0
7. Other *(please specify)*	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**
Solvent and other product use	0	0	0	0	0	0	0	0	0	0	1	0	0	0
Polluted surface water	0	0	0	0	0	0	0	0	0	0	0			0
Total Emissions/Removals with LUCF [4]	**159 156**	**159 156**	**166 228**	**164 820**	**166 389**	**167 004**	**172 016**	**180 174**	**165 047**	**171 042**	**166 026**	**169 305**	**175 650**	**175 240**
Total Emissions without LUCF [4]	**160 578**	**160 578**	**167 755**	**166 307**	**168 194**	**168 933**	**173 248**	**181 572**	**166 228**	**172 421**	**167 261**	**170 718**	**177 063**	**176 654**
Memo Items:														
International Bunkers	**39 765**	**39 765**	**41 290**	**42 400**	**44 280**	**42 860**	**44 286**	**45 445**	**48 436**	**49 531**	**51 214**	**53 496**	**57 576**	**57 404**
Aviation	4 497	4 497	4 960	5 910	6 500	6 720	7 665	8 249	8 906	9 709	10 070	10 067	9 855	10 280
Marine	35 267	35 267	36 330	36 490	37 780	36 140	36 621	37 196	39 530	39 822	41 143	43 429	47 721	47 124
Multilateral Operations	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**3 392**	**3 392**	**2 707**	**2 607**	**3 307**	**3 507**	**3 580**	**5 285**	**6 042**	**5 247**	**4 934**	**5 093**	**6 394**	**7 201**

Table A.7.31. 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
	(Gg)													
Total Emissions	**1 302.28**	**1 302.28**	**1 324.75**	**1 273.37**	**1 247.81**	**1 224.31**	**1 190.24**	**1 181.40**	**1 105.06**	**1 068.30**	**1 020.11**	**968.44**	**948.82**	**891.17**
1. Energy	**213.15**	**213.15**	**223.85**	**199.05**	**192.30**	**201.99**	**206.97**	**225.62**	**186.04**	**177.68**	**177.40**	**164.61**	**166.79**	**151.98**
A. Fuel Combustion (Sectoral Approach)	34.38	34.38	35.75	35.95	34.30	33.49	36.65	37.28	29.58	31.12	33.08	33.64	32.65	31.85
1. Energy Industries	3.32	3.32	3.20	3.80	3.40	3.70	4.88	5.70	2.96	4.40	6.00	5.96	5.46	4.91
2. Manufacturing Industries and Construction	2.91	2.91	3.50	4.90	3.20	2.60	5.07	1.83	1.00	1.72	2.92	3.19	2.24	2.26
3. Transport	7.68	7.68	6.75	6.60	6.34	6.09	5.88	5.48	5.19	4.99	4.75	4.36	4.14	4.01
4. Other Sectors	20.37	20.37	22.15	20.46	21.14	20.84	20.51	23.98	20.19	19.78	19.14	19.88	20.55	20.39
5. Other	0.11	0.11	0.15	0.19	0.22	0.26	0.30	0.28	0.24	0.23	0.27	0.27	0.27	0.28
B. Fugitive Emissions from Fuels	178.77	178.77	188.10	163.10	158.00	168.50	170.33	188.34	156.46	146.56	144.32	130.96	134.14	120.12
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	178.77	178.77	188.10	163.10	158.00	168.50	170.33	188.34	156.46	146.56	144.32	130.96	134.14	120.12
2. Industrial Processes	**3.27**	**3.27**	**3.50**	**3.70**	**4.90**	**5.30**	**2.63**	**5.71**	**2.66**	**2.40**	**2.71**	**1.54**	**2.37**	**2.23**
A. Mineral Products	0.21	0.21	0.00	0.00	0.00	0.00	0.10	0.11	0.14	0.13	0.14	0.14	0.13	0.11
B. Chemical Industry	3.02	3.02	0.00	0.00	0.00	0.00	2.49	5.20	2.46	2.22	2.53	1.38	2.01	2.12
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	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
E. Production of Halocarbons and SF_6														
F. Consumption of Halocarbons and SF_6														
G. Other	0.03	0.03	3.50	3.70	4.90	5.30	0.04	0.09	0.06	0.05	0.04	0.02	0.23	0.00
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**
4. Agriculture	**505.33**	**505.33**	**517.09**	**505.78**	**497.83**	**483.13**	**477.04**	**463.58**	**445.80**	**434.71**	**425.01**	**410.53**	**409.68**	**389.07**
A. Enteric Fermentation	401.86	401.86	411.63	401.22	392.69	381.67	376.72	365.86	352.64	341.39	333.89	319.43	321.54	305.78
B. Manure Management	103.47	103.47	105.46	104.56	105.14	101.46	100.32	97.71	93.16	93.32	91.12	91.10	88.14	83.29
C. Rice Cultivation	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
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	**578.48**	**578.48**	**578.30**	**562.84**	**550.83**	**531.90**	**501.53**	**484.52**	**468.59**	**451.56**	**413.13**	**389.85**	**368.14**	**346.09**
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	411.32	389.07	367.42	345.37
B. Waste-water Handling	6.55	6.55	5.98	2.38	6.31	5.10	1.46	1.27	0.79	3.78	1.81	0.78	0.72	0.72
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. 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
7. Other *(please specify)* ...	**2.05**	**2.05**	**2.02**	**2.00**	**1.94**	**1.98**	**2.06**	**1.98**	**1.97**	**1.94**	**1.85**	**1.91**	**1.85**	**1.81**
Solvents and other product use	0.05	0.05	0.01	0.01	0.01	0.01	0.06	0.03	0.03	0.03	0.02	0.03	0.02	0.02
Polluted surface water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
Degassing drinkwater from ground water	2.00	2.00	2.00	1.98	1.93	1.97	2.00	1.95	1.95	1.91	1.93	1.89	1.83	1.79
Memo Items:														
International Bunkers	**0.14**	**0.14**	**NE**	**NE**	**NE**	**NE**	**0.14**	**0.15**	**0.16**	**0.16**	**0.16**	**0.17**	**0.19**	**NE**
Aviation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine	0.14	0.14	NE	NE	NE	NE	0.14	0.15	0.16	0.16	0.16	0.17	0.19	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: N_2O***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[(1)]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
	(Gg)													
Total Emissions	**52.88**	**52.88**	**53.74**	**56.89**	**59.25**	**57.99**	**58.39**	**57.45**	**57.25**	**56.58**	**55.73**	**53.39**	**51.02**	**49.29**
1. Energy	**1.67**	**1.67**	**1.80**	**1.97**	**2.11**	**2.30**	**2.38**	**2.08**	**2.29**	**2.37**	**2.32**	**2.34**	**2.19**	**2.30**
A. Fuel Combustion (Sectoral Approach)	1.67	1.67	1.80	1.97	2.11	1.90	2.38	2.08	2.29	2.37	2.32	2.34	2.19	2.30
1. Energy Industries	0.47	0.47	0.50	0.50	0.50	0.20	0.49	0.01	0.02	0.46	0.46	0.49	0.37	0.50
2. Manufacturing Industries and Construction	0.11	0.11	0.10	0.10	0.10	0.10	0.13	0.28	0.48	0.10	0.07	0.12	0.10	0.09
3. Transport	1.00	1.00	1.14	1.32	1.45	1.55	1.67	1.70	1.71	1.73	1.72	1.65	1.63	1.63
4. Other Sectors	0.09	0.09	0.06	0.05	0.06	0.05	0.09	0.10	0.08	0.08	0.08	0.08	0.08	0.08
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	0.00	0.00	0.00	0.00	0.00	0.40	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
2. Oil and Natural Gas	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2. Industrial Processes	**24.37**	**24.37**	**24.70**	**24.91**	**26.70**	**25.50**	**24.17**	**24.20**	**24.15**	**24.10**	**23.23**	**22.97**	**21.30**	**20.19**
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
B. Chemical Industry	24.37	24.37	24.70	24.91	26.70	25.50	24.17	24.20	24.15	24.10	23.19	22.97	21.17	20.19
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	0.00	0.00	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.12	0.00
3. Solvent and Other Product Use	**0.73**	**0.73**	**0.65**	**0.65**	**0.60**	**0.56**	**0.64**	**0.47**	**0.42**	**0.52**	**0.50**	**0.44**	**0.37**	**0.29**
4. Agriculture	**21.90**	**21.90**	**22.38**	**25.10**	**25.56**	**25.34**	**26.85**	**26.40**	**25.99**	**25.25**	**25.24**	**23.20**	**22.59**	**21.94**
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	0.66	0.66	0.70	0.70	0.80	0.80	0.74	0.72	0.69	0.67	0.65	0.62	0.63	0.59
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	21.24	21.24	21.68	24.40	24.76	24.54	26.11	25.67	25.29	24.58	24.58	22.58	21.96	21.35
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	**0.40**	**0.40**	**0.40**	**0.45**	**0.47**	**0.47**	**0.54**	**0.48**	**0.58**	**0.53**	**0.62**	**0.62**	**0.75**	**0.75**
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. Waste-water Handling	0.40	0.40	0.40	0.45	0.47	0.47	0.50	0.48	0.58	0.53	0.59	0.62	0.60	0.60
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	0.00	IE
D. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.04	0.00	0.15	0.15
7. Other *(please specify)*	**3.81**	**3.81**	**3.81**	**3.82**	**3.81**	**3.82**	**3.82**	**3.82**	**3.82**	**3.82**	**3.83**	**3.82**	**3.82**	**3.82**
Solvent and other product use	0.01	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
Polluted surface water	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80
Memo Items:														
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Aviation	0.01	0.01	NE	NE	NE	NE	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Marine	0.04	0.04	NE	NE	NE	NE	0.04	0.04	0.04	0.04	0.04	0.05	0.05	0.05
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: HFCs, PFCs and SF_6***

Note: 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
	(Gg)													
Emissions of HFCs[5] - CO_2 equivalent (Gg)	**6 018.31**	**4 431.84**	**3 451.56**	**4 447.33**	**4 998.06**	**6 486.69**	**6 018.31**	**7 675.65**	**8 306.57**	**9 360.41**	**4 921.92**	**3 878.85**	**1 506.87**	**1 572.42**
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
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
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
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
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	66.24
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
HFC-134a	181.48	0.00	0.00	18.01	12.16	92.99	181.48	434.57	687.30	710.14	764.91	632.66	440.16	327.79
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
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
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	51.43
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
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
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	26.79
Emissions of PFCs[5] - CO_2 equivalent (Gg)	**1 836.07**	**2 416.48**	**2 419.23**	**2 078.51**	**2 095.16**	**1 863.75**	**1 836.07**	**2 014.30**	**2 164.13**	**1 737.58**	**1 470.84**	**1 577.56**	**1 482.26**	**1 200.39**
CF_4	223.00	301.00	301.00	258.00	260.00	228.00	223.00	247.00	261.00	195.16	153.90	160.40	154.80	140.18
C_2F_6	38.00	48.00	48.00	41.00	41.00	38.00	38.00	39.00	40.00	38.70	35.40	37.80	34.40	14.09
C_3F_8														
C_4F_{10}														
$c-C_4F_8$														
C_5F_{12}														
C_6F_{14}														
PFC unspecified	4.40	2.19	2.52	2.89	3.33	3.83	4.40	5.95	11.86	13.45	17.24	22.29	19.00	19.00
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**	**356.25**	**343.59**
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	14.91	14.38

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.7.34. 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
	CO_2 equivalent (Gg)													
Net CO_2 emissions/removals	159 156.45	159 156.45	166 227.54	164 820.13	166 388.69	167 004.10	172 015.69	180 174.26	165 047.34	171 041.65	166 025.92	169 305.23	175 649.90	175 240.27
CO_2 emissions (without LUCF) [4]	160 578.35	160 578.35	167 755.15	166 307.39	168 194.42	168 933.45	173 247.97	181 571.94	166 227.69	172 421.22	167 261.50	170 718.50	177 063.16	176 653.54
CH_4	27 347.91	27 347.91	27 819.82	26 740.70	26 203.98	25 710.44	24 995.05	24 809.45	23 206.35	22 434.31	21 422.21	20 337.14	19 925.32	18 714.65
N_2O	16 392.45	16 392.45	16 660.78	17 637.32	18 368.89	17 975.45	18 101.54	17 809.45	17 746.28	17 540.37	17 277.62	16 551.76	15 814.84	15 280.00
HFCs	6 018.31	4 431.84	3 451.56	4 447.33	4 998.06	6 486.69	6 018.31	7 675.65	8 306.57	9 360.41	4 921.92	3 878.85	1 506.87	1 572.42
PFCs	1 836.07	2 416.48	2 419.23	2 078.51	2 095.16	1 863.75	1 836.07	2 014.30	2 164.13	1 737.58	1 470.84	1 577.56	1 482.26	1 200.39
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	356.25	343.59
Total (with net CO_2 emissions/removals)	**211 052.44**	**209 962.45**	**216 712.85**	**215 867.07**	**218 204.67**	**219 231.62**	**223 267.91**	**232 795.51**	**216 815.54**	**222 443.15**	**211 435.55**	**211 985.70**	**214 735.44**	**212 351.32**
Total (without CO_2 from LUCF) [6] [8]	**212 474.34**	**211 384.35**	**218 240.45**	**217 354.34**	**220 010.40**	**221 160.97**	**224 500.20**	**234 193.19**	**217 995.89**	**223 822.72**	**212 671.12**	**213 398.96**	**216 148.71**	**213 764.59**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
	CO_2 equivalent (Gg)													
1. Energy	163 110.84	163 110.84	171 414.14	169 728.41	171 676.36	172 448.38	175 979.91	184 513.71	168 171.97	175 462.89	169 719.72	173 661.38	179 888.97	178 569.69
2. Industrial Processes	17 358.87	16 268.88	15 234.87	15 737.97	16 833.11	17 997.62	17 146.42	19 011.36	19 787.08	20 267.30	15 283.23	14 181.98	11 351.91	11 410.22
3. Solvent and Other Product Use	224.75	224.75	301.50	301.50	186.00	173.60	197.57	145.70	128.65	160.30	153.62	137.66	115.04	90.24
4. Agriculture	17 400.93	17 400.93	17 796.69	18 402.38	18 378.03	18 001.13	18 341.34	17 917.53	17 417.46	16 954.86	16 748.06	15 813.13	15 606.12	14 971.87
5. Land-Use Change and Forestry [7]	-1 421.91	-1 421.91	-1 527.61	-1 487.26	-1 805.73	-1 929.35	-1 232.28	-1 397.68	-1 180.35	-1 379.57	-1 235.57	-1 413.26	-1 413.26	-1 413.26
6. Waste	13 154.71	13 154.71	12 269.21	11 959.04	11 713.89	11 315.60	11 608.29	11 379.13	11 264.37	9 751.67	9 541.01	8 380.32	7 963.10	7 500.00
7. Other	1 224.24	1 224.24	1 224.04	1 225.04	1 223.02	1 224.65	1 226.67	1 225.76	1 226.35	1 225.70	1 225.49	1 224.49	1 223.57	1 222.57

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 2001 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 1990-2002 are presented in graph format:

- A.7.39. Shares and trends in NO_x emissions per IPCC sector 1990-2002.
- A.7.49. Shares and trends in CO emissions per IPCC sector 1990-2002.
- A.7.41. Shares and trends in NMVOC emissions per IPCC sector 1990-2002.
- A.7.42. Shares and trends in SO_2 emissions per IPCC sector 1990-2002.

Table A.7.35. 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
		(Gg)												
Total National Emissions and Removals		**599.49**	**586.47**	**578.80**	**554.53**	**529.95**	**517.80**	**501.72**	**470.67**	**460.82**	**464.28**	**447.19**	**436.21**	**429.94**
1. Energy		**592.79**	**573.28**	**566.01**	**541.05**	**519.47**	**513.61**	**497.95**	**466.87**	**459.64**	**462.67**	**445.56**	**434.33**	**428.03**
A. Fuel Combustion	Reference Approach (2)													
	Sectoral Approach (2)	592.66	572.08	564.71	540.05	518.97	513.02	497.46	465.61	458.83	459.75	445.16	433.84	427.73
1. Energy Industries		98.61	95.60	95.90	91.80	81.40	81.29	71.39	62.40	58.18	65.82	64.27	57.87	58.69
2. Manufacturing Industries and Construction		77.27	60.40	61.40	54.60	54.40	55.06	61.42	51.13	49.09	39.70	33.20	35.14	34.14
3. Transport		375.34	371.38	365.36	347.44	341.10	328.79	318.63	313.91	313.24	309.80	303.35	294.05	288.35
4. Other Sectors		41.27	44.50	41.80	45.90	41.70	47.46	45.61	37.27	37.99	43.09	43.92	46.41	46.16
5. Other		0.17	0.20	0.26	0.31	0.37	0.43	0.40	0.90	0.32	1.35	0.42	0.37	0.40
B. Fugitive Emissions from Fuels		0.13	1.20	1.30	1.00	0.50	0.59	0.49	1.25	0.81	2.91	0.40	0.48	0.30
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
2. Oil and Natural Gas		0.13	1.20	1.30	1.00	0.50	0.59	0.49	1.25	0.81	2.91	0.40	0.48	0.30
2. Industrial Processes		**2.71**	**13.10**	**12.70**	**13.40**	**10.40**	**1.75**	**2.28**	**2.30**	**1.06**	**0.68**	**1.55**	**1.43**	**1.84**
A. Mineral Products		1.28	0.00	0.00	0.00	0.00	1.31	1.16	1.23	0.99	0.62	0.97	1.02	0.41
B. Chemical Industry		0.00	0.00	0.00	0.00	0.00	0.12	0.07	0.03	0.00	0.00	0.00	0.00	1.43
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
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
E. Production of Halocarbons and SF_6														
F. Consumption of Halocarbons and SF_6														
G. Other		1.43	13.10	12.70	13.40	10.40	0.31	1.04	1.04	0.07	0.06	0.58	0.41	0.00
3. Solvent and Other Product Use		**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
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
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
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
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
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
F. Field Burning of Agricultural Residues		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
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**
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
B. Forest and Grassland Conversion		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
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
E. Other		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**	**2.37**	**1.41**	**1.42**	**0.04**	**0.85**	**0.00**	**0.37**	**0.00**
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
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
C. Waste Incineration		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	2.37	1.41	1.42	0.04	0.85	0.00	0.37	0.00
7. Other *(please specify)*		**0.09**	**0.09**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.08**	**0.07**	**0.08**
Solvents and other product use		0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.08
Polluted surface water		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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	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**
Aviation		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
Multilateral Operations		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass														

Table A.7.36. 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
					(Gg)									
Total National Emissions and Removals		**1 130.44**	**1 039.00**	**985.15**	**963.94**	**924.58**	**851.37**	**834.57**	**758.78**	**746.88**	**728.19**	**701.76**	**675.72**	**656.47**
1. Energy		**1 082.93**	**909.19**	**881.80**	**862.80**	**820.76**	**815.43**	**796.95**	**718.65**	**704.46**	**690.16**	**658.09**	**628.52**	**652.90**
A. Fuel Combustion	Reference Approach (2)													
	Sectoral Approach (2)	1 076.83	900.99	876.10	856.80	813.16	807.48	788.85	711.46	698.22	685.65	653.81	623.92	648.62
1. Energy Industries		14.65	18.90	16.40	15.40	17.00	16.38	44.99	20.33	22.17	27.38	27.18	24.34	24.06
2. Manufacturing Industries and Construction		224.44	108.30	114.80	139.10	114.30	180.75	168.06	137.94	136.30	127.73	116.78	112.93	147.82
3. Transport		765.00	675.37	645.43	597.58	579.09	544.88	508.96	486.68	476.18	469.12	447.42	424.02	414.30
4. Other Sectors		72.04	97.50	98.30	103.30	101.10	63.56	65.04	62.62	62.35	55.49	60.64	60.77	60.68
5. Other		0.70	0.92	1.17	1.42	1.67	1.92	1.80	3.90	1.22	5.93	1.79	1.86	1.76
B. Fugitive Emissions from Fuels		6.10	8.20	5.70	6.00	7.60	7.95	8.10	7.18	6.25	4.52	4.27	4.60	4.27
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
2. Oil and Natural Gas		6.10	8.20	5.70	6.00	7.60	7.95	8.10	7.18	6.25	4.52	4.27	4.60	4.27
2. Industrial Processes		**43.31**	**127.40**	**101.10**	**99.10**	**101.70**	**33.39**	**34.92**	**37.49**	**40.31**	**35.61**	**41.58**	**45.12**	**1.39**
A. Mineral Products		3.52	0.00	0.00	0.00	0.00	2.45	1.01	1.63	1.51	1.69	1.56	1.41	1.24
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
C. Metal Production		35.11	0.00	0.00	0.00	0.00	30.32	33.03	34.96	38.74	31.95	39.66	41.45	0.15
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
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
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
G. Other		4.68	127.40	101.10	99.10	101.70	0.62	0.88	0.91	0.07	1.98	0.36	2.25	0.00
3. Solvent and Other Product Use		**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
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
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
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
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
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
F. Field Burning of Agricultural Residues		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
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**
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
B. Forest and Grassland Conversion		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
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
E. Other		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**	**0.55**	**0.50**	**0.01**	**0.31**	**0.01**	**0.11**	**0.11**
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
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
C. Waste Incineration		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	0.55	0.50	0.01	0.31	0.01	0.11	0.11
7. Other *(please specify)*		**2.28**	**2.40**	**2.25**	**2.04**	**2.12**	**2.15**	**2.15**	**2.14**	**2.09**	**2.11**	**2.08**	**1.98**	**2.08**
Solvents and other product use		2.28	2.40	2.25	2.04	2.12	2.15	2.15	2.14	2.09	2.11	2.08	1.98	2.08
Polluted surface water		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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	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**
Aviation		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
Multilateral Operations		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass														

Table A.7.37. 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
		(Gg)												
Total National Emissions and Removals		**490.46**	**461.82**	**437.50**	**403.59**	**389.31**	**361.90**	**308.17**	**281.38**	**298.03**	**287.01**	**267.08**	**251.23**	**244.29**
1. Energy		**275.19**	**245.74**	**235.79**	**220.25**	**215.20**	**210.05**	**201.19**	**181.91**	**173.90**	**167.23**	**158.84**	**153.81**	**147.48**
A. Fuel Combustion	Reference Approach (2)													
	Sectoral Approach (2)	220.25	198.27	192.31	178.27	172.80	167.24	159.07	145.26	142.27	137.17	131.57	125.53	121.76
1. Energy Industries		3.57	4.10	4.30	3.60	3.90	5.20	6.90	2.70	3.14	4.40	4.51	3.95	3.89
2. Manufacturing Industries and Construction		3.41	4.30	5.80	2.90	2.60	3.87	2.37	1.70	3.18	1.58	1.87	2.08	1.72
3. Transport		197.92	178.10	170.16	158.75	154.31	144.42	135.03	127.19	122.58	118.35	112.35	106.59	103.23
4. Other Sectors		15.14	11.50	11.70	12.60	11.50	13.19	14.24	12.96	12.95	11.88	12.35	12.42	12.39
5. Other		0.20	0.27	0.34	0.42	0.49	0.56	0.53	0.72	0.43	0.95	0.49	0.49	0.53
B. Fugitive Emissions from Fuels		54.94	47.47	43.48	41.99	42.40	42.80	42.12	36.65	31.62	30.07	27.27	28.28	25.72
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
2. Oil and Natural Gas		54.94	47.47	43.48	41.99	42.40	42.80	42.12	36.65	31.62	30.07	27.27	28.28	25.72
2. Industrial Processes		**86.43**	**121.54**	**116.10**	**100.77**	**89.08**	**53.70**	**29.57**	**29.92**	**46.32**	**39.36**	**38.91**	**32.46**	**31.11**
A. Mineral Products		1.04	0.00	0.00	0.00	0.00	0.45	0.44	0.41	0.27	0.23	0.19	0.23	0.21
B. Chemical Industry		33.11	0.30	0.41	0.47	0.62	17.89	18.02	16.13	13.98	13.33	12.56	11.25	11.53
C. Metal Production		3.15	0.35	0.30	0.30	0.27	2.60	2.19	2.32	2.12	2.72	1.93	1.13	1.67
D. Other Production (3)		10.76	0.00	0.00	0.00	0.00	7.33	2.45	5.78	6.46	5.48	5.66	5.61	5.38
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
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
G. Other		38.36	120.90	115.40	100.00	88.20	25.44	6.47	5.28	23.48	17.60	18.57	14.24	12.32
3. Solvent and Other Product Use		**127.12**	**92.85**	**83.95**	**80.95**	**83.45**	**96.23**	**75.46**	**67.86**	**76.18**	**79.14**	**68.11**	**63.75**	**64.54**
4. Agriculture		0.16	0.20	0.20	0.20	0.20	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
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
C. Rice Cultivation		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils		0.16	0.20	0.20	0.20	0.20	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
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
F. Field Burning of Agricultural Residues		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
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**
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
B. Forest and Grassland Conversion		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
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
E. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste		**1.56**	**1.49**	**1.46**	**1.42**	**1.37**	**1.76**	**1.79**	**1.52**	**1.47**	**1.10**	**1.06**	**1.05**	**0.99**
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
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
C. Waste Incineration		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other		0.11	0.03	0.03	0.03	0.03	0.49	0.56	0.33	0.33	0.05	0.07	0.12	0.12
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**
Solvents and other product use		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Polluted surface water		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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	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**
Aviation		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
Multilateral Operations		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass														

Table A.7.38. 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
					(Gg)									
Total National Emissions and Removals		**203.52**	**173.45**	**167.37**	**160.29**	**146.21**	**142.47**	**135.50**	**117.67**	**109.80**	**104.80**	**90.81**	**90.06**	**85.43**
1. Energy		**191.95**	**151.04**	**148.56**	**143.58**	**130.00**	**138.85**	**131.96**	**114.50**	**107.06**	**102.33**	**88.38**	**87.47**	**83.25**
A. Fuel Combustion	Reference Approach [2]													
	Sectoral Approach [2]	184.34	141.34	136.96	132.08	119.40	128.63	121.37	104.42	99.21	93.27	81.88	80.69	77.03
1. Energy Industries		105.06	88.60	81.10	77.40	66.20	68.25	63.92	55.46	52.80	50.61	42.31	43.67	41.20
2. Manufacturing Industries and Construction		44.15	17.50	20.00	17.60	16.20	26.78	27.13	22.84	19.67	15.79	13.88	13.30	12.54
3. Transport		30.53	31.12	31.63	31.25	31.57	30.55	27.70	23.80	24.78	24.67	23.91	21.93	21.52
4. Other Sectors		4.57	4.10	4.20	5.80	5.40	3.02	2.55	2.25	1.90	2.11	1.69	1.76	1.73
5. Other		0.03	0.02	0.02	0.03	0.03	0.04	0.08	0.07	0.06	0.10	0.09	0.03	0.03
B. Fugitive Emissions from Fuels		7.61	9.70	11.60	11.50	10.60	10.22	10.59	10.08	7.84	9.06	6.50	6.78	6.22
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
2. Oil and Natural Gas		7.61	9.70	11.60	11.50	10.60	10.22	10.59	10.08	7.84	9.06	6.50	6.78	6.22
2. Industrial Processes		**7.39**	**22.40**	**18.80**	**16.70**	**16.20**	**3.34**	**3.36**	**3.06**	**2.71**	**2.43**	**2.42**	**2.53**	**2.13**
A. Mineral Products		6.31	0.00	0.00	0.00	0.00	2.77	2.75	2.46	2.24	2.42	2.04	2.15	2.00
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	0.13
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
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
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
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
G. Other		1.08	22.40	18.80	16.70	16.20	0.57	0.61	0.60	0.47	0.01	0.37	0.38	0.00
3. Solvent and Other Product Use		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
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
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
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
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
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
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
G. Other		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**
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
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
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
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
E. Other		NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste		**4.17**	**0.00**	**0.00**	**0.00**	**0.00**	**0.27**	**0.16**	**0.10**	**0.01**	**0.02**	**0.00**	**0.04**	**0.04**
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
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
C. Waste Incineration		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	0.27	0.16	0.10	0.01	0.02	0.00	0.04	0.04
7. Other *(please specify)*		**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**
Solvents and other product use		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
Polluted surface water		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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	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**
Aviation		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
Multilateral Operations		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass														

Figure A.7.39. Shares and trends in NO_x emissions per IPCC sector 1990-2002

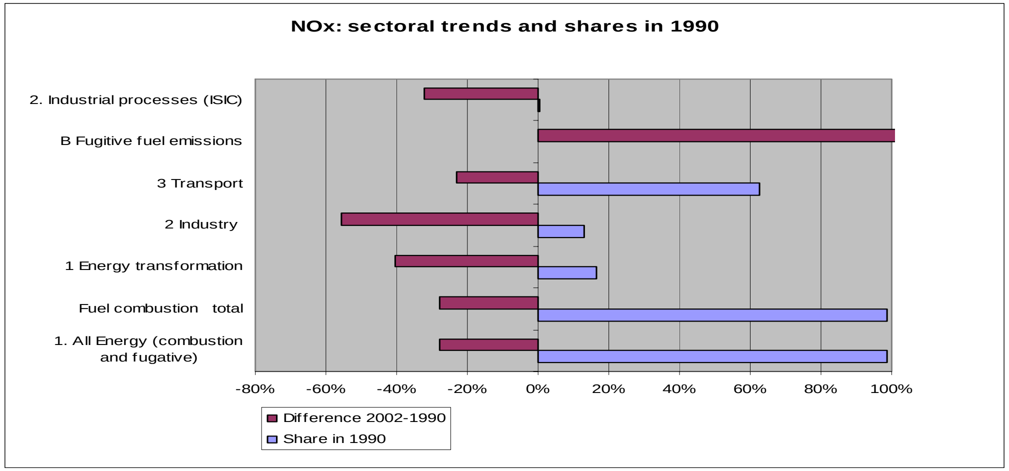


Figure A.7.40. Shares and trends in CO emissions per IPCC sector 1990-2002

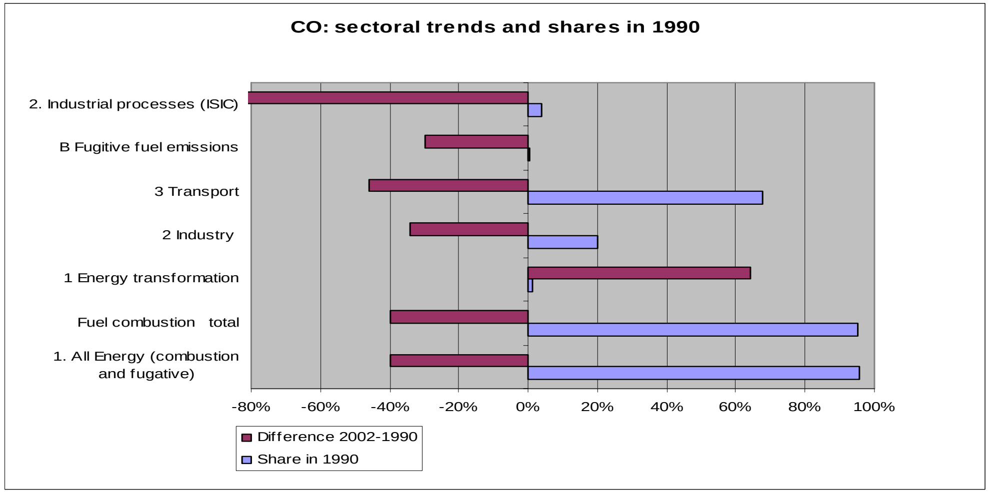


Figure A.7.41. Shares and trends in NMVOC emissions per IPCC sector 1990-2002

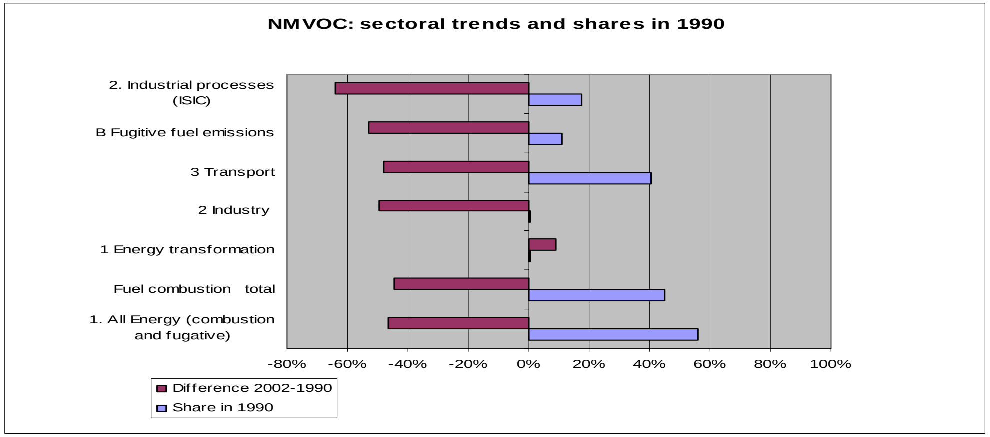
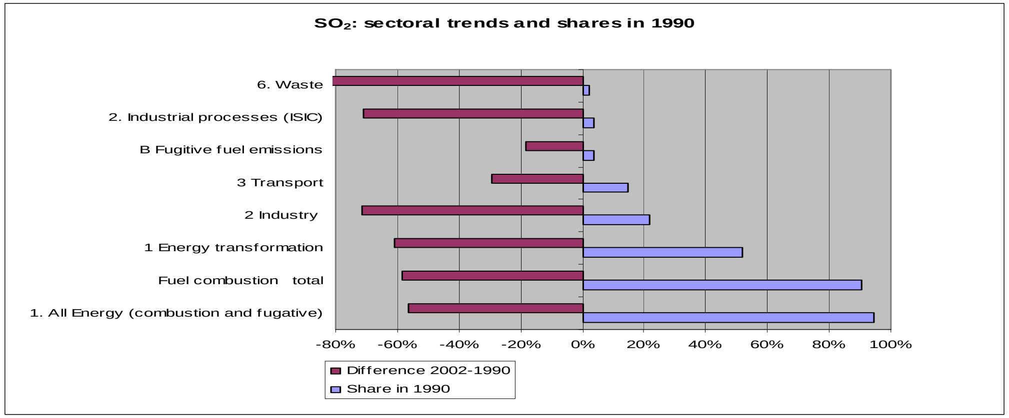


Figure A.7.42. Shares and trends in SO_2 emissions per IPCC sector 1990-2002



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
BOD	Biological Oxygen Demand
C	Confidential (notation key in CRF)
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
MJV	Annual Environmental Report
MNP	National 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
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
OECD	Organisation for Economic Cooperation and Development
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)
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