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Greenhouse Gas Emissions in the Netherlands 1990-2000. National Inventory Report 2002

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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

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Abstract

This report documents the 2002 Netherlands' annual submission of its greenhouse gas emission inventory in accordance with the United Nation's Framework Convention on Climate Change (UNFCCC) and the European Union's Greenhouse Gas Monitoring Mechanism. The report comprises explanations of observed trends in emissions; a description of a first assessment of key sources and their uncertainty; documentation of methods, data sources and emission factors applied; and a description of the quality assurance system and the verification activities performed on the data. Total CO_2-equivalent emissions of the six greenhouse gases together increased in 2000 by about 3% relative to 1990 (1995 for fluorinated gases). This increase would be a half per cent less when comparing temperature-corrected emissions. Without policy measures, emissions in 2000 would have been about 10% higher. Due to recalculations, total CO_2-eq. emissions for the base year decreased by 5.2 Tg CO_2-eq. or 2.4%, mainly caused by the application of new, measured emission factors and elimination of statistical differences in the energy balance. The uncertainty in total *annual* CO_2-equivalent emissions is estimated at 5%; the uncertainty in the 1990/95-2000 *trend* of total emissions is about ±3% points, based on the IPCC Tier 1 trend uncertainty assessment (95% confidence interval). Emissions of CO_2 and N_2O have increased from 1990 to 2000 by about 9% and 3%, respectively, while in the same period CH_4 emissions have decreased by 24%. Of the fluorinated greenhouse gases, for which 1995 is the reference year, emissions of HFCs, PFCs and SF_6 decreased by 34%, 18% and 9% in 2000, respectively. Per individual gas, the IPCC Tier 1 *trend* uncertainty in total emissions of CO_2, CH_4, N_2O and the total group of F-gases has been calculated at ±3%, ±7%, ±12% and ±11% points, respectively.

Contents

Executive Summary

This report documents the 2002 Netherlands' annual submission of its greenhouse gas emission inventory in accordance with the United Nation's Framework Convention on Climate Change (UNFCCC) and the European Union's Greenhouse Gas Monitoring Mechanism. The report comprises (a) explanations of the trends in greenhouse gas emissions for the period 1990-2000, (b) a first assessment of so-called 'key sources' and their uncertainty following the Tier 1 and Tier 2 approach of the *IPCC Good Practice Guidance*, (c) documentation of methods, data sources and emission factors applied, and (d) of Quality Assurance and Quality Control activities. Electronic data on emissions, activity data and implied emission factors in the so-called *Common Reporting Format* (CRF) spreadsheet files as requested by the UNFCCC secretariat are a separate annex to this report. In the appendices to this report a copy is included of the CRF Trend Tables 10 and the IPCC Summary Tables 7A for the period 1990-2000 (all 2000 data are preliminary), Recalculation and Explanations Tables 8 and Completeness Tables from the CRF files.

The emissions data reported in these tables differ from the data reported in the previous report, mainly due to elimination of statistical differences in the energy balances of 1990 and 1995-1998, including an improvement in the energy statistics of fuel consumption data in the chemical industry; recalculation of CO_2 emissions and sinks to LUCF; recalculation of N_2O emissions from transport and from nitric acid production; revision of HFC emissions and addition of an SF_6 source (production of soundproof double glazed windows). Due to these recalculations, total CO_2-eq. emissions in the base year decreased by 5.2 Tg CO_2-eq. or 2.4%. Emissions of CO_2 and N_2O in 1990 have decreased by 1.6 and 3.2 Tg CO_2-eq., respectively, due to these recalculations, HFC emissions decreased in 1995 by 0.7 Tg CO_2-eq, while SF_6 emissions increased by 0.2 Tg CO_2-eq. This is mainly caused by the application of new, measured emission factors and elimination of statistical differences in the energy balance.

In *Table 3.1* trends in national total (net) emissions are summarised for 1990-2000 (uncorrected for temperature). Total CO_2 equivalent emissions of the six greenhouse gases together increased in 2000 by about 3% relative to 1990 (1995 for fluorinated gases). This increase would be a half per cent less when comparing temperature-corrected emissions. Without policy measures emissions in 2000 would have been about 10% higher. Emissions of CO_2 and N_2O have increased from 1990 to 2000 by about 9% and 3%, respectively, while in the same period CH_4 emissions have decreased by 24%. Of the fluorinated greenhouse gases, for which 1995 is the reference year, emissions of HFCs and PFCs decreased by 34 and 18% in 2000, respectively, while SF_6 emissions (completely recalculated) decreased by about 9%.

In the period 1990-2000 the largest sectoral growth of CO_2 emissions occurred in the transport sector (21% or 6.0 Mton). In 2000, total CO_2 emissions increased by 1% (1.3 Mton) compared to 1999. This was mainly caused by increased energy consumption in the industry, domestic and transport sectors. In 2000, temperature-corrected CO_2 emissions were 5.1 Mton or 2% higher than total national uncorrected CO_2 emissions. The results of a provisional *IPCC Reference Approach* calculation for CO_2 showed that on average the sum of annual sectoral emissions differs 1.0% from the reference calculation.

In 2000, total CH_4 emissions have decreased by 24% compared to the 1990 level. Sectors that contributed most to the decrease were the waste sector (-29%) and the agricultural sector (-19%) with 1.6 and 1.0 Mton CO_2-eq., respectively. In 2000, total N_2O emissions increased by about 3% compared to 1990, mainly due to the increase of the emission from agriculture (10%) and from transport (65%) with 2.2 and 0.8 Mton CO_2-eq., respectively. In 2000, total emissions of all F-gases decreased by about 30% compared to the 1995 level (18% compared to 1990), which is equivalent to 2.6 Mton CO_2-eq.

The uncertainty in total *annual* CO_2 equivalent emissions is estimated at 5%; the uncertainty in the 1990/95-2000 *trend* of total emissions is about ±3% points, based on the IPCC Tier 1 trend uncertainty assessment (95% confidence interval). For individual compounds our current overall uncertainty estimate in *annual* emissions is ±3% for CO_2, ±25% for CH_4, ±50% for N_2O; ±50% and for HFCs, PFCs and SF_6: ±50% Per individual gas, the Tier 1 trend uncertainty in total emissions of CO_2, CH_4, N_2O and the total group of F-gases has been calculated at ±3%, ±7%, ±12% and ±11% points, respectively.

However, the annual uncertainty in 2000 emissions and in the trend is probably larger due to the temporarily deterioration of data quality in the last years compared with data for earlier years. This is due to changes in (a) data collection from individual companies and (b) delays in compiling (preliminary) statistics for the last but one calendar year, notably for energy consumption.

Samenvatting (Dutch)

Dit rapport over de Nederlandse inventarisatie van broeikasgasemissies is geschreven om te voldoen aan de nationale rapportageverplichtingen in 2002 van het Klimaatverdrag van de Verenigde Naties (UN-FCCC) en van het Bewakingsmechanisme Broeikasgassen van de Europese Unie. Dit rapport bevat trendanalyses voor de emissies van broeikasgassen in de periode 1990-2000; een eerste 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 verificatie van de emissiecijfers voor de Nederlandse Emissie-Registratie. Electronische data op file over emissies, activiteitendata en afgeleide emissiefactoren in het zgn. *Common Reporting Format* (CRF), waar door het VN-Klimaat-secretariaat om wordt verzocht, vormen een aparte annex bij dit rapport. In de appendices bij dit rapport zijn de CRF trend-tabellen en de IPCC tabellen '7A' opgenomen voor 1990-2000 (alle cijfers voor 2000 zijn voorlopig), alsmede tabellen over herberekeningen en compleetheid van emissiebronnen.

De emissiecijfers zoals hier gerapporteerd verschillen van de vorige rapportage, met name als het gevolg van wijzigingen door het wegwerken van statistische verschillen in de energiebalansen van 1990 en 1995-1998, waarbij gelijktijdig de energiestatistieken van het brandstofgebruik in de chemische industrie zijn bijgewerkt. Andere oorzaken van verschillen zijn de herberekening van CO_2 vastlegging in biomassa, herberekening van N_2O emissies in de transport sector en salpeterzuurfabricage, herziening van HFC emissies en het toevoegen van een emissiebron voor SF_6 (geluidisolerend dubbel glas). Als gevolg van deze herberekeningen zijn in het basisjaar de totale CO_2-equivalente emissies met 5.2 Tg CO_2-eq. of 2.4% gedaald. In totaal zijn de emissies in het basisjaar van CO_2, N_2O en HFK's resp. 1,6 , 3,2 en 0,7 Mton CO_2-equivalent lager geworden; de SF_6 emissies zijn in 1995 toegenomen met 0,2 Mton CO_2-eq. Dit wordt met name veroorzaakt door het gebruik van nieuwe, gemeten emissiefactoren en door de eliminatie van het statistisch verschil in de nationale energiebalans.

In *Tabel 9.1* zijn de totale emissietrends 1990-2000 samengevat (zonder temperatuurcorrectie). De totale netto CO_2-eq.-emissies waren in 2000 3% hoger dan in 1990 (1995 voor de F-gassen). Dit wordt een half procent minder na temperatuurcorrectie. Zonder beleidsmaatregelen zouden de emissies in 2000 ca. 10% hoger zijn geweest. In die periode zijn de emissies van CO_2 en N_2O met resp. 9% en 3% gestegen, terwijl de CH_4-emissies met 24% daalden. Van de zgn. F-gassen, waarvoor 1995 het referentiejaar is, daalden de HFK- en PFK-emissies met resp. 34% and 18% in 2000 ten opzichte van 1995, terwijl de emissies van SF_6 met 9% daalden.

In de periode 1990-2000 vond de grootste sectorale groei in de CO_2-emissies plaats in de transportsector (21% of 6.0 Mton). In 2000 zijn de totale CO_2-emissies met 1,3 Mton gestegen ten opzicht van 1999. Dit werd met name veroorzaakt door een toename van het energiegebruik door industrie, consumenten en de transportsector. De resultaten van een voorlopige zgn. *IPCC Referentieberekening voor* CO_2 lieten een verschil zien van gemiddeld 1.0% met de som van de jaarlijkse sectorale emissies.

In 2000 waren de methaanemissies 24% lager dan in 1990. De afvalsector (-29%) en de landbouwsector (-19%) droegen hieraan het meest bij (resp. 1,6 en 1,0 Mton CO_2-eq.). De N_2O-emissies zijn in 2000 ca. 3% gestegen ten opzichte van 1990, vooral als gevolg van een stijging van emissies uit de landbouw (10%) en de transportsector (65%) (resp. 2,2 en 0,8 Mton CO_2-eq.). De actuele emissies van F-gassen zijn in de periode 1995-1999 met 30% afgenomen (18% t.o.v. 1990), hetgeen overeenkomt met 2,6 Mton CO_2-eq.

De onzekerheid in de totale *jaarlijkse* emissies wordt geschat op 5%; de onzekerheid in de *trend* over de periode 1990/95-1999 wordt op ±3%-punten geschat, gebaseerd op de zgn. 'Tier 1' methodiek van de IPCC voor trendonzekerheden (met 95% betrouwbaarheidsinterval).Voor de afzonderlijke stoffen wordt thans 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%, ±7%, ±12% and ±11%-punten.

Daarbij moet worden opgemerkt dat de onzekerheid in de emissiecijfers voor 2000 en in de emissietrend waarschijnlijk groter is dan hierboven genoemd is, 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 energiegebruik.

Chemical compounds

CF_4	Perfluoromethane (tetrafluoromethane)
C_2F_6	Perfluoroethane (hexafluoroethane)
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
FICs	Fluoroiodocarbons
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)

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)

Conversion factors for emissions

<u>From element basis to full molecular mass:</u>

$C \rightarrow CO_2$:	x 44/12 = 3.67
$C \rightarrow CH_4$:	x 16/12 = 1.33
$C \rightarrow CO$:	x 28/12 = 2.33
$N \rightarrow N_2O$:	x 44/28 = 1.57
$N \rightarrow NO$:	x 30/14 = 2.14
$N \rightarrow NO_2$:	x 46/14 = 3.29
$N \rightarrow NH_3$:	x 17/14 = 1.21
$N \rightarrow HNO_3$:	x 63/14 = 4.50
$S \rightarrow SO_2$:	x 64/32 = 2.00

<u>From full molecular mass to element basis:</u>

$CO_2 \rightarrow C$:	x 12/44 = 0.27
$CH_4 \rightarrow C$:	x 12/16 = 0.75
$CO \rightarrow C$:	x 12/28 = 0.43
$N_2O \rightarrow N$:	x 28/44 = 0.64
$NO \rightarrow N$:	x 14/30 = 0.47
$NO_2 \rightarrow N$:	x 14/46 = 0.30
$NH_3 \rightarrow N$:	x 14/17 = 0.82
$HNO_3 \rightarrow N$:	x 14/63 = 0.22
$SO_2 \rightarrow S$:	x 32/64 = 0.50

1. Introduction

This report documents the 2002 Netherlands' annual submission of its greenhouse gas emission inventory in accordance with the guidelines provided by the United Nation's *Framework Convention on Climate Change* (UNFCCC) and the European Union's *Greenhouse Gas Monitoring Mechanism*. These guidelines aim at facilitating verification, technical assessment and expert review of the inventory information. For this purpose the inventories should be *transparent, consistent, comparable, complete* and *accurate* as defined in UNFCCC (1999) and be prepared using *good practice* as described in IPCC (2000).

Thus, this report comprises explanations of the trends in greenhouse gas emissions for the period 1990-2000 and descriptions of methods and data sources; of Tier 1 assessments of the uncertainty in annual emissions and in emission trends; of a preliminary assessment of key sources following the Tier 1 and Tier 2 approach of the *IPCC Good Practice Guidance* (IPCC, 2000); and of Quality Assurance and Quality Control activities. The emissions data presented in this report are identical to those officially published in the *Emission Monitor 2001* (Van Harmelen *et al*., 2001) and used in RIVM (2001a). We note that all data in this dataset presented for 2000 are preliminary. For 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, 2001, in Dutch), the *Third Netherlands' National Communication on Climate Change Policies* (VROM, 2001) and special assessments [Van den Wijngaart and Ybema (2002), Beker and Peek (2002), Menkveld *et al.* (2002)] available in Dutch and English.

Electronic data on emissions, activity data and implied emission factors in the so-called *Common Reporting Format* (CRF) spreadsheet files as requested by the UNFCCC secretariat are available as 11 Common Reporting Format (CRF) data files, named 'crf-nld-2002-NN.xls' with NN = 90 .. 00, compressed into three zip-files: crf-nld-2002-v2-90-93.zip; crf-nld-2002-v2-94-97.zip; crf-nld-2002-v2-98-00.zip, which accompany this report. In Annex 5 of this report a copy is included of the Trend Tables 10 and a selection of IPCC Summary Tables 7A for the period 1990-2000 (2000 data are preliminary), Recalculation and Explanation Tables 8 and Completeness Tables from the CRF files.

Presentation of sources: Netherlands' Target Groups and IPCC source categories

UNFCCC guidelines for reporting greenhouse gas emissions (UNFCCC, 1997) require the use of source categories as defined in *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
6. Waste
7. Miscellaneous

The first category comprises both fossil and biofuel fuel use, and is subdivided in *1A Fuel Combustion* and *1B Fugitive emissions from Fuels.* For users in the Netherlands, where usually a subdivision of emissions sources is made into so-called Target Groups, we show in *Table 1.1* the correspondence between Netherlands' Target Group emissions to nomenclature of UNFCCC/IPCC source categories used in this report.

Table 1.1. Correspondence between Netherlands Target Group emissions to IPCC source categories

Target Group	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	1A1b	Fuel combustion; Energy Industries; sub b (electricity and heat production)	1B2	Fugitive emissions from oil and natural gas
Energy sector - power generation	1A1a	Fuel combustion; Energy Industries; a	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	1Aa	Fuel combustion; Energy Industries; a [4)]		
- WWTP			6B	Waste; Wastewater Handling
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	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)

Notes:
1) N_2O from polluted surface water: *7 Miscellaneous*
2) CO_2 from non-energy use of fuels e.g. chemical feedstock are reported under *1A 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 energetic purposes.
5) CH_4 and NMVOC: *7 Miscellaneous.*

Inventory preparation: quality assurance/quality control

Chapter 2 describes the Dutch National Emission Inventory System and the Quality Assurance/ Quality Control activities performed. This includes the response to issues raised in reviews by UNFCCC and others.

Trend assessments

In Chapter 3 the aggregated trends and the contribution of emissions per greenhouse gas to annual CO_2-eq. emissions are described. In addition, in Chapters 8 and 9 the trends in emissions of greenhouse gas and of precursor gases are described and explained in detail. A comparison with a provisional *CO_2 Reference Approach* calculation for the 1990-2000 period showed that the sum of annual sectoral CO_2 emissions differ by 0.1% on average from the reference calculation (range of ±3%-points). The analysis of trends and uncertainty estimates in emissions (see Chapter 7) of the various sources has been made in cooperation with the following RIVM experts: Mr. Dik Beker (waste), Mr. Robert van den Brink (transport), Mr. Klaas van der Hoek (agriculture), Mrs. Johanna Montfoort (fugitive emissions, energy), Mr. Kees Peek (industry) and Mr. Durk Nijdam (small combustion). In addition, Mr. Ed Zonneveld of CBS provided pivotal information on CO_2 related to energy use. The group also provided activity data for the CRF files, in cases where these were not included in the data sheets submitted by the ER Task Groups.

Country-specific definitions and changes

In Chapter 4 the emission calculation methods and data sources are briefly described and documented. To improve the consistency of times series, changes have been made in the source allocation for the period 1990-2000. These changes are discussed briefly in Chapter 5. This also includes a summary of the degree of completeness of the CRF data files:

- the CRF files for 1990 and 1995-2000 now also include sectoral background data for 1A Fuel combustion;
- CO_2 emissions of cement clinker production included;
- CO_2 sinks from category 5A have now been calculated for all years;
- SF_6 emissions were added from the production of double glazed windows.

Country-specific definitions of source categories are provided in Chapter 6. This includes a summary of identified missing sources. The emission data for 1990 and 1995-1999 as reported in the CRF tables differ from the data reported in the previous NIR 2001 mainly due to:

- elimination of statistical differences in the energy balances of 1990 and 1995-1998, including an improvement in the energy statistics of fuel consumption data in the chemical industry;
- recalculation of CO_2 emissions and sinks from forestry;
- recalculation of N_2O emissions from transport and from nitric acid production;
- revision of HFC emissions;
- addition of a SF_6 source (production of soundproof double glazed windows).

Due to these recalculations, total CO_2-eq. emissions in the base year decreased by 5.2 Tg CO_2-eq. or 2.4%. Emissions of CO_2 and N_2O in 1990 have decreased by 1.6 and 3.2 Tg CO_2-eq., respectively. HFC emissions decreased in 1995 by 0.7 Tg CO_2-eq, while SF_6 emissions increased by 0.2 Tg CO_2-eq. in 1995.

Key source and uncertainty assessment

In Chapter 7 a uncertainty assessment is presented as well as a preliminary assessment of key sources, that has been made using both the Tier 1 and Tier 2 approach of the *IPCC Good Practice Guidance* report.

The uncertainty in the emission estimates per gas is based on an IPCC Tier 1 uncertainty assessment of the uncertainty in the underlying emission factors and activity data for the list of possible key sources. All uncertainty figures in this report should be interpreted as 95% confidence ranges, in conformity with the IPCC report on *Good Practice Guidance and Uncertainty Management* (IPCC, 2000). These uncertainties are based on the results of a national workshop on data quality held in 1999 (Van Amstel *et al*., 2001a), RIVM factsheets on emission data quality, default values provided in the *IPCC Good Practice Guidance* and expert judgement by RIVM experts. In the Chapter 7 the uncertainty estimates for both annual uncertainty and the trend uncertainty are calculated using simple, standard error propagation of the overall uncertainty per greenhouse gas as defined in the IPCC Tier 1 approach and assuming no correlation between sources and normal distribution of the uncertainties. Our actual overall estimate of total *annual* uncertainty per greenhouse gas, which is based on the IPCC Tier 1 uncertainty assessment (95% confidence interval), is currently estimated by RIVM as:

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 about 5%. The uncertainty in the *trend* of total emissions is about ±3% points, based on the IPCC Tier 1 trend uncertainty assessment. Per individual gas, the Tier 1 trend uncertainty in total emissions of CO_2, CH_4, N_2O and the total group of F-gases has been calculated at ±3%, ±7%, ±12% and ±11% points, respectively.

Using the IPCC Tier 1 uncertainty approach, the uncertainties in national *annual* total emissions of precursor gases are estimated at (RIVM, 1999, 2001a):

CO	±25%
NO_x	±11%
NMVOC	±26%
SO_2	±8%

We note that in the IPCC Tier 1 uncertainty assessment no correction is made for possible correlations or not-reported sources. Moreover, the presented figures may not be valid for the 2000 provisional emissions, due to additional uncertainties in this dataset (see Section 7.1).

Print out of CRF summary tables

Finally, in the annexes a description of the method for LUCF (5A), the temperature correction method and a printed summary version of the CRF files are provided:

- IPCC Summary Tables 7A for 1990-2000 (CRF Summaries 1);
- Recalculation Tables and Explanation Table 8.a and 8.b for 1990 and 1995-1999;
- Completeness Table 9 for 1990;
- Trend Tables 10 for each gas individually and for all gases and source in CO_2-eq.;
- Trend Tables 10 for precursor gases.

The complete set of CRF files as well as the NIR in pdf format is available at RIVM's website (www.rivm.nl).

Presentation of figures; rounding and summation

Please note that in all tables the same number of decimal digits is used within a table (or per compound column). Therefore, the number of (decimal) digits shown does not correspond with the number significant digits of the figures presented. Please note too that in the tables the figures may not exactly add up to the (sub)totals because of independent rounding. We refer to Chapter 7 for information about the uncertainty in sectoral and national total emissions.

2. Inventory Preparation: Quality Assurance/Quality Control

2.1. Introduction

Data collected in the National Inventory Report are based on the National *Pollutant Emission Register* (PER or short 'ER'), also called the Emission Inventory System. This system compromises the registration, analysis, localisation and presentation of emission data of both industrial and non-industrial sources in the Netherlands. Section 2.2 gives more information on the Emission Inventory System. Annually, in year *t* final emissions are calculated for year *t-2* and preliminary estimates are made for emissions of the last year but one (*t-1*). In addition, in case of methodological changes, emissions are recalculated for *t-3* as well as for 1990 and 1995. This means that in 2001 emissions were (re)calculated for 1990, 1995, 1998, 1999 and 2000.

The data from the PER have to be "translated" to the Common Report Format (CRF). Also additional information and calculations are necessary to fill the CRF-files. Several institutes are involved in this process. To improve the transparency of this process, the actual situation in the Netherlands with respect tot the IPCC Good Practice Guidelines was evaluated. In section 2.3 the conclusions from this study are included. In Sections 2.3 and 2.4 the quality assurance and control activities of the Dutch Emission Inventory in 2001 are described, respectively.

In 2000 a Greenhouse Gas Inventory Improvement Programme was started. This programme is guided by a *Working Group Emission Monitoring of Greenhouse Gases* (WEB). This committee directs future actions aimed at improving the monitoring of greenhouse gas emissions, relevant to report to the UNFCC in all aspects. In section 2.4 we summarise the main actions. One of the action is aimed at improving the process of data collection and calculations by the use of protocols, that in 2003 should be included in the PER system (see Section 2.2).

In the reviews on the National Inventory Report, including CRF files, suggestions were made to improve the quality. In *Section 2.4* we describe the Netherlands' response to the issues raised in those reviews.

2.2. National Emission Inventory System

The Netherlands has already for many years a pollutant emission inventory system that collects data on emissions to air, water and soil. This inventory has been established in a co-operation between:

- Inspectorate for Environmental Protection of the Ministry of Housing, Spatial Planning and the Environment (VROM/HIMH) [from January 2002 the 'Inspectorate HIMH' changed to 'VROM Inspectorate']
- Statistics Netherlands (CBS)
- National Institute of Public Health and Environment (RIVM)
- Ministry of Agriculture, Nature Conservation and Fishery (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)

Agreement on definitions, methods and emission factors, is established in the *Co-ordination Committee for Monitoring of Target Groups* (CCDM), based on reports by expert groups. So-called *Task Groups* collect the data required and perform the emission calculations.

The emissions of large industrial point sources are registered individually, based upon detailed information of each individual plant. This process, however, has been changed substantially in the last years (see *Box 2.1* and *Figure 2.1*). As explained in *Box 2.1*, 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 temporarily deteriorated. In the next section we discuss actions that started to improve data quality again. The emissions of small and medium-sized enterprises as well as of non-industrial sources are calculated collectively with statistical activity data and emission factors.

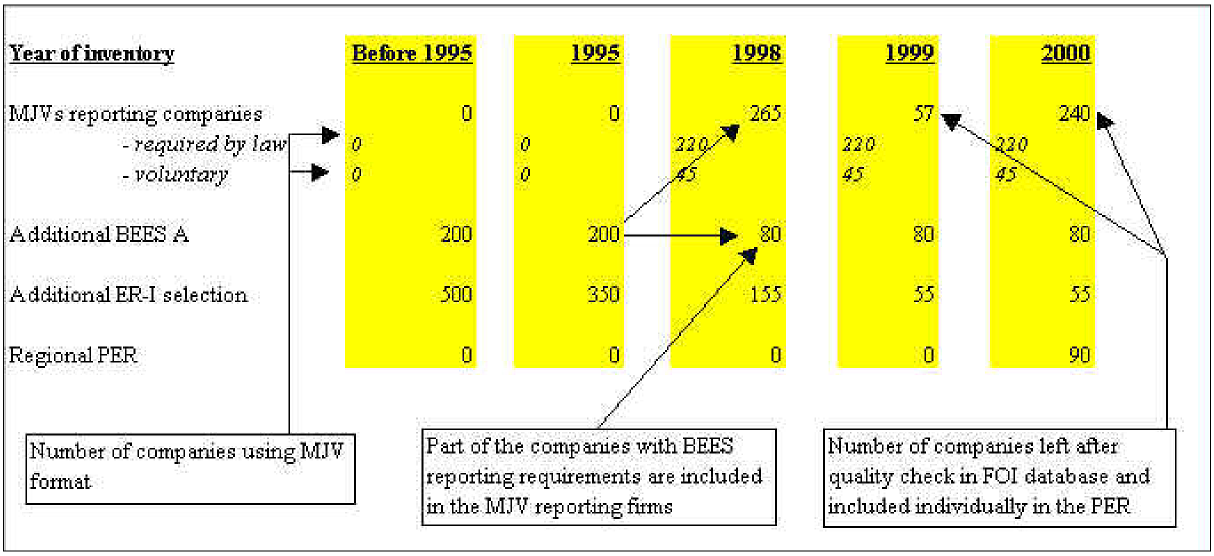

Figure 2.1. Changes in time in data sources used for the individually registered point sources in the PER (for abbreviations see Box 2.1).

Box 2.1: Major changes in data collection and submission of emissions and activity data by large companies

The method for the collection of emissions of large industrial point sources has been changed since 1995 (see *Figure 2.1*). 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, when requested, 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 is 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.

For the emissions of 1999 and subsequent years, the annual environmental reports are collected and, after approval by the provinces, processed and included in a database by the *Facilitating Organisation for Industry* (FOI). For the 1999 PER, a group of 220 companies were obliged to report their emissions in the format of the *annual environmental reports* (*MJVs*). An additional number of 45 companies reported their emissions in a voluntary MJV. Subsequently this administrative FOI database is 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. The emissions of the remaining companies were not registered individually but were used as part of the supplementary estimate, resulting in a smaller detailed data set for individual registered companies. The PER data set was extended as in former years 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 also the voluntarily submitted MJVs were included in the ER-I. In total the individual data set holds emissions for 192 companies.

The PER 2000 includes the individual registered emissions based on the MJVs reported by 240 companies. Also emission data from a regional PER (from the province Noord-Brabant) are included. So the individual data set holds emissions for 465 companies. This data set was used to compile the CRF data for 1999 (final data) and was also used to make the preliminary estimate for the CRF data for 2000.

In 2001 the ministry of VROM improved the reporting format in which the individual companies have to report their emissions. This combined with the action to make the format electronically available is expected to improve data quality for the emission figures from 2002 onwards. Quality control in this new system is still subject of discussion.

2.3. Quality Assurance

Quality Assurance for the Netherlands' PER

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. This project plan includes responsibilities of the involved parties, the members of the Task Groups, the division of tasks, the selection of substances and years, the list of source categories and the time schedule. Each Task Group has the task to define or update a protocol for the monitoring process of their specific Target Group. 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 reports the necessary improvements identified for next year's emission inventory update.

In 1997 the quality assurance system ISO 9001 has been 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 Groups are not yet part of the formal ISO quality assurance program.

Quality of Annual Environmental Reports (MJVs)

As presented in *Figure 2.1* and *Box 2.1* the *Annual Environmental Reports* (in Dutch: *'MJVs'*) hold the data for the large companies that are 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 by virtue of statutory obligation prepared this report themselves. Analysis on these MJVs and a trend analysis on emission data 1998 and 1999 for 171 companies resulted in doubts about the quality. For example CO_2 emissions reduced from 1998 to 1999 for these 171 companies by 33%. 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, to technical improvements, production disturbance and improved measurements. Also mistakes in units, calculations etc. showed. Overall the improved data for these companies result in a new figure for CO_2 emissions. The CO_2 reduction was not 33%, but 7% (Heslinga, 2001a).

As mentioned in Section 5.5, the CRF files now also include sectoral background data (i.e. emissions per fuel type) for *1A Fuel combustion*, including *1A1: Energy Industries* and *1A2: Manufacturing Industries* for the years 1990 and 1995-2000. However, 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 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 20% in 1996-1998 and to 34% in 1999; i.e. this percentage of national CO_2 emissions could not be allocated to a specific fuel type in either an energy or manufacturing industry sector. In other words, due to limited data quality and completeness of point source data, about 10 to 35% of national CO_2 emissions from fossil fuel consumption could not be reported as gas, oil or coal, but has been included under *'Other fuels'*, for which no correct and meaningful so-called *'Implied Emission Factors'* could be provided in the CRF. This primarily refers to three groups of economic sectors, that account for almost all of the unspecified emissions in 1999, each contributing about one-third: (a) refineries and iron and steel production, of which *all* CO_2 emissions in 1999 could not - or not properly - associated with reported fossil fuel consumption; (b) public electricity production; and (c) the chemical industry. We refer to Sections 8.1.3 and 8.1.4 for more details.

Also an investigation has been made of the quality of MJVs submitted on 2000 emissions (Heslinga, 2001b). In the MJV the energy input, specified by energy sources, should be reported. It was concluded that only for 40% this detail information could be used. And this information is essential as activity data as well as for the calculation of GHG emissions. In the MJVs in total 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. This is also the situation for NO_x: 36 Gg out of a total of 65 Gg. These remarks for 1999 and 2000 do not mean to say that these data are wrong, but rather it means 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 several reporting formats for the MJV is reduced to one format, which has to be used for the MJV 2002. In this format the companies has to report for several processes. This classification of the processes makes the differences between fuel combustion and non-combustion emissions more transparent. The Ministry of VROM will annually report the progress in this improvement plan (VROM, 2002).

Documentation of methodologies used in the PER

In the course of time, the methodology for calculating emissions to air and water in the Netherlands' Emission Registration has described in a number of reports:

- general methodologies and data in Van der Most *et al.* (1998) [in Dutch];
- the methodology for calculating greenhouse gas emissions is described in more detail in Spakman *et al.* (1997) [in Dutch];
- specific changes in methods of datasets are described in the annual reports on Emissions and Waste, e.g. Van Harmelen *et al.* (2001) [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. Van Harmelen *et al.* (2002);
- a set of source category reports documenting or summarising the methodology used by the Task Groups is in preparation (so-called meta-data files) (TNO, 2001).

Finally, since 1994 changes in methodologies, deviating source definitions and changes in source allocations in greenhouse gas emissions are reported in the annual National Inventory Reports on greenhouse gas emissions in the Netherlands prepared/coordinated by RIVM for submission to the UNFCCC and the EU Greenhouse Gas Monitoring Mechanism.

QA/QC system for the NIR/CRF process

In 2001 the Working Group Emission Monitoring of Greenhouse Gases (WEB) started a two-phase project, to develop a QA/QC system for the Dutch NIR/CRF process which is in line with the QA/QC guidelines from the UNFCCC and the IPCC. The first phase evaluated existing practices; the second phase is directed to develop and implement the QA/QC system itself and will start in 2002. Seven aspects of existing practice were reviewed (DHV, 2002): (a) inventory agent; (b) QA/QC plan and report; (c) general QC procedures (Tier 1); (d) source category specific QC procedures (Tier 2); (e) QA procedures; (f) verification; and (g) documentation, archiving and reporting. From the overview of the general process and the gap analyses conclusions were drawn and recommendations were formulated. The main conclusion from phase 1 is that in general the transparency of the Dutch system, the consistency and comparability of the emission data could be improved. The completeness and comparability (i.e. data are unbiased and a true reflection of national emissions) are in conformity with UNFCCC guidelines (DHV, 2002).

Protocols for CO_2 and non-CO_2 greenhouse gas emissions

In 2001 a project was started to develop specific monitoring protocols for the non-CO_2 greenhouse gas emissions in the Netherlands, which is co-ordinated by Novem. With key firms, organisations involved in the PER process and other research institutes a discussion was started to document the methods used, the willingness to provide (confidential) data, and to change methods to bring these in line with the IPCC Good Practice guidelines. For four (key) sources the first phase finished in 2001 with draft protocols: N_2O related to nitric acid production, HFC-23 related to HCFC-22 production, CH_4 related to landfills, and SF_6 for the high voltage switchgear (GIS) manufacturer and GIS users. In the second phase, these draft protocols will be discussed with the ER Task Groups and, ultimately, approved by the CCDM. The aim is to incorporate these protocols in the PER process by 2003. In 2002 also a start was made with developing protocols for CO_2 emissions.

Documentation of completing CRF files

The PER database does not hold all information necessary to fill the CRF files. In general additional data are needed for four groups:

- data for the *IPCC Reference Approach* for CO_2 from fuel combustion;
- recalculations (and additional data) for the years 1991-1994, 1996-1997, which were not considered in the inventory update project in 2001;
- documentation on recalculations as described in the UNFCCC guidelines and the IPCC Good Practice report, respectively;
- additional activity data for the agricultural sector, for the waste sector and for fuel combustion;
- data related to Land Use Change and Forestry (sinks).

Changes in the data are reported in the CRF Recalculation Tables 9a/b (see Annex 5.3). The activities and data sources to complete the CRF files have been documented in Dutch in Coenen en Olivier (2002).

2.4. Quality Control

The Quality Control (QC) activities of the Dutch Emission Inventory can be divided in several phases:

- QC by ER Task Groups before data delivery to TNO
- QC by TNO
- QC by ER Task Groups before the trend verification workshop
- QC by ER Task Groups and Target Group co-ordinators of RIVM at the workshop
- QC for the IPCC summary tables included in the annual 'Emission Monitor'.

Verification by ER Task Groups and TNO during the preparation of the new inventory

The data deliveries and feedback to the Task Groups is performed in accordance with the procedure "Data handling and presentation" from the quality assurance system of the Dutch Emission Inventory System. The Task Groups filled a standard-format spreadsheet delivered by TNO with emission data for 1998, 1999 and 2000 and for the years 1995 and 1990. The emission file is checked by the chairmen of the Task Groups and then sent to TNO. TNO performed QC activities such as checks on completeness, consistency and formats. The (corrected) data was processed to a comprehensive draft data file. The relevant emissions in the draft data file are sent back to the Task Groups in order to check the data handling of TNO. Observed errors and information about how the quality controls are performed by the Task Groups are reported to TNO. After corrections made in the draft data file, TNO sent the new file to the chairmen of the Task Groups.

In July 2001 a workshop was held for trend analysis of emissions to air. In advance, the Task Groups compared the emissions in the new draft data file for each source category with emissions previously provided from the same source category and checked for consistency in the algorithm/method used for calculations throughout the time series. The Task Groups performed checks for, amongst others, the greenhouse gases carbon dioxide, methane and nitrous oxide emissions from all sectors for the years 1990, 1995, 1998, 1999 and 2000. Firstly, the totals for the sectors were compared with last year's dataset. When significant differences were found the Task Groups looked at the emission data in more detail. The results of these checks were discussed at the workshop. The proposed changes have been sent to the chairmen of the Task Groups and then signed as correct. The new emission spreadsheet was then sent to TNO, which processed the second data delivery into a new comprehensive data file. The chairmen approved the new data file and then the emission data were released by TNO to the participating agencies.

TNO made time series of emissions per substance for the individual Target Groups. The Task Group members, the chairman of the Task Group and the co-ordinator of the Target Group examined these time-series. Remarkable trend changes are noted and discussed at the workshop. If the Task Group members could explain a large change in the trend, it was removed from the list. Inexplicable trend changes are studied in more detail at emission source level after the workshop. In the days directly after the workshop the results are send by mail between the institutes. Points of special interest concerning combustion emissions have been discussed with the chairman of the Task Group. In some cases the differences could be explained or the emission figures are corrected and send to the chairmen of the Task Groups. Finally, the Task Groups made a list of recommended improvements for next year's inventory compilation.

Box 2.2. Results of the trend verification workshop

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

Task Group Energy, Industry and Waste Handling:
- Action TNO, CBS: correction of gaseous and liquid fuel figures in the industry sector.
- Action RIVM: check carbon dioxide emissions of metal industry, since these may contain double counting.

Task Group Residential, Commercial and Construction sectors:
- Action TNO, RIVM: check NMVOC, NH_3 and PM_{10} emissions of residential sector, these may contain doublings or errors.

Task Group Traffic and Transport:
- Action CBS, RIVM: check greenhouse gas emissions, these may contain doublings.

Task Group Agriculture:
- Action TNO: no problems observed on greenhouse gases.

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

Verification at IPCC source category level after finalising the new inventory

The annually published national emissions report (Van Harmelen *et al.,* 2002) contains the IPCC Summary Tables 7A for the last three years. Thus, subsequently the emissions for these years were aggregated in the format of IPCC Summary Table 7A. A distinct difference with the national sectoral reporting is that for international reporting according to the IPCC format the sectoral emission sources of most so-called Target Groups 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 1998 and 1999 were compared with the table published last year; (b) annual trends for 99/98 and 2000/1999 have been calculated as percentages.

The NIR co-ordinator summarised observed relatively large differences and contacts the relevant sectoral expert of RIVM in the Task Groups to check the correctness of the source allocation and the plausibility of the difference for all flagged items. This results in a confirmation or correction (e.g. of the IPCC source allocation) and in explanations in terms of either a deliberate recalculation or a probable cause in case of large annual changes. 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 dataset, 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 of 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 sectoral expert of RIVM in the ER Task Groups 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. Since 2001 these activities are documented (see, e.g., Coenen and Olivier, 2002).

2.5. Response to the issues raised in reviews

2.5.1. UNFCCC reviews

At present the Netherlands greenhouse gas inventory were subjected to the following reviews by the Climate Secretariat: (a) Desk Review and Centralised Review of the NIR 2000; (b) Country section of Synthesis & Assessment report on the NIR 2001. In general the findings of the different UNFCCC reviews are well observed and described. The Netherlands response to the general remarks is as follows:

- *Inconsistency in time series*
  Some of the apparent inconsistencies in time series are due to (a) limited recalculations (only for 1990, 1995 and the last three years) due to 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 and 1996-1997) due to 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. However, as explained in the next Section 2.5 this aspect is part of the improvement programme.
- *Missing notation keys and other documentation in CRF tables*
  The use of notation keys could be improved; however, due to the redundancy in the various tables and files, it is not an easy task to do. We included most of them now in the SBT and have documented where 'IE' keys refer to (IE = 'Included Elsewhere').
- *Incompleteness of CRF and NIR*
  A lot of comments refer to incompleteness of the CRF, which was due to limited capacity and limited data availability in the proper format. However, also some tables are in fact redundant in the CRF, e.g. the Trend Tables for the greenhouse gases are identical in all files and could be linked to other tables in the CRF. Instructions are not always clear to what extent documentation should be provided in the CRF and which part should be explained in the NIR. In the 2002 submission most of the items are included, which were observed as missing in the NIR 2001.
- *Additional info in NIR*
  The review reports make recommendations on inclusion in the NIR of information provided in other Dutch reports, which are cited. In general this rises the question how extensive the explanations in the NIR should be, given that the report needs to be submitted annually. The 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 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, amongst others: (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; (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, discrepancies found are still of importance to check if errors have been made in the emission compilation or reporting process.

In the NIR/CRF 2002 the following specific changes were made in the CRF tables, 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, NO, IE, C, where appropriate;
- CRF tables improved by adding to the completeness table and other documentation boxes the source allocation used in cases of 'IE';
- Many data gaps in sectoral background tables have been filled (activity data and emissions, including SBT 5A (exceptions: 1991-1994 data for categories 1A1, 1A2, 1A4; category 2 excluding cement clinker and aluminium production; and all data for categories 5B-E);
- Correction of typing/unit errors as observed;
- IEF for CO_2 from fuel combustion have been improved substantially by moving all point source data with inconsistent - i.e. incomplete - fuel/emissions data to the category 'other fuels';
- CO_2 from cement clinker production 1990-1992 were added/corrected (about 0.4 Gg);
- CH_4 from enteric fermentation by horses in 1998-1999 has been added (about 4 Gg CH_4).

Likewise, the following specific changes were made in the NIR 2002:
- Addition of methodological description for N_2O emissions from road transport (Section 5.13)
- Addition of explanation about annual variability of N_2O from nitric acid and HFC emissions from HFC usage (Section 8.9)
- Addition of explanation on accounting of CO_2 from biofuels in relation to category 5A without double counting (Chapter 4, Section 8.10 and Annex 2)
- Specification added of 'other oil' category in CO_2 Reference Approach (Section 8.1.1)
- Specification added that 'aviation gasoline' is included under 'jet kerosene' (Section 8.1.11)
- Note added that CO_2 from cement clinker production are estimated using clinker production, not cement production (Section 8.1.4)
- Explanation added on the mix of dairy and non-dairy cattle subtypes, resulting in changing implied emission factors of CH_4 for enteric fermentation of the categories dairy cattle and non-dairy cattle (Section 8.2.2)
- Note added on N_2O from crop residues and cultivation of histosols (Section 8.3.3)
- Explanation added on how indirect N_2O emissions from agriculture were estimated and where reported (Chapter 4 and Section 8.3.3)
- Note added on how/where N_2O from human sewage was estimated (Chapter 4 and Section 8.3.3).

2.5.2. Other external reviews

Although the contents of the PER as a whole is not subjected to regular external reviews, in recent years a number a reviews have been conducted regarding the greenhouse gas emissions data and on the PER as National System for compiling the national greenhouse gas inventory:
- On request of RIVM, in 1999 Utrecht University has 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; c) a wider consultation of experts to analyse the uncertainty in the data.
- On request of the UNFCCC secretariat, a consultant has described and evaluated the quality of the Netherlands' present National System for compiling the National Greenhouse Gas Emission Inventory (Mareckova, 2000).

2.6. Inventory improvement programme

The preparation of the greenhouse gas emission data is just a part of the larger national annual emission inventory containing over 100 different pollutants from point sources, area sources and diffuse sources with emissions to air, water, soil and including waste handling data. This process is organised as a project with an annual cycle. Prior to the next data collection changes in coverage of sources and pollutants and priorities for improvement are discussed and documented in a project plan (Wg EAJR CCDM, 2001). In particular, studies have been carried to evaluate and improve the quality and uncertainty of the emissions presently reported by individual companies (through MJV and ER-I) (Heslinga, 2001a,b; Engelen, 2001). Some highlights are presented in Section 2.2.

The inventory for the greenhouse gases has different requirements due to the other status of these emissions (e.g. possibly subject to international trading) and due to the reporting guidelines of UNFCCC and EU as well as the guidelines for the National System. Therefore it was decided to start a separate process to improve - where necessary - data quality, methodologies, documentation and data compilation procedures, notably of greenhouse gas emissions. In 1999 two workshops were held on the quality of methodology and data used for calculation greenhouse gas emissions in the Netherlands. This workshop was attended both by experts involved in the ER project as well as by other Dutch experts on greenhouse gas emission estimation from universities and other research institutes (Van Amstel *et al*., 2000a,b). Subsequently, the ***Working Group Emission Monitoring of Greenhouse Gases*** (WEB) was created to direct future actions aimed at improving the monitoring of greenhouse gas emissions in all aspects. Besides general improvements of procedures and documentation, data quality improvement actions for specific sources are discussed, defined and approved for execution. The results of these activities will lead to adaptations in the regular ER project activities. The WEB has three subgroups: the Project Groups on CO_2, on non-CO_2 and Sinks. WEB and project groups are composed of persons from the relevant ministries and institutes, usually also involved in the Emission Registration project, in order to include the appropriate expertise and for optimal communication with the parties of the ER project. The WEB actions are carried out under formal responsibilities of the Ministry for Environment (VROM) and are co-ordinated by Novem. This programme includes actions such as:

- improvement of specific data, emission factors, etc.;
- developing protocols for monitoring of CO_2 emissions, non-CO_2 emissions and for sinks, with clear and updated descriptions of methods, procedures, working processes and responsibilities;
- improvement of the QA/QC procedures;
- improvement of uncertainty management, including a Tier 2 uncertainty assessment.

In 2001, the WEB started three projects relevant for the NIR. Firstly, a project to develop a QA/QC system for the Dutch NIR/CRF process, of which the first phase was finished (see Section 2.3). Secondly, a project to improve the degree of completeness of the CRF files. For forestry (category 5A) this resulted in new data for CRF Table 5A. For the other CRF Tables on LUCF new information related to land use and soils is now under discussion (see Chapter 8 and Annex 3). Thirdly, a project to carry out an IPCC Tier 2 uncertainty analysis of the Dutch emission inventory and to evaluate the differences found between the Tier 1 and Tier 2 methods. In the next NIR the results of this project will be included.

Furthermore, the ***Project Group CO_2*** initiated a study to evaluate the documentation and validity of the present set of country-specific CO_2 emission factors for fuels. 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. A recommendation was made to draw up a set of guidelines on the proper application of the set of national emission factors that has been agreed upon and to communicate those broadly, e.g. to the companies that report their emissions through the MJV (Van Harmelen and Koch, 2002). This has been planned for 2002. At present no change of national emission factors for CO_2 is being considered. Another study deals with CO_2

emissions related to non-energetic use of energy carriers (notably as chemical feedstock). Within the EU project on *Non-energy use and CO_2 emissions* (Patel *et al.,* 2000) accounting tables are being developed. These are used to evaluate the present methods to define the non-energy use and to estimate the related CO_2 emissions. The ***Project Group Non-CO_2*** performed a study to identify those sources of non-CO_2 greenhouse gases which are yet unknown. In total about 60 'new' sources have been recorded (DHV, 2000). Some of these sources, such as SF_6 from the production of double glazed windows, have already included in the PER 2001 and, thus, also in this NIR. In particular potential sources related to waste handling systems were identified. It has to be determined to what extent these are already covered by the present emission estimating methods. As mentioned above, this Project Group also initiated the development of monitoring protocols for non-CO_2 greenhouse gas emissions.

3. Trends in total 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) for a time horizon of 100 years. For the ozone precursor gases CO, NO_x and NMVOC no total GWP exist. Also for SO_2 no GWP is available.

In *Table 3.1* trends in national total (net) emissions are summarised for 1990-2000. The trends are also visualised in *Figures 3.1* and *3.2*, showing the relative contribution of each gas to annual total emissions. Synthesis analyses by gas can be found in Chapter 8. Trends in CO_2-equivalents by gas and by main source category are provided in Annex 5.4. Total CO_2-equivalent emissions of the six greenhouse gases together increased by about 3% in 2000 relative to 1990 (1995 for fluorinated gases). Without policy measures emissions in 2000 would have been about 10% higher (RIVM, 2001a). CO_2 emissions increased by about 9% (temperature-corrected: 8%) from 1990 to 2000, mainly due to the increase of the emission in the energy sector (15%) and transport sector (21%).

CH_4 emissions have decreased by 24% in 2000 compared to the 1990 level, mainly due the decrease in the waste sector (-29%) and the agricultural sector (-19%). N_2O emissions increased by about 3% in 2000 compared to 1990, mainly due to the increase of the emission from agriculture (10%) and from transport (65%). Of the fluorinated greenhouse gases, for which 1995 is the reference year, emissions of HFCs, PFCs and SF_6 decreased in 2000 by 34%, 18% and 9%. Total emissions of all F-gases decreased by about 30% compared to the 1995 level (18% compared to 1990).

Table 3.1. Total greenhouse gas emissions in CO_2-eq. and indexed (no T-correction) 1990-2000

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**[1)]
Emissions (Tg CO_2-eq)											
CO_2 [2)]	158.1	166.0	164.2	166.1	166.8	171.4	178.3	167.8	173.7	170.8	172.1
CH_4	27.1	27.5	26.4	25.7	25.3	24.6	24.6	23.1	22.4	21.8	20.6
N_2O	16.5	19.2	19.7	19.7	20.2	18.2	20.3	21.1	17.8	17.4	17.0
HFCs	4.4	4.8	4.5	5.1	6.3	6.0	7.2	8.2	9.2	4.8	3.9
PFCs	2.4	2.4	2.1	2.1	1.9	1.9	2.0	2.2	1.7	1.4	1.5
SF_6	0.2	0.1	0.1	0.1	0.1	0.4	0.4	0.4	0.4	0.3	0.3
Total [group of six]	**208.9**	**220.0**	**217.0**	**218.9**	**220.7**	**222.4**	**232.8**	**222.8**	**225.2**	**216.6**	**215.5**
Index (1990=100)											
Index CO_2	100	104.9	103.8	105.0	105.5	108.4	112.7	106.1	109.8	108.0	108.8
Index CH_4	100	101.3	97.3	94.9	93.1	90.5	90.8	85.2	82.4	80.3	76.0
Index N_2O	100	116.2	119.0	119.2	122.3	110.0	122.6	127.8	107.9	105.1	102.8
Total [group of three]	**100**	**105.3**	**104.2**	**104.8**	**105.2**	**106.1**	**110.6**	**105.0**	**105.9**	**104.0**	**103.9**
Index HFCs	100	108.8	102.4	114.3	143.0	134.9	162.7	185.3	207.9	109.1	88.4
Index PFCs	100	100.2	86.3	87.1	77.7	76.8	84.0	88.6	71.0	59.4	62.8
Index SF_6 (potential)	100	53.7	56.9	58.8	79.2	193.1	195.1	206.3	197.5	179.9	174.9
Index [group of six]	**100**	**105.3**	**103.9**	**104.8**	**105.6**	**106.4**	**111.4**	**106.6**	**107.8**	**103.7**	**103.2**
Index (1995 = 100)											
Index HFCs	74.1	80.6	75.9	84.7	106.0	*100*	120.6	137.4	154.1	80.9	65.5
Index PFCs	130.3	130.5	112.4	113.5	101.3	*100*	109.4	115.4	92.5	77.4	81.8
Index SF_6 (potential)	51.8	27.8	29.5	30.5	41.0	*100*	101.1	106.8	102.3	93.2	90.6
Index [group of F-gases]	**85.9**	**89.7**	**82.2**	**88.9**	**102.1**	**100.0**	**117.2**	**131.0**	**137.8**	**80.6**	**70.3**
Index ('90; new gases '95) [3)]											
Index [group of six composite]	**99.5**	**104.7**	**103.3**	**104.2**	**105.0**	**105.9**	**110.8**	**106.0**	**107.2**	**103.1**	**102.6**
International bunkers CO_2 [4)]	39.7	41.3	42.4	44.3	42.9	44.3	45.5	48.4	49.5	51.2	53.5
Index bunkers CO_2 (1990 = 100)	100	104.0	106.8	111.6	108.1	111.6	114.6	121.9	124.7	129.0	134.8

[1)] Data for 2000 are preliminary. In particular in this submission this 't-1' dataset is of a relatively low quality (see Section 7.1).
[2)] Net emissions, including LUCF (category 5A).
[3)] Base year = 100.
[4)] Emissions from international marine and aviation bunkers are not included in national totals.

The uncertainty in CO_2-equivalent emissions of the six greenhouse gases together is about ±3% points, based on the *IPCC Tier 1 trend uncertainty assessment* (see Section 7.1). 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 Chapter 5, is estimated at ±3%, ±7%, ±12% and ±11% points, respectively (*Figure 3.3*). However, it should be kept in mind that the 2000 emissions, although preliminary by definition, include additional uncertainty as explained in Section 7.1. The uncertainty in *annual* emissions of N_2O and CH_4 is estimated at ±50% and ±25%, respectively. For CO_2 the estimate of uncertainty in *annual* emissions is ±3%, for HFCs, PFCs and SF_6 ±50% (see Chapter 7).

In comparison with the previous submission reported by Olivier *et al*. (2001), N_2O is no longer the second greenhouse gas in the Netherlands. This is the result of the recalculation of N_2O emissions in the transport and industry sectors (-9% or -3.2 Tg CO_2-eq.) (see Chapter 5).

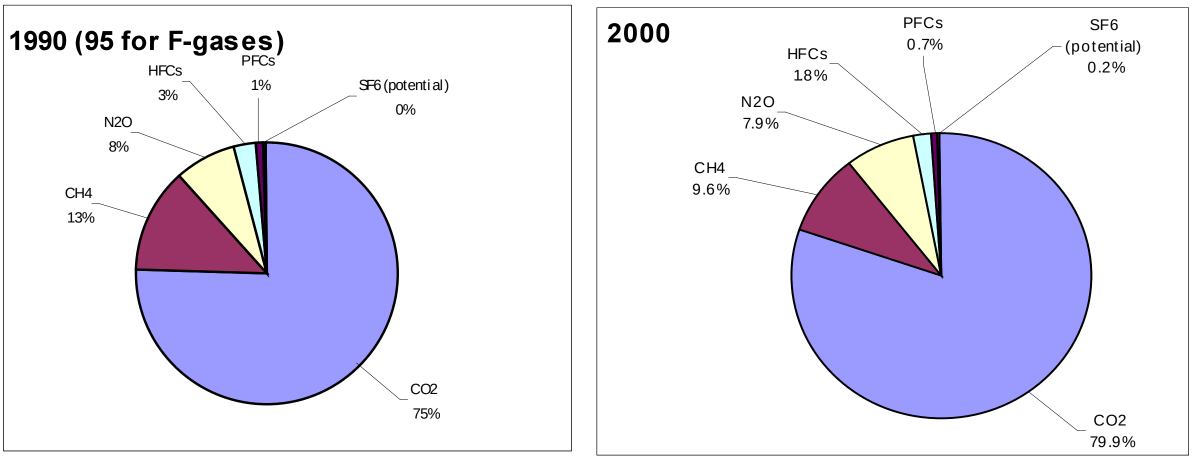

Figure 3.1. Shares of greenhouse gases in total emissions in 1990 (left) and 2000 (right)

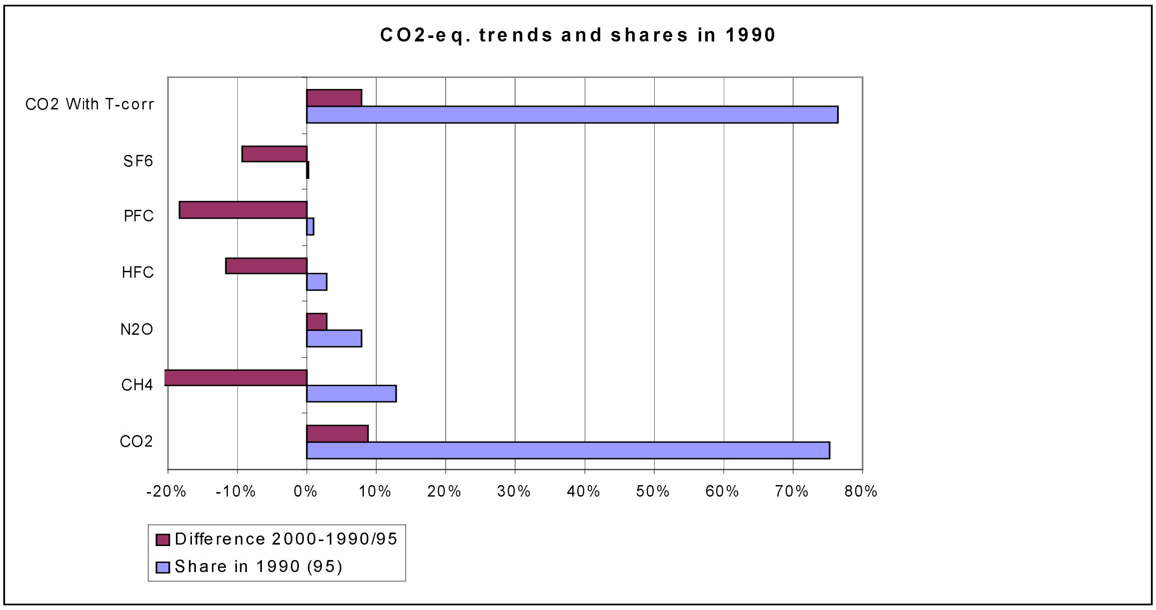

Figure 3.2. Shares and trends in greenhouse gas emissions per gas 1990-1999 (1995-2000 new gases) (also showing CO_2 with temperature correction)

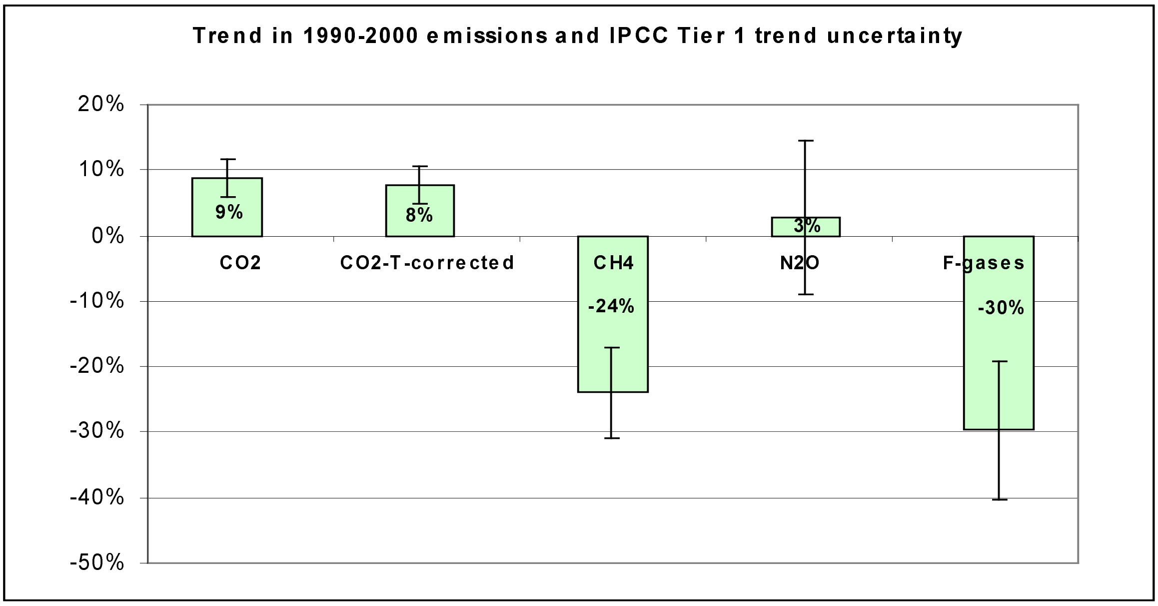

Figure 3.3. Trends in greenhouse gas emissions per gas 1990-1999 (1995-2000 new gases) and their uncertainty according to the IPCC Tier 1 trend uncertainty analysis (also showing CO_2 with temperature correction)

Table 3.2. Total greenhouse gas emissions with temperature correction, in CO_2-eq. and indexed, 1990-2000

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**[1)]
Emissions (Tg CO_2-eq)											
CO_2 (T-corrected) [2)]	164.4	166.4	168.5	167.2	170.6	174.0	174.0	170.1	177.2	175.9	177.2
CH_4	27.1	27.5	26.4	25.7	25.3	24.6	24.6	23.1	22.4	21.8	20.6
N_2O	16.5	19.2	19.7	19.7	20.2	18.2	20.3	21.1	17.8	17.4	17.0
HFCs	4.4	4.8	4.5	5.1	6.3	6.0	7.2	8.2	9.2	4.8	3.9
PFCs	2.4	2.4	2.1	2.1	1.9	1.9	2.0	2.2	1.7	1.4	1.5
SF_6	0.2	0.1	0.1	0.1	0.1	0.4	0.4	0.4	0.4	0.3	0.3
Total [group of six]	**215.1**	**220.4**	**221.3**	**220.0**	**224.4**	**225.0**	**228.6**	**225.1**	**228.7**	**221.6**	**220.6**
Index (1990 = 100)											
Index CO_2 (T-corrected)	*100*	101.2	102.5	101.7	103.7	105.8	105.9	103.5	107.8	107.0	107.8
Index CH_4	*100*	101.3	97.3	94.9	93.1	90.5	90.8	85.2	82.4	80.3	76.0
Index N_2O	*100*	116.2	119.0	119.2	122.3	110.0	122.6	127.8	107.9	105.1	102.8
Total [group of three]	**100**	**102.4**	**103.1**	**102.2**	**103.8**	**104.2**	**105.2**	**103.0**	**104.5**	**103.3**	**103.2**
Index ('90; F-gases '95) [3)]											
Index [group of six composite]	**99.5**	**101.9**	**102.3**	**101.7**	**103.8**	**104.0**	**105.7**	**104.1**	**105.7**	**102.5**	**102.0**

1) Data for 2000 are preliminary. In particular in this submission this 't-1' dataset is of a relatively low quality (see Section 7.1).
2) Net emissions, including LUCF (category 5A).
3) Base year = 100.

In *Table 3.2* the emissions of greenhouse gases are presented but now with CO_2 emissions corrected for temperature in order to exclude the climatic influence that partially masks the trends in emissions. With temperature correction, the 2000-1990 increase of CO_2 emissions is 1 per cent point less than without this correction. The influence of the weather on annual emissions, e.g. as suggested by the bump in 1996 in *Figure 3.5*, can indeed be traced back by annual variation in residential, commercial and agricultural emissions as presented in *Figure 3.6*. Both the cold winter in 1996 and the mild winter in 1990 cause the emissions from the 'small combustion sector' to clearly deviate from the trend. For more details we refer to Section 8.1.2.

CO_2 emissions increased by 13% (temperature-corrected: 6%) in the period 1990-1996, while from 1996 till 1999 the CO_2 emissions decreased by about 4% (temp. corrected: +1%). In 2000, total CO_2 emissions increased by 1% (1.3 Mton) compared to 1999. This was mainly caused by the increased energy use in the industry, domestic and transport sector. In 2000, total CH_4 emissions have decreased by 24% compared to the 1990 level. Sectors that contributed most to the decrease were the waste sector (-29%) and the agricultural sector (-19%) with 1.6 and 1.0 Mton CO_2-eq., respectively. In 2000, total N_2O emissions increased by about 3% compared to 1990, mainly due to the increase of the emission from agriculture (10%) and from transport (65%) with 2.2 and 0.8 Mton CO_2-eq., respectively. In 2000, total emissions of all F-gases decreased by about 30% compared to the 1995 level (18% compared to 1990), which is equivalent to 2.6 Mton CO_2-eq.

In *Figures 3.4* and *3.6* the trend in *total* CO_2-eq. emissions (i.e. for all six gases jointly) is presented per IPCC source category. From *Figure 3.4* it can be concluded that the sector that showed the largest growth in CO_2-eq. emissions in the past ten years is the transport sector (about 21%), whereas the energy sector showed a growth of about 8%. Clear exceptions are the waste sector and agriculture, which showed a *decrease* in CO_2-eq. emissions of 27% and 8%, respectively. Emissions from the residential and service sectors decreased by 5%, but these are substantially influenced by climatic effect: when including the temperature correction these emissions *decreased* by about 7%.

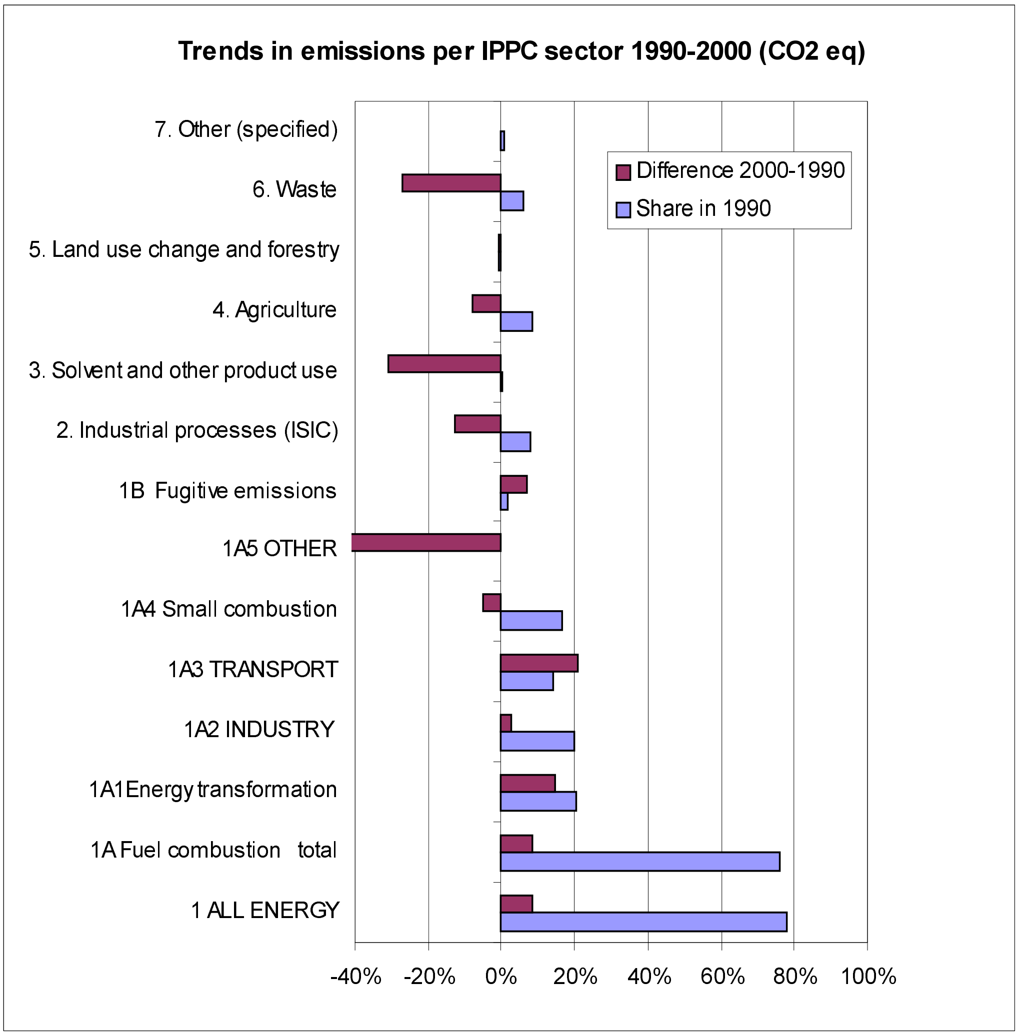

Figure 3.4. Shares and trends in CO_2-eq. emissions per sector 1990-2000 (1995-2000 for new gases) (no T-correction)

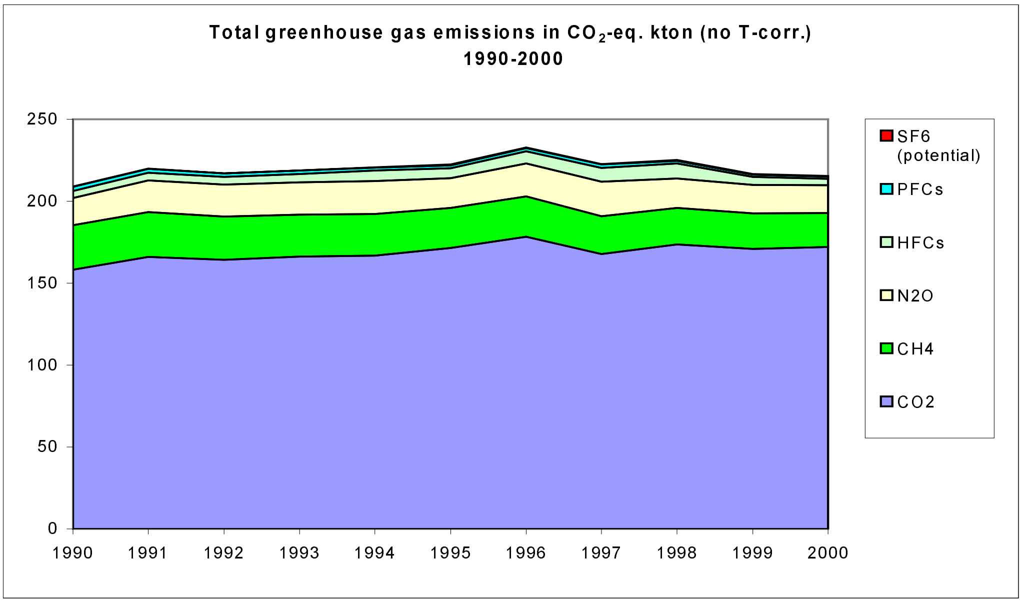

Figure 3.5. Trend in greenhouse gas emissions per gas 1990-2000 (no T-correction)

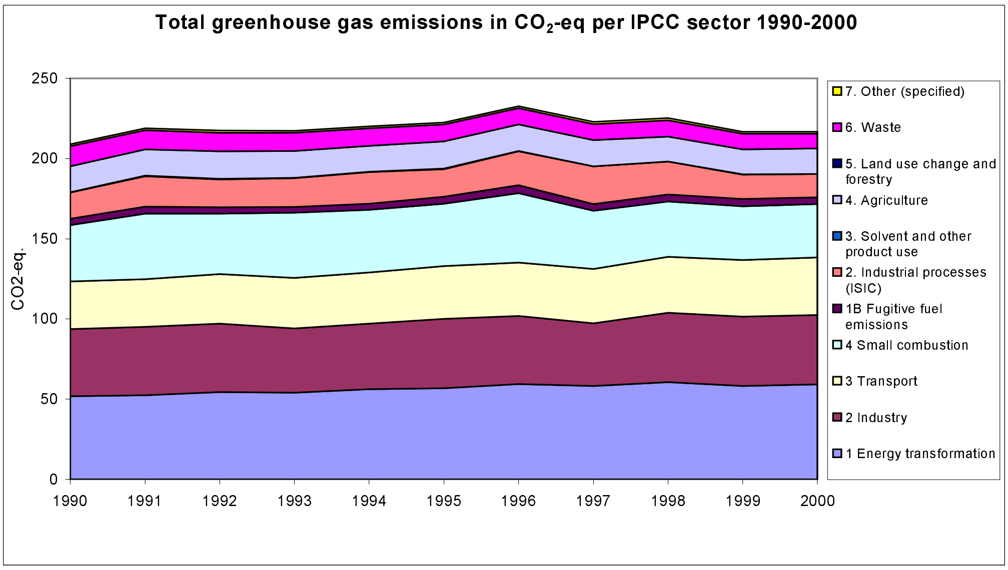

Figure 3.6. Trend in CO_2-eq. emissions per sector 1990-2000 (no T-correction)

4. General Methodological Overview

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]. For methane and nitrous oxide these methods have been 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 1. Below we will summarise some specific features of the Netherlands country-specific methodology, whereas *Table 4.2* shows the CRF Summary 3 table for the methods and emission factors used. Major methodological changes compared to the previous report are:

- N_2O from transport, notably road transport;
- N_2O from nitric acid manufacture, except for 1991-1994 and 1996-1997, with emission factors now based on measurements instead of default IPCC emission factors;
- CO_2 from elimination of statistical differences in the energy balances have been removed for all years except 1991-1994, which has also affected CO_2 emissions in other 1A source categories (also due to other energy data improvements);
- HFC and PFC emissions from HFC use and aluminium, respectively;
- CO_2 from sinks, where the underlying datasets have been refined and, where necessary, corrected.

4.1. Carbon dioxide emissions

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. However, emissions from public electricity production, refineries, large industries and waste incineration are for about 75% directly reported by the individual companies (see *Figure 4.1*). 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 addition, per economic sub-sector 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. 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 be off from the reference calculation by more than 5% (in practice, the group total may show much less deviation).

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 8.1.1. (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.).

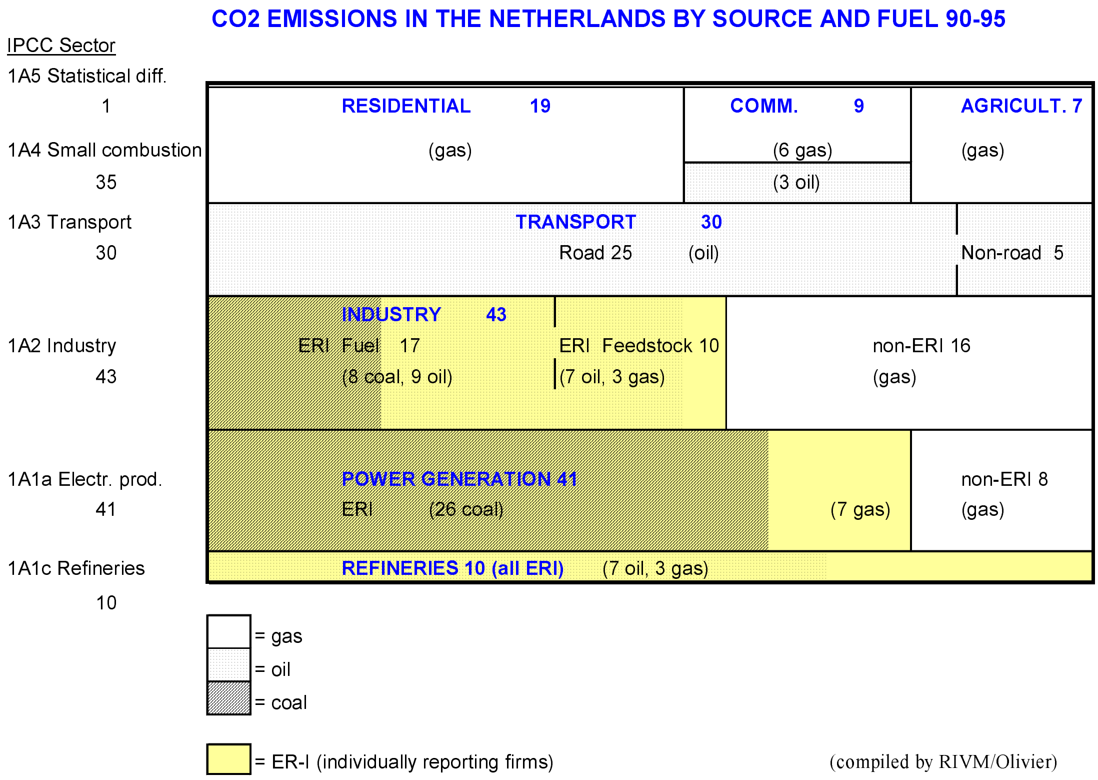

Figure 4.1. Schematic overview of CO_2 emissions from fuel combustion (Tg) (IPCC category 1A), showing the relative shares of sub-sectors as well as main fuel types and the total contribution of individually reporting firms (ER-I). Data are representative for the period 1990 to 1995 (source: Van Amstel et al., 2000a)

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 4.1*). This reference calculation is also used to calculate the remainder of feedstock emissions in case total CO_2 from feedstocks reported by the petrochemical industries is less than the reference value. In addition, carbon dioxide emissions are calculated for fossil-fuel related carbon (e.g. plastics) in incinerated waste. The accounts for about 1 Mton of CO_2, annually.

Fossil-based CO_2 emissions from *waste incineration* is 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 8.14*. 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 5.1 for more details). Since the energy balances 1991-1994 have not been revised, it is currently 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 4.1*). A description of this method is given in Annex 4.

Table 4.1. 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*., 1997).

4.2. CO_2 from sinks

The Netherlands presently only estimates CO_2 removals for *LUCF category 5.A*. For the period 1990-2000 the data on carbon stock and carbon changes are based on:

- forest area (in ha) ;
- average annual growth by category (in m^3/ha/year);
- 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 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 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. See Annex 2 for a detailed description.

4.3. Methane

Methane from combustion is estimated using the energy statistics and emission factors from the annual *Emission Monitor* with figures provided by the Emission Registration system (PER). 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.

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 11% in 2000;
- methane generation (i.e. decomposition) rate constant (k): 0.094 up to and including 1989, decreasing to 0.0693 in 1995 and constant thereafter; this corresponds to half-life times of 7.4 and 10 year, respectively;
- methane oxidation factor: 10%;
- fraction methane in landfill gas: 60%;
- fraction of DOC actually dissimilated (DOC_F): 0.58.

The change in DOC values is amongst others due to the prohibition of landfilling combustible wastes, whereas the change in k values is caused by a strong increase of the recycling of vegetable, fruit and garden waste in the early 1990s. The integration time for the emission calculation is for all years the period from 1945 to the year for which the calculation is made.

Methane emissions from agricultural soils are regarded as 'natural' (non-anthropogenic) and are estimated on the basis of the methane background document. They are reported as anthropogenic emissions under IPCC category 7. 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. Furthermore, 'natural emissions' are methane emissions from wetlands and water.

4.4. Nitrous oxide

The nitrous oxide emissions estimate is based on the methods described in the nitrous oxide background document by Kroeze (1994). We note that indirect N_2O emissions from atmospheric deposition are not yet estimated. Other indirect N_2O emissions are either included under '*4.D Background agricultural soils*' or as ***category*** *7 'Polluted surface water*'. These 'background' emissions include N_2O emissions from cultivation of histosols and emissions from manure and fertiliser applications in the past. This is to reflect that agricultural soil emissions will not stop when agricultural activities are stopped. Also emissions are included from crop residues left in the field. The latter category 7 is a fixed value that comprises leaching and run-off from agricultural activities (3/4) and from other nitrogen sources (1/4), 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 ***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 Kroeze (1994).

The calculation of animal manure production and waste management systems is described in Van der Hoek *et al.* (1997). Emissions from the production of chemicals include N_2O from nitric acid, acrylonitril and caprolactam production as reported by the manufacturing industry and included in the Netherlands' Emission Registration system (PER) (Spakman *et al.,* 1997). 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 we refer to Section 8.3.1.

4.5. HFCs, PFCs and SF_6

Emissions from HFC consumption are calculated using Tier 2 methodologies as described by Matthijsen and Kroeze (1996). HFC and PFC emissions from HCFC-22 production and primary aluminium production, respectively, are based on measured data reported by producing companies. 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 and for semiconductor manufacture. As of this year, SF_6 emissions from the production of SF_6 containing soundproof double glazed windows have been included for 1995 onwards.

4.6. Data sources

The following primary data sources are used for 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 accountant firm KPMG (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
- 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; RIVM estimates for recent years.

Table 4.2. CRF Summary table 3 with methods and emission factors applied

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2		CH_4		N_2O	
	Method applied (1)	Emission factor (2)	Method applied (1)	Emission factor (2)	Method applied (1)	Emission factor (2)
1. Energy						
A. Fuel Combustion						
1. Energy Industries	CS	PS, CS	CS	PS, CS	CS	PS, D
2. Manufacturing Industries and Constructio	CS	PS, CS	CS	PS, CS	CS	PS, D
3. Transport	CS	CS	CS/T3 (road)	CS	CS/T3 (road)	CS
4. Other Sectors	CS	CS	CS	CS	CS	D
5. Other	CS	CS	CS	CS	NE	
B. Fugitive Emissions from Fuels						
1. Solid Fuels	IE		IE		IE	
2. Oil and Natural Gas	CS	CS	CS	CS	CS	CS
2. Industrial Processes						
A. Mineral Products	CS	PS, CS	CS	PS, CS	NO	
B. Chemical Industry	CS	PS, CS	CS	PS, CS	CS/T1	PS
C. Metal Production	CS	PS, CS	NE		NO	
D. Other Production	NO					
E. Production of Halocarbons and SF_6						
F. Consumption of Halocarbons and SF_6						
G. Other	CS	PS, CS	CS	PS, CS	NO	
3. Solvent and Other Product Use	**CS**	**CS**			**CS**	**CS**
4. Agriculture						
A. Enteric Fermentation			cattle 90: T2; rest:	cattle: CS; rest: D		
B. Manure Management			CS	CS (=D,corrected)	CS	CS
C. Rice Cultivation			NO			
D. Agricultural Soils	NE		IE	CS	CS	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. CO_2 Emissions and Removals from Soil	NE					
E. Other	NO		NO		NO	
6. Waste						
A. Solid Waste Disposal on Land	NE		M, CS	CS		
B. Wastewater Handling			CS	CS	CS	CS
C. Waste Incineration	CS		NO (IE)		NO (IE)	
D. Other	CS	CS	CS	CS	CS	CS
7. Other *(please specify)*						
Solvents/polluted surface water	NA		CS	CS	CS	CS

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	HFCs		PFCs		SF_6	
	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	PS	NO		NO	
C. Metal Production			CS	PS	NO	
D. Other Production						
E. Production of Halocarbons and SF_6	CS/T2	PS	NO		NO	
F. Consumption of Halocarbons and SF_6	M,CS/T2	CS	T2/T3b	D	T2/T3b	PS/CS/D
G. Other	NO		NO		NO	

Explanation of notation keys used:

- 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).

5. Overview of Recalculations

In this chapter we outline the key differences compared with the previous submission reported by Olivier *et al.* (2001). Because most changes are only of a minor nature and since recalculations have not been performed for all years prior to 1998, but mostly only to 1990 and 1995, emission figures of all gases have been kept unchanged for the years 1991-1994 compared to the previous submission. For these years, however, a number of source allocation improvements have been made. An exception is the emissions of HFCs, PFCs and SF_6, which have been revised for the whole time period 1990-2000.

5.1. Differences due to changes in methodology or data

In 2001, in case of methodological changes recalculations were made for the years 1990, 1995, 1998, 1999 and (new) 2000. This means that for 1994-1994 and 1996-1997 no recalculations have been made, except in the cases explicitly mentioned below.

The main recalculations are due to (a) elimination of statistical differences in the energy balances of 1990 and 1995-1998, including an improvement in the energy statistics of fuel consumption data in the chemical industry; (b) recalculation of CO_2 emissions and sinks to LUCF; (c) recalculation of N_2O emissions from transport and (d) from nitric acid production; (e) revision of PFC and HFC emissions and addition of an SF_6 source (production of soundproof double glazed windows). Due to these recalculations, total CO_2-eq. emissions in the base year decreased by 5.2 Tg CO_2-eq. or 2.4%. Emissions of CO_2 and N_2O in 1990 have decreased by 1.5 and 3.2 Tg CO_2-eq., respectively, due to these recalculations, HFC emissions decreased in 1995 by 0.7 Tg CO_2-eq, while SF_6 emissions increased by 0.2 Tg CO_2-eq. This is mainly caused by the application of new, measured emission factors and elimination of statistical differences in the energy balance.

5.1.1. Elimination of statistical differences in the energy balances of 1990 and 1995-1998 [1A]

This major recalculation has affected the CO_2 emissions in category 1A5 (*Other*), and conversely all other combustion emissions 1A1-4, in particular the categories 1A2 (*Manufacturing Industry*) and 1A4 (*Other sectors*, notably 1A4a *Commercial/Institutional services*). However, also in category 1A1 (*Energy industries*) some changes were made. In addition, for some liquid fuels in the categories 1A3 (*Transport*, notably 1A3c *Road transport*) and *International Bunkers*, the consumption data were adjusted.

There are two methods to collect information on the national energy use. One is the national energy consumption is the sum of indigenous production plus import minus export minus bunkers plus/minus stock change. The other is a bottom-up sum of all sectoral energy use. 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. The fuel use related tot this *statistical differences* is included 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. In mid 1990's this statistical differences increased and several institutes in the Netherlands started to recalculate this energy use to sectors. The CBS Division on Energy Statistics started a project to eliminate this statistical difference to ensure that all institutes can use a same set of data on national energy consumption. In this recalculation project also other relevant elements to improve the quality of the energy statistics were included:

- elimination of the statistical differences in the national energy balance for 1990 and from 1995 onwards;
- improved data on energy use in the petrochemical sector for 1990 and 1995, amongst others the fraction of fuels used as chemical feedstock;

- rearrangement of the companies for the year 1990, using the new sectoral coding system (SBI93), that is in line with the new NACE system;
- change of the trade-system for including import-export in the energy data 1990 (amongst others to the 'general trade' system);
- improved allocation of energy products in custom entrepots for 1990.

Elimination of the statistical differences in the energy balances for 1990 and 1995 onwards

In 2000, Statistics Netherlands published the 1999 national energy balance in that the statistical difference was effectively eliminated (CBS, 2000a). The data 1990-1998 in the Netherlands' greenhouse gas inventory included the fuel use related to statistical differences as a source of CO_2, since it has been assumed that the associated fuel use is real but not accounted for in individual end-use sectors. The statistical difference between supply and demand was usually smaller than 2%, but became much larger in the second half of the 1990s. Per energy carrier the difference may vary both in sign and size, as is shown in *Table 5.1*.

Table 5.1. Energy use related to the statistical differences 1990-1999, NIR 2001 and 2002 [category 1A5]

Submission 2001	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
A. Energy (PJ)										
- Coal	7	0	-4	9	-9	15	27	30	24	0
- Oil	16	25	15	26	24	28	28	62	36	0
- Natural gas	-13	-14	-20	-20	-8	-17	-23	-18	-24	0
B. CO_2 emissions (Tg)										
- Coal	0.7	0.0	-0.4	0.8	-0.8	1.4	2.6	2.8	2.3	0.0
- Oil	1.2	1.8	1.1	1.9	1.8	2.0	2.1	4.5	2.6	0.0
- Natural gas	-0.7	-0.8	-1.1	-1.1	-0.4	-1.0	-1.3	-1.0	-1.3	0.0
Total NIR 2001	**1.1**	1.0	-0.4	1.6	0.5	**2.5**	**3.4**	**6.4**	**3.6**	0.0
Total NIR 2002	**0.0**	1.0	-0.4	1.6	0.5	**0.0**	**0.0**	**0.0**	**0.0**	0.0

The elimination of the statistical differences started for the year 1999. For that year for each energy carrier the first step was to allocate the source for the differences in the end use energy data and to research for additional data to improve the energy data. E.g. in the original energy balance 1998 the available amount of gasoline was 427 million kg higher than the use. With additional information the energy use for mobile vehicles (in agriculture and construction sector) and for inland water transport was improved. The next step was analysing import and export data. In this example the export data for gasoline increased in a combined research for the energy statistics and the import and export statistics. A similar process was conducted for coal, which resulted in an adjusted figure for export. For 1999 about 2/3 of the statistical differences was solved using a more complete observation of the foreign trade, especially the export and more detailed information on the energy use for sectors. About 1/3 is allocated on best fit within the energy balance.

A next step was to improve the data for the period 1995-1998. For 1996-1998 the energy balance was recalculated, based on extrapolations for the new balance data 1999 and the original balance data 1996-1998 (see Annex 3 for details on the changes per fuel type). For the year 1995 an additional element was included in this recalculation: adjusted data for the petrochemical sector (see next paragraph). The evaluation of energy data reported in monitoring the Long Term Agreement and the energy statistics offered a lot of additional detail information on the energy end use that made it possible to allocate more precise the use of energy carriers.

As a final step the statistics for 1990 were analysed. A specific problem for this year was that the energy data were organised for sectors, based on company classifications that changed in 1993. So additional to the recalculation of the data, the allocation into sectors in line with the new classification system (SBI93) was conducted. But for 1990 also the import-export data were presented in the general trade system for the foreign trade, while in more recent years these data are presented in the special trade system. The differences between these two methods are that in the general trade system the energy carriers located in custom entrepots are included in the domestic energy use and in the special trade system these are not included (allocated to abroad use). An additional problem for the recalculation is a change in a function of the custom entrepots: the blending of energy carriers within these entrepots was in 1990 common practice, but declined heavily in later years. As result the calculations for 1990 were more complicated than for 1995-1998 and more assumptions were needed. So less detailed tables are available for the recalculated energy use 1990.

These recalculations for 1990 and 1995 onwards resulted not only in a redistribution of the energy used amongst end-users, but as a result from changes in energy import and export data, also total national energy use changed. These new data were used in combination with other data from the national Pollutant Emission Register to recalculate the sectoral emissions (see below in this section). Recalculating energy data for the years 1991-1994 is at least as complicated as for the year 1990. Due to priority setting at Statistics Netherlands, it has not been possible to produce an energy balance without statistical differences for those years. So for 1991-1994 the same emissions caused by statistical differences are included in the 2002 submissions as in 2001 (see *Table 5.1).*

Improvement in the energy statistics of fuel consumption data in the chemical industry

The Ministry of Economic Affairs had *Long Term Agreements* (LTAs) on energy efficiency improvements with industrial sectors for the period 1990-2000. On of the sectors was the chemical industry. The annual monitoring reports showed improvements in the energy efficiency, but the underlying energy use was not in line with the energy use reported by the Energy Statistics. In *Table 5.2* the primary energy use for energetic use as calculated from the energy balances and the monitoring are presented.

Table 5.2. Calculated primary energy use for energetic use in the chemical sector 1990-1998, unrevised data (unit: PJ)

Data source	1990	1991	1992	1993	1994	1995	1996	1997	1998
Energy Statistics	325	314	305	302	319	340	328	326	319
Monitoring LTA	321	314	313	305	313	328	322	327	321
Difference	*4*	*0*	*-8*	*-4*	*6*	*12*	*6*	*-1*	*-2*

Source: internal Novem paper.

Mid 1990s the CBS Division on Energy Statistics, Novem as organiser of the monitoring process for the LTA and the petrochemical companies conducted a combined project to evaluate the energy data. The majority of the differences between the two sources were caused by two elements:

- *Differences in definitions.* The group petrochemical industry in the LTA did not hold exactly the same companies as the sector petrochemical industry in the energy balances. The calculation of the energy use of CHP units differs as well as the allocation of CHP units to sectors.
- *Differences in original energy data.* The Energy Statistics use information from energy costs and production statistics while the LTA monitoring collected the information from energy managers. Also the way of defining non-energy use (feedstock) was different.

Using the detailed information from the energy managers, the interpretation of the data on energy costs could be improved. The energy use in feedstock in the revised data is lower for 1990 and 1995 and higher for 1996-1998 than in the previous submission (see *Table 5.3*). More detailed information is presented in Annex 3.

Table 5.3. Non-energetic use (feedstock) in 1990 and 1995-1998 (in PJ) used in NIR 2001 and NIR 2002

Submission	1990	1995	1996	1997	1998
NIR 2002	57	221	200	230	227
NIR 2001	277	251	194	204	213
Difference	*- 220*	*- 30*	*6*	*25*	*13*

Revised sectoral energy data and CO_2 emissions [1A]

One of the elements in the statistical differences not mentioned above was a difference in the measured domestic gas supply and the measured gas delivered by the gas distribution companies. In the revised energy balances this difference has been eliminated by adjusting (increasing) the national gas production figures. For the calculation of the emission this approach was not followed, but the same method as for the 1991-1994 data was continued. This method adjusts (decreases) gas use for the Dutch sector 'Other users' (IPCC category 1A4 '*Other sectors*') as reported by in the energy balance to the (original) lower level of the measured gas supply.

Table 5.4. CO_2 emissions from fuel combustion [category 1A], NIR 2001 and NIR 2002

CO_2 emissions (Tg)		**1990**	**1995**	**1996**	**1997**	**1998**
NIR 2001	Total category 1A	157.1	170.3	177.0	166.1	171.6
NIR 2002	Total category 1A	158.5	172.9	180.1	178.3	177.4
Difference		*1.4*	*2.6*	*3.1*	*12.2*	*5.9*
NIR 2001	Statistical differences [1A5]	1.1	2.5	3.4	6.4	3.6

Table 5.5. Effects of recalculation of CO_2 emissions from fuel combustion (including non-energy use as feedstock) [category 1A] (unit: Tg CO_2)

	Source category		**1990**	**1995**	**1996**	**1997**	**1998**	**1999**
1A1a	Electricity and heat production	new	41.0	45.2	46.8	46.1	48.0	45.8
1A1a	Electricity and heat production	old	41.2	45.0	47.0	45.9	47.8	44.9
1A1a	Electricity and heat production	diff.	-0.2	0.2	-0.2	0.2	0.3	0.9
1A1bc	Other transformation	new	10.5	11.4	12.6	12.1	12.4	12.2
1A1bc	Other transformation	old	10.9	12.3	11.9	12.0	12.2	12.2
1A1bc	Other transformation	diff.	-0.4	-0.9	0.7	0.1	0.2	0.0
1A2	Industry	new	41.9	43.1	42.2	39.0	43.2	43.2
1A2	Industry	old	41.9	43.4	42.1	44.5	44.0	43.5
1A2	Industry	diff.	0.0	-0.3	0.1	-5.5	-0.7	-0.4
1A3b	Road transport	new	25.4	28.4	29.2	29.5	30.2	31.1
1A3b	Road transport	old	25.4	NA	30.4	29.5	30.2	31.1
1A3b	Road transport	diff.	0.0	NA	-1.2	0.0	0.0	0.0
1A3x	Other domestic transport	new	3.7	3.7	3.5	3.5	3.7	3.6
1A3x	Other domestic transport	old	3.7	NA	3.5	3.5	3.8	3.6
1A3x	Other domestic transport	diff.	0.0	NA	0.0	0.0	0.0	0.0
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
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
1A4c	Agriculture / Forestry / Fishing	new	8.4	8.1	8.9	7.5	7.5	7.1
1A4c	Agriculture / Forestry / Fishing	old	7.4	8.9	10.3	7.7	7.5	7.8
1A4c	Agriculture / Forestry / Fishing	diff.	1.0	-0.8	-1.4	-0.2	0.0	-0.7
1A5	Other	new	0.0	0.0	0.1	0.0	0.0	0.0
1A5	Other	old	1.1	2.5	2.0	6.3	3.6	0.0
1A5	Other	diff.	-1.1	-2.5	-1.9	-6.3	-3.6	0.0

Note: 1990-1998 due to elimination of statistical differences and improvement in chemical industry; 1999 due to final estimate in present report vs. preliminary data in NIR 2001.

Moreover, the revised energy data were combined with data from several sources to calculate energy use and emissions for the various fuel types and end-use sectors. Two main other data sources are:

- energy use in the agricultural sector, for emission estimates in the PER specified by LEI;
- energy use in the PER-Individual Companies for industry and energy transformation sectors.

After the quality improvements and the elimination of statistical differences in general, the CO_2 emissions for 1990 and 1995-1998 are higher. In *Table 5.4* the resulting revision of total CO_2 emission data for the IPCC category 1A is summarised, whereas in *Table 5.5* the changes at sectoral level are presented. From this table it can be concluded, that the 1990-1999 trends have not changed significantly, except for the commercial and agricultural sectors [categories 1A4a and 1A4c], where the trend changed from +20% to +3% and from -15% to +5%, respectively.

International marine bunkers

As a part of the project to eliminate statistical differences it became clear that marine bunkers also hold some lubricants. In the NIR 2001 only the 1999 marine bunker data included lubricants consumption. Now also data for 1990 and 1995-1998 include lubricant consumption. For some years there was also a slight change in one of the other fuel types. In *Table 5.6* the data for both energy consumption and CO_2 emissions from international air transport and international shipping are presented per fuel type.

Table 5.6.a. International bunkers NIR 2002: energy consumption (in PJ) and related CO_2 emissions (in Gg)

NIR 2002	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Energy consumption											
Marine bunkers	**463**	**476**	**478**	**495**	**474**	**481**	**488**	**518**	**522**	**539**	**571**
- heavy fuel oil	*370*	*396*	*398*	*411*	*386*	*377*	*393*	*429*	*429*	*448*	*475*
- lubricant	*4*					*4*	*5*	*5*	*5*	*5*	*6*
- gasoline	*89*	*80*	*80*	*84*	*88*	*100*	*90*	*84*	*88*	*86*	*88*
Aviation Bunkers	**61**	**68**	**81**	**89**	**92**	**105**	**113**	**122**	**133**	**138**	**138**
TOTAL Bunkers	**524**	**544**	**559**	**585**	**566**	**586**	**601**	**639**	**655**	**677**	**707**
Emissions											
Marine bunkers	**35 280**	**36 330**	**36 490**	**37 780**	**36 140**	**36 620**	**37 200**	**39 530**	**39 820**	**41 140**	**43 440**
- heavy fuel oil	*28 490*	*30 490*	*30 650*	*31 650*	*29 720*	*29 030*	*30 260*	*33 030*	*33 030*	*34 490*	*36 580*
- lubricant	*290*					*290*	*370*	*370*	*370*	*370*	*440*
- gasoline	*6 500*	*5 840*	*5 840*	*6 130*	*6 420*	*7 300*	*6 570*	*6 130*	*6 420*	*6 280*	*6 420*
Aviation Bunkers	**4 450**	**4 960**	**5 910**	**6 500**	**6 720**	**7 660**	**8 250**	**8 910**	**9 710**	**10 070**	**10 070**
TOTAL Bunkers	**39 730**	**41 290**	**42 400**	**44 280**	**42 860**	**44 280**	**45 450**	**48 440**	**49 530**	**51 210**	**53 510**

Source: CBS, 1990-2000 (NEH/Energy Monitor, Table 1.1; revised data)

Table 5.6.b. International bunkers (NIR 2001): energy consumption (in PJ) and related CO_2 emissions (in Gg)

Old (NIR 2001)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Energy consumption										
Marine bunkers *	**466**	**476**	**478**	**495**	**474**	**479**	**488**	**518**	**517**	**559**
- heavy fuel oil	*386*	*396*	*398*	*411*	*386*	*377*	*393*	*429*	*429*	*473*
- gasoline	*80*	*80*	*80*	*84*	*88*	*102*	*95*	*89*	*88*	*86*
Aviation Bunkers	**61**	**68**	**81**	**89**	**92**	**105**	**113**	**123**	**131**	**138**
TOTAL Bunkers	**527**	**544**	**559**	**585**	**566**	**584**	**601**	**641**	**648**	**697**
Emissions										
Marine bunkers *	**35 560**	**36 330**	**36 490**	**37 780**	**36 140**	**36 480**	**37 200**	**39 530**	**39 798**	**40 757**
- heavy fuel oil	*29 720*	*30 490*	*30 650*	*31 650*	*29 720*	*29 030*	*30 260*	*33 030*	*3 3015*	*34 494*
- gasoline	*5 840*	*5 840*	*5 840*	*6 130*	*6 420*	*7 450*	*6 940*	*6 500*	*6 392*	*6 263*
Aviation Bunkers	**4 450**	**4 960**	**5910**	**6 500**	**6 720**	**7 670**	**8 250**	**8 980**	**9 521**	**10 066**
TOTAL Bunkers	**40 010**	**41 290**	**42 400**	**44 280**	**42 860**	**44 150**	**45 450**	**48510**	**49 319**	**50 823**

Source: CBS, 1990-1999 (NEH/Energy Monitor, Table 1.1)

* For 1999, in the NIR 2001 also an amount of lubricant consumption in marine bunkers was reported of 5.3 PJ, which is equivalent to 0.4 Tg CO_2.

Table 5.6.c. Recalculation results for international marine bunker CO_2 emissions (in Tg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NIR 2002 marine bunkers	35.3	36.3	36.5	37.8	36.1	36.6	37.2	39.5	39.8	41.1
NIR 2001 marine bunkers	35.6	36.3	36.5	37.8	36.1	36.5	37.2	39.5	39.8	40.8
Difference	**0.3**	**0.0**	**0.0**	**0.0**	**0.0**	**-0.1**	**0.0**	**0.0**	**0.0**	**-0.4**
Difference (% of total)	*0.7%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*-0.3%*	*0.0%*	*0.0%*	*0.0%*	*-0.8%*

IPCC Reference Approach and CO_2 from feedstocks in the Reference Approach

As discussed above, the elimination of the statistical differences for 1990 and 1995-1998 resulted in adjustments of statistics for *import, export* and *bunkers* as well as in changes in amounts of fuels used for *non-energy* purposes. In addition, *gas production* statistics were adjusted as well. More details on the changes in PJ can be found in Annex 4. In *Table 5.7* the resulting changes in the *IPCC Reference Approach* (RA) calculations are presented. This will also affect the comparison made between the sectoral totals in the national approach and the results of the RA. However, we recall that all RA calculations are preliminary since no official carbon content figure for crude oil consumption in the Netherlands has been appointed yet.

Table 5.7. Changes in preliminary CO_2 Reference Approach results for 1990 and 1995-1998 due to recalculation of energy balances (in Tg)

		1990	1995	1996	1997	1998
NIR 2002	Liquids	52.3	54.6	55.4	54.8	55.4
	Solids	34.7	35.9	34.4	33.6	33.5
	Gaseous	72.5	79.6	88.9	83.5	82.9
	Total	**159.6**	**170.1**	**178.7**	**171.9**	**171.8**
NIR 2001	Liquids	50.6	56.3	56.6	58.8	58.2
	Solids	35.4	37.2	36.8	36.2	36.4
	Gaseous	71.7	79.6	87.6	82.5	81.5
	Total	**157.7**	**173.1**	**180.9**	**177.5**	**176.1**
Difference	Liquids	1.7	-1.7	-1.1	-4.0	-2.8
	Solids	-0.7	-1.2	-2.4	-2.6	-2.8
	Gaseous	0.8	0.0	1.3	1.0	1.3
	Total	**1.9**	**-3.0**	**-2.2**	**-5.6**	**-4.3**
Difference (%)	*Liquids (%)*	*3.4%*	*-3.1%*	*-2.0%*	*-6.8%*	*-4.8%*
	Solids (%)	*-1.9%*	*-3.3%*	*-6.5%*	*-7.2%*	*-7.8%*
	Gaseous (%)	*1.2%*	*0.0%*	*1.5%*	*1.2%*	*1.6%*
	Total (%)	***1.2%***	***-1.7%***	***-1.2%***	***-3.2%***	***-2.4%***

5.1.2. Recalculation of CO_2 removals due to LUCF 1990-1999 [5A]

In 2001 special attention has been given to improve information on emissions related to *Land Use Change and Forestry*. For category 5.A (*Changes in forest and other woody biomass stocks)* an improved and completed forestry dataset for the whole period 1990-2000 has been included in this report (Daamen, 2002). In Annex 2 a full description of methodology and data sources is provided.

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. In the NIR 2001 the *Sectoral Background Table* 5A (SBT) held only data for 1990, 1994 and 1995. The group *Temperate, other* had been specified for exploited, non-exploited and for other forest. The group *Non-forest trees* had been specified for trees in line, solitaires, urban parks, fruit trees and nurseries. The group *Total biomass removed* had been specified for forest and non-forest. In this NIR/CRF, data have been included in SBT 5A for all years; in addition, the specifications for all groups have been changed. As two ratios are used to convert volume to dry matter, the groups *Temperate, other* as well as *Biomass* *removed* are now specified for coniferous and for broadleaf separately. The group *Non-forest trees* now also holds this specification. In *Table 5.8* the main data changes are summarised for the years 1990, 1994 and 1995.

Table 5.8. Comparison of key data for LUCF category 5A in NIR 2001 (old) and NIR 2002 (new)

Variable	Unit	1990		1994		1995	
		Old	New	Old	New	Old	New
Temperate forest	Gg C	833	861	806	863	806	895
Non forest trees	Gg C	239	40	232	110	232	33
Total biomass removed	Gg C	676	513	455	447	449	591
Net emissions	Gg CO_2	-1 452	-1 422	-1 657	-1 929	-1 687	-1 232

Based on the more detailed data for 1990, 1994 and 1995 in the previous NIR 2001 a simple estimate was made for the other years. In this NIR the calculation for all years of CO_2 removals in category 5.A are based on the new dataset. In *Table 5.9* the changes in removals for the period 1990-1999 are summarised. The differences are mainly caused by differences in figures for removed biomass.

For LUCF subcategories 5B-5E also new datasets were being compiled, of which some preliminary results are presented in Annex 2. However, since these are still under discussion, no new data are for the other subcategories 5B to 5E have been included in this submission.

Table 5.9. Effects of recalculation of CO_2 emissions/removals for changes in forest and other woody biomass stocks [5A] (Gg CO_2)

Submission	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NIR 2002	-1 422	-1 528	-1 487	-1 806	-1 929	-1 232	-1 398	-1 180	-1 380	-1 236
NIR 2001	-1 500	-1 600	-1 600	-1 600	-1 600	-1 700	-1 700	-1 700	-1 700	-1 700
Difference	*78*	*72*	*113*	*-194*	*-329*	*468*	*302*	*520*	*320*	*464*

5.1.3. Recalculation of N_2O emissions from transport 1990-1999 [1A3]

In 2001, the ER Task Group *Traffic and Transport* revised the N_2O emission factors for transportation. The main reason for the revision were the results of a Dutch research project in which 33 petrol-fuelled passenger cars were tested, ranging from the Euro 1 to Euro 3 category, as well as 9 diesel-fuelled cars and 3 LPG-fuelled cars (Feijen-Jeurissen *et al*., 2001). The findings in this study were recently also reported in Gense and Vermeulen (2002) (see *Box 5.1*). The most important findings of this research were:

- the emission factors of current-generation catalyst-equipped petrol cars are lower than of the first-generation catalyst-equipped cars which entered the market in the early nineties;
- current heavy-duty diesel engines emit hardly any N_2O emissions;
- oxidation catalysts used in new light-duty diesel vehicles - in order to reduce soluble particulates, CO and NMVOC - appear to form significant amounts of N_2O.

Passenger cars

In the emission factors applied previously the trend of newer catalyst-equipped petrol cars emitting less N_2O was already incorporated. This was because the N_2O emission factor was believed to be dependent on the NO_x emission and the NO_x emissions were reduced as a result of emission control policy. However, the emission factors used in the NIR 2001 were quite different from those measured by Feijen-Jeurissen *et al*. (2001), recently also published in Gense and Vermeulen (2002). At the time of compilation of the 2001 PER dataset (spring 2001) the data published in Feijen-Jeurissen *et al*. (2001) were the only available data which are more or less representative for passenger cars in the Netherlands. Therefore the emission factors per environmental class as reported in Feijen-Jeurissen *et* *al*. (2001) were adopted for urban, rural and highway driving conditions (see *Box 5.1*) after being rounded to units of 5 mg/km. *Table 5.10* shows these emission factors for passenger cars that are presently used as well as the emission factors used in the NIR 2001. The present emission factors for urban driving are 70% lower than the corresponding NIR 2001 factors, highway emission factors 60% lower and rural factors 15% lower.

Box 5.1. Approach and classification of passenger cars with N_2O emission factors measured by Gense and Vermeulen (2002) and preliminary results reported in Feijen-Jeurissen et al. (2001)

Number of cars:
- 33 petrol-fuelled cars ranging from Euro1 to Euro3 (24 Euro 1; 6 Euro 2; 3 Euro 3)
  (in Gense and Vermeulen: 5, 3 and 2, respectively)
- 9 diesel-fuelled cars ranging from pre-Euro to Euro3
- 3 LPG-fuelled cars (only Euro2)

Vintage of technology types:
- Euro1 cars were produced between 1990 en 1996
- Euro2 cars were produced between 1992 en 2000
- Euro3 cars were produced after 1999

Basis of emission factors used in NIR 2002 are the reported measured emission factors for the urban and extra-urban (rural) part of the standardised European Driving Cycle (EDC) and for a highway driving cycle as reported in Feijen-Jeurissen *et al.* (2001):
- urban emission factor: Urban Driving Cycle cold engine (part of ECE Driving Cycle)
- rural emission factor: Extra-Urban Driving Cycle (part of ECE Driving Cycle)
- highway emission factor: Highway Cycle (free flow traffic, speed limit 100 km/h)

In the final report (Gense and Vermeulen, 2002), published early 2002, these emission factors have been converted into 'real-world' factors for urban, rural and highway driving using (a) correction factors for real world driving behaviour, and (b) a correction for ambient temperature, based on additional measurement data for 10 petrol-fuelled cars under real-world driving conditions. These corrected emission factors have not been used in this NIR 2002.

No correction factor for ageing of the catalyst could be obtained from the measurement results due to the limited number of data available. However, to be able to use the emission factors in future emission inventories, the effect of ageing should be known, especially for Euro 3 cars with relatively new catalysts.

Data quality:
- only few Euro 3 petrol cars, diesel cars and LPG cars were tested;
- some vehicles were tested in the Highway Cycle with cooled-down engines, while in real-world conditions this will not be the case. This results in an overestimation of highway emission factors as presently used;
- factors used in NIR 2002 have not yet been corrected for real-world conditions as recently published in Gense and Vermeulen (2002);
- if corrected emission factors from Gense and Vermeulen (2002a,b) would have been used, the estimate for the N_2O emissions from passenger cars in 2000 had been approximately 0.5 Gg lower and total N_2O emissions by road transport in 2000 would have been around 25% lower; the present emission factors will be revised in the future when the results of a new measurement programme, to be carried out during 2002, will become available.

Quantitative uncertainty estimates were not provided in the reports, but the variability of the emission factors between cars of the same technology type was very large (50% or more).

Light-duty vehicles (vans)

For light-duty vehicles with petrol-fuelled and LPG-fuelled engines, the emission factors for passenger car from *Table 5.10* were adopted because petrol and LPG-fuelled vans (light duty vehicles) hardly differ from passenger cars. For diesel vans the IPCC defaults were adopted, since the measurement basis was judged too small to be representative for average fleet conditions (see *Table 5.11*).

Table 5.10. Comparison of old and new N_2O emission factors for passenger cars per fuel type, environmental class and driving cycle (mg/km)

	NIR 2001			NIR 2002		
Passenger cars	urban	rural	highway	urban	rural	highway
Petrol/LPG without catalyst				5	5	5
Petrol/LPG Euro 1				40	20	20
Petrol/LPG Euro 2				25	5	5
Petrol/LPG Euro 3				10	5	5
Petrol total (1999)	**82**	**13**	**27**	**26**	**11**	**11**
Difference				*-70%*	*-15%*	*-60%*
Diesel without oxidation cat.				5	5	5
Diesel with oxidation cat.				10	10	10
Diesel total (1999)	**15**	**9**	**11**	**8**	**8**	**8**
Difference				*-45%*	*-10%*	*-25%*
TOTAL (1999)	**74**	**12**	**24**	**22**	**10**	**10**
Difference				*-70%*	*-15%*	*-60%*

Source: based on Feyen-Jeurissen *et al*. (2001), except for gray values, which are based on IPCC (1997).

Heavy-duty vehicles (trucks/lorries)

Gense and Vermeulen (2002) found that heavy-duty diesel engines emit hardly any N_2O. The emission factors used in the previous NIR were based on a literature research in 1994 by Baas (1994), who found a broad range of 30-800 mg/km for the N_2O emission factor of heavy duty trucks and proposed 200 mg as best estimate. We presume now that the high estimate in Baas (1994) is due to N_2O formation in the measurement sample. For the time being, because Gense and Vermeulen (2002) only tested one single truck engine, it was decided to adopt the IPCC default emission factor of 30 mg/km (IPCC, 1997). *Table 5.12* shows the difference between emission factor for heavy-duty vehicles in the present report and in the NIR 2001.

Table 5.11. Comparison of old and new N_2O emission factors for other road and for non-road transport

	fuel type	NIR 2001	NIR 2002	*difference*
Road transport		[mg/km]	[mg/km]	
light-duty vehicles [1)]	petrol/LPG	37	14	
	diesel	24	20	
	[total (1999)]	**[26]**	**[20]**	*[-25%]*
heavy-duty vehicles	diesel	160–250 [2]	30	
mopeds	petrol	0.2	1	*+500%*
motor cycles	petrol	1.3	2	*+55%*
Non-road transport		[g/kg fuel]	[g/kg fuel]	
aviation	jet kerosine	0.21	0.10	*-50%*
navigation	diesel	0.69	0.08	*-90%*
mobile machinery	diesel	0.69	0.08	*-90%*
rail transport	diesel	0.69	0.08	*-90%*

Source: petrol/LPG fuelled light-duty vehicles based on Feijen-Jeurissen *et al*. (2001); others (gray values) are based on IPCC (1997).

1) Excluding passenger cars.

2) In the NIR 2001 N_2O emission factors were supposed to be dependent on NO_x emission levels and NO_x emission levels differ for single trucks and articulated trucks.

Non-road transport

The emission factors for N_2O from non-road transport in the NIR 2001 were based on the ratio between N_2O and NO_x for heavy-duty diesel vehicles. Because the IPCC default value was adopted in the case of heavy-duty road vehicles, this was also done for non-road transport. *Table 5.11* again shows the differences between NIR 2001 and NIR 2002 with emission factors expressed as emissions per kg fuel use.

Table 5.12 shows the effect of the recalculation on the emissions in 1990, 1995 and 1999. The emission levels in the present report are 65 to 80% lower than in the NIR 2001, which is in particular caused by the adoption of other emission factors for heavy-duty diesel engines (both road and non-road). The trend in the NIR 2001 of decreasing N_2O emissions from transport between 1995 and 1999 has now changed in a slight increase of N_2O emissions.

Table 5.12. Effects of recalculation of N_2O emissions for transport 1990-1999 (Gg)

Source	**1990**		**1995**		**1999**	
	NIR 2001	**NIR 2002**	**NIR 2001**	**NIR 2002**	**NIR 2001**	**NIR 2002**
Passenger cars	2.4	0.7	3.7	1.4	3.1	1.4
Light-duty vehicles	0.3	0.1	0.4	0.2	0.5	0.3
Heavy-duty vehicles	2.1	0.2	1.8	0.2	1.6	0.2
Total road transport	**4.8**	**1.1**	**6.0**	**1.8**	**5.3**	**1.9**
Non-road transport	0.7	0.1	0.8	0.1	0.7	0.1
Total transport	**5.6**	**1.2**	**6.8**	**2.0**	**6.0**	**2.0**
Difference		-78%		-71%		-66%

5.1.4. Recalculation of N_2O emissions from nitric acid production in 1990, 1995 and 1998-1999 [2B]

Based on recent measurements of N_2O emissions from nitric acid manufacture, in the present inventory new emission factors are applied than have been used previously. The recalculation, however, was only made for the years 1990, 1995 and 1998-1999, which were the years that have been updated in the PER 2002 dataset.

Until recently, N_2O emissions from nitric acid production were based on default IPCC emission factors. However, N_2O emission measurements made in 1998 and 1999 at all 6 manufacturing plants have resulted in new, plant-specific emission factors. As the accuracy of the emission factors obtained from plant-specific measurements is much better than the previous used default factors, they have now been used to recalculate the process emissions of N_2O from these plants. Also, it may be assumed that the emission factors did and do not change over time, since the operation conditions did not change over time and no emission control measures have been taken. As this source category is also a key source (see Sections 7.2 and 8.3), this can be considered as the first step towards the application of a Tier 2 methodology. The new method used for this submission is to calculate N_2O emissions at plant level by the individual manufacturing companies by multiplying the annual activity data by the new emission factors and to report resulting total emissions. Only the resulting emissions data for 1990, 1995 and 1998-1999 have been published, the underlying activity data and emission factors are kept confidential. In *Table 5.13* an overview is provided of the effect of the recalculation on the level and trend of the N_2O emissions.

Table 5.13. Effects of recalculation of N_2O emissions from nitric acid production 1990-1999 (in Gg)

Submission	**1990**	**1991***	**1992***	**1993***	**1994***	**1995**	**1996***	**1997***	**1998**	**1999**
NIR 2002	20.4	28.3	26.4	26.0	27.6	20.3	27.7	31.0	20.1	19.1
NIR 2001	27.5	28.3	26.4	26.0	27.6	27.6	27.7	31.0	32.0	32.1
Difference	*7.1*					*7.3*			*12.1*	*13.0*

* Emissions for 1991-1994 and 1996 and 1997 have not yet been recalculated; this will done for the next submission.

Because no measures haven been taken during the period 1990-1998, the emission factors obtained from the 1998 measurements have also been used to recalculate the emissions for 1990 and 1995.

5.1.5. Recalculation/revision of F-gas emissions in 1990 and 1995-1999

Recalculations of emissions of fluorinated gases have been made due to new data that have become available from measurements and sector studies as well as the identification of a new source category. However, not all recalculations have yet been made for the complete time series 1990-1999, as will be described below.

PFCs from aluminium production

Based on recent measurements of PFC emissions from aluminium production in the present inventory lower emission factors are applied than previously were used. A recalculation, was made for the years 1998-1999 by applying different emission factors by one of the two production facilities, which has switched from side feed to point feed in 1998. Due to this (error) correction the national total PFC emissions in 1998 are now about one-third lower than in the previous submission.

HFC emissions from HFC use

Based on a recent study of the refrigeration sector new leakage fractions for 1999 have become available: 5% on average for stationary refrigeration and air-conditioning and 9% for mobile air-conditioning in 1999 (STEK, 2001). These fractions were also used for 2000 emissions. The accuracy of this figure is better than the old leakage fractions of 17 to 12% for stationary refrigeration in 1995 to 1999, respectively, and 33% for mobile air-conditioning, which were based on an extrapolation of a leak fraction of the early 1990s. The new leakage fractions (%) and the activity levels have been used to (re)calculate the actual emissions of this sector.

This recalculation was made by replacing the old leakage fraction for 1999 and 2000 by the new leakage fraction. For 1994-1998 new leakage fractions have been derived by interpolation to 10% in 1995 for stationary refrigeration and by assuming 13% leakage for mobile air-conditioning for all years up to 1998 (STEK, 2001). *Table 5.14* provides an overview of the effect of the recalculation on the level and trend of the HFC emissions from HFC usage.

Table 5.14. Effect of recalculation of HFC emissions from HFC use 1990-1999 (in ton)

Submission	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NIR 2002	0	0	0	0	50	155	358	565	660	692
NIR 2001	0	0	0	0	63	186	427	668	785	860
Difference	*0*	*0*	*0*	*0*	*13*	*31*	*69*	*103*	*125*	*168*

SF_6 emissions from SF_6 use

A study to identify possible missing sources of SF_6 revealed the production of soundproof double glazed windows containing SF_6 as a missing source in the Netherlands, that account for about same SF_6 emissions as the other sources already included in the inventory. To improve the completeness of the national greenhouse gas inventory, this year the emissions for this source category have been added to the national inventory. In addition, the existing estimates for SF_6 from the electricity sector has been updated for 1990.

Table 5.15. Effect of recalculation of SF_6 emissions from SF_6 use in 1990-1999 (in ton)

Submission	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NIR 2002	7.8	4.2	4.5	4.6	6.2	15.1	15.3	16.1	15.4	14.1
NIR 2001	6.1	4.2	4.5	4.6	6.2	7.3	6.7	7.6	5.5	5.7
Difference	*1.7*	*0.0*	*0.0*	*0.0*	*0.0*	*7.8*	*8.6*	*9.5*	*9.9*	*8.4*

The actual SF_6 emissions from the production of double glazed windows only came available for 2000. To recalculate the 1995-1999 period, actual emissions have been estimated by extrapolation back in time. Emissions for 1990-1994 have not been estimated for this source category as it is not accurately known when the use of SF_6 for this application started. *Table 5.15* provides an overview of the effect of the revision on the level and trend of total SF_6 emissions.

5.1.6. Changes in ozone precursors and SO_2 since the previous submission

The emissions data reported in these tables differ from the data reported in the previous report (see *Table 5.16*), mainly due to:

- emissions from road transport based on a new measurement programme of emission factors from passenger cars;
- revised sectoral energy data for 1990 and 1995-1999;
- a shift from non-combustion processes to combustion processes in the industrial sector.

The figures reported here comply with the *Environmental Balance 2001* (RIVM, 2001a,b) and with the annual *Emission Monitor 2001* describing emissions and waste in 1998, 1999 and 2000 (Van Harmelen *et al.,* 2001), except some minor differences, mainly source allocations, due to different production dates. We recall that all data in this report presented for 2000 are preliminary (see also Section 7.1).

Table 5.16. Effect of recalculations on emissions of precursor gases in NIR 2001 and NIR 2002 (in Gg)

Indirect greenhouse gases and SO_2	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
NIR 2001 NO_x	563.2	551.4	539.0	518.9	493.2	497.4	480.8	459.5	422.9	408.4
NIR 2002 NO_x	573.8	551.4	539.0	518.9	493.2	483.5	474.4	446.1	428.5	421.7
Difference	*10.6*	*0*	*0*	*0*	*0*	*-13.9*	*-6.4*	*-13.4*	*5.6*	13.3
NIR 2001 CO	1139.2	1022.5	966.3	948.6	905.1	909.0	835.9	791.5	721.8	679.4
NIR 2002 CO	1164.5	1022.5	966.3	948.6	905.1	894.0	865.0	777.8	739.4	711.8
Difference	*25.3*	*0*	*0*	*0*	*0*	*-15*	*29.1*	*-13.7*	*17.6*	*32.4*
NIR 2001 NMVOC	500.0	460.6	436.2	403.2	387.7	369.7	347.7	323.4	297.6	281.6
NIR 2002 NMVOC	503.7	460.6	436.2	403.2	387.7	369.6	348.7	316.9	301.5	289.9
Difference	*3.7*	*0*	*0*	*0*	*0*	*-0.1*	*1*	*-6.5*	*3.9*	*8.3*
NIR 2001 SO_2	193.3	163.5	157.2	150.4	136.5	144.7	132.2	117.5	106.8	100.4
NIR 2002 SO_2	202.4	163.5	157.2	150.4	136.5	141.4	133.5	116.5	108.0	102.9
Difference	*9.1*	*0*	*0*	*0*	*0*	*-3.3*	*1.3*	*-1*	*1.2*	*2.5*

5.2. Summary of error corrections

Detailed analysis of the previous submission as reported in the previous NIR uncovered a few errors in the 2001 files. These were rectified in the 2002 submission and were related to:

- *Cement clinker production*: for 1990-1992 the CO_2 emissions from clinker production in the cement industry was not included in the inventory. Based on 1990-1992 cement production data, the emissions from this process were estimated to 400, 380 and 350 Gg CO_2, respectively.
- *Emissions from biomass:* In the previous submission some of the CO_2 emissions originating from biomass combustion were erroneously allocated under fossil fuel emissions. In this submission improvements were made to identify biomass in the fossil fuel data and subsequently make a proper allocation for the related CO_2 emissions. Improvements were incorporated for the years 1990, 1995 and 1998 to 2000 amounting changes of national CO_2 emissions of -0.4, 0.1, 0.5 and 0.6 Tg, respectively.

5.3. Revised source allocations

In the Netherlands for domestic purposes emissions are grouped by so-called Target Groups, on which environmental policy is focused. The definition of these groups is provided in Olivier *et al.* (1999). An updated correspondence table for emissions from Target Groups and IPCC source categories is provided in *Table 1.1*. As a next 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 'rapcodes') have received an additional attribute 'IPCC subsector'. In the year 2001 the 'rapcodes' used in past years, were revised in order to improve the link between emissions and IPCC subsectors. Based on these new rapcodes, improvements of the rapcode to 'IPCC sector' correspondence table have been made. This was done to achieve the best possible compliance with source category definitions in the *Revised 1996 IPCC Guidelines* within the constraints of lowest sub-source categories presently identified (rapcodes) in the Netherlands' Emission Registration system (Coenen and Olivier, 2002).

All emission data for the year 1990, 1995, 1998, 1999 and 2000 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:

- CO_2: reallocation between and within categories 1, 2 and 6 mainly due to improved identification of combustion, process and biomass emissions in the inventory data;
- CO_2: category 5A recalculation and allocation into subcategories.

For the years 1997 and 1998 only the emissions in the sectors 1.A.1 and 1.A.2 were submitted using the updated rapcodes, resulting in a change in allocation within these categories. Furthermore:

- CO_2: category 5A recalculation and allocation into subcategories.

The historic inventory datasets used for reporting data for the 1991-1994 period were only partly revised en thus the overall source allocation did not change for these years. Nevertheless for the years 1991-1994 the following improvements on sub-sector level were made:

- CO_2: category 5A recalculation and allocation into subcategories
- CO_2: detailed fuel allocation for 1.A.3 (transport);
- CH_4 and N_2O: reallocation within categories 4A and 4B related to split into the animal subcategories;
- N_2O: reallocation within categories 4.D related to the split into the subcategories.

5.4. Explanation of major changes in the year 1990

The Dutch total CO_2 equivalent emissions (with *Land-Use Change and Forestry*) for 1990 are now calculated 2.5 % (5.4 Tg CO_2 equivalent) less than in the previous submission. This decrease can be explained by the following most relevant changes (all in CO_2 equivalent):

For CO_2:

- 1,721 Gg decrease in the category *Energy* [1A], mainly due to removal of the statistical difference in 1A5 and improved allocation;
- 0.3 Gg decrease in *Fugitive emissions from Oil and Gas* [1B2] due to recalculation;
- 390 Gg increase in *Waste* [6D] on the basis of improved allocation of fuel related emissions;
- 211 Gg decrease in the category *Industrial processes* [2] due to error corrections in source allocation (↓) and error correction in the emissions from cement clinker production (↑);

For CH_4:

- 25 Gg decrease in the category *Energy* [1A], mainly due to recalculation in *Fugitive emissions from Oil and Gas* [1B2] and improved allocation;
- 10 Gg increase in *Manure management* [4B] due to improved data;

For N_2O:

- 1,023 Gg decrease due to recalculation of emissions from *Transport* [1A3], in particular from passenger cars;
- 2,232 Gg decrease due to recalculation of emissions from *Nitric Acid production* [2B].

For HFCs:

- a decrease of 712 Gg in 1990 and 746 Gg in 1995 due to recalculation of emissions from *HCFC-22 production* [2E]
- a decrease of 50 Gg in 1995 for *HFC consumption* [2F] due to improved data on leakage from refrigeration and air-conditioning equipment;

For SF_6:

- an increase of 186 Gg in 1995 due to new source: production of soundproof double glazing windows.

These changes are described in detail in the previous paragraphs. Improved data and changes in source allocation can explain the remainder of the differences in emissions.

5.5. Changes in CRF files compared to the previous submission

The tables included in the *Annex 5* represent the *printed summary version* of the 2002 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* and include:

- IPCC Summary Tables 7A for base years 1990 and 1995 and for the last two years (1999 and preliminary 2000) (CRF Summaries 1);
- Trend Tables 10 for each gas individually and for all gases and source in CO_2-eq. (is included in crf-nld-2002-00.xls);
- Trend Tables 10 for precursor gases (in crf-nld-2002-00.xls);
- Recalculation Tables and Explanation Table 8.a and 8.b for base years 1990 and 1995 and for 1996-1999;
- Completeness Table 9 for 1990.

The largest changes are (see copy of recalculation checklist below):

- Data for 1998 and 1999 were updated (1999 data were preliminary in the previous submission);
- Data for 2000 has been added (all figures for 2000 are preliminary data);
- Data for 1990-1998 were updated (according to the latest data and methodology (see also 5.1 to 5.4), including changes announced in the previous three inventory reports);
- Also more detailed data have been added to the set of CRF files that accompany this report:
  - In particular for fuel combustion (IPCC category 1A) in the years 1990, 1995 to 1999, the split of the emissions data per sector by fuel type was uniformed and improved for the fossil fuel types solid, liquid and gaseous. For the years 1999 and 2000 this could not be done in large extent due to limited detail in the reports of the individual companies that make up the largest part in the source categories 1A1 and 1A2;
  - Improvement of agriculture activity data and related emissions (minor changes);
  - For the years 1991 to 1994 the fuel split and related emissions in 1A3 (transport) were improved and uniformed;
  - The CO_2 emissions/sinks due to LUCF for the years 1990 to 2000 were (re)calculated and included in the CRF files.
  - For HFCs and SF_6 the complete time series 1990-2000 has been revised. For HFCs from 1990 onwards; new source of SF_6 emissions (production of soundproof double glazed windows) has been added for 1990 and 1995-2000.

In the files for 1991 to 1994 only data for HFCs, LUCF, agriculture and transport have been changed due to the above mentioned recalculations.

Status reports on recalculations

For information we summarise the CRF status reports on recalculations below.

Recalculations for 1991-1994:

Recalculation:		Energy	Ind.Processes	Solvent Use	LUCF	Agriculture	Waste
	CO_2	☑	☐	☐	☑	☐	☐
	CH_4	☑	☐	☐	☐	☑	☐
	N_2O	☑	☐	☐	☐	☑	☐
	HFCs, PFCs, SF_6		☑				
	Explanations:	☑	☑	☐	☑	☑	☐
	Recalculation tables for all recalculated years:			☑			
	Full CRF for the recalculated base year:			☑			

Recalculations for 1990, 1995-1999: recalculations based on more detailed data

Recalculation:		Energy	Ind.Processes	Solvent Use	LUCF	Agriculture	Waste
	CO_2	☑	☑	☑	☑	☐	☑
	CH_4	☑	☑	☐	☐	☑	☑
	N_2O	☑	☑	☑	☐	☑	☑
	HFCs, PFCs, SF_6		☑				
	Explanations:	☑	☑	☐	☑	☑	☑
	Recalculation tables for all recalculated years:			☑			
	Full CRF for the recalculated base year:			☑			

Recalculations for 1999: full recalculation, since previous data had status "preliminary", which is now changed in "final".

Recalculation:		Energy	Ind.Processes	Solvent Use	LUCF	Agriculture	Waste
	CO_2	☑	☑	☐	☑	☐	☑
	CH_4	☑	☑	☐	☐	☑	☑
	N_2O	☑	☑	☑	☐	☑	☑
	HFCs, PFCs, SF_6		☑				
	Explanations:	☑	☑	☐	☑	☑	☑
	Recalculation tables for all recalculated years:			☑			
	Full CRF for the recalculated base year:			☑			

Completeness of the CRF files

As mentioned above, the CRF files for 1990 and 1995-2000 now also include sectoral background data for *1A1 Fuel combustion*, including *1A1: Energy Industries* and *1A2: Manufacturing Industries*. That is to say, to the extent that in the various industry sectors emissions were reported in the national Emission Registration system per fuel type (solid, liquid, gaseous). For this NIR report, a special effort was made to recalculate CO_2 emissions for 1996 and 1997 due to the revision of the energy balances. Derived gases (coke oven gas, blast furnace gas etc.) were included under 'Solid 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 20% in 1996-1997 and to 34% in 1999; i.e. this percentage of CO_2 emissions could not be allocated to a specific fuel type. In addition, sectoral background data are now completed for *1A3 Transport* (all years) and *1A4 Other sectors* (1990 and 1995-2000). Moreover, sectoral background data on *1B2 Fugitive oil and gas* are now provided for 1990 and 1995-2000 as well as 1990-2000 data for *cement clinker production* [2A1] and *aluminium production* [2C3], *CH_4* from *enteric fermentation* and from *manure management* [4A and 4B], *N_2O from* *agricultural soils* [4D] and CO_2 removals from LUCF subcategory 5A. In addition, a special effort was made to include background data for category 6A *'Solid waste disposal'*.

In general, completeness of the CRF tables is limited by present level of detail of ER-I data storage, in particular for IPCC categories 1A1, 1A2 and 2 (see *Table 5.16*). These are the sectors that are for a very large part reported by individual firms of which the level of detail, completeness and quality varies considerably (see Section 2.2 on Quality Assurance). For example, in cases where point sources reported different, thus inconsistent, fuel consumption figures associated with emissions of CO_2, CH_4 and N_2O, respectively, it was decided to use the fuel data for CO_2 in the CRF tables, since CO_2 is be far the most important gas of the three. As a consequence, however, in these cases the implied emission factors for CH_4 and N_2O will show another value than could be calculated from the original reported activity data.

For PFCs and SF_6 presently 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 KPMG report 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".

Table 5.16 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 the importing data into the CRF is very time consuming because great accuracy is required and it is done for the first time. It can be expected that next year more complete data for some subcategories will be provided.

Table 5.16.a. Summary of completeness of Common Reporting Format files 1990-2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
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)
2. Manufacturing Industries and Construction	IEF 1)	EM	EM	EM	EM	IEF 1)	IEF 1)	IEF 1)	IEF 1)	IEF 1)	IEF 1)
3. Transport	IEF	EM	EM	EM	EM	IEF	IEF	IEF	IEF	IEF	IEF
4. Other Sectors	IEF	EM	EM	EM	EM	IEF	IEF	IEF	IEF	IEF	IEF
5. Other	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
2. Oil and Natural Gas	IEF 2)	EM	EM	EM	EM	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
3. Limestone and Dolomite Use	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
B. Chemical Industry											
2. Nitric Acid Production	IEF	C	C	IEF	IEF	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
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)
D. Other Production	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
F. Consumption of Halocarbons and SF_6											
1 Refrigeration	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
8 Other	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
3. Solvent and Other Product Use	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
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)
C. Rice Cultivation	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
Animal Wastes Applied to Soils	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
Crop Residue	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)
Animal Production	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF
Atmospheric Deposition	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)
Background agricultural soils	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
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	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
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)
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)
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)
E. Other	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
B. Wastewater Handling											
Wastewater/Sludge	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)
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
D. Other	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
Polluted surface water	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)
Marine	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

For notes see next page.

Table 5.16.b. Summary of completeness of Common Reporting Format files 1990-2000: industrial processes

SPECIFICATION OF INDUSTRIAL PROCESSES:	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2. Industrial Processes											
A. Mineral Products											
1. Cement Production	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
4. Soda Ash	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Glass Production	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
B. Chemical Industry											
1. Ammonia Production (3)	IE										
2. Nitric Acid Production	IE	C	C	IEF	IEF	C	C	C	C	C	C
4. Carbide Production	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
5. Other *(please specify)*	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
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
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)
D. Other Production											
1. Pulp and Paper	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
E. Production of Halocarbons and SF_6											
1. By-product Emissions HCFC-22 productio	C	C	C	C	C	C	C	C	C	C	C
F. Consumption of Halocarbons and SF_6											
1 Refrigeration	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
2 Foam Blowing	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
3 Fire Extinguishers											
4 Aerosols											
5 Solvents											
6 Semiconductors											
7 Electric Equipment											
8 Other *(please specify)*	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
G. Other											

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 for solid, liquid and gaseous fossil fuel use are now in line with underlying fuel consumption due to allocation under 'other fuels' in case CO and related fuel consumption did not properly match; however, this approach did not simultaneously improve the IEFs for CH_4 and N O. 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 has been included under 'other fuels'.
2) Only IEFs for CH_4; not for flaring/venting separately.
3) IEFs for PFCs; other process emissions are includes elsewhere.
4) Activity data are included when not considered confidential.
5) No split of amount of manure per type of 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 *6B Wastewater/Sludge treatment* and *7 Polluted surface water*.
9) Only for CO (CH_4 and N O not estimated).

6. Source Allocation and Completeness

6.1. Territorial aspects; import/exports

The territory of the Netherlands from which emissions are reported is the legal territory, including a twelve miles zone from the coastline and inland water bodies. This 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 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.

6.2. Source allocations and national emissions

We recall that due to data processing limitations some sub-categories have been defined somewhat differently than the source category definition in the *Revised IPCC Guidelines* (IPCC, 1997). Also the source allocation for 1991-1994 may 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 90/91 and 95/96.

6.2.1. Allocation of feedstock emissions (non-energy)

In line with the comparison made in the CRF between CO_2 emissions from source category 1A *'Fuel combustion'* and CO_2 emissions calculation using the *IPCC Reference Approach*, the CO_2 emissions from feedstock use of energy carriers have been reported in category 1A1 *'Manufacturing Industries and Construction'*.

6.2.2. Allocation of emissions in the transportation sector

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). In addition, pipeline transport (excluding natural gas) is also included in this sector.

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 as included in the energy sales statistics of the Netherlands. The *Revised IPCC Guidelines* 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 7.1.4 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 based on fuel sold from so-called bunkers. However, a small part of inland ships also consume 'Dutch' fuel in other countries, e.g. when moving along international waterways, of which the emissions are excluded in the ER reports. It was chosen to copy this minor correction for 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 include in the official Netherlands' national inventory with emissions for all compounds, called the national *Pollutant Emission Register* (PER) (see *Table 6.1*). 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 the emissions from the IPCC *1A3 'Transport'* category. For other compounds however, this difference is rather small.

Table 6.1 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	• Ibidem
• 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 neglected)	• Ibidem: - 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 not reported (except for CO_2).

Air traffic

For calculating CO_2 emissions from domestic air transport domestic fuel sales figures for aircraft from the Netherlands' Energy Statistics were used. 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 neglected). Indeed, in the Netherlands by far the most aircraft activities (>90%) are related to Schiphol Airport.

For the emissions of non-CO_2 greenhouse gases, the inventory of the national *Pollutant Emission Register* (PER) is used. 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 the LTO emissions at Schiphol Airport (Amsterdam), i.e. LTO cycles at other airports are neglected. 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 was made to estimate specific emissions related to all *domestic* flights (including cruise emissions of these flights), since these emissions are almost negligible anyway.

Off-road mobile sources

This category comprises agricultural machinery such as tractors, road and building construction machinery. Emissions of these sources are reported under *1A3: 'Transport'.*

6.2.3. Allocation of emissions of cogeneration from autoproducers

These emissions are allocated to the various *Target Groups* that own the cogeneration (Combined Heat and Power, CHP) facilities. These are notably the Energy Sector (public electricity generation), Industry, Agriculture, Retail/Services/Government, and the Residential Sector. Thus, the combustion emissions due to cogeneration are reported under the *IPCC Sectors* that correspond to these *Target Groups.* Often new CHP installations are operated as a joint venture with the energy sector, in which all heat is delivered to the industrial plant and all electricity is sold to the energy sector. In this case the CHP installation is regarded as a venture with main activity to produce heat and electricity, and it is therefore allocated within the energy sector. So the stabilisation of industrial CO_2 emissions is partly caused by the allocation of emissions towards the energy sector. In total, electricity production by CHP comprises almost 1/3 of all domestic electricity production (see *Table 8.6*).

6.2.4. Allocation of emissions from coke ovens and other energy transformation

Emissions from coke ovens are included under *1A2: 'Industry'*. Under *1A1c: 'Other Energy transformation'* we include not only the emissions from refineries, but also from lubricants and waxes manufacturing and combustion emissions from the oil and gas production and distribution industry.

6.2.5. Allocation of emissions from military activities

Military emission sources can be distinguished into mobile and stationary sources:

- Emissions of mobile military sources may be included in the Target Group *'Traffic and Transport'.* These are reported under IPCC-category *A3: 'Transport';*
- Emissions of stationary military sources (e.g. space heating of buildings) may be included in the Target Group *Retail/Services/Government.* The combustion emissions of this category are reported under *1A4a: 'Commercial/Institutional',* whereas the process emissions are reported under *3: 'Solvents and other product use'.* For these activities no separate emission estimates may be available.

6.3. Completeness of sources

In this submission the following sources are now included, which were not estimated in the NIR 2001:

- CO_2 from cement clinker production was missing for 1990-1992; this accounts for about 0.4 Tg CO_2;
- CO_2 sinks from category *5A: 'Changes in forest and other woody biomass stocks'* have now been calculated from basic data for all years 1990-2000;
- CH_4 from enteric fermentation by horses 1998-1999 was missing about 4 Gg CH_4;
- SF_6 from the production of sound-insulating double glazed windows.

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

- 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 (positive) anthropogenic emissions;
- CH_4, N_2O and other non-CO_2 emissions from *international bunkers* are not yet estimated/ reported.

For LUCF subcategories 5B-5E also new datasets were being compiled, of which some preliminary results are presented in Annex 2. However, since these are still under discussion, no new data are for the other subcategories 5B to 5E have been included in this submission.

In addition, when verifying the data in the CRF files, it was found that incorrect notation keys were used for the following sources:

- NO instead of NE for emissions from horse manure [4B]
- 0 instead of NE for CO emissions/sinks from agricultural soils [4D]
- NO instead of NE for emissions from 5B to 5E

These accidental errors will be improved in a next update of the inventory. For more details on sources reported elsewhere see the Completeness Table 9 for 1990 in *Annex 5.3* and the documentation boxes in the CRF files.

A survey made to check for possibly unidentified sources of non-CO_2 emissions in the Netherlands showed that some 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; to be included when monitored regularly and when not already included in the present emission inventory.
- N_2O: 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: some minor sources; to be included when monitored regularly and when not already included in the present emission inventory.

These sources may be included in a later stage, when checked that they are not already included in the present emission inventory and when it has been decided to monitor them regularly.

7. Uncertainty and Key Source Assessment

The newly developed IPCC Tier 1 methodology for estimating uncertainty in annual emissions and in trends has recently been applied to the more detailed IPCC list of possible key sources (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, and will be important for meeting the National System requirements, the information presented in this Chapter should be only be considered as a first step in this process.

7.1. Uncertainty assessment (IPCC Tier 1)

For estimating the uncertainty in activity data and emission factors, the following information sources were used (Olivier and Brandes, 2002):

- At a national workshop in 1999 estimates used for reporting uncertainty in greenhouse gases emissions in the Netherlands were discussed (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;
- Any other recent information on the data quality.

These were supplemented with expert judgement of RIVM emission experts. Next, emissions in 1990 and 2000 were split according to the IPCC Tier 1 methodology for estimating uncertainty in both annual emissions as well as in the emission trend was applied to the emissions for the Netherlands.

Data used

For estimating 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. The emissions data for 1990 and 2000 were taken from the preliminary submission to the EU and allocated to the IPCC source category list, i.e. when 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 from CO_2 from fuel combustion. All uncertainty figures are to be interpreted as corresponding with an 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.

Results

The results of the uncertainty calculation according to the *IPCC Tier 1 uncertainty approach* are summarised in *Table 5.1*. The Tier 1 calculation of annual uncertainty in CO_2-eq. emissions results in 2%, 17%, 35% and 21% for CO_2, CH_4, N_2O and F-gases, respectively, and in overall uncertainty of 4%. However, these figures do not include the correlation that exists between source categories (e.g. energy amounts for feedstocks and for fuel combustion, cattle numbers for enteric fermentation and for animal manure production) nor include correction of not-reported sources. Therefore, the actual uncertainty of total *annual* emissions per compound and of the total will be somewhat higher, and is currently estimated by RIVM at:

CO	±3%	HFCs	±50%
CH_4	±25%	PFCs	±50%
N O	±50%	SF_6	±50%

Table 7.1. 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)

IPCC	Source category	CO_2-eq. 90/95	CO_2-eq. 2000	AD unc	EF unc	EM unc
1A	Emissions from stationary combustion: gas	66.628	74.314	3%	1%	3%
1A	Emissions from stationary combustion: coal	33.733	30.138	3%	3%	4%
1A	Mobile combustion: road vehicles	25.369	31.468	2%	2%	3%
1A	Emissions from stationary combustion: oil	19.860	21.178	3%	2%	4%
1A	Feedstock gas	4.805	5.287	5%	10%	11%
1A	Feedstock oil	2.550	3.697	20%	50%	54%
1A	Mobile combustion: other	2.346	2.365	50%	2%	50%
1A	Mobile combustion: water-borne navigation	877	1.004	100%	2%	100%
1A	Mobile combustion: aircraft	492	283	50%	2%	50%
1A	Feedstock coal	481	408	5%	10%	11%
2	Other industrial: CO2	1.290	923	20%	5%	21%
2	Emissions from cement production	400	437	5%	10%	11%
7	Misc. CO2	797	2.025	20%	50%	54%
	Total CO2	**159.630**	**173.527**			**2%**
						-> 3%
1A	Emissions from stationary combustion: non-CO2	558	594	3%	50%	50%
1A	Mobile combustion: road vehicles	158	87	5%	60%	60%
1A	Mobile combustion: other	8	7	50%	100%	112%
1B	Fugitive emissions from oil and gas operations: gas productio	2.097	1.467	1%	25%	25%
1B	Fugitive emissions from oil and gas operations: gas distributi	1.524	1.217	5%	50%	50%
1B	Fugitive emissions from oil and gas operations: other	133	71	20%	50%	54%
2	Other industrial: CH4	69	59	10%	50%	51%
4A	CH4 emissions from enteric fermentation in domestic livestoc	7.678	6.000	5%	20%	21%
4A	CH4 emissions from enteric fermentation in domestic livestoc	438	413	5%	50%	50%
4A	CH4 emissions from enteric fermentation in domestic livestoc	286	220	5%	30%	30%
4A	CH4 emissions from enteric fermentation in domestic livestoc	37	75	5%	30%	30%
4B	Emissions from manure management : swine	1.033	893	10%	100%	100%
4B	Emissions from manure management : cattle	905	751	10%	100%	100%
4B	Emissions from manure management : poultry	216	189	10%	100%	100%
4B	Emissions from manure management : other	19	22	10%	100%	100%
6A	CH4 emissions from solid waste disposal sites	11.805	8.480	15%	30%	34%
6B	Emissions from wastewater handling	138	53	20%	25%	32%
7	Misc. CH4	43	40	20%	25%	32%
	Total CH4	**27.143**	**20.638**			**17%**
						-> 25%
1A	Mobile combustion: road vehicles	340	589	5%	50%	50%
1A	Emissions from stationary combustion: non-CO2	208	177	2%	50%	50%
1A	Mobile combustion: other	35	32	50%	100%	112%
2	Emissions from nitric acid production	7.554	7.119	10%	50%	51%
4B	Emissions from manure management	205	195	10%	100%	100%
4D	Direct N2O emissions from agricultural soils	5.189	5.892	10%	60%	61%
4D	Indirect N2O emissions from nitrogen used in agriculture	1.460	1.460	50%	200%	206%
6B	Emissions from wastewater handling	126	177	20%	50%	54%
7	Polluted surface water	1.181	1.184	50%	200%	206%
7	Misc. N2O	225	155	50%	50%	71%
	Total N2O	**16.524**	**16.980**			**35%**
						-> 50%
2	HFC-23 emissions from HCFC-22 manufacture	5.768	2.838	15%	25%	29%
2	Emissions from substitutes for ozone depleting substances (O	210	1.079	10%	50%	51%
2	PFC emissions from aluminium production	1.799	1.390	5%	20%	21%
2	PFC emissions from PFC use	68	136	5%	25%	25%
2	SF6 emissions from SF6 use	361	327	50%	25%	56%
	Total F-gases	**8.206**	**5.771**			**21%**
		-> 50% for HFCs ,PFCs and SF6				
	Total Netherlands (CO2-eq.)	**211502**	**216915**			**4%**
						-> 5%

Note: In some cases the value used for uncertainty in the emission factor is the equivalent value of the sum of a Tier 1 uncertainty estimate for the sum of underlying sub-sources. Also, 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.

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 2000' in *Table 7.2*), the sources contributing most to total *annual uncertainty* in 2000 are:

IPCC	IPCC Source category	Uncertainty (as % of total national emissions in 2000)
2	N O emissions from nitric acid production	1.7%
4D	Direct N O emissions from agricultural soils	1.7%
4D	Indirect N O emissions from nitrogen used in agriculture	1.4%
6A	CH_4 emissions from solid waste disposal sites	1.3%
7	N O emissions from polluted surface water	1.1%
1A	CO emissions from stationary combustion gas	1.1%
1A	CO emissions from feedstock: oil	0.9%
1A	CO emissions from stationary combustion: coal	0.6%
4A	CH_4 emissions from enteric fermentation in domestic livestock: cattle	0.6%
1A	CO emissions from mobile combustion: other	0.5%

In *Table 7.2* the estimate of the *trend uncertainty 1990-2000* calculated according to the IPCC Tier 1 approach in the *IPCC Good Practice Guidance* (IPCC, 2000) is summarised. The result is a trend uncertainty in the total CO_2-eq. emissions for 1990-2000 (1995 for F-gases) of ±3% points. This means that the increase in total CO_2-eq. emissions between 1990 and 2000, which is calculated to be 3%, will lie between 0 and 6%. Per individual gas, the Tier 1 trend uncertainty in total emissions of CO_2, CH_4, N_2O and the total group of F-gases has been calculated at ±3%, ±7%, ±12% and ±11% points, respectively. Sources contributing most to *trend uncertainty* in the national total are:

IPCC	IPCC Source category	Uncertainty (as % into trend in total national emissions)
1A	CO emissions from stationary combustion: gas	1.5%
6A	CH_4 emission from solid waste disposal sites	1.0%
1A	CO emissions from mobile combustion: other	0.8%
1A	CO emissions from mobile combustion: water-borne navigation	0.7%
1A	CO emissions from stationary combustion: coal	0.6%
1A	CO emissions from feedstock: oil	0.6%
2	N O emissions from nitric acid production	0.5%
4D	Indirect N O emissions from nitrogen used in agriculture	0.5%
2	HFC-23 emissions from HCFC-22 manufacture	0.5%
4D	Direct N O emissions from agricultural soils	0.4%

When we compare this list with the 10 largest contributors to annual uncertainty, we can conclude that except for CO_2 from water borne navigation, N_2O from polluted surface water CH_4, from enteric fermentation of cattle and HFC from HCFC-22 manufacture, all 8 others are included both lists.

Because of the problems identified with annual environmental reports (see *Box 2.1*) an extra uncertainty in national CO_2 emissions is estimated for 2000 of 2% (Heslinga, 2001b). In additional, delays in compiling (preliminary) 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 4th quarter of 2000. For the same reason the other greenhouse gas emissions are also more uncertain in 2000, but this extra uncertainty has not been quantified.

Limitations

The uncertainty estimates presented in *Table 7.1* 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

Table 7.2. Tier 1 trend uncertainty assessment 1990-2000 (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)	2000 Emissions	Activity data uncertainty	Emission factor uncertainty	Combined Uncertainty	Combined Uncertainty as % of total national emissions in 2000
1A	Emissions from stationary combustion: gas	CO2	66628	74314	3%	1%	3%	1.1%
1A	Emissions from stationary combustion: coal	CO2	33733	30138	3%	3%	4%	0.6%
1A	Emissions from stationary combustion: oil	CO2	19860	21178	3%	2%	4%	0.4%
1A	Mobile combustion: road vehicles	CO2	25369	31468	2%	2%	3%	0.4%
1A	Mobile combustion: other	CO2	2346	2365	50%	2%	50%	0.5%
1A	Mobile combustion: water-borne navigation	CO2	877	1004	100%	2%	100%	0.5%
1A	Mobile combustion: aircraft	CO2	492	283	50%	2%	50%	0.1%
1A	Feedstock gas	CO2	4805	5287	5%	10%	11%	0.3%
1A	Feedstock oil	CO2	2550	3697	20%	50%	54%	0.9%
1A	Feedstock coal	CO2	481	408	5%	10%	11%	0.0%
2X	Emissions from cement production	CO2	400	437	5%	10%	11%	0.0%
2X	Other industrial: CO2	CO2	1290	923	20%	5%	21%	0.1%
7	Misc. CO2	CO2	797	2025	20%	50%	54%	0.5%
	TOTAL CO2	CO2	159630	173527	**9%**	**increase**		
1A	Emissions from stationary combustion: non-CO2	CH4	558	594	3%	50%	50%	0.1%
1A	Mobile combustion: road vehicles	CH4	158	87	5%	60%	60%	0.0%
1A	Mobile combustion: other	CH4	8	7	50%	100%	112%	0.0%
1B	Fugitive emissions from oil and gas operations: gas production	CH4	2097	1467	1%	25%	25%	0.2%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH4	1524	1217	5%	50%	50%	0.3%
1B	Fugitive emissions from oil and gas operations: other	CH4	133	71	20%	50%	54%	0.0%
2X	Other industrial: CH4	CH4	69	59	10%	50%	51%	0.0%
4A	CH4 emissions from enteric fermentation in domestic livestock: cattle	CH4	7678	6000	5%	20%	21%	0.6%
4A	CH4 emissions from enteric fermentation in domestic livestock: swine	CH4	438	413	5%	50%	50%	0.1%
4A	CH4 emissions from enteric fermentation in domestic livestock: sheep	CH4	286	220	5%	30%	30%	0.0%
4A	CH4 emissions from enteric fermentation in domestic livestock: other	CH4	37	75	5%	30%	30%	0.0%
4B	Emissions from manure management : swine	CH4	1033	893	10%	100%	100%	0.4%
4B	Emissions from manure management : cattle	CH4	905	751	10%	100%	100%	0.3%
4B	Emissions from manure management : poultry	CH4	216	189	10%	100%	100%	0.1%
4B	Emissions from manure management : other	CH4	19	22	10%	100%	100%	0.0%
6A	CH4 emissions from solid waste disposal sites	CH4	11805	8480	15%	30%	34%	1.3%
6B	Emissions from wastewater handling	CH4	138	53	20%	25%	32%	0.0%
7X	Misc. CH4	CH4	43	40	20%	25%	32%	0.0%
	TOTAL CH4	CH4	27143	20638	**-24%**	**(= decrease)**		
1A	Emissions from stationary combustion: non-CO2	N2O	208	177	2%	50%	50%	0.0%
1A	Mobile combustion: road vehicles	N2O	340	589	5%	50%	50%	0.1%
1A	Mobile combustion: other	N2O	35	32	50%	100%	112%	0.0%
2	Emissions from nitric acid production	N2O	7554	7119	10%	50%	51%	1.7%
4B	Emissions from manure management	N2O	205	195	10%	100%	100%	0.1%
4D	Direct N2O emissions from agricultural soils	N2O	5189	5892	10%	60%	61%	1.7%
4D	Indirect N2O emissions from nitrogen used in agriculture	N2O	1460	1460	50%	200%	206%	1.4%
6B	Emissions from wastewater handling	N2O	126	177	20%	50%	54%	0.0%
7	Polluted surface water	N2O	1181	1184	50%	200%	206%	1.1%
7X	Misc. N2O	N2O	225	155	50%	50%	71%	0.1%
	TOTAL N2O	N2O	16524	16980	**3%**	**increase**		
2	HFC-23 emissions from HCFC-22 manufacture	HFC	5768	2838	15%	25%	29%	0.4%
2X	Emissions from substitutes for ODS substitutes: HFC	HFC	210	1079	10%	50%	51%	0.3%
2X	PFC emissions from aluminium production	PFC	1799	1390	5%	20%	21%	0.1%
2X	PFC emissions from PFC use	PFC	68	136	5%	25%	25%	0.0%
2X	SF6 emissions from SF6 use	SF6	361	327	50%	25%	56%	0.1%
	TOTAL F-gases	F-gases	8206	5771	**-30%**	**(= decrease)**		
	TOTAL CO2-eq.	GHG	211502	216915	**3%**	**increase**		**3.4%**

Table 7.2.(continued) Tier 1 trend uncertainty assessment 1990-2000 (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	Activity data quality indicator
1A	Emissions from stationary combustion: gas	CO2	1.2%	47%	0.0%	2.0%	2.0%	R	R
1A	Emissions from stationary combustion: coal	CO2	-4.1%	19%	-0.1%	0.8%	0.8%	R	R
1A	Emissions from stationary combustion: oil	CO2	-0.3%	13%	0.0%	0.6%	0.6%	R	R
1A	Mobile combustion: road vehicles	CO2	2.4%	20%	0.0%	0.6%	0.6%	R	R
1A	Mobile combustion: other	CO2	-0.1%	1%	0.0%	1.0%	1.0%	R	R
1A	Mobile combustion: water-borne navigation	CO2	0.0%	1%	0.0%	0.9%	0.9%	R	R
1A	Mobile combustion: aircraft	CO2	-0.2%	0%	0.0%	0.1%	0.1%	R	R
1A	Feedstock gas	CO2	0.0%	3%	0.0%	0.2%	0.2%	R	R
1A	Feedstock oil	CO2	0.6%	2%	0.3%	0.7%	0.7%	R	R
1A	Feedstock coal	CO2	-0.1%	0%	0.0%	0.0%	0.0%	R	R
2X	Emissions from cement production	CO2	0.0%	0%	0.0%	0.0%	0.0%	R	D
2X	Other industrial: CO2	CO2	-0.3%	1%	0.0%	0.2%	0.2%	R	R
7	Misc. CO2	CO2	0.7%	1%	0.4%	0.4%	0.5%	R	R
	TOTAL CO2	CO2					**3%p. in trend of 9%**		
1A	Emissions from stationary combustion: non-CO2	CH4	0.6%	2%	0.3%	0.1%	0.3%	R	R
1A	Mobile combustion: road vehicles	CH4	-0.1%	0%	-0.1%	0.0%	0.1%	R	R
1A	Mobile combustion: other	CH4	0.0%	0%	0.0%	0.0%	0.0%	R	R
1B	Fugitive emissions from oil and gas operations: gas production	CH4	-0.5%	5%	-0.1%	0.1%	0.1%	R	R
1B	Fugitive emissions from oil and gas operations: gas distribution	CH4	0.2%	4%	0.1%	0.3%	0.3%	R	R
1B	Fugitive emissions from oil and gas operations: other	CH4	-0.1%	0%	-0.1%	0.1%	0.1%	R	R
2X	Other industrial: CH4	CH4	0.0%	0%	0.0%	0.0%	0.0%	R	R
4A	CH4 emissions from enteric fermentation in domestic livestock: cattle	CH4	0.6%	22%	0.1%	1.6%	1.6%	R	D
4A	CH4 emissions from enteric fermentation in domestic livestock: swine	CH4	0.3%	2%	0.1%	0.1%	0.2%	D	R
4A	CH4 emissions from enteric fermentation in domestic livestock: sheep	CH4	0.0%	1%	0.0%	0.1%	0.1%	D	R
4A	CH4 emissions from enteric fermentation in domestic livestock: other	CH4	0.2%	0%	0.1%	0.0%	0.1%	D	R
4B	Emissions from manure management : swine	CH4	0.4%	3%	0.4%	0.5%	0.6%	D	R
4B	Emissions from manure management : cattle	CH4	0.2%	3%	0.2%	0.4%	0.5%	D	R
4B	Emissions from manure management : poultry	CH4	0.1%	1%	0.1%	0.1%	0.1%	D	R
4B	Emissions from manure management : other	CH4	0.0%	0%	0.0%	0.0%	0.0%	D	R
6A	CH4 emissions from solid waste disposal sites	CH4	-1.8%	31%	-0.5%	6.6%	6.6%	R	R
6B	Emissions from wastewater handling	CH4	-0.2%	0%	0.0%	0.1%	0.1%	R	R
7X	Misc. CH4	CH4	0.0%	0%	0.0%	0.0%	0.0%	R	R
	TOTAL CH4	CH4					**7%p. in trend of -24%**		
1A	Emissions from stationary combustion: non-CO2	N2O	-0.2%	1%	-0.1%	0.0%	0.1%	R	R
1A	Mobile combustion: road vehicles	N2O	1.4%	4%	0.7%	0.3%	0.8%	R	R
1A	Mobile combustion: other	N2O	0.0%	0%	0.0%	0.1%	0.1%	R	R
2	Emissions from nitric acid production	N2O	-3.9%	43%	-1.9%	6.1%	6.4%	R	R
4B	Emissions from manure management	N2O	-0.1%	1%	-0.1%	0.2%	0.2%	D	R
4D	Direct N2O emissions from agricultural soils	N2O	3.4%	36%	2.0%	5.0%	5.4%	D	D
4D	Indirect N2O emissions from nitrogen used in agriculture	N2O	-0.2%	9%	-0.5%	6.2%	6.3%	D	R
6B	Emissions from wastewater handling	N2O	0.3%	1%	0.1%	0.3%	0.3%	R	R
7	Polluted surface water	N2O	-0.2%	7%	-0.4%	5.1%	5.1%	R	R
7X	Misc. N2O	N2O	-0.5%	1%	-0.2%	0.7%	0.7%	R	R
	TOTAL N2O	N2O					**12%p. in trend of 3%**		
2	HFC-23 emissions from HCFC-22 manufacture	HFC	-14.7%	35%	-3.7%	7.3%	8.2%	M,R	D
2X	Emissions from substitutes for ODS substitutes: HFC	HFC	11.3%	13%	5.7%	1.9%	6.0%	D	D
2X	PFC emissions from aluminium production	PFC	1.5%	17%	0.3%	1.2%	1.2%	M,R	D
2X	PFC emissions from PFC use	PFC	1.1%	2%	0.3%	0.1%	0.3%	M,R	D
2X	SF6 emissions from SF6 use	SF6	0.9%	4%	0.2%	2.8%	2.8%	R	R
	TOTAL F-gases	F-gases					**11%p. in trend of -30%**		
	TOTAL CO2-eq.	GHG					**17% unc. in +3% trend**		

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. Also, 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.

Notation keys used for basis of uncertainty in emission factors (EF) and activity data (AD):

D = Default of IPCC source category
R = National Referenced data
M = Measurement based

following conditions: a) standard-normal division ('Gaussian'), b) 2σ smaller than 60%, c) sector to sector, substance to substance are independent. 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. Also, for some sources it is already known that the probability distribution is not normal; in particular when uncertainties are very high (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, unavoidably uncertainty estimates are in the end based on expert judgement of representativity for the Netherlands' circumstances of the particular source category. Sometimes, however, only limited reference to actual Netherlands data was possible to support these estimates. Focussing 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.

Furthermore, in using the uncertainty estimates presented in *Table 7.1*, 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 7.1*). However, as described in Chapter 4, total CO_2 emissions per industrial sub-sector cannot be off from the reference calculation by more than 5% (in practice, the group total may show much less deviation).

7.2. Key Source Identification (preliminary assessment)

For preliminary identification of 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, where possible. For the Netherlands, with its high share of feedstock use of fuels, this non-combustion category of CO_2 has been added to the list. A number of others could not be clearly identified in the present dataset, the largest being CO_2 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 results of these listings are presented in *Table 7.3* and *Table 7.4*, respectively. The grey areas at the top of the tables are the largest sources of which the total adds to 95% of the national total: 16 sources for annual level assessment and 18 sources for the trend assessment out of a total of 52 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 level and trend assessment are summarised in *Table 7.5*. As could be expected, the Tier 2 level and trend assessment increases 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 are shifted above this line in the Tier 2 assessment.

Key source identification and methodological choice

The result is a list of about 21 source categories out of a total of 52, which 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 7.5*. For many of the country-specific methods the associated IPCC Tier has still to be determined, but it seems clear that for instance for CH_4 from national gas distribution and CH_4 from enteric fermentation of cattle the methods used will probably need to be improved in future. However, a comprehensive analysis has yet to be made.

Table 7.3. Source ranking using IPCC Tier 1 level assessment 2000 (amounts in Gg CO_2-eq.)

IPCC	Category	Gas	CO_2-eq 2000	Share	Cum. share
1A	Emissions from stationary combustion: gas	CO2	74314	34%	34%
1A	Mobile combustion: road vehicles	CO2	31468	15%	49%
1A	Emissions from stationary combustion: coal	CO2	30138	14%	63%
1A	Emissions from stationary combustion: oil	CO2	21178	10%	72%
6A	CH4 emissions from solid waste disposal sites	CH4	8480	4%	76%
2	Emissions from nitric acid production	N2O	7119	3%	80%
4A	CH4 emissions from enteric fermentation in domestic livestock: cattle	CH4	6000	3%	82%
4D	Direct N2O emissions from agricultural soils	N2O	5892	3%	85%
1A	Feedstock gas	CO2	5287	2%	88%
1A	Feedstock oil	CO2	3697	2%	89%
2	HFC-23 emissions from HCFC-22 manufacture	HFC	2838	1%	91%
1A	Mobile combustion: other	CO2	2365	1%	92%
7	Misc. CO2	CO2	2025	1%	93%
1B	Fugitive emissions from oil and gas operations: gas production	CH4	1467	1%	93%
4D	Indirect N2O emissions from nitrogen used in agriculture	N2O	1460	1%	94%
2	PFC emissions from aluminium production	PFC	1390	1%	95%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH4	1217	1%	95%
7	Polluted surface water	N2O	1184	1%	96%
2	Emissions from CFC-substitutes: HFC	HFC	1079	0%	96%
1A	Mobile combustion: water-borne navigation	CO2	1004	0%	97%
2	Other industrial: CO2	CO2	923	0%	97%
4B	Emissions from manure management : swine	CH4	893	0%	97%
4B	Emissions from manure management : cattle	CH4	751	0%	98%
1A	Emissions from stationary combustion: non-CO2	CH4	594	0%	98%
1A	Mobile combustion: road vehicles	N2O	589	0%	98%
2	Emissions from cement production	CO2	437	0%	99%
4A	CH4 emissions from enteric fermentation in domestic livestock: swine	CH4	413	0%	99%
1A	Feedstock coal	CO2	408	0%	99%
2	SF6 emissions from SF6 use	SF6	327	0%	99%
1A	Mobile combustion: aircraft	CO2	283	0%	99%
4A	CH4 emissions from enteric fermentation in domestic livestock: sheep	CH4	220	0%	99%
4B	Emissions from manure management	N2O	195	0%	99%
4B	Emissions from manure management : poultry	CH4	189	0%	99%
6B	Emissions from wastewater handling	N2O	177	0%	100%
1A	Emissions from stationary combustion: non-CO2	N2O	177	0%	100%
7	Misc. N2O	N2O	155	0%	100%
2	PFC emissions from PFC use	PFC	136	0%	100%
1A	Mobile combustion: road vehicles	CH4	87	0%	100%
4A	CH4 emissions from enteric fermentation in domestic livestock: other	CH4	75	0%	100%
1B	Fugitive emissions from oil and gas operations: other	CH4	71	0%	100%
2	Other industrial: CH4	CH4	59	0%	100%
6B	Emissions from wastewater handling	CH4	53	0%	100%
7	Misc. CH4	CH4	40	0%	100%
1A	Mobile combustion: other	N2O	32	0%	100%
4B	Emissions from manure management : other	CH4	22	0%	100%
1A	Mobile combustion: other	CH4	7	0%	100%
	TOTAL		216915		
4B	Emissions from agricultural residue burning	n-CO2	NO		
2	Emissions from lime consumption	CO2	IE		
2	Emissions from iron and steel industry	CO2	IE		
2	PFC, HFC, SF6 emissions from semiconductor manufacturing (GWP)	PFC	IE		
2	Other industrial: N2O	N2O	IE		
6C	Emissions from waste incineration	n-CO2	IE		

NO = Not Occuring; NA = Not Applicable; IE = Included Elsewhere.
Sources: Olivier *et al.* (2000) [emissions], Van Amstel *et al.* (2000a), IPCC (2000) and own RIVM expert judgement of uncertainties.

Limitations

We recall that Tier 2 key source assessments are subject to the limitations of the Tier 1 uncertainty estimates as discussed in Section 7.1. 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.

Table 7.4. Source ranking using IPCC Tier 1 trend assessment (amounts in Gg CO_2-eq.)

IPCC	Category	Gas	CO2-eq 1990	CO2-eq 2000	Level assess-ment 90/95	Level assess-ment 2000	Trend assess-ment	% Contr. to trend	Cumu-lative total
2	HFC-23 emissions from HCFC-22 manufacture	HFC	5768	2838	3%	1%	2.9%	17%	17%
1A	Emissions from stationary combustion: gas	CO2	66628	74314	32%	34%	2.5%	15%	31%
6A	CH4 emissions from solid waste disposal sites	CH4	11805	8480	6%	4%	2.3%	14%	45%
1A	Emissions from stationary combustion: coal	CO2	33733	30138	16%	14%	2.3%	14%	59%
1A	Mobile combustion: road vehicles	CO2	25369	31468	12%	15%	2.0%	12%	71%
4A	CH4 emissions from enteric fermentation in domestic livestock: cattle	CH4	7678	6000	4%	3%	1.1%	6%	77%
1B	Fugitive emissions from oil and gas operations: gas production	CH4	2097	1467	1%	1%	0.5%	3%	80%
1A	Emissions from stationary combustion: oil	CO2	19860	21178	9%	10%	0.4%	2%	82%
1A	Feedstock oil	CO2	2550	3697	1%	2%	0.3%	2%	84%
2	Emissions from nitric acid production	N2O	7554	7119	4%	3%	0.3%	2%	86%
2	PFC emissions from aluminium production	PFC	1799	1390	1%	1%	0.3%	2%	87%
2	Other industrial: CO2	CO2	1290	923	1%	0%	0.3%	2%	89%
4D	Direct N2O emissions from agricultural soils	N2O	5189	5892	2%	3%	0.2%	1%	90%
7	Misc. CO2	CO2	797	2025	0%	1%	0.2%	1%	91%
1B	Fugitive emissions from oil and gas operations: gas distribution	CH4	1524	1217	1%	1%	0.2%	1%	93%
1A	Mobile combustion: aircraft	CO2	492	283	0%	0%	0.2%	1%	94%
1A	Feedstock gas	CO2	4805	5287	2%	2%	0.2%	1%	94%
6B	Emissions from wastewater handling	CH4	138	53	0%	0%	0.1%	1%	95%
4B	Emissions from manure management : cattle	CH4	905	751	0%	0%	0.1%	1%	96%
4B	Emissions from manure management : swine	CH4	1033	893	0%	0%	0.1%	1%	96%
2	Emissions from CFC substitutes: HFC	HFC	210	1079	0%	0%	0.1%	0%	97%
1A	Mobile combustion: road vehicles	N2O	340	589	0%	0%	0.1%	0%	97%
1A	Mobile combustion: road vehicles	CH4	158	87	0%	0%	0.1%	0%	97%
1B	Fugitive emissions from oil and gas operations: other	CH4	133	71	0%	0%	0.1%	0%	98%
7	Misc. N2O	N2O	225	155	0%	0%	0.1%	0%	98%
1A	Feedstock coal	CO2	481	408	0%	0%	0.0%	0%	98%
4A	CH4 emissions from enteric fermentation in domestic livestock: sheep	CH4	286	220	0%	0%	0.0%	0%	99%
1A	Mobile combustion: water-borne navigation	CO2	877	1004	0%	0%	0.0%	0%	99%
2	SF6 emissions from SF6 use	SF6	361	327	0%	0%	0.0%	0%	99%
1A	Emissions from stationary combustion: non-CO2	N2O	208	177	0%	0%	0.0%	0%	99%
1A	Mobile combustion: other	CO2	2346	2365	1%	1%	0.0%	0%	99%
4A	CH4 emissions from enteric fermentation in domestic livestock: swine	CH4	438	413	0%	0%	0.0%	0%	99%
4D	Indirect N2O emissions from nitrogen used in agriculture	N2O	1460	1460	1%	1%	0.0%	0%	99%
4B	Emissions from manure management : poultry	CH4	216	189	0%	0%	0.0%	0%	99%
6B	Emissions from wastewater handling	N2O	126	177	0%	0%	0.0%	0%	100%
2	PFC emissions from PFC use	PFC	68	136	0%	0%	0.0%	0%	100%
7	Polluted surface water	N2O	1181	1184	1%	1%	0.0%	0%	100%
2	Emissions from cement production	CO2	400	437	0%	0%	0.0%	0%	100%
1A	Emissions from stationary combustion: non-CO2	CH4	558	594	0%	0%	0.0%	0%	100%
4A	CH4 emissions from enteric fermentation in domestic livestock: other	CH4	37	75	0%	0%	0.0%	0%	100%
4B	Emissions from manure management	N2O	205	195	0%	0%	0.0%	0%	100%
2	Other industrial: CH4	CH4	69	59	0%	0%	0.0%	0%	100%
7	Misc. CH4	CH4	43	40	0%	0%	0.0%	0%	100%
1A	Mobile combustion: other	N2O	35	32	0%	0%	0.0%	0%	100%
4B	Emissions from manure management : other	CH4	19	22	0%	0%	0.0%	0%	100%
1A	Mobile combustion: other	CH4	8	7	0%	0%	0.0%	0%	100%
	TOTAL		211502	216915	100%	100%		100%	

Abbreviations:

NO = Not Occuring;

NA = Not Applicable;

IE = Included Elsewhere: see *Table 7.2*.

Sources: Van Amstel *et al.* (2000a), IPCC (2000) and own RIVM expert judgement of uncertainties.

Table 7.5. Preliminary key source identification using to the IPCC Tier 1 and 2 approach

IPCC	Gas	Source category	Tier 1	Tier 2	Key ?	Method/Tier	Emission factor
		ENERGY SECTOR					
1A	CO2	Emissions from stationary combustion: gas	L, T	L, T	Key	CS	PS, CS
1A	CO2	Emissions from stationary combustion: oil	L, T	L	Key(L,T1)	CS	PS, CS
1A	CO2	Emissions from stationary combustion: coal	L, T	L, T	Key	CS	PS, CS
1A	CO2	Mobile combustion: road vehicles	L, T	L, T	Key	CS, T2	CS
1A	CO2	Mobile combustion: water-borne navigation		L, T	Key (L2,T2)	CS	CS
1A	CO2	Mobile comustion: aircraft	T	T	Key (T)	CS	CS
1A	CO2	Mobile combustion: other	L	L	Key (L)	CS	CS
1A	CO2	Feedstock gas	L, T		Key (L1, T1)	CS, T1	PS, CS
1A	CO2	Feedstock oil	L, T	L, T	Key	CS, T1	PS, CS
1A	CO2	Feedstock coal				CS, T1	PS, CS
1A	CH4	Emissions from stationary combustion: non-CO2				CS	PS, CS
1A	CH4	Mobile combustion: road vehicles		T	Key (T2)	CS, T3 (road)	CS
1A	CH4	Mobile combustion: other				CS	CS
1A	N2O	Emissions from stationary combustion: non-CO2				CS	PS, D
1A	N2O	Mobile combustion: road vehicles		T	Key (T2)	CS, T3 (road)	CS
1A	N20	Mobile combustion: other				CS	CS
1B	CH4	Fugitive emissions from oil and gas: gas production	L, T	T	Key(L1,T)	CS	CS
1B	CH4	Fugitive emissions from oil and gas: gas distribution	T	L, T	Key(L2,T)	CS, T1	CS
1B	CH4	Fugitive emissions from oil and gas operations: other		T	Key(T2)	CS	CS
		INDUSTRIAL PROCESSES					
2	CO2	Emissions from cement production				CS	PS, CS
2	CO2	Other industrial: CO2	T	T	Key (T)	CS	PS, CS
2	CH4	Other industrial: CH4				CS; PART?	PS, CS
2	N2O	Emissions from nitric acid production	L, T	L, T	Key	CS, T1	D/PS
2	F-gas	HFC-23 emissions from HCFC-22 manufacture	L, T	L, T	Key	CS	PS
2	F-gas	Emissions from substitutes for ODS substitutes: HFC		T	Key (T2)	CS, T2	CS
2	F-gas	PFC emissions from aluminium production	L, T	T	Key (L1,T)	CS	M, PS
2	F-gas	PFC emissions from PFC use				T2	D
2	F-gas	SF6 emissions from SF6 use				T2	PS, CS, D
		AGRICULTURAL SECTOR					
4A	CH4	CH4 emissions from enteric fermentation: cattle	L, T	L, T	Key	90:T2; T1	CS
4A	CH4	CH4 emissions from enteric fermentation: swine				T1	D
4A	CH4	CH4 emissions from enteric fermentation: sheep				T1	D
4A	CH4	CH4 emissions from enteric fermentation: other				T1	D
4B	CH4	Emissions from manure management : cattle		L,T	Key (L2,T2)	CS	CS (=D, corrected)
4B	CH4	Emissions from manure management : swine		L,T	Key (L2,T2)	CS	CS (=D, corrected)
4B	CH4	Emissions from manure management : poultry				CS	CS (=D, corrected)
4B	CH4	Emissions from manure management : other				CS	CS (=D, corrected)
4B	N2O	Emissions from manure management				CS	CS
4D	N2O	Direct N2O emissions from agricultural soils	L, T	L, T	Key	CS; PART?	CS
4D	N2O	Indirect N2O emissions from nitrogen used in agriculture	L	L, T	Key (L,T2)	CS; PART?	CS
		WASTE SECTOR					
6A	CH4	CH4 emissions from solid waste disposal sites	L, T	L, T	Key	CS (T2)	CS
6B	CH4	Emissions from wastewater handling	T	T	Key (T)	CS	CS
6B	N2O	Emissions from wastewater handling				CS	CS
		OTHER					
7	CO2	Misc. CO2	L, T	L, T	Key (L,T)	CS	CS
7	CH4	Misc. CH4				CS	CS
7	N2O	Polluted surface water		L	Key (L2)	CS	CS
7	N2O	Misc. N2O		T	Key (T2)	CS	CS
			21	28	of 46	L, T = Level, Trend	
	Included elsewhere or not occuring:					CS = country-specific	
1B						T1 = IPCC Tier 1	
2	N2O	Other industrial: N2O	IE			T2 = IPCC Tier 2	
1A/2	CO2	Emissions from iron and steel industry	IE			PS = Point source	
2	CO2	Emissions from lime consumption	IE			D = IPCC Source Cat. Default	
2	N2O	Other industrial: N2O	IE			PART = Partial	
2	PFC	PFC, HFC, SF6 emissions from semiconductor manufacturing	IE			IE = Included Elsewhere	
4B	n-CO2	Emissions from agricultural residue burning	NO			NO = Not Occurring	
6C	n-CO2	Emissions from waste incineration	IE			M = Measured	

Legend for notation keys used for method and emission factors: see bottom part of the table and the footnotes of *Table 4.2*.

8. Greenhouse Gas Inventory by Gas and Source Category

In this chapter the trends in emissions are presented per IPCC category in tabular and graphic form. We recall that the data for 2000 are all preliminary data. The figures show both percentage change of emissions between 1990 and 2000 and the share of the sectors in 1990. When interpreting the relevance of large changes for national total emissions, these shares need to be taken into account as well. In addition, we refer to Chapter 7 for the uncertainty estimate in annual emissions and in the overall trend.

8.1. Emissions and Sinks of CO_2

Box 8.1. CO_2 key source identification using to the IPCC Tier 1 and 2 approach (L= Level, T= Trend)

1A	CO emissions from stationary combustion: gas	Key (L,T)
1A	CO emissions from stationary combustion: oil	Key (L,T1)
1A	CO emissions from stationary combustion: coal	Key (L,T)
1A	CO emissions from mobile combustion: road vehicles	Key (L,T)
1A	CO emissions from mobile combustion: water-borne navigation	Key (L2,T2)
1A	CO emissions from mobile combustion: aircraft	Key (T)
1A	CO emissions from mobile combustion: other	Key (L)
1A	CO emissions from feedstock: gas	Key (L1,T1)
1A	CO emissions from feedstock: oil	Key (L,T)
2	Other industrial: CO	Key (T)
7	Misc. CO	Key (L,T)

In *Box 8.1* the CO_2 key sources based on level, trend or both are presented. These sources will be discussed in the next paragraphs. Stationary combustion per fuel type will be discussed per IPCC subsector; feedstock emissions are discussed under industrial combustion. Miscellaneous CO_2 sources comprise fugitive emissions, solvent use and waste.

Trends in emissions per IPCC sector have been summarised in *Table 8.1* and *Figure 8.1*. In 2000 net total CO_2 emissions increased by about 9% compared to 1990 (8% when comparing temperature-corrected emissions; see Chapter 3). The largest increase of emissions (6.0 Tg) occurred in the transport sector (*Table 8.1*). 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 increase in fossil-fuel related emissions in the industry appears to by caused by an increase of feedstock emissions; total combustion emissions remained almost constant. Emissions from agriculture, being recalculated, now show a decreasing trend. In the following sections the emission trends for the energy sector, industry, transport and the other sectors are discussed in more detail. In addition, trends in CO_2 associated with statistical differences and CO_2 from international bunkers are discussed.

The uncertainty in *annual* 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 to be about 3% (with order of magnitude-factor of 1.5) (see Chapter 7). The uncertainty is not well known for other sources, in particular for feedstock use of oil products. 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 total CO_2 emissions has been calculated at ±3% points.

Table 8.1. CO_2 emissions and sinks per IPCC sector 1990-2000 (no T-correction) (Tg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000[1)]
TOTAL NET NATIONAL EMISSIONS	**158.2**	**166.0**	**164.2**	**166.1**	**166.8**	**171.4**	**178.3**	**167.8**	**173.7**	**170.8**	**172.1**
1. All Energy (combustion and fugitive)	**157.4**	**165.9**	**164.3**	**166.7**	**167.3**	**171.1**	**178.0**	**167.1**	**173.2**	**170.3**	**171.7**
A Fuel combustion total	157.1	165.4	164.0	166.4	167.1	170.3	177.0	166.1	171.6	168.7	170.1
1 a Electricity & heat production	41.0	41.6	43.3	43.2	44.8	45.2	46.8	46.1	48.0	45.8	47.0
1 bc Other transformation	10.5	10.6	10.9	10.6	11.2	11.4	12.6	12.1	12.4	12.2	12.1
2 Industry	41.9	42.7	42.5	39.9	41.0	43.1	42.2	39.0	43.2	43.2	43.0
3 Transport	29.1	29.1	30.4	30.9	31.2	32.1	32.6	33.0	34.0	34.7	35.1
4 a Commercial/Institutional	6.4	10.3	9.4	10.6	10.1	9.2	9.0	7.6	7.7	6.6	6.6
4 b Residential	19.8	21.6	19.5	20.6	19.6	21.2	24.8	20.8	18.8	19.3	19.5
4 c Agriculture/Forestry/Fishing	8.4	8.5	8.5	8.8	8.8	8.1	8.9	7.5	7.5	7.1	6.9
5 Other	0.0	1.1	-0.4	1.7	0.6	0.0	0.1	0.0	0.0	0.0	0.0
B Fugitive fuel emissions	0.3	0.5	0.4	0.4	0.2	0.8	1.0	1.0	1.6	1.6	1.6
2 Crude oil and natural gas	0.3	0.5	0.4	0.4	0.2	0.8	1.0	1.0	1.6	1.6	1.6
2. Industrial processes (ISIC)	**1.7**	**1.5**	**1.3**	**1.2**	**1.4**	**1.4**	**1.7**	**1.7**	**1.3**	**1.3**	**1.4**
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**
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**
6. Waste	**0.5**	**0.0**	**0.0**	**0.0**	**0.0**	**0.1**	**0.0**	**0.1**	**0.6**	**0.5**	**0.5**
Bunkers 2[)]	**39.7**	**41.3**	**42.4**	**44.3**	**42.9**	**44.3**	**45.5**	**48.4**	**49.5**	**51.2**	**53.5**
Aviation bunkers	4.5	5.0	5.9	6.5	6.7	7.7	8.3	9.0	9.7	10.1	10.0
Marine bunkers	35.3	36.3	36.5	37.8	36.1	36.6	37.2	39.5	39.8	41.1	43.4

Data for 2000 are preliminary. In particular in this submission this 't-1' dataset is of a relatively low quality (see Section 7.1).

Emissions from bunkers are not included in national totals.

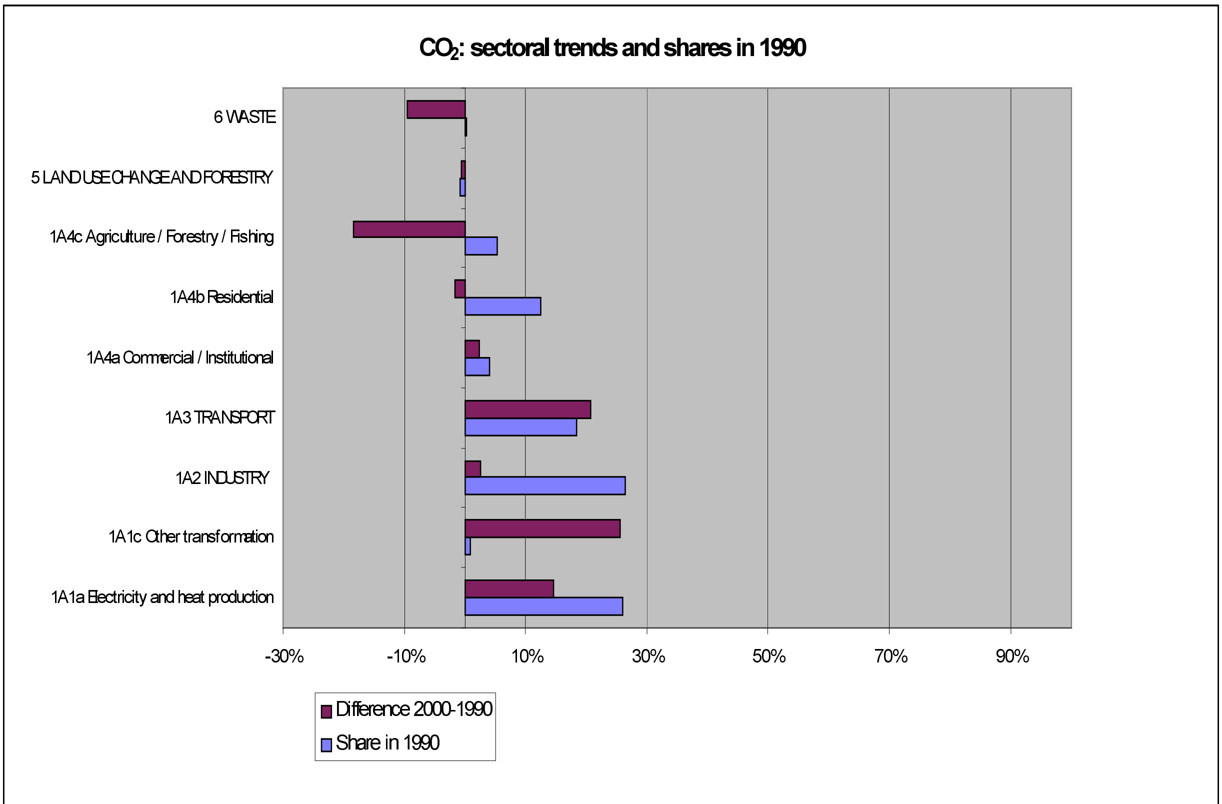

Figure 8.1 CO_2 emission shares and trends per IPCC sector 1990-2000 (no T-correction)

8.1.1. IPCC Reference Approach for CO_2

Included in the CRF files is a *provisional* calculation of the *IPCC Reference Approach* (RA) for CO_2 from energy use, which uses apparent consumption data per fuel type to estimate CO_2 emissions from fossil fuel use. Due to a current lack of information on the carbon content of crude oil, natural gas liquids and other refinery inputs, which is required for this reference calculation, this could only be done with *estimated figures* for the carbon content of refinery inputs. In *Table 8.2* the results of the Reference Approach calculation are presented for 1990-2000 and compared with the official national totals. The annual difference varies between +2.7% for 1994 and -3.5% for 1997 with an average of 0.1%. The relatively large difference for 2000 is due to the normal preliminary status of data for the last but one year, however, we recall that due to changes in data collection from individual companies and delays in compiling (preliminary) energy consumption statistics for 2000 the total sectoral estimate now includes additional uncertainty. The 1990-2000 trends differ by 1%-point: 8.3% for the National Approach (= sum of sectoral emissions) and 9.3% for the provisional Reference Approach. The energy balance data show an 18% increase in emissions from liquid fuels and 13% increase from gaseous fuels; CO_2 emissions from solid fuels decreased in this period by 10%.

Table 8.2. Comparison of CO_2 emissions (Tg): Reference Approach versus National Approach*

Fuel type	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000***
Liquid fuels***	52.3	52.2	51.9	50.5	51.5	54.6	55.4	54.8	55.4	56.3	61.5
Solid fuels	34.7	32.1	31.3	32.8	33.2	35.9	34.4	33.6	33.5	30.4	31.3
Gaseous fuels	72.5	80.2	77.7	80.1	78.0	79.6	88.9	83.5	82.9	80.6	81.7
Total RA	**159.6**	**164.5**	**161.0**	**163.4**	**162.6**	**170.1**	**178.7**	**171.9**	**171.8**	**167.3**	**174.5**
National Approach	**157.1**	**165.4**	**164.0**	**166.4**	**167.1**	**170.3**	**177.0**	**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%*

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

For the years 1990-1994 CO_2 emissions associated with statistical differences in coal, oil and gas consumption are included in the *IPCC Reference Approach*. For all other years the statistical difference have been effectively eliminated from the national energy balance resulting in a new set of data for the national approach as well as the *IPCC Reference Approach* (see Sections 5.1 and 8.1.7). In *Table 5.7* the old and the new dataset are compared. Here we present in *Table 8.3* the differences in results of the comparison of CO from fossil fuel combustion in the National Approach versus the IPCC Reference Approach according to the present and last year's dataset. The main difference between the comparisons with preliminary *IPCC Reference Approach* data is found in the 1990 and 1997 data, of which the difference between the approaches changed from -0.6% to +1.5% for 1990 and from -0.4% to +3.5% for 1997.

Table 8.3. Effects of recalculation on comparison of CO_2 emissions National versus Reference Approach (Tg)*

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
NA NIR 2002	157.1					170.3	177.0	166.1	171.6		
RA NIR 2002	159.6					170.1	179.7	171.9	171.8		
Difference (%)	***1.5%***					***-0.1%***	***0.9%***	***3.5%***	***0.1%***		
NA NIR 2001	158.5					173.0	180.1	178.3	177.4		
RA NIR 2001	157.7					173.1	181.0	177.5	176.1		
Difference (%)	***-0.6%***					***0.1%***	***0.4%***	***-0.4%***	***-0.7%***		

* Preliminary calculation, using provisional carbon factors for crude oil and natural gas liquids (NGL).
N.B. Difference = RA/NA-1 (in %).

We stress that these results are preliminary, since the reference calculation for the Netherlands is rather 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 for crude oil showed that the annual average difference of sectoral and reference calculation may vary between 0.3% and 1.9% (Olivier *et al*., 2000). As a part of the greenhouse gas inventory improvement programme, a study is being made to establish country-specific carbon content factors for crude oil and natural gas liquids used by refineries in the Netherlands. Final results are not yet available, however, it is expected that for crude oil a new a set of national emission factors can be provided based on some properties like API gravity.

8.1.2. Temperature correction for CO_2

All CO_2 figures presented in the CRF tables and most tables presented in this report are without temperature correction. However, in the Netherlands the annual variation of heating degree days can be considerable, especially in the category *1A.4 'Other sectors'*, where most of the fuel is used for space heating. In particular in 1990 the winter was relatively very warm, but also in 1992, 1994, 1998 1999 and 2000 winters were relatively warm, whereas the winter of 1996 was relatively cold.

For policy purposes, trends in CO_2 emissions are therefore corrected for climate variation of fuel consumption for space heating. In *Table 8.4* 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 amount of other fuels used for space heating is negligible. A description of the methodology for this correction is provided in Annex 4. Positive figures in the table indicate an addition of natural gas consumption and thus CO_2 emissions due to a relatively warm winter in that calendar year. The correction factor for gas consumption varies between -11% in 1996 to +20% in 1990. In 2000, CO_2 emissions were corrected by 5.1 Tg or 3% of total national emissions, while 1990 emissions have been corrected by 6.2 Tg or 4% of the total national emissions.

Table 8.4.Temperature-correction values for energy and CO_2 emissions per IPCC sector 1990-2000

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Heating Degree Days (HDD-t) [HDD]		2677	3163	2829	3076	2835	2917	3504	2929	2821	2676	2659
HDD: 30-year moving average (HDD-av)		3211	3198	3203	3177	3156	3140	3124	3135	3133	3118	3098
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**
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
1A2a-e	Industry	13.7	0.9	8.0	2.1	7.1	5.1	-5.4	2.9	7.2	10.5	10.7
1A4a	Commercial/Institutional	17.9	1.4	16.1	4.3	14.3	9.6	-16.6	9.1	13.5	17.8	17.8
1A4b	Households	52.6	3.2	36.1	9.1	29.8	21.4	-36.1	20.0	27.7	40.9	41.6
1A4c	Agriculture/Forestry/Fishing	24.1	1.3	15.0	3.9	13.6	8.8	-15.8	8.8	12.0	17.0	16.6
TOTAL correction gas consumption		**111.0**	**7.0**	**77.1**	**19.9**	**66.8**	**46.3**	**-76.1**	**41.9**	**62.8**	**89.8**	**90.3**
CO_2 Emissions [Gg]												
1A1a	Electricity & heat production	160	10	110	30	110	80	-120	60	140	210	210
1A2a-e	Industry	770	50	450	120	400	290	-300	160	400	590	600
1A4a	Commercial/Institutional	1000	80	900	240	800	540	-930	510	760	1000	990
1A4b	Households	2950	180	2020	510	1670	1200	-2020	1120	1550	2290	2330
1A4c	Agricultur/Forestry/Fishing	1350	70	840	220	760	490	-880	490	670	950	930
Total correction CO_2 emissions		**6230**	**390**	**4320**	**1120**	**3740**	**2600**	**-4250**	**2340**	**3520**	**5040**	**5060**

8.1.3. CO_2 emissions from the energy sector [1A1]

The trend in emissions of CO_2 from the energy sector is summarised in *Table 8.5.* Between 1990 and 2000 the emissions increased by 13% from 52 to 59 Tg. A major part of this increase can be attributed to the increase of the emissions from electricity production which corresponds with (a) an increase of the use of fossil fuel by power plants, (b) a shift from coal to natural gas, and (c) an increase of the efficiency of power plants.

As can be seen from *Table 8.5* the emissions of CO_2 increase up to 1998. In 1999 however the emissions of public electricity and heat production are 5% lower than in 1998, while the electricity consumption in the Netherlands in 1999 is 2% higher than in 1998 (*Table 8.6*). This difference in trends is due to the marked increase of imported electricity in 1999, which almost doubled compared with 1998, and to a relatively large shift from coal to oil and natural gas in 1999 (*Figure 8.2*). The higher import corresponds with an emission of about 4 Tg CO_2; the shift from coal to natural gas and oil with about 1 Tg CO_2. In the year 2000 import of electricity remains at the same high level; net import, emissions from the public electricity and heat production, as well as total consumption of electricity all rise with approximately 3%.

Table 8.5. CO_2 emissions from the energy sector 1990-2000 (Tg)

Source	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Public Electricity and Heat Production	41.0	41.6	43.3	43.2	44.8	45.2	46.8	46.1	48.0	45.8	47.0
o.w. Liquid Fuels	*0.2*					*0.0*	*0.2*	*0.2*	*0.2*	*0.1*	*0.1*
o.w. Solid Fuels	*25.5*					*27.0*	*26.4*	*24.0*	*26.7*	*17.5*	*23.4*
o.w. Gaseous Fuels	*13.8*					*16.3*	*18.4*	*16.6*	*18.9*	*10.1*	*21.0*
*o.w. Other Fuels/Unspecified Emissions **	*1.5*					*1.9*	*1.7*	*5.3*	*2.4*	*18.0*	*2.5*
Petroleum Refining	9.2	IE	IE	IE	IE	9.8	10.9	10.4	10.2	10.4	10.4
Other energy industries	1.3	10.6	10.9	10.6	11.2	1.6	1.7	1.7	2.1	1.8	1.7
Total	**51.5**	**52.2**	**54.1**	**53.8**	**56.0**	**56.6**	**59.3**	**58.2**	**60.4**	**57.9**	**59.1**

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

* 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 invisibility in this table of the increase of liquid fuel emissions in 1999 observed in *Figure 8.2*.

As mentioned in Section 5.5, 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 in the CRF *Sectoral Background Tables* under *'Other fuels'*. In *Table 8.*5, where these data are presented for the energy sector, it clearly shows that for the public electricity and heat production sector the fraction of unspecified fossil-fuel related CO_2 emissions is quite small for all years except for 1997 and 1999 where these fractions are 11% and 30%, respectively. 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 in 1999 could not - or not properly - associated with reported fossil fuel consumption. In 1990, these fractions were only about 5% for both power generation and refineries.

Table 8.6. Gross production, import, export, and gross consumption of electricity 1990-2000 (1000 mln kWh) Source: CBS, 2001a.

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Gross production	71.9	74.4	77.2	76.9	79.7	81.0	85.2	86.7	91.0	86.7	89.5
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*
Nuclear	*3.5*	*3.3*	*3.8*	*3.9*	*4.0*	*4.0*	*4.2*	*2.4*	*3.8*	*3.8*	*3.9*
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*
Import	9.7	9.8	8.9	10.6	10.9	12.0	11.3	13.1	12.2	22.4	23.0
Export	0.5	0.6	0.2	0.3	0.3	0.6	0.7	0.5	0.4	4.0	4.0
Gross domestic use	81.1	83.5	85.9	87.3	90.2	92.4	95.8	99.2	102.8	105.1	108.4

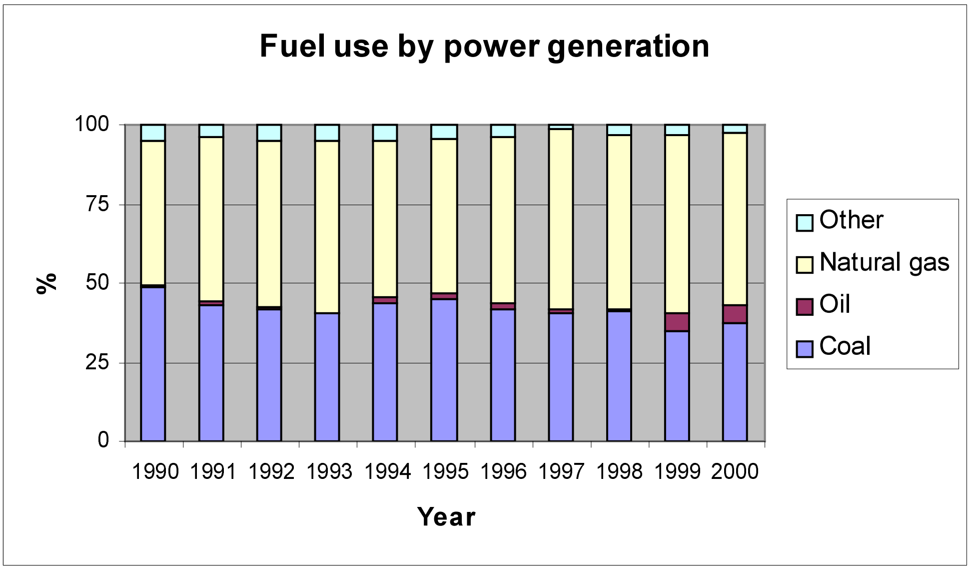

Figure 8.2. Shares of fuel use by power plants1990-2000 (CBS, several years)

8.1.4. CO_2 emissions from manufacturing industries [1A2]

Between 1990 and 2000 the emissions of CO_2 due to fossil fuel use by industry have increased from 41.9 to 43.0 Tg (+3%) (*Table 8.7*), which is dominated by the chemical industry. This includes actual emissions of CO_2 from feedstock use of energy carriers of 8.3 and 9.5 Tg, respectively, which appears to be the main cause of the 1 Tg increase in industrial fossil fuel emissions. As shown in *Table 8.7* and *Table 8.9* the combustion emissions, also of other industrial sectors, remained fairly constant in this period. In the 1990-2000 period according to national energy statistics between 14 and 19 Tg CO_2 is annually stored in oil products (*Table 8.10*). Compared to the growth of industrial production in this period of 17% (in monetary units), the increase of 3% in CO_2 emissions is relatively low. This difference can be explained mainly by energy conservation. Between 1989 and 1999, the Netherlands' industry has attained an improvement of 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 note that the trend in energy consumption in the industry, and thus in CO_2 emissions, is influenced by the fraction of fuel used for privately owned cogeneration facilities (see Section 6.2.3 on allocating CHP to either the industry or the energy sector).

Table 8.7. CO_2 emissions from fuel use in manufacturing industries and construction (unit: Tg)

Subsector	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
a. Iron and Steel	6.3	*NA*	*NA*	*NA*	*NA*	6.5	5.3	5.1	6.4	6.5	6.2
b. Non-Ferrous Metals	0.2	*NA*	*NA*	*NA*	*NA*	0.2	0.1	0.1	0.2	0.1	0.1
c. Chemicals	23.9	*NA*	*NA*	*NA*	*NA*	25.1	25.4	23.0	24.6	24.5	24.9
d. Pulp, Paper and Print	1.6	*NA*	*NA*	*NA*	*NA*	2.0	2.1	2.1	2.0	1.6	1.6
e. Food Processing	4.2	*NA*	*NA*	*NA*	*NA*	4.4	4.4	3.2	4.4	4.7	4.4
f. Other	5.9	42.7	42.5	39.9	41.0	4.8	5.0	5.6	5.7	5.9	5.8
1.A.2 Manufacturing industries	**41.9**	**42.7**	**42.5**	**39.9**	**41.0**	**43.1**	**42.2**	**39.0**	**43.2**	**43.2**	**43.0**

Including non-energy use of fuels e.g. as chemical feedstock
Including Beverages and Tobacco
Note: NA = Not Available (for 1991-1994 no breakup in sub-sectors has been made in the CRF files).

As mentioned in Section 5.5, 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 in the CRF *Sectoral Background Tables* under *'Other fuels'*. In *Table 8.8*, where these data are presented for the total industry sector, it clearly shows that the fraction of unspecified fossil-fuel related emissions was about 30% up to 1996, but increased to about 60% in the years 1996 to 1998. Inspection of the subsectoral data reveals that the high fractions in recent years relate to the iron and steel industry, of which all CO emissions are not related to fuel consumption and to the chemical industry, where 3/4 of reported CO emissions was not or not properly associated with reported fossil fuel consumption. In 1990, these fractions were only 20% and 30%, respectively.

Table 8.8. CO_2 emissions by fuel type in the manufacturing industries and construction (unit: Tg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total industrial combustion	41.9	42.7	42.5	39.9	41.0	43.1	42.2	39.0	43.2	43.2	43.0
o.w. Liquid fuels	3.0					2.1	3.7	2.4	2.5	0.7	2.7
o.w. Solid fuels	5.7					5.2	2.7	2.0	1.4	1.1	1.4
o.w. Gaseous fuels	21.0					15.9	22.2	12.3	13.5	14.2	20.5
o.w. Other fuels/Unspecified emissions*	12.2	42.7	42.5	39.9	41.0	19.8	13.7	22.3	25.9	27.2	18.4
Fraction unspecified	*29%*					*46%*	*32%*	*57%*	*60%*	*63%*	*43%*

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

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 we show in *Tables 8.9* and *8.10* 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.

Table 8.9. Trend in CO_2 emitted by feedstock use of energy carriers according to the IPCC Reference Approach (Gg)*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Liquids	2 947	4 207	3 835	3 065	3 182	3 344	3 073	3 425	3 404	3 796	4 251
Solids	569	416	417	372	1 788	386	433	417	408	NE**	NE**
Gaseous	4 803	5 144	5 102	4 866	5 172	5 510	5 283	5 667	5 390	5 345	5 287
Total	8 319	9 767	9 353	8 303	10 142	9 240	8 789	9 510	9 203	9 141	9 538

* 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, no data are available for 1999 and 2000 according to the old definition.

Table 8.10. 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
Liquid	13 145	18 036	16 790	14 265	14 536	13 916	12 563	14 242	13 857	15 801	17 769
Solid Fuels	610	544	550	702	558	601	632	576	594	157	224
Gaseous	534	572	567	541	575	612	587	630	599	594	587
Total	14 289	19 152	17 907	15 508	15 669	15 129	13 781	15 448	15 050	16 552	18 580

* Using country-specific carbon storage factors.

8.1.5. CO_2 emissions from transport [1A3]

By far the largest contributor to this sector is road transport, which accounted in 1990 for 87% (*Table 8.11*). Next are off-road vehicles, contributing about 8% in 1990. These off-road vehicles are used in agriculture and for building and road construction. CO_2 emissions from total transport have increased by 21% in the period 1990-2000.

This increase is predominantly caused by an increase in energy consumption by road transport, of which fuel consumption increased by 24% in this period. In *Table 8.12* fuel consumption by road transport is presented, 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 gasoline 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 43% in 1990 to 51% in 2000 (*Figure 8.3*).

Table 8.11. CO_2 emissions from transport in 1990 and 2000, by transport mode (Tg)

Transport mode	**Emissions 1990**	**Share in 1990**	**Emissions 2000**	**Share in 2000**	**Increase 2000/1990**	
		(%)		(%)	(Tg)	(%)
Road Transportation	25.4	87%	31.5	90%	6.1	24%
Other Transportation (off-road)	2.3	8%	2.3	6%	0.0	0%
Internal navigation	0.9	3%	1.0	3%	0.1	14%
Civil aviation	0.5	2%	0.3	1%	-0.2	-43%
Railways	0.1	0%	0.1	0%	0.0	26%
Total	**29.1**		**35.1**		**6.0**	**21%**

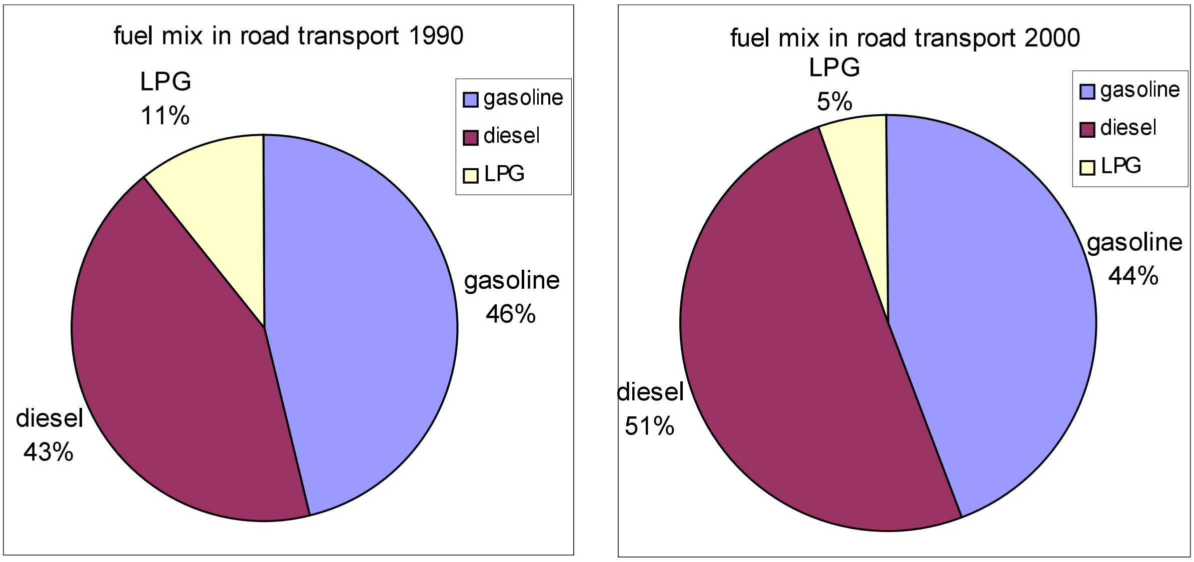

Figure 8.3. Shares of gasoline, diesel and LPG in fuel consumption for road transport 1990 and 2000

Another observation that can be made from *Table 8.12* is, 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%. This difference is not so much caused by gasoline, which shows only differences up to +8, with an average of 1.6%, but rather by diesel and LPG figures, which differ annually up to -30%, with an average of about -14 and -19% for diesel and LPG, respectively (*Figure 8.4*). These differences can be explained to some extent, e.g. by fuel bought at both sides of the Netherlands' borders but consumed at the other side (Van Amstel *et al*., 2000a), but not completely. As illustrated in *Figure 8.4*, per fuel type the annual differences 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 by and large, both methods show similar trends in fuel consumption by fuel type over the last 10 years.

Table 8.12. Fuel consumption by road transport 1990-2000: fuel deliveries versus fuel consumption based on road transport statistics

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2000/1990
A. deliveries												
gasoline	152.0	152.4	158.3	167.2	169.8	175.1	177.1	176.5	178.2	180.7	176.0	16%
diesel	159.1	163.2	174.9	176.4	180.4	183.8	192.8	198.4	207.0	219.9	232.6	46%
LPG	41.0	39.8	39.0	37.2	35.3	34.1	33.5	33.3	32.8	29.1	25.6	-38%
TOTAL	352.1	355.4	372.2	380.8	385.5	393.0	403.4	408.2	418.0	429.6	434.1	23%
B. consumption												
gasoline	149.6	153.3	161.5	166.4	172.6	174.9	178.9	180.3	179.5	187.0	191.5	28%
diesel	139.9	145.4	152.2	149.3	154.6	160.2	164.4	171.2	186.3	200.9	218.6	56%
LPG	35.6	36.1	34.1	30.6	30.9	29.5	26.0	26.6	24.5	23.8	22.9	-36%
TOTAL	325.2	334.8	347.8	346.3	358.1	364.6	369.3	378.0	390.3	411.8	433.0	33%
Difference [(B-A)/A]												average
gasoline	-2%	1%	2%	0%	2%	0%	1%	2%	1%	3%	8%	1.6%
diesel	-14%	-12%	-15%	-18%	-17%	-15%	-17%	-16%	-11%	-9%	-6%	-13.7%
LPG	-15%	-10%	-14%	-21%	-14%	-16%	-29%	-25%	-34%	-22%	-12%	-19.4%
TOTAL	-8%	-6%	-7%	-10%	-8%	-8%	-9%	-8%	-7%	-4%	0%	-6.9%

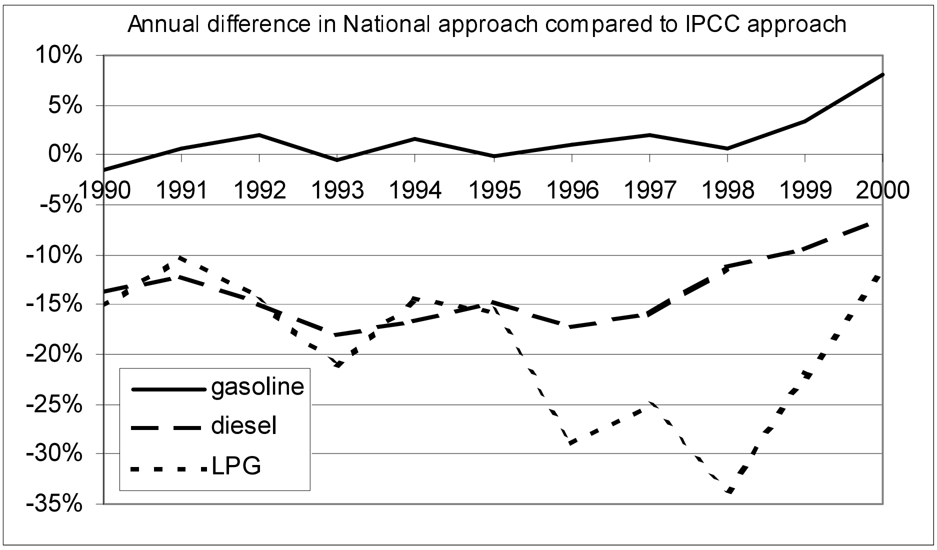

Figure 8.4. Annual differences per fuel type between fuel consumption according to the national approach (based on vehicle-km statistics) and the IPCC approach (based on fuel deliveries to fuelling stations)

8.1.6. CO_2 emissions from the other sectors [1A4]

This sector comprises the residential sector, commercial/institutional services and agriculture. As can be observed from the temperature correction data in *Table 8.4*, in particular these sectors are quite sensitive to weather conditions since the largest part of the fuel use in these sectors is for space heating. With temperature correction, the emissions in these sectors changed by –4 (residential), +1 (commercial), and -20% (agriculture) in the 1990-2000 period (*Table 8.13*).

We 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 are less accurate monitored than the residential sector, of which gas consumption is annually monitored in the 'BAK' survey. This is reflected in the changes in the 1990-2000 trends of the sectors: in the previous NIR 2001, i.e. before elimination of the statistical differences, commercial sector emissions increased in 1990-1999 by about 19% and agricultural emissions remained almost constant in the 1990-1999 period (+2%). So trend conclusions for these subcategories should be treated with some caution (see *Table 5.5* in Section 5.1 for details).

Table 8.13. Temperature-corrected CO_2 emissions from the residential, commercial and agricultural sectors (Tg)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Residential sector	22.8	21.8	21.5	21.2	21.2	22.4	22.8	21.9	20.4	21.5	21.8
Commercial sector	7.4	10.4	10.3	10.9	10.9	9.7	8.1	8.1	8.4	7.6	7.5
Agriculture	9.8	8.5	9.3	9.0	9.5	8.6	6.8	8.0	8.2	8.0	7.8
Total	**39.9**	**40.7**	**41.1**	**41.0**	**41.7**	**40.7**	**37.7**	**37.9**	**37.0**	**37.2**	**37.2**

The decrease of 4% in the residential sector seems incompatible with the increase of the number of inhabitants and households in the Netherlands (*Figure 8.5*), but can be explained by the increase of energy conservation by households in the past decade. In particular the increased use of highly efficient heating appliances and the improvement of the insulation of houses in this period have attributed to this trend (RIVM, 2001a).

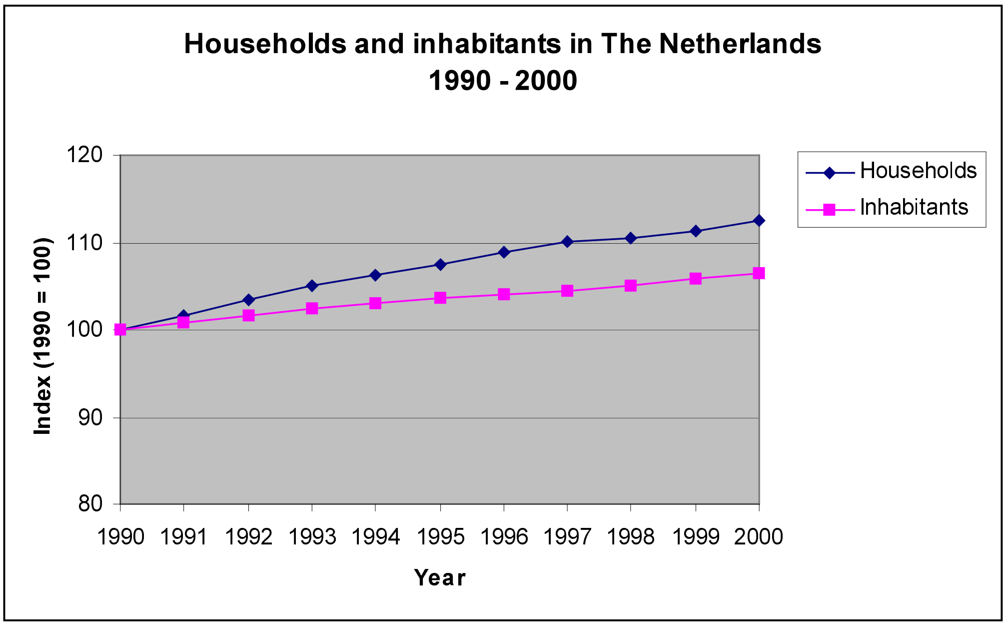

Figure 8.5. Development of the number of inhabitants and households in the Netherlands (1990-2000). Source: RIVM (2001b)

For the commercial/institutional sector the increase between 1990 and 1999 of persons employed of 31% (RIVM/CBS, 2001b) is significantly higher than the 3% increase of the temperature-corrected CO_2 emissions. Large part of this difference is due to energy conservation measures implemented in the sector.

Temperature-corrected CO_2 emissions from the agricultural sector decreased by 20% in the period 1990-2000. This is mainly due to energy conservation measures in the greenhouse horticulture, which accounts for approximately 85% of the primary energy use of the agricultural sector. Space heating and artificial lighting are the dominant uses here. This sector has improved its energy efficiency in the past decade significantly. In the period 1991-1997 the physical production (in m^2) increased by 12%, while the primary use of energy (i.e. including electricity) of the agricultural sector decreased by almost 6% (Van Harmelen *et al*., 2000). We should note, however, that included in the CO_2 emissions from this sector is fuel consumption for privately owned co-generation facilities, which may also provide electricity to the public grid.

8.1.7. CO_2 emissions related to statistical differences [1A5]

In previous NIR's fuel use related to statistical differences was included as a source of CO_2 emission since it has been assumed that the associated fuel use is real but not accounted for in individual end-use sectors. The statistical difference between supply and demand was usually smaller than 2%. Per energy carrier, however, the difference varied both in sign and size, as is shown in *Table 5.1*. Recently, Statistics Netherlands (CBS) has revised the national energy balances and effectively eliminated the statistical differences for all years from 1990 onwards, except for 1991-1994 (see Section 5.1 for more details). Since the energy balances 1991-1994 have not been revised, the CO related to statistical differences remain in the inventory for these years (*Table 8.14*).

At present, there are no plans to revise the energy balances for the years 1991-1994 in the same fashion, 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 the Dutch statistics since 1993.

Table 8.14. CO_2 emissions from statistical differences 1991-1994

Fuel type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
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**

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

8.1.8. CO_2 emissions from industrial processes [2]

CO_2 emissions from industrial process in the Netherlands occur mainly during the production of cement clinker, lime use for mineral products and as an emission from flue gas desulphurisation units in power plants. In *Table 8.15* an overview of the trend in CO_2 emissions from industrial processes is given. We note that CO_2 from cement production are estimated using clinker production, not cement production. The Netherlands imports a large fraction of the cement clinker used for cement production, so comparison with emission factors based on cement production would give a wrong picture.

Table 8.15. Emissions of CO_2 from industrial processes 1990-2000 (Gg)

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Power generation (flue gas desulphurisation)	212	207	155	189	271	296	359	289	291	284	357
Cement clinker production	403	383	356	364	368	339	251	376	376	486	437
Lime use for mineral products	721	741	344	686	682	775	649	711	649	489	544
Other	354	169	415	0	119	32	441	413	3	57	22
Totak	**1690**	**1500**	**1270**	**1239**	**1440**	**1442**	**1700**	**1727**	**1319**	**1316**	**1360**

8.1.9. CO_2 emissions from fugitive oil and gas, solvent use and waste [1B2, 3, 6D]

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 emissions as reported by refineries, which have by far the largest share in this subcategory. However, this does not necessarily correspond a large rise in CO_2 emissions since the separation between combustion and process emissions as officially reported by refineries varies substantially over time. The minor CO_2 emissions from ***category 3*** refer to fireworks, whereas the CO_2 emissions that are reported under ***category 6D*** comprise combustion emissions from wastewater treatment plants and miscellaneous non-combustion emissions from other waste handling activities.

8.1.10. CO_2 sinks from land use change and forestry [5A]

For land use change new data were researched and the preliminary results are still under discussion. So CO_2 sinks data are only related to forestry and other woody biomass stocks (table 5A). For the period 1990-2000 the new data on C stock and changes forestry are based on three elements: forest stock (in ha), average annual growth by category (in m^3/ha/year) and harvest by category (in m^3/ha/year). The amount of fuelwood consumed is implicitly included in these variables, so including them separately would result in double counting. The total annual increment is about 900 to 1,000 Gg C, with exception of 1992, when the increment is 877. In that year the carbon uptake increment is only 3,217 Gg CO_2 (see *Table 8.16*). The areas of biomass increase slowly; in the period 1990-2000 by 19 ha. About ¾ of the growth was for the broadleaved forestland area that increased from 151 ha in 1990 through 156 ha in 1995 to 164 ha in the year 2000. The coniferous forest area increased from 190 ha in 1990 through 195 ha in 1995 to 196 ha in 2000.

On average, trees in the Netherlands are growing older and heavier. Since 1990, a slow reduction in growth rate (because of maturing forests) has been slightly overcompensated by planting fast-growing species like poplar and Douglas The average annual growth rate for broadleaved forest increased from 5.11 t dm/ha in the year 1990 to 5.68 in 2000. Because of fellings, part of the volume increment of biomass is reduced. In the years 1990-1994 the fellings reduced slightly, but from 1995 onwards yearly about 2200 km^2 wood is removed. The resulting carbon release clearly shows up in *Table 8.16.*

Table 8.16. CO_2 emissions for changes in forest and other woody biomass stocks

Gg CO_2	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Carbon uptake increment*	3302	3340	3217	3516	3569	3402	3574	3522	3600	3410	3593
Carbon release **	-1880	-1812	-1730	-1710	-1640	-2170	-2176	-2342	-2220	-2174	-2180
Net CO removals	1422	1528	1487	1806	1929	1232	1398	1180	1380	1236	1423

* Forest and non-forest trees.

** Biomass consumption from stocks.

8.1.11. CO_2 emissions from international bunkers

In *Table 8.17* both energy consumption and CO_2 emissions from international air transport and international shipping are presented per fuel type. In 2000, bunker emissions of CO_2 have increased by about 13.8 Tg or 35% compared to 1990. In particular international aviation has shown a very high growth of about 126%, whereas international shipping increased by 23%. Because the majority of bunkers emissions stem from marine bunkers, international shipping and aviation contributed both about equally to this increase of 13.8 Tg CO_2. Due to the much higher growth of international air traffic its share in international bunkers emissions has doubled from about 11% in 1990 to about 19% in 2000. Due to elimination of statistical differences (see Section 5.1.1) new data for lubricant consumption for 1990 and 1995-2000 is added to *Table 8.17.*

Table 8.17. International bunkers: energy consumption (PJ) and related CO_2 emissions (Gg) 1990-2000

Source	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Energy consumption											
Marine bunkers	**463**	**476**	**478**	**495**	**474**	**481**	**488**	**518**	**522**	**539**	**571**
- heavy fuel oil	370	396	398	411	386	377	393	429	429	448	475
- gasoline	89	80	80	84	88	100	90	84	88	86	88
- lubricant	4	NE	NE	NE	NE	4	5	5	5	5	6
Aviation Bunkers	**61**	**68**	**81**	**89**	**92**	**105**	**113**	**122**	**133**	**138**	**138**
- jetfuel (kerosine)	61	68	81	89	92	105	113	122	133	138	138
- aviation gasoline	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
TOTAL Bunkers	524	544	559	585	566	586	601	639	655	677	707
Emissions											
Marine bunkers	**35 280**	**36 330**	**36 490**	**37 780**	**36 140**	**36 620**	**37 200**	**39 530**	**39 820**	**41 140**	**43 440**
- heavy fuel oil	28 490	30 490	30 650	31 650	29 720	29 030	30 260	33 030	33 030	34 490	36 580
- gasoline	6 500	5 840	5 840	6 130	6 420	7 300	6 570	6 130	6 420	6 280	6 420
- lubricant	290					290	370	370	370	370	440
Aviation Bunkers	**4 450**	**4 960**	**5 910**	**6 500**	**6 720**	**7 660**	**8 250**	**8 910**	**9 710**	**10 070**	**10 070**
- jetfuel (kerosine)	4 450	4 960	5 910	6 500	6 720	7 660	8 250	8 910	9 710	10 070	10 070
- aviation gasoline	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
Total Bunkers	**39 730**	**41 290**	**42 400**	**44 280**	**42 860**	**44 280**	**45 450**	**48 440**	**49 530**	**51 210**	**53 510**

Source: CBS, 1990-2000 (NEH/Energy Monitor, Table 1.1; revised data).
N.B. Aviation gasoline is included under jetfuel.

8.2. Emissions of CH_4

Box 8.2. CH_4 key source identification using to the IPCC Tier 1 and 2 approach (L= Level, T= Trend)

1A	CH4 emissions from mobile combustion: road vehicles	Key (T2)
1B	Fugitive CH4 emissions from oil and gas: gas production	Key (L1,T)
1B	Fugitive CH4 emissions from oil and gas: gas distribution	Key (L2,T)
1B	Fugitive CH4 emissions from oil and gas: other	Key (T2)
4A	CH4 emissions from enteric fermetation: cattle	Key (L,T)
4B	CH4 emissions from manure management: cattle	Key (L2,T2)
4B	CH4 emissions from manure management: swine	Key (L2,T2)
6A	CH4 emissions from solid waste disposal sites	Key (L,T)
6B	CH4 emissions from waste water handling	Key (T)

In *Box 8.2* the CH_4 key sources based on level, trend or both are presented. These sources will be discussed per IPCC subsector in the next paragraphs. In 2000, total methane emissions have decreased by 24% compared to the 1990 level. Sectors that contributed most to the decrease were the waste sector (-29%) and the agricultural sector (-19%) with 1.6 and 1.0 Mton CO_2-eq., respectively (see *Table 8.18* and *Figure 8.6*). Lower quantities of organic carbon deposited into landfills and higher methane recovery rates from landfills, decreasing numbers of livestock, and also lower fugitive fuel emissions were major determining factors for this decrease. In the following sections the emission trends for these sectors are discussed in more detail.

The uncertainty in emission estimates of CH_4 emissions from most sectors is estimated between 20 and 60%, with an exception for the uncertainty in emissions from animal manure management, estimated at about 100%. The uncertainty in the overall *annual* total will be roughly about 25% (with order of magnitude-factor of 1.5) (see Chapter 7). The Tier 1 *trend* uncertainty in total CH_4 emissions has been calculated at ±7% points.

Table 8.18. CH_4 emissions per IPCC sector 1990-2000 (Gg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL NET NATIONAL EMISSIONS	**1292.2**	**1308.9**	**1257.1**	**1226.0**	**1203.0**	**1170.0**	**1173.1**	**1100.7**	**1064.6**	**1037.8**	**982.8**
1. All Energy (combustion and fugitive)	**212.9**	**223.9**	**199.1**	**192.5**	**202.3**	**207.0**	**225.4**	**185.9**	**177.2**	**177.3**	**164.0**
A Fuel combustion total	34.1	35.8	36.0	34.5	33.8	36.7	37.0	29.4	30.7	33.1	32.7
1 Energy	3.3	3.2	3.8	3.4	3.7	4.8	5.7	3.0	4.3	6.0	5.9
2 Industry	2.9	3.5	4.9	3.2	2.6	5.1	1.8	1.1	1.8	3.2	3.2
3 Transport	7.9	7.0	6.8	6.5	6.3	6.2	5.6	5.3	5.1	4.8	4.5
4 a Commercial/ Institutional	0.9	1.1	1.0	0.9	1.4	0.5	1.1	0.5	0.9	0.8	0.8
4 b Residential	16.8	18.3	16.8	17.7	17.0	17.4	20.0	17.2	16.2	15.9	16.1
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
B Fugitive fuel emissions	178.8	188.1	163.1	158.0	168.5	170.3	188.3	156.5	146.6	144.3	131.2
2 Crude oil and natural gas: process emissions	178.8	188.1	163.1	158.0	168.5	170.3	188.3	156.5	146.6	144.3	131.2
2. Industrial processes (ISIC)	**3.3**	**3.5**	**3.7**	**4.9**	**5.3**	**2.6**	**5.7**	**2.7**	**2.4**	**2.7**	**2.8**
3. Solvent and other product use	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
4. Agriculture	**505.3**	**517.1**	**505.8**	**497.8**	**483.1**	**477.0**	**463.6**	**445.8**	**434.7**	**425.0**	**407.8**
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
B Manure management	103.5	105.5	104.6	105.1	101.5	100.3	97.7	93.2	93.3	91.1	88.4
5. Land use change and forestry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6. Waste	**568.7**	**562.4**	**546.5**	**528.8**	**510.0**	**481.3**	**476.4**	**464.3**	**448.3**	**430.8**	**406.3**
A Solid waste disposal on land											
B Waste water handling											
7. Other	**2.1**	**2.0**	**2.0**	**2.0**	**2.3**	**2.1**	**2.0**	**2.0**	**1.9**	**1.9**	**1.9**

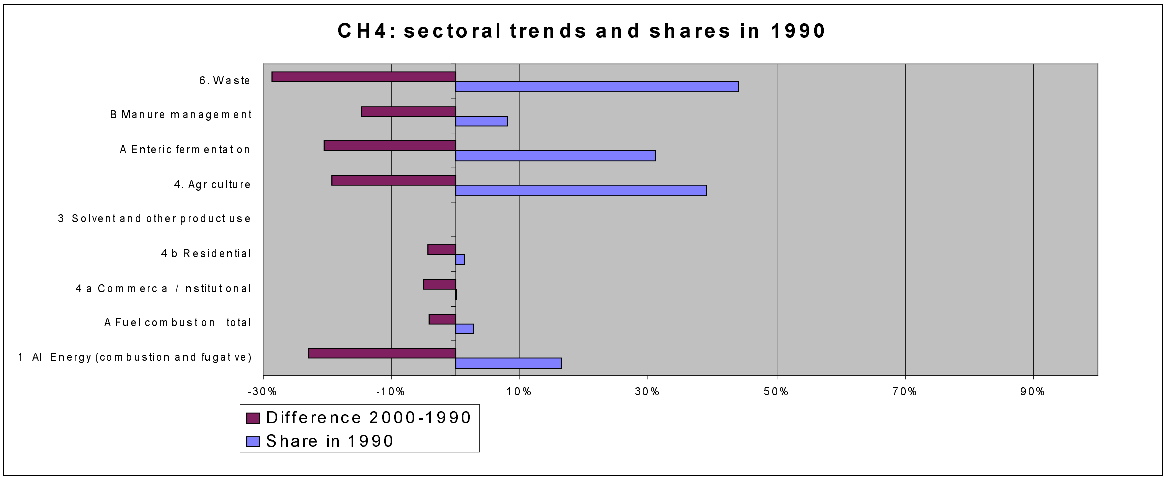

Figure 8.6. CH_4 emission shares and trends per IPCC sector 1990-2000

8.2.1. CH_4 from road transport [1A3]

CH_4 emissions from road transport were calculated using mass fractions of total VOC. 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 catalyst.

Total CH_4 emissions by road transport reduced by 45% between 1990 and 2000: petrol vehicles from 6 to 3.5 Gg, diesel vehicles from 1.0 to 0.4 Gg and LPG vehicles from 0.5 to 0.1 Gg. This reduction is related to the reduction of 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 40% in the 1990-2000 period. This reduction was mainly the result of the penetration of catalyst-equipped cars into the passenger car fleet. In the period 1990-2000 the average emission factor for petrol-fuelled road vehicles decreased from 40 to 20 g/GJ, while the emission factors of LPG-fuelled vehicles decreased from 13 to 6 g/GJ in the same period.

Diesel-fuelled vehicles emit less CH_4 per unit of total VOC than petrol-fuelled vehicles. In the same period 2000 their average emission factor decreased from 6 to 2 g/GJ.

8.2.2. CH_4 from fugitive oil and natural gas emissions [1B2]

The fugitive emissions of CH_4 are almost completely due to the production, transmission and distribution of natural gas. The emission trends are summarised in *Table 8.19*. In the period 1990-2000 the estimated emission of CH_4 decreased from 179 to 131 Gg per year (-27%). This major reduction of the emissions is not the result of a decrease in activity data: both amounts of gas distribution and gas transmission increased, while gas production decreased only slightly, although there was a movement towards more offshore production of gas and less onshore production (*Table 8.20*). 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 (NER, 1996). The gas leakage from distribution networks is assumed to decrease because of the gradual replacement of old cast iron pipes by modern materials. In *Figure 8.7* the trends of the production and transmission of natural gas and related CH_4 emissions are shown (including emissions from oil). The peak emissions in 1996 are due to the relatively cold winter (see *Table 8.4*), in which the amount of gas consumption and production was much higher than in other years.

Table 8.19. CH_4 emissions of production, transmission and distribution of oil and gas1990-2000 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Production/Processing	100	101	90	86	102	95	104	87	81	82	70
Transmission	6	7	7	7	6	6	7	5	4	4	3
Distribution	73	81	75	78	69	70	78	65	62	59	58
Total	179	189	172	171	177	170	188	156	146	144	131

Table 8.20. Activity data of production, transmission and distribution 1990-2000 (source: EZ, 2002; Gasunie, 2001 and 2002)

Source	Unit	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
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
Gas production	PJ	2292	2608	2628	2659	2482	2478	2839	2590	2529	2280	2144
Gas transmission	PJ	2292	2608	2652	2738	2598	2630	2968	2660	2527	2385	2310
Gas distribution	PJ	657	759	731	784	717	757	879	762	763	725	715

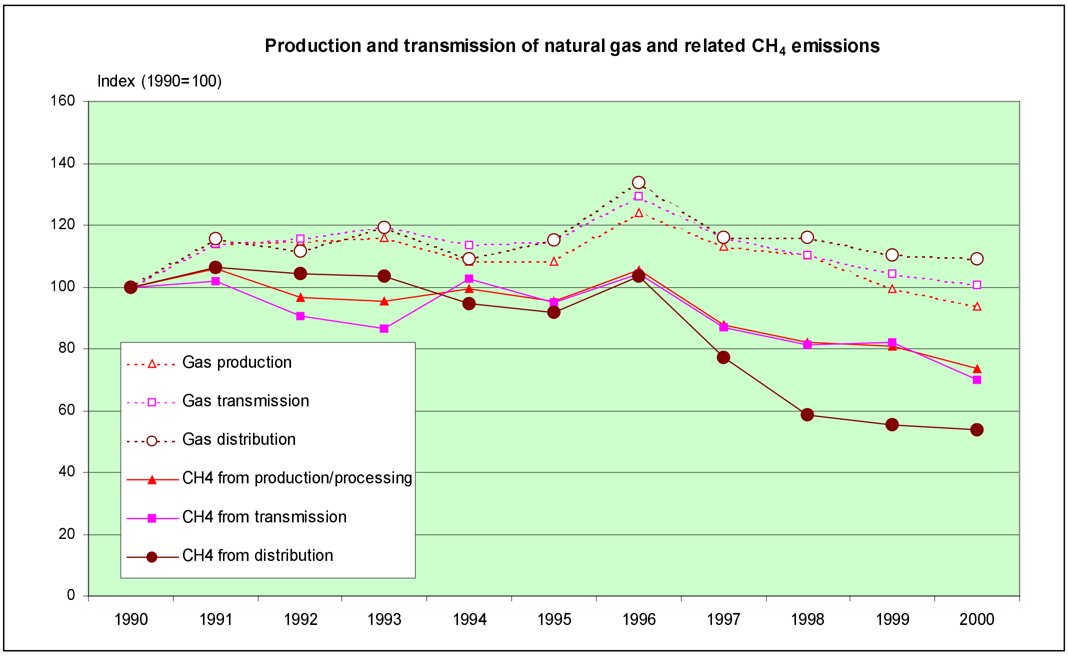

Figure 8.7. Trends in production, transmission and distribution of natural gas and oil and related CH_4 emissions in the period 1990-2000

8.2.3. CH_4 emissions from enteric fermentation [4A]

The trend in CH_4 emissions due to enteric fermentation is summarised in *Table 8.21.* The annual emission by dairy cattle as well as non-dairy cattle is determined on basis of the number of cattle in that year and emission factors (amount of CH_4 per animal per year). Since 1990 the number of dairy and non-dairy cattle in the Netherlands has decreased from 3.6 to 2.8 million animals (-21%) and from 1.32 to 1.23 million animals (-7%), respectively (*Table 8.22).* It is obvious that these smaller numbers of cattle are the main cause of the decrease of the CH_4 emissions.

In *Figure 8.8* the development of the number of cattle and their emission of CH_4 due to enteric fermentation is shown. There is a close relation between the trends of the number of cattle and the emission of CH_4 due to enteric fermentation. The remainder of the difference in the trend of cattle can be explained by the shift in shares of the subtypes considered in the emission calculation, each having a different emission factor (see *Table 8.23).*

Table 8.21. CH_4 emissions due to enteric fermentation 1990-2000 (Gg)

Animal type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cattle	365.6	374.8	362.3	352.8	343.4	339.3	328.5	315.2	307.0	299.0	285.7
Dairy Cattle	290.8	291.0	280.0	271.0	263.9	265.5	262.3	252.1	247.8	241.6	230.5
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
Sheep	13.6	15.1	15.6	15.3	14.1	13.4	13.0	11.7	11.2	11.2	10.5
Goats	0.5	0.6	0.5	0.5	0.5	0.6	0.8	1.0	1.1	1.2	1.4
Horses	1.3	1.4	1.6	1.7	1.8	1.8	1.9	2.0	2.0	2.1	2.1
Swine	20.9	19.8	21.2	22.5	21.9	21.6	21.6	22.8	20.2	20.4	19.7
Poultry	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	401.9	411.6	401.2	392.7	381.7	376.7	365.9	352.6	341.4	333.9	319.4

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

Table 8.22. Number of animals1990-2000 (1000 head) (CBS/RIVM, 2001)

Animal type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cattle	4 926	5 062	4 920	4 797	4 716	4 654	4 551	4 411	4 283	4 206	4 070
Dairy Cattle	3 607	3 627	3 490	3 360	3 277	3 298	3 276	3 150	3 061	2 972	2 840
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
Sheep	1 702	1 882	1 952	1 916	1 766	1 674	1 627	1 465	1 394	1 401	1 308
Goats	61	70	63	57	64	76	102	119	132	153	179
Horses	70	77	86	92	97	100	107	112	114	115	118
Pigs	13 915	13 217	14 160	14 964	14 565	14 398	14 419	15 189	13 446	13 567	13 118

Table 8.23. 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
Dairy cattle												
< 1 yr young	49.25	806	820	774	737	735	740	760	698	658	634	600
> 1 yr young female	62.80	880	908	893	836	803	808	805	822	757	714	699
female	102.13	1878	1852	1775	1747	1698	1708	1665	1591	1611	1588	1504
> 1 yr male	93.22	43	48	48	41	41	42	46	40	36	36	37
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
Non-dairy cattle												
Veal calves	17.65	602	622	638	656	690	669	678	704	711	753	783
Steers	87.01	598	674	646	624	603	541	451	412	366	328	285
Female > 1 yr [2]	102.13	120	139	146	156	146	146	146	145	145	153	163
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

Emission factor for CH_4 from enteric fermentation in kg CH_4/head/year. Source: Van Amstel *et al.* (1993).

2 Suckling cows.

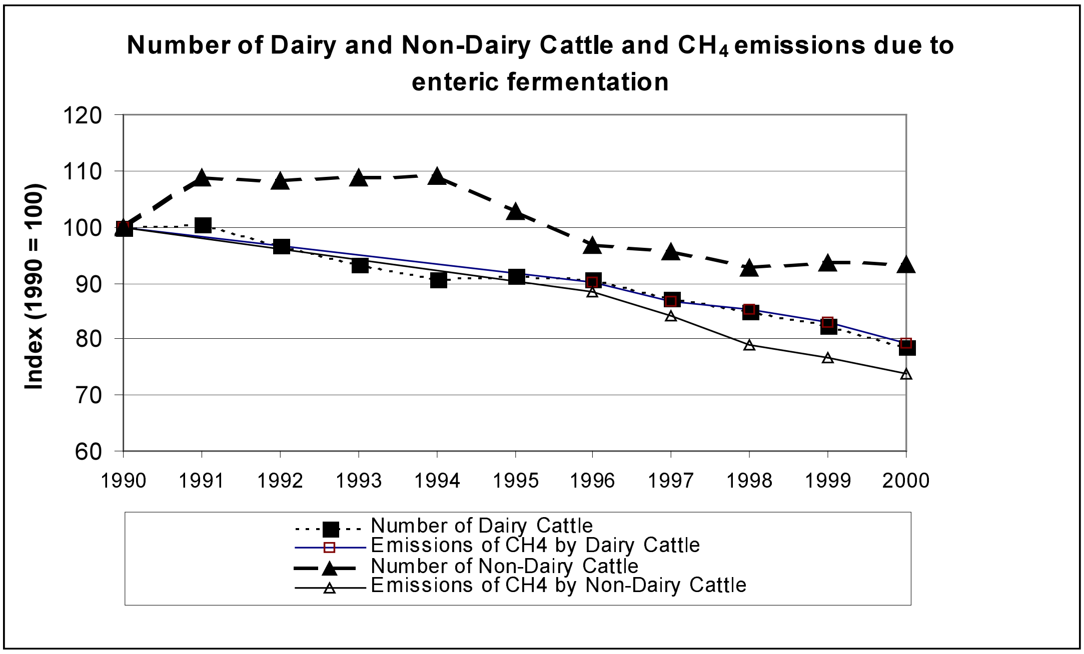

Figure 8.8. Number of cattle and emissions of CH_4 due to enteric fermentation from cattle

8.2.4. CH_4 emissions from manure management [4B]

The trend in emissions of CH_4 due to manure management is summarised in *Table 8.24*. In the period 1990-2000 the emission of CH_4 decreased from 103 to 88 Gg (-15%). As can be seen from *Table 8.24* this decrease is mainly due too the decrease of emissions from manure management of swine (6.7 Gg), dairy cattle (5.3 Gg), and non-dairy cattle (2.1 Gg).

Table 8.24. Trend in CH_4 emissions from manure management 1990-2000 (Gg)

Animal type	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2000/1990
Cattle	43.1	44.7	43.7	43.0	42.1	41.5	39.7	38.5	37.7	37.1	35.8	
Dairy Cattle	25.9	25.8	24.8	24.2	23.5	23.6	23.3	22.3	22.1	21.7	20.6	-20%
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	-12%
Sheep	0.8	0.8	0.9	0.9	0.8	0.8	0.8	0.7	0.7	0.7	0.7	
Goats	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.4	
Swine	49.2	49.3	49.2	51.0	49.3	48.6	47.7	45.2	45.6	44.1	42.5	-14%
Poultry	10.3	10.4	10.6	10.2	9.2	9.4	9.4	8.5	9.1	8.9	9.0	
TOTAL	103.5	105.5	104.6	105.1	101.5	100.3	97.7	93.2	93.3	91.1	88.4	

The annual CH_4 emissions are determined on basis of the amount of stable manure per year and emission factors (amount of CH_4 per m^3 stable manure). The emission factors are different for the various animal types. As has been described in the previous section, the number of cattle in the Netherlands has decreased by 17% in the period 1990-2000. This decrease is reflected in the amount of stable manure and the related emissions of CH_4.

Table 8.25 also shows that the number of swine has hardly changed between 1990 and 2000. However for swine the decrease of the CH_4 emissions from manure management (-14%) is related to the decrease of the amount of manure produced per swine. During the last years the amount of manure per swine has decreased by approximately 9% as a result of changes in agricultural practice in the Netherlands (*Table 8.25* and *Figure 8.9*).

Table 8.25. Number of swine and manure from swine 1990-2000 (CBS/RIVM, 2001)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Number of swine (1,000,000)											
Fattening pigs	7.0	7.0	7.1	7.5	7.3	7.1	7.1	7.4	6.6	6.8	6.5
Sows	1.7	1.7	1.7	1.8	1.7	1.7	1.7	1.8	1.8	1.6	1.5
Total	8.7	8.8	8.9	9.3	9.0	8.8	8.8	9.2	8.4	8.3	8.0
Manure production by swine (mln kg)											
TOTAL	16.4	16.4	16.3	17.0	16.4	16.1	16.2	15.0	15.2	14.6	14.1

[1)] When piglets are included the amount of swine is considerably higher (cf. *Table 8.22*). Since the manure produced by piglets is attributed to the sows, piglets are not relevant for the calculation of the amount of manure.

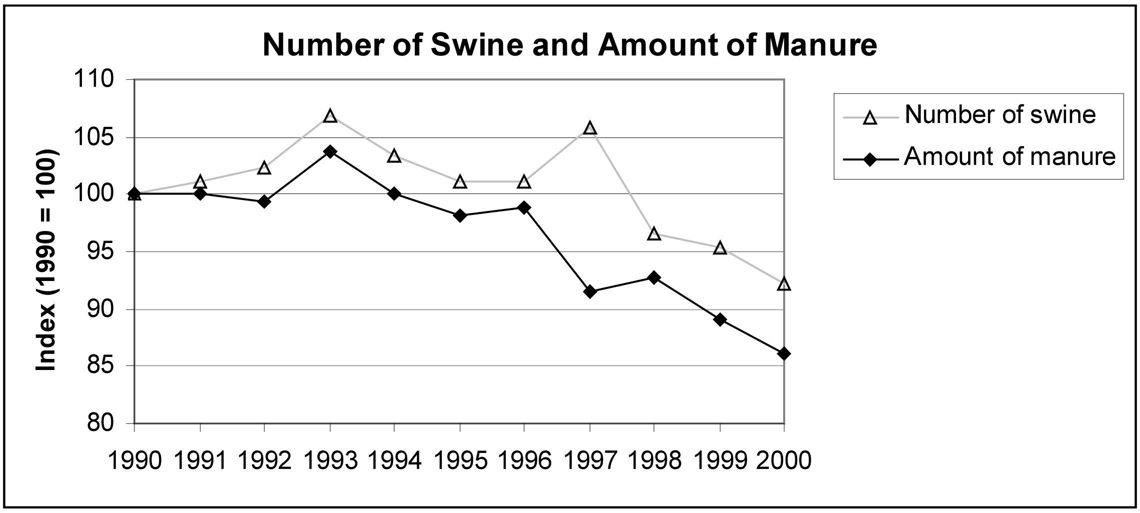

Figure 8.9. Trend of the number of swine and the amount of manure from swine between 1990 and 2000

8.2.5. CH_4 emissions from solid waste disposal sites [6A]

The emission trend for landfills is summarised in *Table 8.26*. In this table also the amount of CH_4 is shown that has been recovered (mostly for energy use). In the period 1990-2000 the emissions of CH_4 have decreased from 562 to 404 Gg per year (-28%). This decrease is due to the threefold increase of the amount of CH_4 recovered from about 5% in 1990 to 18% in 2000 (*Table 8.26*), but also due to the decrease of the amount of methane produced in solid waste disposal sites. The main factors that influence the quantity of CH_4 produced are the *amount* of waste disposed of on land and the *concentration* of C (carbon) in that waste.

Table 8.26. Net CH_4 emissions and CH_4 recovered from solid waste disposal sites 1990-2000 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*
CH_4 emissions (net)	562	556	540	522	505	479	477	464	445	428	404
CH_4 recovered	27	37	47	58	68	78	73	73	76	76	86
% of gross emissions	5%	6%	8%	10%	12%	14%	13%	14%	15%	15%	18%

* Preliminary data.

Since 1990, the amounts of waste as well as the concentration of C have decreased, and thus the quantity of CH_4 produced has decreased too. 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 8.27* shows the waste disposal situation in the Netherlands for the period 1990-2000. It clearly shows that in particular the amount of waste disposed of in landfills decreased substantially. With respect to the composition, the decreasing carbon concentration is reflected by lower percentages of paper and higher percentages of ‘inert’ materials.

Table 8.27. Waste disposal (excluding discharge into surface water)(Mton) and the composition of the landfilled waste (kg C/ton)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000*
Incinerated	3.9	4.1	4	3.8	4.4	4.7	5.6	6.7	6.8	7.1	7.2
Reused/recycled	30.6	32.6	33.4	33.1	34.9	37.7	39.4	42	43.3	43.5	45.3
Landfilled	13.9	11.9	11.6	11.2	9.0	8.2	6.7	5.8	5.5	5.5	5.1
Composition of landfilled waste**	131	130	129	128	128	128	128	126	124	120	110

* Preliminary data.
** Unit: kg C/ton waste.

8.2.6. CH_4 emissions from other sources [1A, 2, 6B-D, 7]

The CH_4 emissions from ***category 1A*** mainly stem from the residential sector, partly from gas consumption for cooking (start-up losses), space heating and water heating, and partly from biofuel combustion in this sector. Since non-combustion emissions of CH_4 from the residential and commercial sectors cannot be reported in the CRF under IPCC ***category 3*****,** these are reported under ***category*** *7 'Solvents and other product use'*. These include tobacco smoking and emissions from fireworks.

The small CH_4 emissions from ***category 2*** stem mainly from various non-combustion processes in the chemical industry (2B). In addition very small CH_4 emissions from this category are reported under 2A, referring to non-combustion emissions from ceramics, glass and mineral building materials production, and under category 2G, comprising miscellaneous non-combustion emissions from food processing and manufacture of textile, leather, paper and board, and wood products.

The decrease of emissions from ***category 6B*** wastewater treatment plants (WWTP) after 1990 is caused by the introduction of a new sludge stabilisation system in one of the largest WWTPs in 1990, of which the operation took a few years to get optimised. This caused much more venting emissions in the introductory than during normal operation conditions. The interannual changes in the late 90's are due to varying fractions of methane being flared instead of vented or used for energy purposes.

The very small CH_4 emissions from ***category 6D*** comprise combustion emissions from wastewater treatment plants and miscellaneous non-combustion emissions from other waste handling activities.

8.3. Emissions of N_2O

Box 8.3. N_2O key source identification using to the IPCC Tier 1 and 2 approach (L= Level, T= Trend)

1A	N O emissions from mobile combustion: road vehicles	Key (T2)
2	N O emissions from nitric acid production	Key (L,T)
4D	Direct N O emissions from agricultural soils	Key (L,T)
4D	Indirect N O emissions from nitrogen used in agriculture	Key (L,T2)
7	N O emissions from polluted surface water	Key (L2)
7	Misc. N O	Key (L2)

We recall that the Netherlands does not use the IPCC method for estimating indirect emissions of N O. Indirect N O emissions are partly estimated for the Netherlands and reported under *IPCC categories 4D, 6B* and *7 (Polluted surface water*). They do not include secondary emissions due to atmospheric deposition.

In 2000 total N_2O emissions increased by about 3% compared to 1990 (*Table 8.28*), mainly due to the increase of the emission from agriculture (10%) and transport (65%) with 2.2 and 0.8 Mton CO_2-eq., respectively (*Table 8.28* and *Figure 8.10*). In road transport, increasing (though due to recalculation much lower) emissions due to the further penetration of catalyst-equipped petrol cars were partly compensated by decreasing N_2O emissions from diesel vehicles resulting in emissions in this sector effectively decreasing from 1999. Although in the period 1990-2000 the amount of nitrogen in manure that has been applied to agricultural soils decreased with approximately 5%, the emissions of N_2O are much higher because the application method has changed considerably. In *Box 8.3* the N_2O key sources based on level, trend or both are presented. In the next sections the emission trend for the keys sources agricultural sector and road transport sector is discussed in more detail.

The uncertainty in emission estimates for N_2O emissions is related to uncertainty in activity data and in emission factors for N_2O. Compared to sources of CO_2 and CH_4, the uncertainty in emission factors for identified sources is often fairly large: in the order of 50 to 100%, and for indirect N_2O emissions from agriculture even more. Also, some sources are not well-known or may not have been identified yet. The uncertainty in the overall *annual* total of sources included in the inventory is estimated to be roughly about 50% (with order of magnitude-factor of 1.5) (see Chapter 7). The Tier 1 *trend* uncertainty in total N_2O emissions has been calculated at ±12% points.

Table 8.28. N_2O emissions per IPCC sector 1990-2000 (Gg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOTAL NET NATIONAL EMISSIONS	**53.3**	**61.9**	**63.4**	**63.5**	**65.2**	**58.6**	**65.4**	**68.1**	**57.5**	**56.0**	**54.8**
1. All Energy (combustion and fugitive)	**1.9**	**2.1**	**2.3**	**2.4**	**2.6**	**2.7**	**2.3**	**2.2**	**2.7**	**2.6**	**2.6**
A Fuel combustion total	1.9	2.1	2.3	2.4	2.2	2.7	2.3	2.2	2.7	2.6	2.6
1 Energy transformation	0.5	0.5	0.5	0.5	0.2	0.5	0.0	0.1	0.5	0.5	0.4
2 Industry	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.0	0.1	0.1	0.1
3 Transport	1.2	1.4	1.6	1.7	1.8	2.0	2.0	2.0	2.0	2.0	2.0
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
5 Other	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
2. Industrial processes	**24.4**	**32.3**	**30.4**	**30.0**	**31.6**	**24.2**	**31.7**	**35.0**	**24.7**	**23.2**	**23.0**
3. Solvent and other product use	**0.7**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.7**	**0.6**	**0.5**	**0.5**	**0.5**
4. Agriculture	**22.1**	**22.7**	**25.9**	**26.2**	**26.1**	**26.9**	**26.4**	**26.0**	**25.2**	**25.2**	**24.3**
5. Land use change and forestry	-	-	-	-	-	-	-	-	-	-	-
6. Waste	**0.4**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.6**	**0.5**	**0.6**	**0.6**
7. Other (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**

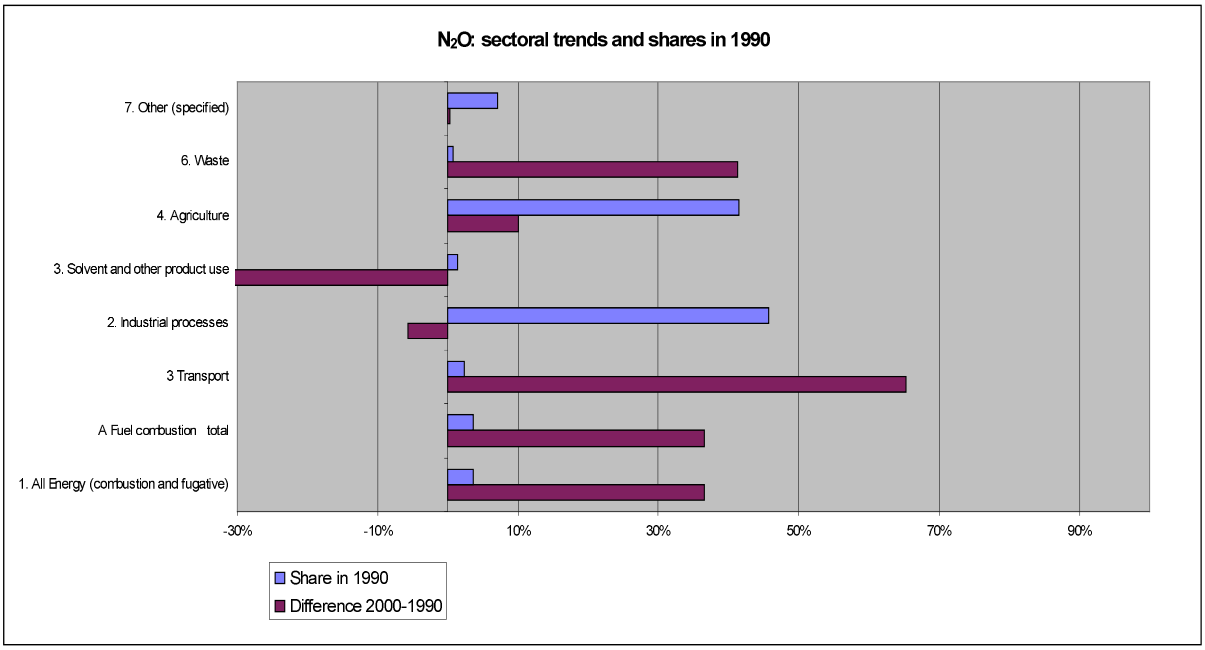

Figure 8.10. N_2O emission shares and trends per IPCC sector 1990-2000

8.3.1. N_2O emissions from road transport [1A3]

The N_2O emissions from transport have have been recalculated because of new insights in the N_2O emissions of especially diesel engines (see Section 5.1.3). From now on, The Netherlands use measurement results from TNO (Gense and Vermeulen, 2002) for the N_2O emissions from passenger cars. For other road vehicles and non-road vehicles the IPCC-defaults are used (IPCC, 1997).

Due to the recalculation, emissions in 1990 diminished from 5.6 Tg in the NIR 2001 to 1.2 Tg in the NIR 2002. In the revised estimates the N_2O emissions from road transport increase from 1.2 Tg in 1990 to 2.0 Tg in 1999. Between 1999 and 2000 the N_2O emission from transport did not increase any further. The increasing trend up tot 1999 could be expected from the increase in vehicles kilometres and from the increasing share of gasoline cars equipped with a catalytic converter, which have a much higher emission factor than cars without this emission control technology (*Table 8.29*). The fact that N_2O emissions from transport maintained constant between 1999 and 2000, 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 gasoline cars, has increased over the last few years.

These trends have been summarised in *Table 8.29*. 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 cause the overall emission factor for N_2O from road transport to maintain constant between 1999 and 2000. This has been visualised in *Figures 8.11* and *8.12*.

Table 8.29. Trend in N_2O emission factors for passenger cars 1990-2000 (g/km)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
A. By fuel type											
Gasoline total	0.009	0.011	0.013	0.014	0.015	0.017	0.017	0.016	0.016	0.015	0.014
o.w. gasoline without cat.	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
o.w. gasoline with cat.	0.026	0.025	0.025	0.025	0.025	0.025	0.023	0.021	0.020	0.018	0.017
Share of cars with cat.	*22%*	*32%*	*41%*	*47%*	*53%*	*59%*	*64%*	*69%*	*73%*	*76%*	*79%*
Diesel	0.005	0.005	0.005	0.005	0.005	0.005	0.006	0.006	0.007	0.008	0.008
LPG	0.010	0.013	0.015	0.016	0.018	0.020	0.020	0.019	0.019	0.018	0.018
B. Share of fuels in passenger car km											
gasoline	63%	64%	66%	68%	67%	68%	69%	68%	67%	67%	66%
diesel	21%	20%	19%	19%	19%	20%	20%	20%	23%	24%	26%
LPG	16%	16%	15%	14%	13%	13%	11%	11%	10%	9%	8%
C. Average factor	0.009	0.010	0.012	0.013	0.014	0.015	0.015	0.014	0.014	0.014	0.013

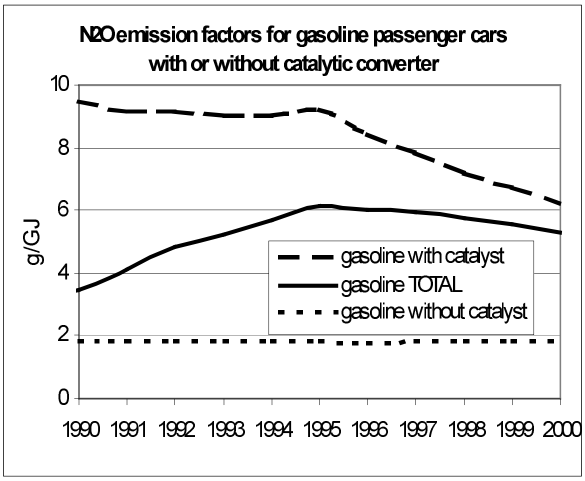

Figure 8.11. Trend in emission factors for N_2O from gasoline passenger cars in the Netherlands 1990-1999 due to increasing shares of cars equipped with a catalytic converter

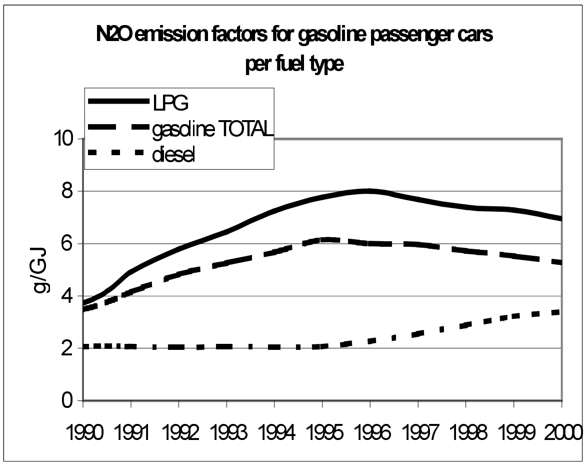

Figure 8.12. Trend in emission factors for N_2O from passenger cars in the Netherlands 1990-1999 by fuel type (gasoline, diesel, LPG)

8.3.2. N_2O emissions from industrial processes [2B]

The most important industrial non-combustion process in the Netherlands with associated N_2O emissions is nitric acid production. In *Table 8.30* an overview is presented of the trend in N_2O emissions from industrial processes in the period 1990-2000. The emissions remained rather constant in this period, because no measures were taken to control these emissions. The apparent inconsistent values in 1991-1994 and 1996-1997 are caused by the fact that emissions for these years have not yet been recalculated.

Table 8.30. N_2O emissions from industrial processes 1990-2000 (Gg N_2O)

Source	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Nitric acid production	20.4	28.3	26.4	26.0	27.6	20.3	27.7	31.0	20.1	19.1	19.0
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
Total	**24.4**	**32.3**	**30.4**	**30.0**	**31.6**	**24.3**	**31.7**	**35.0**	**24.1**	**23.1**	**23.0**

8.3.3. N_2O emissions from agriculture [4B, D]

The Netherlands does not use the IPCC method to estimate indirect N_2O emissions; instead (enhanced) background emissions from foregoing applications of manure and fertilisers on agricultural soils been calculated and reported under 4.D *'Other'* as *'Background emissions from agricultural soils'*. These include emissions due to the cultivation of histosoils and from crop residues left in the field. These have been calculated using a country-specific method (see Chapter 4 for more information).

The trend in N_2O emissions from agricultural soils is summarised in *Table 8.31.* In the period 1990-2000 the emission of N_2O has increased from 21.5 to 23.7 Gg (+10%). This increase is almost completely due to the increase of the emissions related to the application of animal manure to agricultural soils. Although in the period 1990-2000 the amount of nitrogen in manure that has been applied to agricultural soils decreased with approximately 5%, the emissions of N_2O are much higher because the application method has changed considerably. Before 1990 manure was applied by surface spreading *on* grasslands as well as agricultural soils. As a result of the policy for reduction of ammonia emissions, in the past 10 years this practice has changed to incorporation of manure *into* the soil (injection and ploughing in). Due to this new incorporation method the local concentration of nitrogen in the upper layer of the soil is higher, which leads to changes in the microbial environment and in microbial processes and ultimately to an increase of N_2O emissions per amount of manure applied.

Incidentally, in 1998 the emission was lower than in 1997 due to the rainy weather in the second half of 1998. Therefore part of the manure could not be applied in 1998 and part of the manure application was postponed to 1999. Consequently, the emissions in 1999 have been relatively high.

Table 8.31. N_2O Emissions from agricultural soils 1990-2000 (Gg N_2O)*

Source	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Direct Soil Emissions	13.0	13.4	16.8	17.0	17.2	18.0	17.4	17.1	16.8	17.2	16.4
o.w. Synthetic Fertilisers	*6.9*	*6.7*	*6.6*	*6.6*	*6.3*	*6.8*	*6.5*	*6.7*	*6.8*	*6.5*	*6.5*
o.w. Animal Wastes Applied to Soils	*5.8*	*6.5*	*10.0*	*10.3*	*10.7*	*10.9*	*10.7*	*10.2*	*9.8*	*10.5*	*9.7*
o.w. 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*
Animal Production	3.8	3.8	3.7	3.7	3.4	3.4	3.5	3.5	3.1	2.7	2.6
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
Total category 4D	**21.5**	**22.0**	**25.2**	**25.4**	**25.3**	**26.1**	**25.7**	**25.3**	**24.6**	**24.6**	**23.7**

* Excluding emissions from animal houses, which are included in IPCC category *4.A Agriculture* in *Table 8.27.*

8.3.4. N_2O emissions from other sources [1A, 3, 6B-D, 7]

The negligible emissions from ***category 1A*** mainly stem from road transport. Emissions from stationary combustion of fossil fuels and biofuel are mainly due to coal combustion for public power generation. The N_2O emissions from ***category 3*** refer to the use of nitrous oxide as anesthesia and as propellant in spray cans and to emissions from fireworks, whereas the negligible N_2O emissions reported under ***category 6D*** comprise combustion emissions from wastewater treatment plants and other waste handling activities. N_2O emissions from human sewage are reported partly under ***category 6B*** *'Wastewater handling'* and partly under ***category 7*** as *'Polluted surface water'*. The latter includes indirect N_2O emissions from leaching and run-off of nitrogen from agricultural and industrial sources, of which three-quarter stems from agricultural sources.

8.4. Emissions of fluorinated halocarbons

Box 8.4. F-gas key sources (L= Level, T= Trend)

2	HFC-23 emissions from HCFC-22 manufacture (by-product)	Key (L,T)
2	PFC emissions from aluminium production (by-product)	Key (L1,T)
2	HFC emissions from substitutes for CFCs	Key (T2)

In *Box 8.4* the F-gas key sources based on level, trend or both are presented. In the next sections we will discuss the trends in emissions from production processes and the use of F-gases in more detail.

In *Table 8.32* an overview of the trend in F-gas emissions during 1990-2000 is given. It shows that the F-gas emissions have decreased in 2000 by 30% compared to 1995 (50% compared to 1998). The uncertainty in actual emission estimates of HFC, PFC and SF_6 is related to the uncertainty in activity data, emission factors, and other factors such as duration of storage and leakage rates. Activity data are often rather precise; the largest uncertainties are found in the other data.

Table 8.32. Actual emissions of HFCs, PFCs and SF_6 1990-2000 (Gg CO_2-eq.)

Compound group	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
HFC total	4 432	4 820	4 540	5 066	6 338	5 979	7 210	8 215	9 213	4 833	3 917
PFC total	2 432	2 437	2 099	2 118	1 890	1 867	2 042	2 154	1 728	1 444	1 526
SF_6 total	187	100	106	110	148	361	365	386	369	336	327
Total HFC/PFC/SF_6	**7 050**	**7 358**	**6 745**	**7 294**	**8 377**	**8 207**	**9 617**	**10 755**	**11 310**	**6 614**	**5 770**

8.4.1. F-gas emissions from production processes (by-products) [2C, E]

Production processes where F-gas by-product emissions occur in the Netherlands are HCFC-22 production (HFC-23) and primary aluminium industry (PFCs). In *Table 8.33* an overview of the trend in F-gas emissions from production processes during the period 1990-2000 is given. In the period 1995-2000 the emission of HFC-23 from the manufacture of HCFC-22 decreased with 58%, because a thermal afterburner was installed.

PFC emissions from the primary aluminium production have been updated for 1998 and 1999(1998 and 1999 data were preliminary in the previous submission). The PFC emissions from aluminium production decreased by about 30% during the period 1995-2000. Switching from side feeding to point feeding at one of the producing companies is the main cause.

Interannual changes of about 10% as can be observed. However, these changes relate to variations in annual production levels, that may occur in practice.

Table 8.33. Actual HFC and PFC emissions per compound from production processes 1990-2000 (Gg CO_2-eq.)

Compound	**IPCC**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
HFC-23	2E	4 432	4 820	4 540	5 066	6 271	5 759	6 709	6 709	7 791	3 440	2 421
HFC total		*4 432*	*4 820*	*4 540*	*5 066*	*6 271*	*5 759*	*6 709*	*6 709*	*7 791*	*3 440*	*2 421*
CF_4 (PFC-14)	2C	1 957	1 957	1 677	1 690	1 482	1 450	1 606	1 697	1 269	1 000	1 043
C F_6 (PFC-116)	2C	442	442	377	377	350	350	359	368	356	326	348
PFC total		*2 398*	*2 398*	*2 054*	*2 067*	*1 832*	*1 799*	*1 964*	*2 065*	*1 625*	*1 326*	*1 390*
Total HFC/PFC		**6 830**	**7 219**	**6 594**	**7 133**	**8 103**	**7 558**	**8 673**	**8 773**	**9 415**	**4 766**	**3 811**

Note: 2E refers to HCFC-22 manufacture; 2C refers to primary aluminium production.

8.4.2. Consumption of HFCs, PFCs and SF_6 [2F]

Trends in *actual* emissions from 1990 onwards are presented in *Table 8.34*, whereas *potential emissions* (or so-called *apparent consumption*) are shown in *Table 8.35*. Actual emissions of HFCs for 1994 onwards have been recalculated due to new information on the shares of various applications. It shows that HFC emissions are a factor of 7 higher in 2000 than in 1995, largely because of an increase in HFC consumption as a substitute for (H)CFC use, in particular of HFC-134a (see *Figure 8.13*). 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. From 1995 onwards a missing source - production of sound-insulating double glazed windows - has been added tot the actual emissions of SF_6.. In addition, the SF_6 emission of 1990 has been updated. In the period 1995-2000 the actual emission of SF_6 kept stable.

Table 8.34. Actual emissions per compound from the use of HFCs, PFCs and SF_6 1990-2000 (Gg CO_2-eq.)

Compound	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
HFC-134a	0	0	0	0	65	198	441	801	817	875	829
HFC-143a	0	0	0	0	0	8	27	49	137	153	315
HFC-125	0	0	0	0	0	11	25	43	102	140	186
HFC-152a	0	0	0	0	3	0	0	0	0	0	3
HFC-32	0	0	0	0	0	2	0	2	1	0	0
Other HFCs	0	0	0	0	0	2	9	611	366	225	162
HFC TOTAL	0	0	0	0	67	220	502	1 506	1 422	1 393	1 496
PFC-use	34	39	44	51	59	68	78	89	103	118	136
SF6-use	187	100	106	110	148	361	365	386	369	336	327
TOTAL HFC/PFC/SF_6	**221**	**139**	**151**	**161**	**274**	**649**	**944**	**1 981**	**1 894**	**1 848**	**1 959**

Table 8.35. Potential emissions per compound from the use of HFCs, PFCs and SF_6 1990-2000 (Gg CO_2-eq.)

Compound	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
HFC-134a	0	0	0	0	356	590	1 187	1 398	1 365	1 366	1 391
HFC-143a	0	0	0	0	0	129	315	350	456	642	790
HFC-125	0	0	0	0	0	140	286	274	333	543	728
HFC (unspecified)	0	0	0	0	8	69	168	138	147	57	33
HFC TOTAL	0	0	0	0	364	928	1 956	2 160	2 301	2 609	2 942
PFC use	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
TOTAL HFC/PFC/SF_6	**0**	**0**	**0**	**0**	**364**	**928**	**1 956**	**2 160**	**2 301**	**2 609**	**2 942**

Note: C = Confidential Business Information.

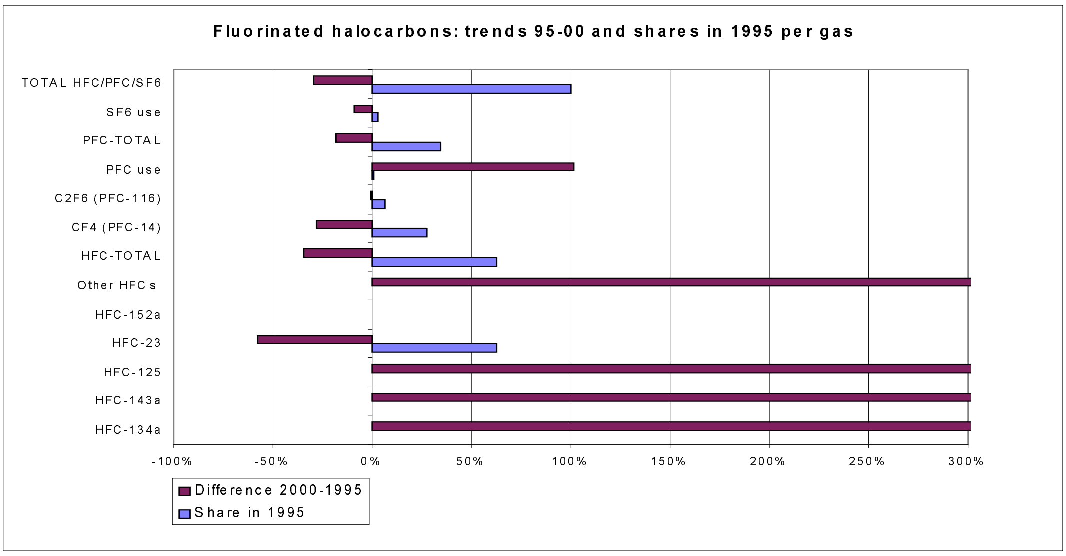

Figure 8.13. Shares and trends in actual emissions of fluorinated gases 1995-2000

9. Emission trends of precursor gases and SO_2

Trends in total emissions of CO, NO_x, NMVOC, and SO_2 are presented in *Table 9.1* and in *Figure 9.1* to *8.5*. In *Table 9.1* and *Figure 9.1* it clearly shows that the CO and NMVOC emissions are in 2000 reduced by about 40-45% compared to 1990, for SO_2 even 55%, but for NO_x, the 2000 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 Chapter 4).

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 emission factors for SO_2 from fuel combustion (basically the sulphur content of the fuels) the uncertainty is estimated in the range of 10-25%. 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 of the order of 25% for CO, 10% for NO_x and SO_2 and about 25% for NMVOC. (RIVM, 2001a).

Table 9.1. Trend in emissions of precursors1990-2000

Indirect greenhouse gases and SO_2	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Emissions in kton											
Total NO_x	573.8	551.4	539.0	518.9	493.2	483.5	474.4	446.1	428.5	421.7	421.0
Total CO	1164.5	1022.5	966.3	948.6	905.1	894.0	865.0	777.8	739.4	711.8	701.0
Total NMVOC	503.7	460.6	436.2	403.2	387.7	369.6	348.7	316.9	301.5	289.9	280.7
Total SO_2	202.4	163.5	157.2	150.4	136.5	141.4	133.5	116.5	108.0	102.9	91.2
Index (1990-2000)											
Index Total NO_x	100.0	96.1	93.9	90.4	86.0	84.3	82.7	77.7	74.7	73.5	73.4
Index Total CO	100.0	87.8	83.0	81.5	77.7	76.8	74.3	66.8	63.5	61.1	60.2
Index Total NMVOC	100.0	91.4	86.6	80.0	77.0	73.4	69.2	62.9	59.9	57.6	55.7
Index Total SO_2	100.0	80.8	77.7	74.3	67.5	69.9	66.0	57.5	53.4	50.9	45.1

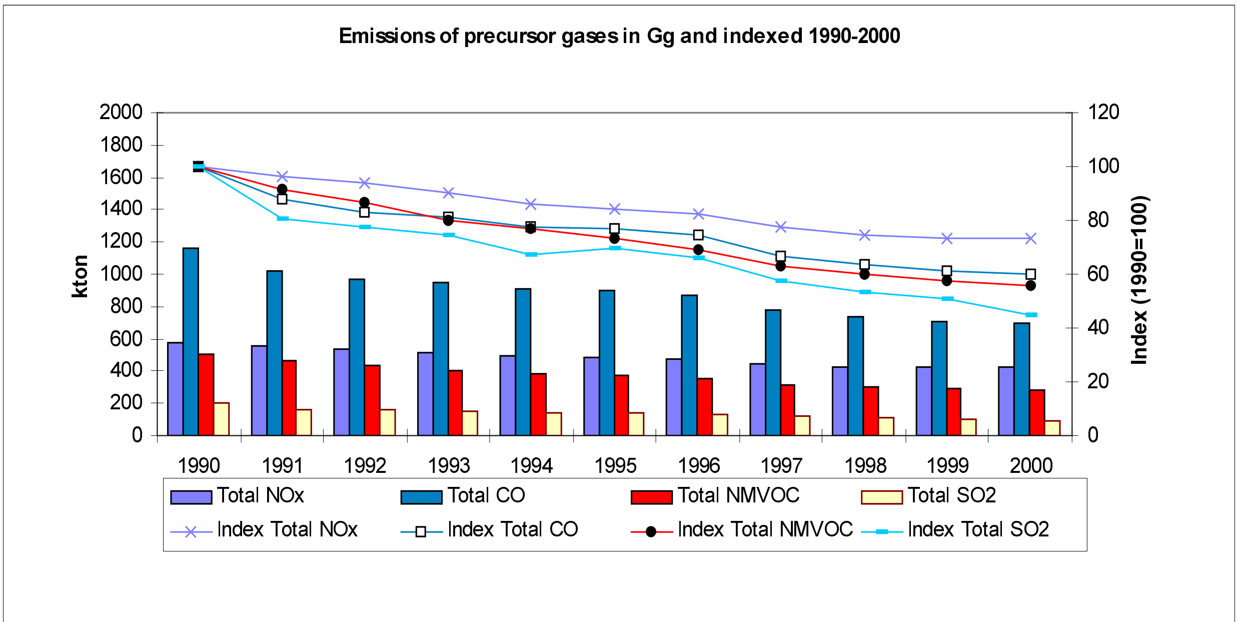

Figure 9.1. Trends in total emissions of NO_x, CO, NMVOC and SO_2 1990-2000

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ANNEX 1: Additional information to be considered as part of the NIR submission

The following reports should be considered as part of this NIR submission:

A) 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. 37, July 1997. *Translation in English in prep*.
- TNO, 2002: *Meta information on PER 2001 dataset* [in Dutch]. TNO, Apeldoorn, *in prep*.

B) documentation of uncertainties used in IPCC Tier 1 uncertainty assessments and Tier 2 key source identification

- Olivier, J.G.J., 2002: *Estimate of annual and trend uncertainty for Dutch sources of greenhouse gas emissions using the IPCC Tier 1 approach.* RIVM, Bilthoven, *in prep*.

C) 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.
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D) 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.
- Wg EAJR CCDM, 2001: *Project Plan Annual Emission and Waste Report 2001* [in Dutch]. Ministry of VROM/HIMH, The Hague, November.
- Coenen, P.W.H.G.and J.G.J. Olivier, 2002: *Documentation of the activities within the framework of the completion of the CRF for the 2002 submission to the UNFCCC*. TNO-MEP, Apeldoorn. *In prep.*

ANNEX 2: Detailed Methodological description of the LUCF category 5A

For category 5A (*Changes in forest and other woody biomass stocks)* an improved and completed forestry dataset for the whole period 1990-2000 has been compiled and included in the NIR. The method and data sources used to estimate CO 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. Details on how the new data differ from the previous NIR 2000 are provided in Section 5.1.2.

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 methods 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 methods*
- 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.

New consistent 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 that 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) (TBFRA 2000);
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 A.2.1* the area of the distinguished subcategories have been summarised. More details can be found in Daamen (2002).

Table A.2.1. 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 A.2.2* summarises all conversion factors used in the calculation for source/sink category 5A. Again more details can be found in Daamen (2002).

Table A.2.2 Conversion factors used to estimate the Netherlands' CO_2 source/removal IPCC category 5A.

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

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

The net annual CO 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 A.2.3* 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).

Table A.2.3 Annual growth increment and annual fellings in Netherlands' forests 1990-2000 (source: Daamen, 2002).

	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.

LUCF studies in progress

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*., 2002). 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 2002 the results will be evaluated and a decision made to what extent data can be included in future editions of the Netherlands' greenhouse gas inventory.

ANNEX 3: National Energy Balances: Changes in energy data for IPCC Reference Approach 1990-2000

Table A.2.1. Effect of elimination of statistical differences on production, import, export, and bunker statistics1990 and 1995-1998.

PRODUCTION

			1990			1995			1996			1997			1998		
			2001	2002	Dif.	2001	2002	Dif.	2001	2002	Dif.	2001	2002	Dif.	2001	2002	Dif.
FUEL TYPES			PJ			PJ			PJ			PJ			PJ		
Liquid	Primary	Crude Oil	151	151	0	118	116	-2	99	95	-4	92	88	-4	76	73	-3
		Natural Gas Liquids	20	20	0	33	33	0	39	39	0	38	38	0	42	42	0
	Secondary Fuels	Gasoline 3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Jet Kerosene	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Other Kerosene 4)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gas / Diesel Oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Residual Fuel Oil	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		LPG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Naphtha	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lubricants	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Other Oil 5)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Solid	Primary	Other Bit. Coal 6)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Secondary Fuels	BKB & Patent Fuel 7)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Coke Oven/Gas Coke	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gaseous Fossil		Natural Gas (Dry)	2286	2301	15	2537	2537	0	2868	2891	23	2541	2559	18	2416	2440	24
Total			2457	2472	15	2688	2686	-2	3006	3025	19	2671	2685	14	2534	2555	21

IMPORT

			1990			1995			1996			1997			1998		
			2001	2002	PJ	2001	2002	PJ	2001	2002	PJ	2001	2002	PJ	2001	2002	PJ
FUEL TYPES			PJ			PJ			PJ			PJ			PJ		
Liquid	Primary	Crude Oil	1938	3493	1555	3952	3952	0	4227	4227	0	4251	4251	0	4359	4359	0
		Natural Gas Liquids	159	181	22	245	244	-1	247	247	0	228	228	0	232	232	0
	Secondary Fuels	Gasoline 3)	69	194	125	97	97	0	87	87	0	28	110	82	151	151	0
		Jet Kerosene	11	25	14	12	12	0	15	15	0	22	28	6	22	22	0
		Other Kerosene 4)	5	6	1	12	12	0	31	31	0	22	22	0	22	22	0
		Gas / Diesel Oil	262	392	130	217	217	0	329	329	0	385	385	0	365	365	0
		Residual Fuel Oil	129	356	227	319	319	0	303	303	0	325	325	0	288	288	0
		LPG	105	112	7	100	100	0	94	94	0	107	107	0	97	97	0
		Naphtha	129	225	96	195	195	0	192	192	0	245	245	0	182	182	0
		Lubricants	11	16	5	17	17	0	17	17	0	21	21	0	22	22	0
		Other Oil 5)	274	360	86	306	277	-29	280	280	0	297	297	0	338	338	0
Solid	Primary	Other Bit. Coal 6)	475	475	0	470	470	0	455	455	0	535	535	0	571	571	0
	Secondary Fuels	BKB & Patent Fuel 7)	6	5	-1	8	2	-6	8	2	-6	14	2	-12	14	3	-11
		Coke Oven/Gas Coke	10	10	0	19	19	0	8	8	0	11	11	0	12	12	0
Gaseous Fossil		Natural Gas (Dry)	85	85	0	116	116	0	171	171	0	217	217	0	216	216	0
Total			3668	5935	2267	6085	6049	-36	6464	6458	-6	6708	6784	76	6891	6880	-11

EXPORT

			1990			1995			1996			1997			1998		
			2001	2002	Dif.	2001	2002	Dif.	2001	2002	Dif.	2001	2002	Dif.	2001	2002	Dif.
FUEL TYPES			PJ			PJ			PJ			PJ			PJ		
Liquid	Primary	Crude Oil	54	1608	1554	1,670	1670	0	1892	1892	0	1882	1881	-1	1898	1898	0
		Natural Gas Liquids	2	26	24	10	10	0	6	6	0	2	2	0	3	3	0
	Secondary Fuels	Gasoline 3)	285	518	233	364	363	-1	342	337	-5	341	345	4	358	359	1
		Jet Kerosene	170	159	-11	160	160	0	165	165	0	148	148	0	149	149	0
		Other Kerosene 4)	17	15	-2	7	7	0	12	12	0	12	12	0	12	12	0
		Gas / Diesel Oil	618	700	82	798	816	18	856	876	20	906	933	27	892	911	19
		Residual Fuel Oil	397	384	-13	368	367	-1	358	356	-2	376	375	-1	397	397	0
		LPG	41	39	-2	64	64	0	90	90	0	89	89	0	72	72	0
		Naphtha	139	237	98	238	238	0	245	245	0	299	299	0	260	260	0
		Lubricants	28	31	3	33	31	-2	38	31	-7	33	33	0	33	33	0
		Other Oil 5)	342	339	-3	359	359	0	356	356	0	366	366	0	400	400	0
Solid	Primary	Other Bit. Coal 6)	67	73	6	79	89	10	64	87	23	93	110	17	206	218	12
	Secondary Fuels	BKB & Patent Fuel 7)	4	4	0	2	2	0	1	1	0	2	1	-1	2	2	0
		Coke Oven/Gas Coke	24	24	0	31	29	-2	26	23	-3	27	28	1	30	32	2
Gaseous Fossil		Natural Gas (Dry)	1081	1081	0	1,220	1220	0	1464	1464	0	1274	1274	0	1166	1166	0
Total			3269	5238	1969	5403	5425	22	5915	5941	26	5850	5896	46	5878	5912	34

BUNKERS

			1990			1995			1996			1997			1998		
			2001	2002	Dif.	2001	2002	Dif.	2001	2002	Dif.	2001	2002	Dif.	2001	2002	Dif.
FUEL TYPES			PJ			PJ			PJ			PJ			PJ		
Liquid	Secondary Fuels	Gasoline 3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Jet Kerosene	41	62	21	105	105	0	113	113	0	123	122	-1	130	133	3
		Other Kerosene 4)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Gas / Diesel Oil	27	89	62	98	100	2	90	90	0	84	84	0	88	88	0
		Residual Fuel Oil	120	370	250	377	377	0	393	393	0	429	429	0	429	429	0
		LPG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Lubricants	1	4	3	4	4	0	5	5	0	5	5	0	5	5	0
		Other Oil 5)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total			189	525	336	584	586	2	601	601	0	641	640	-1	652	655	3

Table A.2.2. Effect of elimination of statistical differences and improvement in chemical industry on feedstock use of energy carriers 1990 and 1995-1998.

	Fr. Stored	1990			1995			1996			1997			1998		
		2001	2002	Dif.	2001	2002	Dif.	2001	2002	Dif.	2001	2002	PJ	2001	2002	Dif.
FUEL TYPES		PJ			PJ			PJ			PJ			PJ		
Naphtha (2)	0.82	45	45	**0**	27	28	**2**	18	18	**0**	15	15	**0**	14	14	**0**
Coal Oils and Tars (from Coking Coal)	1.00	6	6	0	7	6	**-1**	8	7	**-1**	8	6	**-2**	8	6	**-2**
Gas/Diesel Oil (2)	0.82	7	7	0	0	0	0	0	0	0	0	0	0	0	0	**0**
LPG (2)	0.82	79	74	**-5**	46	46	**0**	38	38	**0**	51	51	**0**	56	56	**0**
aromates/light oils/other oil products	0.82	141	-75	**-216**	172	141	**-31**	131	138	**7**	130	158	**28**	135	151	**16**
Total		277	57	**-220**	251	221	**-30**	194	200	**6**	204	230	**25**	213	227	**13**

1) Fuel types without changes are not presented here.

ANNEX 4: 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.

1. 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.

2. 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 B.1* for the period 1970-1996.

3. 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 18° C. The number of HDDs for a specific day is defined as the number of degrees Centigrade of the mean daily temperature below the 18° C threshold. If, for example, the mean daily temperature for a specific day is 12° 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 Day (HDD), 30-year moving average for normal number of HDDs and the HDD correction factor for the period 1970-2001 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	1986	3333	3228	0.969
1971	3133	3239	1.034	1987	3372	3219	0.955
1972	3379	3228	0.955	1988	2823	3231	1.144
1973	3234	3221	0.966	1989	2729	3219	1.179
1974	3033	3226	1.046	1990	2677	3211	1.199
1975	3083	3221	1.045	1991	3163	3198	1.011
1976	3097	3225	1.041	1992	2829	3203	1.132
1977	2997	3218	1.074	1993	3076	3177	1.033
1978	3304	3209	0.971	1994	2835	3156	1.113
1979	3476	3217	0.926	1995	2917	3140	1.076
1980	3301	3235	0.980	1996	3504	3123	0.891
1981	3244	3238	0.998	1997	2929	3135	1.070
1982	3005	3244	1.080	1998	2821	3133	1.111
1983	2999	3232	1.078	1999	2676	3118	1.165
1984	3177	3229	1.016	2000	2659	3098	1.165
1985	3487	3226	0.925	2001	2880	3076	1.068

Source: EnergieNed, 1995 (pers. comm.) and www.energiened..nl

4. 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.

5. 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, 1995) (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 1990-2000

	1980	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
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

Source: EnergieNed, 1995-2001

6. 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 Mton/PJ)

	A	B	C	D = B * (1 - C)	E = D * A	F = 0.056 * E
Sector	Gas consumption uncorrected [PJ]	Applicat-ion factor	HDD correct-ion factor	Addition factor	Correction of gas consump-tion [PJ]	Correction of CO emissions [Mton]
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 related temperature correction, has changed somewhat.

Table A.4.5.Temperature correction of carbon dioxide emissions per sector 1990-2000 (Gg).

Source category		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A1a	Energy sector	160	10	110	30	110	80	-120	60	140	210	210
1A2	Industry	770	50	450	120	400	290	-300	160	400	590	600
1A4a	Comm. & public services	1000	80	900	240	800	540	-930	510	760	1000	990
1A4b	Residential sector	2950	180	2020	510	1670	1200	-2020	1120	1550	2290	2330
1A4c	Agriculture	1350	70	840	220	760	490	-880	490	670	950	930
Total CO_2 correction		**6230**	**390**	**4320**	**1120**	**3740**	**2600**	**-4250**	**2340**	**3520**	**5040**	**5060**
As % of uncorrected nat. total		*3.9%*	*0.2%*	*2.6%*	*0.7%*	*2.2%*	*1.5%*	*-2.4%*	*1.4%*	*2.0%*	*3.0%*	*2.9%*

7. 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 5: Selection of Common Reporting Format tables

This annex 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 7.1). Please note that all data for 2000 are preliminary.

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 A.5.9*.

Annex 5.1 CRF Summary Table 7A for the base years 1990 and 1995 and the last two years (1999 and preliminary 2000)

Annex 5.2 Recalculation tables for base years 1990 and 1995 and for 1996-1999 (CRF Tables 8.a and 8.b)

Annex 5.3 CRF Completeness Tables 9 for 1990

Annex 5.4 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 5.1: IPCC Tables 7A for base years 1990 and 1995 and for 1999-2000

Table A.5.1. 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	**159 630.29**	**-1 421.91**	**1 292.24**	**53.30**	**0.00**	**4 431.84**	**0.00**	**2 431.74**	**0.00**	**0.01**	**573.80**	**1 164.47**	**503.74**	**202.35**
1. Energy	**157 439.61**		**212.90**	**1.88**							**569.76**	**1 118.76**	**274.37**	**194.14**
A. Fuel Combustion — Reference Approach [2]	159 562.66													
Sectoral Approach [2]	157 143.16		34.15	1.88							569.63	1 112.87	221.78	187.47
1. Energy Industries	51 513.19		3.29	0.46							99.99	16.08	3.38	105.80
2. Manufacturing Industries and Construction	41 889.26		2.90	0.12							77.20	224.44	3.41	44.18
3. Transport	29 085.18		7.87	1.21							350.22	754.22	200.41	29.35
4. Other Sectors	34 643.08		20.00	0.09							41.88	116.49	14.42	7.17
5. Other	12.46		0.08	0.00							0.36	1.63	0.16	0.97
B. Fugitive Emissions from Fuels	296.45		178.75	0.00							0.13	5.89	52.59	6.67
1. Solid Fuels	IE		IE	IE							IE	IE	IE	0.00
2. Oil and Natural Gas	296.45		178.75	0.00							0.13	5.89	52.59	6.67
2. Industrial Processes	**1 690.03**		**3.27**	**24.37**	**0.00**	**4 431.84**	**0.00**	**2 431.74**	**0.00**	**0.01**	**2.71**	**43.31**	**88.13**	**7.41**
A. Mineral Products	1 124.37		0.21	0.00							1.28	3.52	1.04	6.32
B. Chemical Industry	0.00		3.02	24.37	0.00	0.00	0.00	0.00	0.00	0.00	IE	IE	33.67	IE
C. Metal Production	0.00		0.00	0.00				2 398.10		0.00	0.00	35.11	3.27	0.00
D. Other Production [3]	0.00										IE	IE	10.87	IE
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	33.64	0.00	0.01				
G. Other	565.67		0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.43	4.68	39.27	1.09

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	**0.21**			**0.73**							**0.09**	**2.22**	**140.11**	**0.01**
4. Agriculture	**0.00**	**0.00**	**505.33**	**22.11**							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										0.00	
D. Agricultural Soils	(4) IE	(4)	IE	21.45									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	
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	NO		NO	NO							0.00	0.00		
C. Abandonment of Managed Lands	(5) NO	(5) 0.00												
D. CO_2 Emissions and Removals from Soil	(5) NE	(5) 0.00												
E. Other	(5) 0.00	(5) 0.00	0.00	0.00							0.00	0.00		
6. Waste	**500.43**		**568.69**	**0.41**							**1.24**	**0.18**	**0.98**	**0.80**
A. Solid Waste Disposal on Land	(6) 0.00		562.13									0.00	0.91	
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	500.43		0.00	0.00							1.24	0.18	0.06	0.80
7. Other ***(please specify)***	**0.00**	**0.00**	**2.06**	**3.81**	**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			2.06											
Polluted surface water				3.81										

Table A.5.2 Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1995***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[(1)]		PFCs[(1)]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**172 658.62**	**-1 232.28**	**1 170.03**	**58.62**	**928.40**	**5 978.00**	**0.00**	**1 866.76**	**0.00**	**0.02**	**483.52**	**894.03**	**369.59**	**141.42**
1. Energy	**171 103.09**		**206.97**	**2.65**							**481.42**	**858.48**	**213.84**	**137.37**
A. Fuel Combustion — Reference Approach (2)	170 091.39													
Sectoral Approach (2)	170 300.00		36.66	2.65							480.85	850.54	172.20	128.51
1. Energy Industries	56 589.35		4.84	0.49							75.81	16.22	4.94	66.34
2. Manufacturing Industries and Construction	43 083.83		5.06	0.13							60.70	180.80	3.87	26.84
3. Transport	32 129.92		6.18	1.95							304.39	589.60	150.01	29.52
4. Other Sectors	38 486.02		20.49	0.09							39.59	62.52	13.23	4.43
5. Other	10.87		0.08	0.00							0.35	1.39	0.16	1.38
B. Fugitive Emissions from Fuels	803.09		170.31	0.00							0.57	7.95	41.64	8.86
1. Solid Fuels	IE		IE	IE							IE	IE	IE	IE
2. Oil and Natural Gas	803.09		170.31	0.00							0.57	7.95	41.64	8.86
2. Industrial Processes	**1 442.21**		**2.63**	**24.17**	**928.40**	**5 978.00**	**0.00**	**1 866.76**	**CBI**	**0.02**	**1.75**	**33.39**	**55.95**	**3.34**
A. Mineral Products	1 114.26		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	18.90	0.00
C. Metal Production	16.53		0.00	0.00				1 799.10		0.00	0.00	30.32	2.78	0.00
D. Other Production (3)	0.00										0.00	0.00	7.63	0.00
E. Production of Halocarbons and SF_6						5 768.22		0.00		0.00				
F. Consumption of Halocarbons and SF_6					0.00	209.77	0.00	67.66	0.00	0.02				
G. Other	311.42		0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.62	26.20	0.57
3. Solvent and Other Product Use	**0.35**			**0.63**							**0.08**	**2.09**	**98.38**	**0.02**
4. Agriculture	**0.00**	**0.00**	**477.04**	**26.9**							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										0.00	
D. Agricultural Soils	(4) NE	(4) NE	IE	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							0.00	0.00	0.00	
G. Other			NO	NO							0.00	0.00	0.00	
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	NO		NO	NO							0.00	0.00		
C. Abandonment of Managed Lands	(5) NO	(5) 0.00												
D. CO_2 Emissions and Removals from Soil	(5) NE	(5) 0.00												
E. Other	(5) 0.00	(5) 0.00	0.00	0.00							0.00	0.00		
6. Waste	**112.97**		**481.31**	**0.50**							**0.27**	**0.07**	**1.25**	**0.69**
A. Solid Waste Disposal on Land	(6) 0.00		479.85									0.00	0.78	
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	112.97		0.01	0.00							0.27	0.07	0.48	0.69
7. Other *(please specify)* ---	**0.00**	**0.00**	**2.07**	**3.82**	**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			2.07											
Polluted surface water				3.82										

Table A.5.3 Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1999***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[(1)]		PFCs[(1)]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals	**172 060.76**	**-1 235.57**	**1037.782399**	**56.01**	**2 017.20**	**4 826.47**	**0.00**	**1 448.61**	**#VALUE!**	**0.01**	**421.66**	**711.83**	**289.91**	**102.91**
1. Energy	**170 291.88**		**177.331353**	**2.65**							**420.61**	**674.03**	**165.77**	**99.82**
A. Fuel Combustion — Reference Approach (2)	167 330.53													
Sectoral Approach (2)	168 724.37		33.056028	2.65							419.78	668.47	135.76	92.12
1. Energy Industries	57 910.63		6.035104	0.4561							57.60	26.66	4.41	51.98
2. Manufacturing Industries and Construction	43 150.10		3.150510	0.08							44.60	112.48	1.71	15.24
3. Transport	34 682.35		4.780889	2.04							282.34	472.91	117.71	23.48
4. Other Sectors	32 981.26		19.010296	0.07							34.92	55.12	11.79	1.40
5. Other	0.04		0.079228	0.00							0.31	1.30	0.15	0.02
B. Fugitive Emissions from Fuels	1 567.50		144.275325	0.00							0.83	5.57	30.01	7.70
1. Solid Fuels	IE		IE	IE							IE	IE	IE	IE
2. Oil and Natural Gas	1 567.50		144.275325	0.00							0.83	5.57	30.01	7.70
2. Industrial Processes	**1 315.57**		**2.710083**	**23.22227**	**2 017.20**	**4 826.47**	**0.00**	**1 448.61**	**#VALUE!**	**0.01**	**0.68**	**35.61**	**42.03**	**2.43**
A. Mineral Products	974.97		0.140522	0.00							0.51	1.68	0.23	2.42
B. Chemical Industry	0.00		2.532087	23.19	0	0	0	0	0	0	0.00	0.00	13.35	0.00
C. Metal Production	0.00		0.000000	0.00				1 326		0	0.00	31.95	2.72	0.00
D. Other Production (3)	0.00										0.00	0.00	5.76	0.01
E. Production of Halocarbons and SF_6						3 818		0		0				
F. Consumption of Halocarbons and SF_6					0	1 009	0	123	0	0				
G. Other	340.60		0.037473	0.04	0	0	0	0	0	0	0.17	1.98	19.97	0.01

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	**0.57**			**0.50**							**0.08**	**2.05**	**81.13**	**0.03**
4. Agriculture	**0.00**	**0.00**	**425.01**	**25.24**							0.00	0.00	0.163	0.00
A. Enteric Fermentation			333.89											
B. Manure Management			91.13	0.65									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	(4) NE	(4) NE	IE	24.58									0.16	
E. Prescribed Burning of Savannas			NO	NO							NO	NO	NO	
F. Field Burning of Agricultural Residues			NO	NO							NO	NO	NO	
G. Other			NO	NO							NO	NO	NO	
5. Land-Use Change and Forestry	(5) **0.00**	(5) **-1 235.57**	**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
A. Changes in Forest and Other Woody Biomass Stocks	(5) 0.00	(5) -1 235.57												
B. Forest and Grassland Conversion	NO		NO	NO							NO	NO	NO	
C. Abandonment of Managed Lands	(5) NO	(5) NO												
D. CO_2 Emissions and Removals from Soil	(5) NE	(5) NE												
E. Other	(5) 0.00	(5) 0.00	0.00	0.00							0.00	0.00		
6. Waste	**452.74**		**430.79**	**0.57**							**0.30**	**0.14**	**0.819**	**0.64**
A. Solid Waste Disposal on Land	(6) 0.00		428.27									0.00	0.75	
B. Wastewater Handling			2.52	0.57							0.00	0.00	0.00	
C. Waste Incineration	(6) IE		IE	IE							IE	IE	IE	IE
D. Other	452.74		0.01	0.00							0.30	0.14	0.07	0.64
7. Other *(please specify)*	**0.00**	**0.00**	**1.94**	**3.83**	**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			1.94											
Polluted surface water				3.83										

Table A.5.4 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	**173 527.34**	**-1 413.26**	**982.75**	**54.77**	**2 942.40**	**3 912.77**	**0.00**	**1 531.30**	**#VALUE!**	**0.01**	**420.98**	**701.00**	**280.72**	**91.20**
1. Energy	**171 714.18**		**163.96**	**2.57**							**420.01**	**663.53**	**160.63**	**87.98**
A. Fuel Combustion — Reference Approach[2]	174 522.08													
Sectoral Approach[2]	170 142.30		32.74	2.57							419.16	658.23	132.22	81.03
1. Energy Industries	59 084.78		5.94	0.425							57.96	26.59	4.33	41.42
2. Manufacturing Industries and Construction	43 002.78		3.19	0.07							43.29	115.51	1.74	14.74
3. Transport	35 119.57		4.47	2.00							282.87	461.77	114.89	23.62
4. Other Sectors	32 935.13		19.06	0.07							34.73	53.05	11.10	1.22
5. Other	0.039		0.08	0.00							0.31	1.30	0.15	0.02
B. Fugitive Emissions from Fuels	1 571.88		131.22	0.00							0.8479	5.30	28.41	6.95
1. Solid Fuels	IE		IE	IE							IE	IE	IE	IE
2. Oil and Natural Gas	1 571.88		131.22	0.00							0.85	5.30	28.41	6.95
2. Industrial Processes	**1 360.00**		**2.80**	**22.96**	**2 942.40**	**3 912.77**	**0.00**	**1 531.30**	**#VALUE!**	**0.01**	**0.60**	**35.31**	**38.88**	**2.58**
A. Mineral Products	981.30		0.13	0.00							0.60	1.61	0.24	2.57
B. Chemical Industry	0.00		2.66	22.96	0	0	0	0	0	0	0.00	0.00	11.92	0.00
C. Metal Production	21.50		0.00	0.00				1 390		0	0.00	33.70	2.68	0.00
D. Other Production[3]	0.00										0.00	0.00	5.78	0.01
E. Production of Halocarbons and SF_6						2 834		0		0				
F. Consumption of Halocarbons and SF_6					0	1 079	0	141	0	0				
G. Other	357.20		0.000396	0.00	0	0	0	0	0	0	0.00	0.00	18.26	0.00
3. Solvent and Other Product Use	**0.42**			**0.50**							**0.08**	**2.02**	**80.23**	**0.02**
4. Agriculture	**0.00**	**0.00**	**407.78**	**24.35**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			319.43											
B. Manure Management			88.35	0.63									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	(4) NE	(4) NE	IE	23.72									0.16	
E. Prescribed Burning of Savannas			NO	NO							NO	NO	NO	
F. Field Burning of Agricultural Residues			NO	NO							NO	NO	NO	
G. Other			NO	NO							NO	NO	NO	
5. Land-Use Change and Forestry	(5) **0.00**	(5) **-1 413.26**	**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
A. Changes in Forest and Other Woody Biomass Stocks	(5) 0.00	(5) -1 413.26												
B. Forest and Grassland Conversion	NO		NO	NO							NO	NO	NO	
C. Abandonment of Managed Lands	(5) NO	(5) NO												
D. CO_2 Emissions and Removals from Soil	(5) NE	(5) NE												
E. Other	(5) 0.00	(5) 0.00	0.00	0.00							0.00	0.00		
6. Waste	**452.74**		**406.31**	**0.57**							**0.29**	**0.14**	**0.82**	**0.64**
A. Solid Waste Disposal on Land	(6) 0.00		403.79									0.00	0.75	
B. Wastewater Handling			2.52	0.57							0.00	0.00	0.00	
C. Waste Incineration	(6) IE		IE	IE							IE	IE	IE	IE
D. Other	452.74		0.01	0.00							0.29	0.14	0.08	0.64
7. Other *(please specify)*	**0.00**	**0.00**	**1.90**	**3.82**	**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			1.90											
Polluted surface water				3.82										

Annex 5.3: Recalculation and Completeness Tables for 1990 and 1995-1999

This appendix shows information from sheets from the CRF data files of 1990 and for the period 1995-1999. In principle, all figures for 1999 have been revised, due to the provisional status in the previous submission. Total emission figures of CO_2, CH_4 and N_2O for 1991-1994 have not been changed.

Table A.5.5. 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		**161 173.12**	**159 630.29**	**-0.96**	**27 147.24**	**27 137.14**	**-0.04**	**19 757.25**	**16 523.89**	**-16.37**
1. Energy		**159 160.92**	**157 439.61**	**-1.08**	**4 495.06**	**4 470.91**	**-0.54**	**1 617.15**	**584.46**	**-63.86**
1.A.	Fuel Combustion Activities	158 535.67	157 143.16	-0.88	734.34	717.09	-2.35	1 617.15	584.16	-63.88
1.A.1.	Energy Industries	52 117.15	51 513.19	-1.16	26.45	69.09	161.17	140.78	143.96	2.26
1.A.2.	Manufacturing Industries and Construction	41 880.84	41 889.26	0.02	121.47	60.94	-49.83	41.59	36.69	-11.79
1.A.3.	Transport	29 095.35	29 085.18	-0.03	166.41	165.29	-0.67	1 407.56	375.91	-73.29
1.A.4.	Other Sectors	34 320.11	34 643.08	0.94	20.00	20.00	0.00	27.18	27.60	1.51
1.A.5.	Other	1 122.23	12.46	-98.89	0.01	1.78	18 972.42	0.03	0.00	-100.00
1.B.	Fugitive Emissions from Fuels	625.26	296.45	-52.59	3 760.72	3 753.81	-0.18	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	0.00
1.B.2.	Oil and Natural Gas	625.26	296.45	-52.59	3 760.72	3 753.81	-0.18	0.00	0.00	0.00
2. Industrial Processes		**1 901.47**	**1 690.03**	**-11.12**	**71.40**	**68.59**	**-3.94**	**9 773.19**	**7 554.02**	**-22.71**
2.A.	Mineral Products	746.73	1 124.37	50.57	0.00	4.42	0.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	0.00	0.00	0.00	63.49	0.00	9 773.19	7 554.02	-22.71
2.C.	Metal Production	0.62	0.00	-100.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	209.51	0.00	-100.00	0.00	0.00		0.00	0.00	
2.G.	Other	944.61	565.67	-40.12	71.40	0.67	-99.06	0.00	0.00	0.00
3. Solvent and Other Product Use		**0.00**	**0.21**	**0.00**	0.00	**0.00**		**155.00**	**224.75**	**45.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**10 602.38**	**10 611.93**	**0.09**	**6 878.90**	**6 854.10**	**-0.36**
4.A.	Enteric Fermentation	0.00	0.00		8 439.90	8 439.06	-0.01	0.00	0.00	
4.B.	Manure Management	0.00	0.00		2 162.48	2 172.87	0.48	204.60	204.60	0.00
4.C.	Rice Cultivation	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
4.D.	Agricultural Soils[2]	0.00	0.00	0.00	0.00	0.00	0.00	6 674.30	6 649.50	-0.37
4.E.	Prescribed Burning of Savannas	0.00	0.00		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	0.00	0.00
4.G.	Other	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00

Table A.5.5. 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)		(%)
5. Land-Use Change and Forestry (net)		**-1 500.00**	**-1 421.91**	**-5.21**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks			0.00	0.00	0.00		0.00	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	0.00	0.00		0.00	0.00	
5.D.	CO_2 Emissions and Removals from Soil			0.00	0.00	0.00		0.00	0.00	
5.E.	Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00

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		**110.73**	**500.43**	**351.94**	**11 936.40**	**11 942.40**	**0.05**	**155.00**	**125.57**	**-18.98**
6.A.	Solid Waste Disposal on Land	0.00	0.00	0.00	11 804.10	11 804.76	0.01	0.00	0.00	
6.B.	Wastewater Handling				132.30	137.55	3.97	155.00	125.53	-19.01
6.C.	Waste Incineration	IE	IE	0.00	IE	IE	0.00	IE	IE	0.00
6.D.	Other	110.73	500.43	351.94	0.00	0.08	0.00	0.00	0.04	0.00
7. Other *(please specify)*		**0.00**	**0.00**	**0.00**	**42.00**	**43.32**	**3.14**	**1 178.00**	**1 180.98**	**0.25**
				0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items:					0.00	0.00		0.00	0.00	
International Bunkers		**40 010.00**	**39 764.52**	**-0.61**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Multilateral Operations		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass		**3 100.00**	**3 547.21**	**14.43**	0.00	0.00		0.00	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		**5 143.69**	**4 431.84**	**-13.84**	**2 431.78**	**2 431.74**	**0.00**	**144.60**	**186.90**	**29.26**
2.C.3.	Aluminium Production				2 398.10	2 398.10	0.00			0.00
2.E.	Production of Halocarbons and SF_6	5 143.69	4 431.84	-13.84			0.00			0.00
2.F.	Consumption of Halocarbons and SF_6	0.00	0.00	0.00	33.68	33.64	-0.12	144.60	186.90	29.26
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**0.00**	**0.00**		**CBI**	**CBI**		**CBI**	**CBI**	

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry[3]	214 297.68	208 919.60	-2.51
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	215 797.68	210 341.50	-2.53

Table A.5.6. CRF Recalculation Explanation Table 8.b for 1990

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO			
			CHANGES IN:			Addition/removal/ replacement of source/sink categories
			Methods [2]	Emission factors [2]	Activity data [2]	
...						
ALL	ALL	All	In 2001 the source allocation for 1990, 1995, 1998, 1999 and 2000 has been revised based on a new set of allocation codes in the Dutch inventory, resulting in uniformity in the allocation over the mentioned years. Furthermore the identification of biofuels has been improved for			
1.A.1	Energy Industries	CO2	Change in source allocation (see 6 and 1.A.2/5)			
1.A.3	Transport	CO2			Data adjusted	
1.A.4	Other sectors	CO2	Change of method for statistical differences: elimination of statistical difference in gas in 1.A.4.			Elimination of CO2 source
1.A.4	Other Sectors	CO2	Change in source allocation (see 6 and 1.A.1)			
1.A.5	Other	CO2	Change of method for statistical differences: elimination by partly moving to exports (coal), partly to 1.A.2 (oil, mostly feedstocks), and removal of statistical difference in gas in 1.A.5.			Elimination of this CO2 source
1.B.2	Oil and Natural Gas	CO2			data adjusted	
2.A	Mineral Products	CO2	Improvement of emission figure for cement production		data adjusted	
2.D/G	Industrial Processes	CO2	Change in source allocation (To 1.a)			
5.A	Land use change and forestry	CO2			Data adjusted	
6.D	Waste / Other	CO2	Change in source allocation (from 1.a)			
1.A.	Energy	CH4	Change in source allocation (from 1.A.2 and 2)			
1.A.2	Manufacturing Industries	CH4	Change in source allocation (see 1.A.1 and 3)			
1.A.3	Transport	CH4			Data adjusted	
4.A	Enteric fermentation	CH4			Data adjusted	
4.B	Manure management	CH4			Data adjusted	
4.D	Agricultural soils	N2O			Data adjusted	
1.A.3	Transport	N2O			Data adjusted	
2.B	Industrial processes	N2O	Improved method for Nitric acid production, emissionfactor reduced based on measurements	Data adjusted, based on measuring data		
3	Solvent and product use	N2O			Data adjusted	
2.F	Consumption of halocarbons and SF6	HFCs	Method improved based upon new analysis of HFC22 production (HFC23) and leakpercentage for cooling devises reduced based upon new research	Data adjusted		
2.F	Consumption of halocarbons and SF6	SF6	New source identified (SF6) from double glazing		Data adjusted	New source

Table A.5.7. 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		**177 130.00**	**172 658.62**	**-2.52**	**24 620.40**	**24 570.61**	**-0.20**	**22 382.00**	**18 173.28**	**-18.80**
1. Energy		**175 194.00**	**171 103.09**	**-2.34**	**4 395.30**	**4 346.42**	**-1.11**	**2 528.98**	**822.82**	**-67.46**
1.A.	Fuel Combustion Activities	174 224.00	170 300.00	-2.25	315.30	360.11	14.21	2 528.98	822.82	-67.46
1.A.1.	Energy Industries	57 314.00	56 589.35	-1.26	102.90	101.64	-1.22	172.98	150.44	-13.03
1.A.2.	Manufacturing Industries and Construction	43 430.00	43 083.83	-0.80	58.80	106.32	80.81	31.00	39.26	26.63
1.A.3.	Transport	32 030.00	32 129.92	0.31	132.30	129.88	-1.83	2 294.00	605.40	-73.61
1.A.4.	Other Sectors	38 930.00	38 486.02	-1.14	21.30	20.49	-3.80	31.00	27.72	-10.58
1.A.5.	Other	2 520.00	10.87	-99.57	0.00	1.78	0.00	0.00	0.00	0.00
1.B.	Fugitive Emissions from Fuels	970.00	803.09	-17.21	3 654.00	3 576.51	-2.12	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	0.00
1.B.2.	Oil and Natural Gas	970.00	803.09	-17.21	3 654.00	3 576.51	-2.12	0.00	0.00	0.00
2. Industrial Processes		**1 570.00**	**1 442.21**	**-8.14**	**102.90**	**55.30**	**-46.26**	**9 796.00**	**7 493.18**	**-23.51**
2.A.	Mineral Products	1 130.00	1 114.26	-1.39	0.00	2.17	0.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	0.00	0.00	0.00	52.28	0.00	9 796.00	7 493.18	-23.51
2.C.	Metal Production	0.00	16.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
2.G.	Other	440.00	311.42	-29.22	102.90	0.85	-99.18	0.00	0.00	0.00
3. Solvent and Other Product Use		**0.00**	**0.35**	**0.00**	0.00	**0.00**		**155.00**	**194.47**	**25.46**
4. Agriculture		**0.00**	**0.00**	**0.00**	**9 989.70**	**10 017.84**	**0.28**	**8 556.00**	**8 323.50**	**-2.72**
4.A.	Enteric Fermentation	0.00	0.00		7 910.70	7 911.12	0.01	0.00	0.00	
4.B.	Manure Management	0.00	0.00		2 079.00	2 106.72	1.33	248.00	229.40	-7.50
4.C.	Rice Cultivation	0.00	0.00		0.00	0.00	0.00	0.00	0	
4.D.	Agricultural Soils (2)	0.00	0.00	0.00	0.00	0.00	0.00	8 308.00	8 094.10	-2.57
4.E.	Prescribed Burning of Savannas	0.00	0.00		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	0.00	0.00
4.G.	Other	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net)		**-1 700.00**	**-1 232.28**	**-27.51**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks			0.00	0.00	0.00		0.00	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	0.00	0.00		0.00	0.00	
5.D.	CO_2 Emissions and Removals from Soil			0.00	0.00	0.00		0.00	0.00	
5.E.	Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.5.7. 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		**366.00**	**112.97**	**-69.13**	**10 090.50**	**10 107.53**	**0.17**	**168.02**	**156.32**	**-6.96**
6.A.	Solid Waste Disposal on Land	0.00	0.00	0.00	10 059.00	10 076.76	0.18	0.00	0.00	
6.B.	Wastewater Handling				31.50	30.65	-2.69	155.00	156.26	0.81
6.C.	Waste Incineration	IE	IE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.D.	Other	366.00	112.97	-69.13	0.00	0.12	0.00	13.02	0.06	-99.53
7. Other *(please specify)*		**0.00**	**0.00**	**0.00**	**42.00**	**43.52**	**3.61**	**1 178.00**	**1 182.98**	**0.42**
				0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items:					0.00	0.00		0.00	0.00	
International Bunkers		**44 150.00**	**44 286.00**	**0.31**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Multilateral Operations		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass		**3 600.00**	**3 531.80**	**-1.89**	0.00	0.00		0.00	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		**6 723.62**	**5 978.00**	**-11.09**	**1 866.76**	**1 866.76**	**0.00**	**174.47**	**360.89**	**106.85**
2.C.3.	Aluminium Production				1 799.10	1 799.10	0.00			0.00
2.E.	Production of Halocarbons and SF_6	6 463.96	5 768.22	-10.76			0.00			0.00
2.F.	Consumption of Halocarbons and SF_6	259.66	209.77	-19.21	67.66	67.66	0.00	174.47	360.89	106.85
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**928.40**	**928.40**		**CBI**	**CBI**		**CBI**	**CBI**	

	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry(3)	231 197.25	222 375.87	-3.82

Table A.5.8. 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]	
...						
ALL	*ALL*	*All*	*In 2001 the source allocation for 1990, 1995, 1998, 1999 and 2000 has been revised based on a new set of allocation codes in the Dutch inventory, resulting in uniformity in the allocation over the mentioned years. Furthermore the identification of biofuels has been improved for these years.*			
1.A.5	**Other**	CO2	Change of method for statistical differences: elimination by partly moving to exports (coal), partly to 1.A.2 (oil, mostly feedstocks), and removal of statistical difference in gas in 1.A.5.			Elimination of this CO2 source
1.A.4	**Other sectors**	CO2	Change of method for statistical differences: elimination of statistical difference in gas in 1.A.4.			Elimination of CO2 source
1.B.2	**Oil and Natural Gas**	CO2			data adjusted	
2.A	**Mineral Products**	CO2	Change in source allocation (to 1.A.2)			
2.G	**Industrial Processes**	CO2	Change in source allocation (To 1.a.2)			
6.D	**Waste / Other**	CO2	Change in source allocation (see1.A.1)			
5.A	**Land use change and forestry**	CO2			Data adjusted	
1.A.	**Energy**	CH4	Change in source allocation (see 1.A.2)			
1.A.2	**Manufacturing Industries**	CH4	Change in source allocation (see 2.B)			
1.A.3	**Transport**	CH4			Data adjusted	
2.B	**Chemical Industry**	CH4	Change in source allocation (see 1.A.2)			
4.A	**Enteric fermentation**	CH4			Data adjusted	
4.B	**Manure management**	CH4			Data adjusted	
4D	**Agricultural soils**	N2O			data adjusted	
1.A.3	**Transport**	N2O			Data adjusted	
2.B	**Industrial processes**	N2O	Improved method for Nitric acid production, emissionfactor reduced based on measurements	Data adjusted, based on measuring data		
4.B/D	**Agriculture**	N2O			Data adjusted	
2.F	**Consumption of halocarbons and S**	HFCs	Method improved based upon new analysis of HFC22 production (HFC23) and leakpercentage for cooling devises reduced based upon new research	Data adjusted		
2.F	**Consumption of halocarbons and S**	SF6	New source identified (SF6) from double glazing		Data adjusted	New Source

Table A.5.9. 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		**184 721.10**	**179 706.10**	**-2.71**	**24 425.94**	**24 635.27**	**0.86**	**22 245.29**	**20 257.84**	**-8.93**
1. Energy		**183 021.10**	**178 005.69**	**-2.74**	**4 503.24**	**4 732.78**	**5.10**	**2 386.69**	**716.06**	**-70.00**
1.A.	Fuel Combustion Activities	182 021.10	177 002.69	-2.76	774.90	777.68	0.36	2 386.69	716.06	-70.00
1.A.1.	Energy Industries	58 900.00	59 305.75	0.69	119.70	119.70	0.00	136.40	3.77	-97.23
1.A.2.	Manufacturing Industries and Construction	42 100.00	42 239.06	0.33	31.71	38.30	20.77	21.70	68.84	217.24
1.A.3.	Transport	33 821.10	32 609.98	-3.58	119.07	118.23	-0.71	2 207.20	614.02	-72.18
1.A.4.	Other Sectors	45 200.00	42 710.20	-5.51	24.02	23.87	-0.63	21.39	29.35	37.23
1.A.5.	Other	2 000.00	137.70	-93.12	0.00	0.22	0.00	0.00	0.08	0.00
1.B.	Fugitive Emissions from Fuels	1 000.00	1 003.00	0.30	3 728.34	3 955.10	6.08	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	0.00
1.B.2.	Oil and Natural Gas	1 000.00	1 003.00	0.30	3 728.34	3 955.10	6.08	0.00	0.00	0.00
2. Industrial Processes		**1 700.00**	**1 700.00**	**0.00**	**120.54**	**120.54**	**0.00**	**9 827.00**	**9 827.00**	**0.00**
2.A.	Mineral Products	900.00	900.00	0.00	2.31	2.31	0.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	0.00	0.00	109.20	109.20	0.00	9 827.00	9 827.00	0.00
2.C.	Metal Production	0.00	0.00	0.00	6.30	6.30	0.00	0.00	0.00	0.00
2.D.	Other Production	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
2.G.	Other	800.00	800.00	0.00	2.73	2.73	0.00	0.00	0.00	0.00
3. Solvent and Other Product Use		**0.00**	**0.41**	**0.00**	0.00	**0.00**		**155.00**	**202.43**	**30.60**
4. Agriculture		**0.00**	**0.00**	**0.00**	**9 731.19**	**9 735.08**	**0.04**	**8 525.00**	**8 182.45**	**-4.02**
4.A.	Enteric Fermentation	0.00	0.00		7 671.30	7 683.12	0.15	0.00	0.00	
4.B.	Manure Management	0.00	0.00		2 059.89	2 051.95	-0.39	217.00	224.44	3.43
4.C.	Rice Cultivation	0.00	0.00		0.00	0.00	0.00	0.00	0	
4.D.	Agricultural Soils (2)	0.00	0.00	0.00	0.00	0.00	0.00	8 308.00	7 958.01	-4.21
4.E.	Prescribed Burning of Savannas	0.00	0.00		#VALUE!	#VALUE!	#VALUE!	0.00	0.00	0.00
4.F.	Field Burning of Agricultural Residues	0.00	0.00		#VALUE!	#VALUE!	#VALUE!	0.00	0.00	0.00
4.G.	Other	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net)		**-1 700.00**	**-1 397.68**	**-17.78**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks			0.00	0.00	0.00		0.00	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	0.00	0.00		0.00	0.00	
5.D.	CO_2 Emissions and Removals from Soil			0.00	0.00	0.00		0.00	0.00	
5.E.	Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.5.9. 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		**0.00**	**0.00**	**0.00**	**10 028.97**	**10 004.87**	**-0.24**	**173.60**	**151.90**	**-12.50**
6.A.	Solid Waste Disposal on Land	0.00	0.00	0.00	10 017.00	9 992.90	-0.24	0.00	0.00	
6.B.	Wastewater Handling				11.97	11.97	0.00	173.60	151.90	-12.50
6.C.	Waste Incineration	IE	IE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.D.	Other	0.00	0.00	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**
	Solvents and other product use			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
Memo Items:					0.00	0.00		0.00	0.00	
International Bunkers		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Multilateral Operations		**37 200.00**	**37 196.00**	**-0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass		**0.00**	**0.00**	**0.00**	0.00	0.00		0.00	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		**7 524.23**	**7 209.41**	**-4.18**	**2 042.11**	**2 042.11**	**0.00**	**160.37**	**364.71**	**127.42**
2.C.3.	Aluminium Production				1 964.30	1 964.30	0.00			0.00
2.E.	Production of Halocarbons and SF_6	6 904.00	6 708.78	-2.83			0.00			0.00
2.F.	Consumption of Halocarbons and SF_6	620.23	500.63	-19.28	77.81	77.81	0.00	160.37	364.71	127.42
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**1 955.90**	**1 955.90**		**CBI**	**CBI**		**CBI**	**CBI**	

	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry (3)	239 419.04	232 817.76	-2.76
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (3)	241 119.04	234 215.44	-2.86

Table A.5.10. 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]	
...						
3	**Solvent and product use**	CO2			Data adjusted	
1A3	**Transport**	CO2, CH4, N2O			Data adjusted	
1.	*ALL*	*ALL*	*Change of method for statistical differences: all combustion emissions were recalculated and allocated. The other sectors were left unchanged.*			
1.A.5	**Other**	CO2	Change of method for statistical differences: elimination by partly moving to exports (coal), most to 1.A.2 (oil, mostly feedstocks), and removal of statistical difference in gas in 1.A.5.			Elimination of this CO2 source
5.A	**Land use change and forestry**	CO2			Data adjusted	
2.F	**Consumption of halocarbons**	HFCs	Method improved based upon new analysis of HFC22 production (HFC23) and leakpercentage for cooling devises reduced based upon new research	Data adjusted		
2.F	**Consumption of halocarbons**	SF6	New source identified (SF6) from double glazing		Data adjusted	New source
4.A	**Enteric fermentation**	CH4			Data adjusted	
4.D	**Agricultural soils**	N2O			Data adjusted	
4.B	**Manure management**	CH4/N2O			Data adjusted	

Table A.5.11. 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		**181 165.50**	**168 973.40**	**-6.73**	**23 158.18**	**23 114.92**	**-0.19**	**22 839.13**	**21 109.39**	**-7.57**
1. Energy		**179 283.44**	**167 101.42**	**-6.79**	**3 917.77**	**3 903.78**	**-0.36**	**2 422.16**	**684.56**	**-71.74**
1.A.	Fuel Combustion Activities	178 265.58	166 083.56	-6.83	632.19	618.20	-2.21	2 422.16	684.56	-71.74
1.A.1.	Energy Industries	57 901.63	58 199.71	0.51	64.24	62.05	-3.40	148.92	28.86	-80.62
1.A.2.	Manufacturing Industries and Construction	44 534.66	39 010.10	-12.41	33.43	23.23	-30.51	19.80	8.59	-56.60
1.A.3.	Transport	33 059.66	33 046.85	-0.04	110.85	110.76	-0.08	2 229.97	621.89	-72.11
1.A.4.	Other Sectors	36 431.30	35 826.89	-1.66	20.17	20.10	-0.35	23.44	25.22	7.63
1.A.5.	Other	6 338.33	0.00	-100.00	0.01	0.00	-100.00	0.03	0.00	-100.00
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	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		**1 726.54**	**1 726.54**	**0.00**	**57.23**	**57.23**	**0.00**	**10 843.73**	**10 843.73**	**0.00**
2.A.	Mineral Products	1 087.17	1 087.17	0.00	2.94	2.94	0.00	0.00	0.00	0.00
2.B.	Chemical Industry	277.22	277.22	0.00	51.73	51.73	0.00	10 843.63	10 843.63	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	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
2.G.	Other	362.15	362.15	0.00	2.57	2.57	0.00	0.10	0.10	0.00
3. Solvent and Other Product Use		**10.54**	**0.46**	**-95.64**	0.00	**0.00**		**177.25**	**170.85**	**-3.61**
4. Agriculture		**0.00**	**0.00**	**0.00**	**9 370.73**	**9 361.80**	**-0.10**	**8 041.40**	**8 055.66**	**0.18**
4.A.	Enteric Fermentation	0.00	0.00		7 405.44	7 405.44	0.00	0.00	0.00	
4.B.	Manure Management	0.00	0.00		1 965.29	1 956.36	-0.45	210.80	214.83	1.91
4.C.	Rice Cultivation	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
4.D.	Agricultural Soils (2)	0.00	0.00	0.00	0.00	0.00	0.00	7 830.60	7 840.83	0.13
4.E.	Prescribed Burning of Savannas	0.00	0.00		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	0.00	0.00
4.G.	Other	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net)		**-1 700.00**	**-1 180.35**	**-30.57**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks			0.00	0.00	0.00		0.00	**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	0.00	0.00		0.00	**0.00**	
5.D.	CO_2 Emissions and Removals from Soil			0.00	0.00	0.00		0.00	**0.00**	
5.E.	Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.5.11. 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	**144.98**	**144.98**	**0.00**	**9 771.08**	**9 750.74**	**-0.21**	**176.59**	**176.59**	**0.00**
6.A. Solid Waste Disposal on Land	0.00	0.00	0.00	9 743.62	9 723.28	-0.21	0.00	0.00	
6.B. Wastewater Handling				27.21	27.21	0.00	176.51	176.51	0.00
6.C. Waste Incineration	IE	IE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.D. Other	144.98	144.98	0.00	0.25	0.25	0.00	0.08	0.08	0.00
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**41.37**	**41.37**	**0.00**	**1 178.00**	**1 178.00**	**0.00**
Solvents and other product use	0.00	0.00	0.00	41.37	41.37	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
Memo Items:				0.00	0.00		0.00	0.00	
International Bunkers	**48 509.00**	**48 509.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Multilateral Operations	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass	**5 313.85**	**5 313.85**	**0.00**	0.00	0.00		0.00	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	**7 884.10**	**8 213.84**	**4.18**	**2 153.98**	**2 153.98**	**0.00**	**181.88**	**385.51**	**111.96**
2.C.3. Aluminium Production				2 064.50	2 064.50	0.00			0.00
2.E. Production of Halocarbons and SF_6	6 901.82	7 415.74	7.45			0.00			0.00
2.F. Consumption of Halocarbons and SF_6	982.28	798.10	-18.75	89.48	89.48	0.00	181.88	385.51	111.96
Other	0.00	0.00	0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**2 159.50**	**2 159.50**		**CBI**	**CBI**		**CBI**	**CBI**	

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry[3]	235 682.76	222 770.69	-5.48
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	237 382.76	223 951.04	-5.66

Table A.5.12. 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.5	*ALL*	*ALL*	*Change of method for statistical differences: all combustion emissions were recalculated and allocated. The other sectors are left unchanged*			
1.A.5	**Other**	CO2	Change of method for statistical differences: elimination by partly moving to exports (coal), most to 1.A.2 (oil, mostly feedstocks), and removal of statistical difference in gas in 1.A.5.			Elimination of this CO2 source
5.A	**Land use change and forestry**	CO2			Data adjusted	
2.F	**Consumption of halocarbons and SF6**	HFCs	Method improved based upon new analysis of HFC22 production (HFC23) and leakpercentage for cooling devises reduced based upon new research	Data adjusted		
2.F	**Consumption of halocarbons and SF6**	SF6	New source identified (SF6) from double glazing		Data adjusted	New source
4.A	**Enteric fermentation**	CH4			Data adjusted	
4.B	**Manure management**	CH4/N2O			Data adjusted	
4.D	**Agricultural soils**	N2O			Data adjusted	
1A3	**Transport**	CO2/CH4/N2O			Data adjusted	

A.5.13. 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		**180 912.64**	**175 056.88**	**-3.24**	**22 297.19**	**22 356.58**	**0.27**	**22 572.98**	**17 822.36**	**-21.05**
1. Energy		**178 948.69**	**173 180.42**	**-3.22**	**3 712.42**	**3 721.75**	**0.25**	**2 115.12**	**828.21**	**-60.84**
1.A.	Fuel Combustion Activities	177 395.37	171 626.89	-3.25	644.42	644.09	-0.05	2 115.12	828.21	-60.84
1.A.1.	Energy Industries	59 957.39	60 378.90	0.70	92.42	89.28	-3.40	147.78	142.74	-3.42
1.A.2.	Manufacturing Industries and Construction	43 981.62	43 243.56	-1.68	37.95	36.85	-2.90	17.05	31.38	83.99
1.A.3.	Transport	33 998.61	33 983.77	-0.04	102.09	106.09	3.92	1 925.78	629.98	-67.29
1.A.4.	Other Sectors	35 852.14	34 009.72	-5.14	411.93	410.18	-0.43	24.46	24.08	-1.55
1.A.5.	Other	3 605.61	10.94	-99.70	0.02	1.68	10 566.57	0.04	0.04	0.00
1.B.	Fugitive Emissions from Fuels	1 553.32	1 553.53	0.01	3 068.00	3 077.66	0.31	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	0.00
1.B.2.	Oil and Natural Gas	1 553.32	1 553.53	0.01	3 068.00	3 077.66	0.31	0.00	0.00	0.00
2. Industrial Processes		**1 767.75**	**1 318.99**	**-25.39**	**50.57**	**50.48**	**-0.18**	**11 157.59**	**7 658.23**	**-31.36**
2.A.	Mineral Products	1 048.50	1 025.40	-2.20	2.68	2.68	0.00	0.00	0.00	0.00
2.B.	Chemical Industry	257.23	0.00	-100.00	46.72	46.72	0.00	11 157.47	7 658.23	-31.36
2.C.	Metal Production	22.61	0.00	-100.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	0.00	0.00	0.00	0.00	0.00		0.00	0.00	
2.G.	Other	439.42	293.59	-33.19	1.17	1.08	-7.62	0.12	0.00	-100.00
3. Solvent and Other Product Use		**11.40**	**0.46**	**-96.00**	0.00	**0.00**		**167.64**	**160.30**	**-4.38**
4. Agriculture		**0.00**	**0.00**	**0.00**	**9 079.35**	**9 128.91**	**0.55**	**7 790.30**	**7 826.88**	**0.47**
4.A.	Enteric Fermentation	0.00	0.00		7 126.35	7 169.19	0.60	0.00	0.00	
4.B.	Manure Management	0.00	0.00		1 953.00	1 959.72	0.34	201.50	208.94	3.69
4.C.	Rice Cultivation	0.00	0.00		0.00	0.00	0.00	0.00	0.00	
4.D.	Agricultural Soils (2)	0.00	0.00	0.00	0.00	0.00	0.00	7 588.80	7 617.94	0.38
4.E.	Prescribed Burning of Savannas	0.00	0.00		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	0.00	0.00
4.G.	Other	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net)		**-1 700.00**	**-1 379.57**	**-18.85**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks			0.00	0.00	0.00		0.00	**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	0.00	0.00		0.00	**0.00**	
5.D.	CO_2 Emissions and Removals from Soil			0.00	0.00	0.00		0.00	**0.00**	
5.E.	Other			0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table A.5.13. CRF Recalculation Table 8.a for 1998 (continued)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2			CH_4			N_2O		
	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)	CO_2 equivalent (Gg)		(%)
6. Waste	**184.80**	**557.02**	**201.42**	**9 414.32**	**9 414.77**	**0.00**	**164.33**	**164.29**	**-0.02**
6.A. Solid Waste Disposal on Land	0.00	0.00	0.00	9 334.50	9 335.19	0.01	0.00	0.00	
6.B. Wastewater Handling	0.00	0.00		79.47	79.47	0.00	164.23	164.23	0.00
6.C. Waste Incineration	IE	IE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.D. Other	184.80	557.02	201.42	0.34	0.10	-69.46	0.09	0.06	-41.01
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**40.53**	**40.67**	**0.34**	**1 178.00**	**1 184.44**	**0.55**
Solvents and other product use	0.00	40.67	0.00	40.53	40.67	0.34	1 178.00	0.00	-100.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1 184.44	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items:				0.00	0.00		0.00	0.00	
International Bunkers	**49 318.78**	**49 531.00**	**0.43**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Multilateral Operations	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass	**5 350.00**	**4 859.30**	**-9.17**	0.00	0.00		0.00	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	**8 695.17**	**9 200.63**	**5.81**	**2 468.50**	**1 727.48**	**-30.02**	**132.41**	**369.11**	**178.77**
2.C.3. Aluminium Production				2 365.60	1 624.58	-31.32			0.00
2.E. Production of Halocarbons and SF_6	7 518.57	8 256.18	9.81			0.00			0.00
2.F. Consumption of Halocarbons and SF_6	1 176.60	944.46	-19.73	102.90	102.90	0.00	132.41	369.11	178.77
Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**1 881.20**	**1 365.00**		**CBI**	**CBI**		**CBI**	**CBI**	

	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry (3)	235 378.89	225 153.47	-4.34
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (3)	237 078.89	226 533.04	-4.45

Table A.5.14. 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]	
...						
ALL	*ALL*	*All*	*In 2001 the source allocation for 1990, 1995, 1998, 1999 and 2000 has been revised based on a new set of allocation codes in the Dutch inventory, resulting in uniformity in the allocation over the mentioned years. Furthermore the identification of biofuels has been improved for these years.*			
1.A.5	**Other**	CO2	Change of method for statistical differences: elimination by partly moving to exports (coal), partly to 1.A.2 (oil, mostly feedstocks), and removal of statistical difference in gas in 1.A.5.			Elimination of this CO2 source
1.A.1	**Energy industries**	CO2	Change in source allocation (see 1A5 and 6)			
1.A.2	**Manufacturing industries**	CO2	Change in source allocation (see 2.G)			
1.A.3	**Transport**	CO2			Data adjusted	
1.A.4	**Other sectors**	CO2	Change of method for statistical differences: elimination of statistical difference in gas in 1.A.4.			Elimination of CO2 source
2.A/B/C/G	**Industrial processes**	CO2	Improved source allocation (to 1)			
3	**Solvent and other product use**	CO2	Change in source allocation (see7)			
5.A	Land use change and forestry	CO2			Data adjusted	
6.D	**Other sectors**	CO2	Change in source allocation (see 1.A.1.a)			
	International bunkers	CO2			Data adjusted	
	CO2 from biomass	CO2			Data adjusted, due to improved identification of biogas combustion	
1.A.1	**Energy industries**	CH4	Improved source allocation			
1.A.3	**Transport**	CH4			Data adjusted	
2.G	**Industrial processes**	CH4	Improved source allocation (to 1A)			
1.A.5	**Other**	CH4	Improved source allocation (from 6 and 1A)			
4.A	**Enteric fermentation**	CH4			Data adjusted	
4.B	**Manure management**	CH4			Data adjusted	
6.A	**Solid waste disposal**	CH4			Data adjusted	
6.B	**Waste water handling**	CH4	Improved source allocation (to 1.a.5)			
6.D	**Other**	CH4	Change in source allocation (see 1A)			
7	**Other**	CH4	Improved source allocation (from 3)			
3	**Solvent and other product use**	N2O	Improved source allocation (to 1A)			
1.A	**Energy industries**	N2O	Improved allocation (see also 1.A.3)			
1.A.3	**Transport**	N2O			Data adjusted	
2.C	**Chemical industry**	N2O	Improved method for Nitric acid production, emissionfactor reduced based on measurements	Data adjusted, based on measuring data		
4.D	**Agricultural soils**	N2O			Data adjusted	
6.D	**Other sectors**	N2O	Change in source allocation (from 1.A)			
2.C.3	**Aluminium production**	PFCs	Recalculation, using plant=specific activity data and emission factors based on new measurements		Use of plant-specific production data	
2.F	**Consumption of halocarbons and SF6**	HFCs	Method improved based upon new analysis of HFC22 production (HFC23) and leakpercentage for cooling devises reduced based upon new research	Data adjusted		
2.F	**Consumption of halocarbons and SF6**	SF6	New source identified (SF6) from double glazing		Data adjusted	New source

Table A.5.15. 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		**172 461.83**	**172 060.76**	**-0.23**	**21 701.71**	**21 793.43**	**0.42**	**22 771.67**	**17 361.89**	**-23.76**
1. Energy		**170 272.56**	**170 291.88**	**0.01**	**3 695.40**	**3 723.96**	**0.77**	**2 002.03**	**820.93**	**-58.99**
1.A.	Fuel Combustion Activities	168 719.24	168 724.37	0.00	627.40	694.18	10.64	2 002.03	820.93	-58.99
1.A.1.	Energy Industries	55 141.25	57 910.63	5.02	86.23	126.74	46.97	103.42	141.40	36.72
1.A.2.	Manufacturing Industries and Construction	43 549.41	43 150.10	-0.92	33.37	66.16	98.24	20.03	23.35	16.55
1.A.3.	Transport	34 699.54	34 682.35	-0.05	95.93	100.40	4.65	1 854.35	633.04	-65.86
1.A.4.	Other Sectors	35 300.67	32 981.26	-6.57	411.84	399.22	-3.07	24.15	23.14	-4.17
1.A.5.	Other	28.37	0.04	-99.86	0.02	1.66	10 481.30	0.07	0.00	-100.00
1.B.	Fugitive Emissions from Fuels	1 553.32	1 567.50	0.91	3 068.00	3 029.78	-1.25	0.00	0.00	0.00
1.B.1.	Solid fuel	0.00	IE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.B.2.	Oil and Natural Gas	1 553.32	1 567.50	0.91	3 068.00	3 029.78	-1.25	0.00	0.00	0.00
2. Industrial Processes		**1 794.61**	**1 315.57**	**-26.69**	**51.97**	**56.91**	**9.51**	**11 157.47**	**7 198.90**	**-35.48**
2.A.	Mineral Products	1 075.36	974.97	-9.34	2.68	2.95	9.99	0.00	0.00	0.00
2.B.	Chemical Industry	257.23	0.00	-100.00	48.11	53.17	10.52	11 157.47	7 187.48	-35.58
2.C.	Metal Production	22.61	0.00	-100.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	0.00	0.00	0.00		0.00			0.00	
2.G.	Other	439.42	340.60	-22.49	1.17	0.79	-32.92	0.00	11.42	0.00
3. Solvent and Other Product Use		**10.86**	**0.57**	**-94.75**		**0.00**		**163.05**	**155.67**	**-4.53**
4. Agriculture		**0.00**	**0.00**	**0.00**	**8 880.19**	**8 925.21**	**0.51**	**7 958.29**	**7 822.85**	**-1.70**
4.A.	Enteric Fermentation		0.00		6 968.22	7 011.59	0.62		0.00	
4.B.	Manure Management		0.00		1 911.97	1 913.63	0.09	198.40	202.28	1.95
4.C.	Rice Cultivation		0.00		0.00	NO	0.00		0	
4.D.	Agricultural Soils [2]		0.00	0.00	0.00	IE	0.00	7 759.89	7 620.58	-1.80
4.E.	Prescribed Burning of Savannas		0.00		0.00	NO	0.00	0.00	0.00	0.00
4.F.	Field Burning of Agricultural Residues		0.00		0.00	NO	0.00	0.00	0.00	0.00
4.G.	Other		0.00		0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net)		**-1 700.00**	**-1 235.57**	**-27.32**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks			0.00		0.00			0.00	
5.B.	Forest and Grassland Conversion			0.00		0.00	0.00		0.00	0.00
5.C.	Abandonment of Managed Lands			0.00		0.00			0.00	
5.D.	CO_2 Emissions and Removals from Soil			0.00		0.00			0.00	
5.E.	Other			0.00		0.00	0.00		0.00	0.00

Table A.5.15. 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	**2 083.80**	**452.74**	**-78.27**	**9 074.15**	**9 046.59**	**-0.30**	**188.82**	**177.48**	**-6.01**
6.A. Solid Waste Disposal on Land	0.00	0.00	0.00	8 994.30	8 993.65	-0.01			
6.B. Wastewater Handling		0.00		79.47	52.83	-33.52	164.23	177.42	8.03
6.C. Waste Incineration	0.00	IE	0.00	0.00	IE	0.00	0.00	IE	0.00
6.D. Other	2 083.80	452.74	-78.27	0.38	0.11	-72.24	24.59	0.06	-99.77
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**40.80**	**40.76**	**-0.10**	**1 178.00**	**1 186.05**	**0.68**
Solvents and other product use		0.00	0.00		40.76	**0.00**		0.00	**0.00**
		0.00	0.00		0.00	**0.00**		1 186.05	**0.00**
		0.00	0.00		0.00	**0.00**		0.00	**0.00**
		0.00	0.00		0.00	**0.00**		0.00	**0.00**
								0.00	**0.00**
Memo Items:									
International Bunkers	**49 318.78**	**51 213.63**	**3.84**	**0.00**	**NE**	**0.00**	**0.00**	**0.00**	**0.00**
Multilateral Operations	**0.00**	**0.00**	**0.00**	**0.00**	**NE**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass	**2.98**	**4 892.70**	**164 167.26**						

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	**8 835.73**	**7 240.66**	**-18.05**	**2 593.78**	**1 448.61**	**-44.15**	**136.71**	**336.27**	**145.98**
2.C.3. Aluminium Production				2 471.20	1 326.03	-46.34			0.00
2.E. Production of Halocarbons and SF_6	7 518.57	3 817.70	-49.22			0.00			0.00
2.F. Consumption of Halocarbons and SF_6	1 317.16	1 008.77	-23.41	122.58	122.58	0.00	136.71	336.27	145.98
Other	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00
Potential Emissions from Consumption of HFCs/PFCs		**P**		**CBI**	**CBI**		**CBI**	**CBI**	

	Previous submission	Latest submission	Difference[1]
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry[3]	228 385.27	216 591.86	-5.16
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry[3]	230 085.27	217 827.43	-5.33

Table.A.5.16. 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]	
...						
ALL	***ALL***			*N.B. All 1999 figures were provisional in the previous submission*	*N.B. All 1999 figures were provisional in the previous submission*	
ALL	***ALL***	*All*	*In this submission the final figures for 1999 are reported. In 2001 the source allocation for 1990, 1995, 1998, 1999 and 2000 was revised based on a new set of allocation codes in the Dutch inventory, resulting in uniformity in the allocation over the mentioned years. Futhermore the identification of biofuels is improved for these years.*			
1,2,3	***All Energy and Industrial sources***	*All, especially CO2*	*Due to new developments in the inventory method for individual industrial sources in 1999 there were less individual data available. These data (from individual companies) are used to calculate the completing estimate to yield the national emission data.The completing estimate is less detailed in source allocation than the data from individual companies, therefore a greater part of the emissions could not be allocated as precise as in former years. Furthermore due to starting up problems in the new inventory far from all fueldata were available from individual companies and thus in the sectoral approach for Energy.*		*Based on incomplete fuel data (with poor quality)*	
1.A.3	**Transport**	N2O			Data adjusted	
6	**Waste**	CH4	Improved source allocation (to 1.A)			
4.A	**Enteric fermentation**	CH4			Data adjusted	
4.B	**Manure management**	CH4			Data adjusted	
6.D	**Other**	CO2	Improved source allocation (from 1.A), and improved allocation of emissions from biomass			
2.C	**Chemical industry**	N2O	Improved method for Nitric acid production, emissionfactor reduced based on measurements	Data adjusted, based on measuring data		
4.D	**Agricultural soils**	N2O			Data adjusted	
6.D	**Other sectors**	N2O	Change in source allocation (to 1.A)			
2.C.3	**Aluminium production**	PFCs	Recalculation, using plant=specific activity data and emission factors based on new measurements		Use of plant-specific production data	
2.F	**Consumption of halocarbons and SF6**	HFCs	Method improved based upon new analysis of HFC22 production (HFC23) and leakpercentage for cooling devises reduced based upon new research	Data adjusted		
2.F	**Consumption of halocarbons and SF6**	SF6	New source identified (SF6) from double glazing		Data adjusted	New source
5.A	**Land use change and forestry**	CO2			Data included	CO2 removals included

Annex 5.3 CRF Completeness Table 9 for 1990

Table A.5.17. CRF Completeness Table 9 for 1990

Sources and sinks not reported (NE)(1)				
GHG	Sector(2)	Source/sink category (2)	Explanation	
CO2	4. Agriculture	Agricultural Soils	Not estimated/monitored	
	5. Land-Use Change and Forestry	Grassland Conversion	Not estimated/monitored	
		D. CO2 Emissions and Removals from Soil	Not estimated/monitored	
CH4	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.
		International bunkers	Not estimated	
N2O	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.
		International bunkers	Not estimated	
HFCs				
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.
SF6	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
CO2	**Specific source categories** Examples: Fugitive oil &gas Industrial processes	**Detailled source category** 1.B.2.a.ii Oil production 2.B.1 Ammonia production	**Within that source category on less detailed level or under "other"** 1.B.2.b.i production/processing 2.G Other	Detailled source categories not distinguishable in inventory data
	Coke production	1.A.1 Energy industries	1.A.2 Manufacturing industries	Source allocated to Target Group Industry
	Off-road vehicles (agriculture)	1.A.4 Small combustion	1.A.3 Transport	Source allocated to Target Group Transport
	Off-road vehicles (construction)	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
CH4	**Specific source categories** Examples: Fugitive oil &gas Industrial processes	**Detailled source category** 1.B.2.a.ii Oil production 2.B.1 Ammonia production	**Within that source category on less detailed level or under "other"** 1.B.2.b.i production/processing 2.B.5 Other	Detailled source categories not distinguishable in inventory data
N2O	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 agricultural	
	6 B Waste water handling	N2O from human sewage	7. Polluted surface water	
HFCs				
PFCs				
SF6				

Annex 5.4: 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 7.1). Please note that all data for 2000 are preliminary. 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.5.18. 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
	(Gg)											
1. Energy	**157 448**	**157 448**	**165 889**	**164 332**	**166 724**	**167 324**	**171 103**	**178 006**	**167 101**	**173 119**	**170 292**	**171 714**
A. Fuel Combustion (Sectoral Approach)	157 152	157 152	165 429	163 962	166 374	167 134	170 300	177 003	166 084	171 566	168 724	170 142
1. Energy Industries	51 513	51 513	52 190	54 130	53 800	55 980	56 589	59 306	58 200	60 379	57 911	59 085
2. Manufacturing Industries and Construction	41 898	41 898	42 660	42 510	39 920	40 950	43 084	42 239	39 010	43 244	43 150	43 003
3. Transport	29 085	29 085	29 119	30 362	30 944	31 184	32 130	32 610	33 047	33 984	34 682	35 120
4. Other Sectors	34 643	34 643	40 390	37 330	40 060	38 460	38 486	42 710	35 827	33 949	32 981	32 935
5. Other	12	12	1 070	-370	1 650	560	11	138	0	11	0	0
B. Fugitive Emissions from Fuels	296	296	460	370	350	190	803	1 003	1 018	1 554	1 568	1 572
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	296	296	460	370	350	190	803	1 003	1 018	1 554	1 568	1 572
2. Industrial Processes	**1 590**	**1 590**	**1 500**	**1 270**	**1 210**	**1 440**	**1 442**	**1 700**	**1 727**	**1 319**	**1 316**	**1 360**
A. Mineral Products	1 024	1 024	700	750	1 050	1 050	1 114	900	1 087	1 025	975	981
B. Chemical Industry	0	0	0	0	0	0	0	0	277	0	0	0
C. Metal Production	0	0	0	0	0	0	17	0	0	0	0	22
D. Other Production	0	0	0	0	0	0	0	0	0	0	0	0
E. Production of Halocarbons and SF_6												
F. Consumption of Halocarbons and SF_6												
G. Other	566	566	800	520	160	390	311	800	362	294	341	357
3. Solvent and Other Product Use	**0**	**0**	**100**	**100**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**
4. Agriculture	**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
B. Manure Management	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
D. Agricultural Soils [2]	0	0	0	0	0	0	0	0	0	0	0	0
E. Prescribed Burning of Savannas	IE	IE	0	0	0	0	NE	0	0	NE	NE	NE
F. Field Burning of Agricultural Residues	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
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**
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
B. Forest and Grassland Conversion	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Abandonment of Managed Lands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. CO_2 Emissions and Removals from Soil	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Other	0	0	0	0	0	0	0	0	0	0	0	0
6. Waste	**500**	**500**	**0**	**0**	**0**	**0**	**113**	**0**	**145**	**557**	**453**	**453**
A. Solid Waste Disposal on Land	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
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	500	500	0	0	0	0	113	0	145	557	453	453
7. Other *(please specify)* ---	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Solvent and other product use	0	0	0	0	0	0	0	0	0	0	0	0
Polluted surface water	0	0	0	0	0	0	0	0	0	0	0	0
Misc.	0	0	0	0	0	0	0	0	0	0	0	0
Misc.	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 Emissions/Removals with LUCF [4]	**158 117**	**158 117**	**165 962**	**164 214**	**166 129**	**166 835**	**171 426**	**178 308**	**167 793**	**173 616**	**170 825**	**172 114**
Total Emissions without LUCF [4]	**159 539**	**159 539**	**167 489**	**165 702**	**167 934**	**168 764**	**172 659**	**179 706**	**168 973**	**174 996**	**172 061**	**173 527**
Memo Items:												
International Bunkers	**39 765**	**39 765**	**41 290**	**42 400**	**44 280**	**42 860**	**44 286**	**45 445**	**48 509**	**49 531**	**51 214**	**53 500**
Aviation	4 497	4 497	4 960	5 910	6 500	6 720	7 665	8 249	8 979	9 709	10 070	10 071
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
Multilateral Operations	0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CO_2 Emissions from Biomass	**3 547**	**3 547**	**2 700**	**2 600**	**3 300**	**3 500**	**3 532**	**4 500**	**5 314**	**4 859**	**4 893**	**4 989**

Table A.5.19. *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
	(Gg)											
Total Emissions	**1 292.24**	**1 292.24**	**1 308.90**	**1 257.10**	**1 226.04**	**1 202.97**	**1 170.03**	**1 173.11**	**1 100.71**	**1 064.60**	**1 037.78**	**982.75**
1. Energy	**212.90**	**212.90**	**223.86**	**199.11**	**192.52**	**202.28**	**206.97**	**225.37**	**185.89**	**177.23**	**177.33**	**163.96**
A. Fuel Combustion (Sectoral Approach)	34.15	34.15	35.76	36.01	34.52	33.78	36.66	37.03	29.44	30.67	33.06	32.74
1. Energy Industries	3.29	3.29	3.20	3.80	3.40	3.70	4.84	5.70	2.95	4.25	6.04	5.94
2. Manufacturing Industries and Construction	2.90	2.90	3.50	4.90	3.20	2.60	5.06	1.82	1.11	1.75	3.15	3.19
3. Transport	7.87	7.87	6.96	6.81	6.52	6.28	6.18	5.63	5.27	5.05	4.78	4.47
4. Other Sectors	20.00	20.00	22.10	20.50	21.40	21.20	20.49	23.87	20.10	19.53	19.01	19.06
5. Other	0.08	0.08	0.00	0.00	0.00	0.00	0.08	0.01	0.00	0.08	0.08	0.08
B. Fugitive Emissions from Fuels	178.75	178.75	188.10	163.10	158.00	168.50	170.31	188.34	156.46	146.56	144.28	131.22
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	178.75	178.75	188.10	163.10	158.00	168.50	170.31	188.34	156.46	146.56	144.28	131.22
2. Industrial Processes	**3.27**	**3.27**	**3.50**	**3.70**	**4.90**	**5.30**	**2.63**	**5.74**	**2.73**	**2.40**	**2.71**	**2.80**
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	0.13
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	2.66
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
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
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	0.13	0.12	0.05	0.04	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**
4. Agriculture	**505.33**	**505.33**	**517.09**	**505.78**	**497.83**	**483.13**	**477.04**	**463.58**	**445.80**	**434.71**	**425.01**	**407.78**
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
B. Manure Management	103.47	103.47	105.46	104.56	105.14	101.46	100.32	97.71	93.16	93.32	91.13	88.35
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
E. Prescribed Burning of Savannas	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
G. Other	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**
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
B. Forest and Grassland Conversion	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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
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
E. 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
6. Waste	**568.69**	**568.69**	**562.45**	**546.51**	**528.79**	**509.96**	**481.31**	**476.42**	**464.32**	**448.32**	**430.79**	**406.31**
A. Solid Waste Disposal on Land	562.13	562.13	556.15	540.21	522.49	504.86	479.85	475.85	463.01	444.53	428.27	403.79
B. Waste-water Handling	6.55	6.55	6.30	6.30	6.30	5.10	1.46	0.57	1.30	3.78	2.52	2.52
C. Waste Incineration	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	0.01	0.00	0.01	0.005	0.005	0.005
7. Other *(please specify)*	**2.06**	**2.06**	**2.00**	**2.00**	**2.00**	**2.30**	**2.07**	**2.00**	**1.97**	**1.94**	**1.94**	**1.90**
Solvent and other product use	2.06	2.06	2.00	2.00	2.00	2.30	2.07	2.00	1.97	1.94	1.94	1.90
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
misc	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
misc	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items:												
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Aviation	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
Multilateral Operations	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass												

Table A.5.20. 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
	(Gg)											
Total Emissions	**53.30**	**53.30**	**61.92**	**63.45**	**63.53**	**65.17**	**58.62**	**65.35**	**68.09**	**57.49**	**56.01**	**54.7732**
1. Energy	**1.88**	**1.88**	**2.06**	**2.26**	**2.41**	**2.60**	**2.65**	**2.31**	**2.21**	**2.67**	**2.65**	**2.57**
A. Fuel Combustion (Sectoral Approach)	1.88	1.88	2.06	2.26	2.41	2.20	2.65	2.31	2.21	2.67	2.65	2.57
1. Energy Industries	0.46	0.46	0.50	0.50	0.50	0.20	0.49	0.01	0.09	0.460	0.456	0.425
2. Manufacturing Industries and Construction	0.12	0.12	0.10	0.10	0.10	0.10	0.13	0.23	0.03	0.10	0.075	0.07
3. Transport	1.21	1.21	1.36	1.56	1.71	1.80	1.95	1.98	2.01	2.03	2.04	2.00
4. Other Sectors	0.09	0.09	0.10	0.10	0.10	0.10	0.09	0.09	0.08	0.078	0.075	0.0737
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
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
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
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
2. Industrial Processes	**24.37**	**24.37**	**32.30**	**30.40**	**30.00**	**31.60**	**24.17**	**31.70**	**34.98**	**24.70**	**23.22**	**22.96**
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
B. Chemical Industry	24.37	24.37	32.30	30.40	30.00	31.60	24.17	31.70	34.98	24.70	23.19	22.96
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
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
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
3. Solvent and Other Product Use	**0.73**	**0.73**	**0.58**	**0.58**	**0.60**	**0.60**	**0.63**	**0.65**	**0.55**	**0.52**	**0.50**	**0.499**
4. Agriculture	**22.11**	**22.11**	**22.68**	**25.91**	**26.23**	**26.07**	**26.85**	**26.40**	**25.99**	**25.25**	**25.24**	**24.35**
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
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	0.63
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
D. Agricultural Soils	21.45	21.45	21.98	25.21	25.43	25.27	26.11	25.67	25.29	24.57	24.58	23.72
E. Prescribed Burning of Savannas	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
G. Other	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**
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
B. Forest and Grassland Conversion	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
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
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
E. 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
6. Waste	**0.41**	**0.41**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.49**	**0.57**	**0.530**	**0.57**	**0.57**
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
B. Waste-water Handling	0.40	0.40	0.50	0.50	0.50	0.50	0.50	0.49	0.57	0.53	0.57	0.57
C. Waste Incineration	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
7. Other *(please specify)* ---	**3.81**	**3.81**	**3.80**	**3.80**	**3.80**	**3.80**	**3.82**	**3.80**	**3.80**	**3.82**	**3.83**	**3.82**
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
Polluted surface water	3.81	3.81	3.80	3.80	3.80	3.80	3.82	3.80	3.80	3.82	3.83	3.82
Misc.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Misc.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items:												
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Aviation	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
Multilateral Operations	**NE**	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass												

Table A.5.21. Emissions of greenhouse gases in the Netherlands; ***CRF Trend Table 10: HFCs, PFCs and SF_6***

Note: The emissions of individual compounds 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
	(Gg)											
Emissions of HFCs[5] - CO_2 equivalent (Gg)	**5 978.00**	**4 431.84**	**4 820.40**	**4 539.60**	**5 066.10**	**6 338.51**	**5 978.00**	**7 209.41**	**8 213.84**	**9 212.13**	**4 833.23**	**3 917.41**
HFC-23	492.21	378.79	412.00	388.00	433.00	536.00	492.21	573.40	573.40	665.86	294.02	206.91
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
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
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
HFC-125	3.83	0.00	0.00	0.00	0.00	0.00	3.83	8.98	15.52	36.32	49.89	66.41
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
HFC-134a	152.42	0.00	0.00	0.00	0.00	49.85	152.42	338.92	615.87	628.42	673.45	638.03
HFC-152a	0.00	0.00	0.00	0.00	0.00	17.86	0.00	0.00	0.00	0.00	0.00	21.93
HFC-143	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-143a	1.70	0.00	0.00	0.00	0.00	0.00	1.70	6.72	12.64	35.80	40.33	83.06
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
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
HFC Unspecified	0.75	0.00	0.00	0.00	0.00	0.00	0.75	3.12	203.67	122.08	74.92	54.03
Emissions of PFCs[5] - CO_2 equivalent (Gg)	**1 866.76**	**2 431.74**	**2 436.78**	**2 098.69**	**2 118.36**	**1 890.43**	**1 866.76**	**2 042.11**	**2 153.98**	**1 727.48**	**1 444.39**	**1 526.44**
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
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
C_3F_8												
C_4F_{10}												
c-C_4F_8												
C_5F_{12}												
C_6F_{14}												
PFC unspecified	8.06	4.01	4.61	5.30	6.09	7.00	8.06	9.26	10.65	12.25	14.09	16.20
Emissions of SF_6[5] - CO_2 equivalent (Gg)	**360.89**	**186.90**	**100.38**	**106.36**	**109.94**	**147.94**	**360.89**	**364.71**	**385.51**	**369.11**	**336.27**	**326.95**
SF_6	15.10	7.82	4.20	4.45	4.60	6.19	15.10	15.26	16.13	15.44	14.07	13.68

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
C_6F_{14}	7400
PFC unspecified	8400
SF_6	23900

Table A.5.22. 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
	CO_2 equivalent (Gg)											
Net CO_2 emissions/removals	158 117	158 117	165 962	164 214	166 129	166 835	171 426	178 308	167 793	173 616	170 825	172 114
CO_2 emissions (without LUCF) (5)	159 539	159 539	167 489	165 702	167 934	168 764	172 659	179 706	168 973	174 996	172 061	173 527
CH_4	27 137	27 137	27 487	26 399	25 747	25 262	24 571	24 635	23 115	22 357	21 793	20 638
N_2O	16 524	16 524	19 195	19 669	19 696	20 204	18 173	20 259	21 110	17 822	17 362	16 980
HFCs	5 978	4 432	4 820	4 540	5 066	6 339	5 978	7 209	8 214	9 212	4 833	3 917
PFCs	1 867	2 432	2 437	2 099	2 118	1 890	1 867	2 042	2 154	1 727	1 444	1 526
SF_6	361	187	100	106	110	148	361	365	386	369	336	327
Total (with net CO_2 emissions/removals)	**209 983**	**208 828**	**220 001**	**217 027**	**218 866**	**220 677**	**222 376**	**232 819**	**222 771**	**225 104**	**216 594**	**215 502**
Total (without CO_2 from LUCF) (6)	**211 405**	**210 250**	**221 528**	**218 515**	**220 672**	**222 607**	**223 608**	**234 217**	**223 952**	**226 483**	**217 830**	**216 916**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
	CO_2 equivalent (Gg)											
1. Energy	162 503	162 503	171 229	169 212	171 513	172 379	176 272	183 456	171 691	177 669	174 837	175 955
2. Industrial Processes	17 418	16 263	18 944	17 516	17 907	19 724	17 196	21 264	23 381	20 336	15 185	14 308
3. Solvent and Other Product Use	225	225	279	281	186	186	195	203	171	161	156	155
4. Agriculture	17 466	17 466	17 890	18 653	18 586	18 227	18 341	17 918	17 417	16 956	16 748	16 110
5. Land-Use Change and Forestry (7)	-1 422	-1 422	-1 528	-1 487	-1 806	-1 929	-1 232	-1 398	-1 180	-1 380	-1 236	-1 413
6. Waste	12 568	12 568	11 966	11 632	11 260	10 864	10 377	10 157	10 072	10 136	9 677	9 163
7. Other	1 224	1 224	1 220	1 220	1 220	1 226	1 227	1 220	1 219	1 225	1 227	1 224

ANNEX 6: 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 Chapter 9). Please note that all data for 2000 are preliminary. Sheets are presented for, respectively:

- NO_x
- CO
- NMVOC
- SO_2

Additionaly the trends in NO_x, CO, NMVOC and SO_2 for the period 1990-2000 are presented in graph format.

- *A.6.5. Shares and trends in NO_x emissions per IPCC sector 1990-2000.*
- *A.6.6. Shares and trends in CO emissions per IPCC sector 1990-2000.*
- *A.6.7. Shares and trends in NMVOC emissions per IPCC sector 1990-2000.*
- *A.6.8. Shares and trends in SO_2 emissions per IPCC sector 1990-2000.*

Table A.6.1. 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
				(Gg)							
Total National Emissions and Removals	**573.80**	**551.40**	**539.00**	**518.90**	**493.20**	**483.52**	**474.39**	**446.10**	**428.54**	**421.66**	**420.98**
1. Energy	**569.76**	**537.90**	**525.90**	**505.10**	**482.40**	**481.42**	**456.47**	**429.10**	**427.06**	**420.61**	**420.01**
A. Fuel Combustion — Reference Approach [2]											
Sectoral Approach [2]	569.63	536.70	524.60	504.10	481.90	480.85	455.97	428.24	426.25	419.78	419.16
1. Energy Industries	99.99	95.60	95.90	91.80	81.40	75.81	72.40	63.67	58.19	57.60	57.96
2. Manufacturing Industries and Construction	77.20	60.40	61.40	54.60	54.40	60.70	45.78	38.71	49.26	44.60	43.29
3. Transport	350.22	336.20	325.50	311.80	304.40	304.39	292.88	288.94	282.47	282.34	282.87
4. Other Sectors	41.88	44.50	41.80	45.90	41.70	39.59	44.91	36.92	36.01	34.92	34.73
5. Other	0.36	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.31	0.31	0.31
B. Fugitive Emissions from Fuels	0.13	1.20	1.30	1.00	0.50	0.57	0.50	0.85	0.81	0.83	0.85
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	0.13	1.20	1.30	1.00	0.50	0.57	0.50	0.85	0.81	0.83	0.85
2. Industrial Processes	**2.71**	**13.10**	**12.70**	**13.40**	**10.40**	**1.75**	**17.80**	**15.04**	**1.06**	**0.68**	**0.60**
A. Mineral Products	1.28	0.00	0.00	0.00	0.00	1.31	1.20	0.00	0.99	0.51	0.60
B. Chemical Industry	IE	0.00	0.00	0.00	0.00	0.12	8.90	0.00	0.00	0.00	0.00
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	7.30	0.00	0.00	0.00	0.00
D. Other Production [3]	IE	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	0.40	15.04	0.07	0.17	0.00
3. Solvent and Other Product Use	**0.09**	**0.10**	**0.10**	**0.10**	**0.10**	**0.08**	**0.10**	**0.08**	**0.08**	**0.08**	**0.08**
4. Agriculture	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
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
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
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
E. Prescribed Burning of Savannas	0.00	0.00	0.00	0.00	NO	0.00	0.00	0.00	0.00	NO	NO
F. Field Burning of Agricultural Residues	NO	0.00	NO	0.00	NO	0.00	0.00	NO	NO	NO	NO
G. Other	NO	0.00	0.00	0.00	0.00	0.00	0.00	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**	**NO**	**NO**	**NO**
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
B. Forest and Grassland Conversion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO	NO
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
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
E. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste	**1.24**	**0.30**	**0.30**	**0.30**	**0.30**	**0.27**	**0.02**	**1.88**	**0.34**	**0.30**	**0.29**
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
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
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	1.24	0.30	0.30	0.30	0.30	0.27	0.02	1.88	0.34	0.30	0.29
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**
Solvents 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
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items: [7]											
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**NE**	**NE**	**NE**	**NE**
Aviation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass											

Table A.6.2. 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
	(Gg)										
Total National Emissions and Removals	**1 164.47**	**1 022.50**	**966.30**	**948.60**	**905.10**	**894.03**	**864.97**	**777.81**	**739.45**	**711.83**	**701.00**
1. Energy	**1 118.76**	**891.30**	**861.60**	**846.10**	**799.90**	**858.48**	**691.36**	**635.24**	**696.95**	**674.03**	**663.53**
A. Fuel Combustion — Reference Approach [2]											
Sectoral Approach [2]	1 112.87	883.10	855.90	840.10	792.30	850.54	683.26	628.64	690.72	668.47	658.23
1. Energy Industries	16.08	18.90	16.40	15.40	17.00	16.22	45.46	20.80	22.17	26.66	26.59
2. Manufacturing Industries and Construction	224.44	108.30	114.80	139.10	114.30	180.80	31.30	29.85	121.67	112.48	115.51
3. Transport	754.22	658.40	626.40	582.30	559.90	589.60	540.89	515.83	483.87	472.91	461.77
4. Other Sectors	116.49	97.50	98.30	103.30	101.10	62.52	65.60	62.16	61.70	55.12	53.05
5. Other	1.63	0.00	0.00	0.00	0.00	1.39	0.00	0.00	1.30	1.30	1.30
B. Fugitive Emissions from Fuels	5.89	8.20	5.70	6.00	7.60	7.95	8.10	6.60	6.23	5.57	5.30
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	5.89	8.20	5.70	6.00	7.60	7.95	8.10	6.60	6.23	5.57	5.30
2. Industrial Processes	**43.31**	**127.40**	**101.10**	**99.10**	**101.70**	**33.39**	**171.70**	**139.90**	**40.31**	**35.61**	**35.31**
A. Mineral Products	3.52	0.00	0.00	0.00	0.00	2.45	1.10	0.00	1.51	1.68	1.61
B. Chemical Industry	IE	0.00	0.00	0.00	0.00	0.00	32.40	0.00	0.00	0.00	0.00
C. Metal Production	35.11	0.00	0.00	0.00	0.00	30.32	132.80	0.00	38.74	31.95	33.70
D. Other Production [3]	IE	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
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
G. Other	4.68	127.40	101.10	99.10	101.70	0.62	5.40	139.90	0.07	1.98	0.00
3. Solvent and Other Product Use	**2.22**	**2.40**	**2.20**	**2.00**	**2.10**	**2.09**	**1.90**	**2.02**	**2.04**	**2.05**	**2.02**
4. Agriculture	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
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
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
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
E. Prescribed Burning of Savannas	0.00	0.00	0.00	0.00	NO	0.00	0.00	0.00	0.00	NO	NO
F. Field Burning of Agricultural Residues	NO	0.00	NO	0.00	NO	0.00	0.00	NO	NO	NO	NO
G. Other	NO	0.00	0.00	0.00	0.00	0.00	0.00	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**	**NO**	**NO**	**NO**
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
B. Forest and Grassland Conversion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO	NO
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
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
E. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste	**0.18**	**1.40**	**1.40**	**1.40**	**1.40**	**0.07**	**0.01**	**0.65**	**0.15**	**0.14**	**0.14**
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
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
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0.18	1.40	1.40	1.40	1.40	0.07	0.01	0.65	0.15	0.14	0.14
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**
Solvents 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
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items: [7]											
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**NE**	**NE**	**NE**	**NE**
Aviation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass											

Table A.6.3. 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
		(Gg)										
Total National Emissions and Removals		**503.74**	**460.60**	**436.20**	**150.40**	**387.70**	**369.59**	**348.74**	**316.91**	**301.52**	**289.91**	**280.72**
1. Energy		**274.37**	**247.60**	**237.60**	**223.00**	**216.80**	**213.84**	**202.23**	**181.91**	**173.03**	**165.77**	**160.63**
A. Fuel Combustion	Reference Approach (2)											
	Sectoral Approach (2)	221.78	200.20	194.20	181.10	174.50	172.20	160.11	145.26	141.41	135.76	132.22
1. Energy Industries		3.38	4.10	4.30	3.60	3.90	4.94	7.40	2.98	3.14	4.41	4.33
2. Manufacturing Industries and Construction		3.41	4.30	5.80	2.90	2.60	3.87	1.36	0.85	3.18	1.71	1.74
3. Transport		200.41	180.30	172.40	162.00	156.50	150.01	137.56	129.03	122.18	117.71	114.89
4. Other Sectors		14.42	11.50	11.70	12.60	11.50	13.23	13.79	12.41	12.77	11.79	11.10
5. Other		0.16	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.15	0.15	0.15
B. Fugitive Emissions from Fuels		52.59	47.40	43.40	41.90	42.30	41.64	42.12	36.65	31.61	30.01	28.41
1. Solid Fuels		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas		52.59	47.40	43.40	41.90	42.30	41.64	42.12	36.65	31.61	30.01	28.41
2. Industrial Processes		**88.13**	**120.90**	**115.40**	**100.00**	**88.20**	**55.95**	**73.40**	**71.77**	**47.44**	**42.03**	**38.88**
A. Mineral Products		1.04	0.00	0.00	0.00	0.00	0.45	0.40	0.00	0.27	0.23	0.24
B. Chemical Industry		33.67	0.00	0.00	0.00	0.00	18.90	17.90	0.00	14.82	13.35	11.92
C. Metal Production		3.27	0.00	0.00	0.00	0.00	2.78	3.10	0.00	2.36	2.72	2.68
D. Other Production (3)		10.87	0.00	0.00	0.00	0.00	7.63	0.00	0.00	6.50	5.76	5.78
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
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
G. Other		39.27	120.90	115.40	100.00	88.20	26.20	52.00	71.77	23.48	19.97	18.26
3. Solvent and Other Product Use		**140.11**	**91.70**	**82.80**	**79.80**	**82.30**	**98.38**	**72.30**	**61.40**	**79.79**	**81.13**	**80.23**
4. Agriculture		0.16	0.20	0.20	0.20	0.20	0.16	0.00	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
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
C. Rice Cultivation		0.00	0.00	0.00	0.00	NO	0.00	0.00	NO	0.00	NO	NO
D. Agricultural Soils		0.16	0.20	0.20	0.20	0.20	0.16	0.00	0.16	0.16	0.16	0.16
E. Prescribed Burning of Savannas		0.00	0.00	0.00	0.00	NO	0.00	0.00	0.00	0.00	NO	NO
F. Field Burning of Agricultural Residues		NO	0.00	NO	0.00	NO	0.00	0.00	NO	NO	NO	NO
G. Other		NO	0.00	0.00	0.00	0.00	0.00	0.00	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**	**NO**	**NO**	**NO**
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
B. Forest and Grassland Conversion		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO	NO
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
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
E. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste		**0.98**	**0.20**	**0.20**	**0.20**	**0.20**	**1.25**	**0.80**	**1.66**	**1.10**	**0.82**	**0.82**
A. Solid Waste Disposal on Land		0.91	0.00	0.00	0.00	0.00	0.78	0.80	0.78	0.75	0.75	0.75
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
C. Waste Incineration		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other		0.06	0.20	0.20	0.20	0.20	0.48	0.00	0.88	0.35	0.07	0.08
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**
Solvents 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
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items: (7)												
International Bunkers		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**NE**	**NE**	**NE**	**NE**
Aviation		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass												

Table A.6.4. 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
		(Gg)										
Total National Emissions and Removals		**202.35**	**163.50**	**157.20**	**150.40**	**136.50**	**141.42**	**133.51**	**116.45**	**108.01**	**102.91**	**91.20**
1. Energy		**194.14**	**140.90**	**138.30**	**133.60**	**120.10**	**137.37**	**115.39**	**99.38**	**104.63**	**99.82**	**87.98**
A. Fuel Combustion	Reference Approach (2)											
	Sectoral Approach (2)	187.47	131.20	126.70	122.10	109.50	128.51	104.89	89.30	96.78	92.12	81.03
1. Energy Industries		105.80	88.60	81.10	77.40	66.20	66.34	63.99	55.52	52.80	51.98	41.42
2. Manufacturing Industries and Construction		44.18	17.50	20.00	17.60	16.20	26.84	12.48	9.46	19.20	15.24	14.74
3. Transport		29.35	21.00	21.40	21.30	21.70	29.52	26.58	22.79	23.45	23.48	23.62
4. Other Sectors		7.17	4.10	4.20	5.80	5.40	4.43	1.85	1.53	1.26	1.40	1.22
5. Other		0.97	0.00	0.00	0.00	0.00	1.38	0.00	0.00	0.06	0.02	0.02
B. Fugitive Emissions from Fuels		6.67	9.70	11.60	11.50	10.60	8.86	10.50	10.08	7.84	7.70	6.95
1. Solid Fuels		0.00	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas		6.67	9.70	11.60	11.50	10.60	8.86	10.50	10.08	7.84	7.70	6.95
2. Industrial Processes		**7.41**	**22.40**	**18.80**	**16.70**	**16.20**	**3.34**	**17.90**	**16.02**	**2.71**	**2.43**	**2.58**
A. Mineral Products		6.32	0.00	0.00	0.00	0.00	2.77	2.80	0.00	2.24	2.42	2.57
B. Chemical Industry		IE	0.00	0.00	0.00	0.00	0.00	4.50	0.00	0.00	0.00	0.00
C. Metal Production		0.00	0.00	0.00	0.00	0.00	0.00	10.10	0.00	0.00	0.00	0.00
D. Other Production (3)		IE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
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
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
G. Other		1.09	22.40	18.80	16.70	16.20	0.57	0.50	16.02	0.47	0.01	0.00
3. Solvent and Other Product Use		0.01	0.20	0.10	0.10	0.20	0.02	0.20	0.23	0.02	0.03	0.02
4. Agriculture		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
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
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
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
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
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
G. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**NO**	**NO**	**NO**
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
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
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
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
E. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste		**0.80**	**0.00**	**0.00**	**0.00**	**0.00**	**0.69**	**0.01**	**0.82**	**0.65**	**0.64**	**0.64**
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
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
C. Waste Incineration		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other		0.80	0.00	0.00	0.00	0.00	0.69	0.01	0.82	0.65	0.64	0.64
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**
Solvents 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
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00
Memo Items: (7)												
International Bunkers		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**NE**	**NE**	**NE**	**NE**
Aviation		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass												

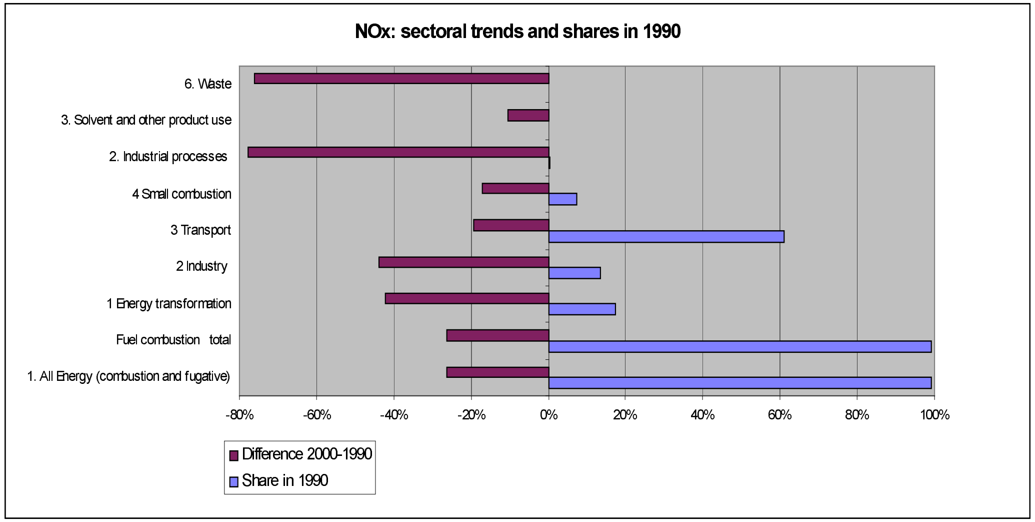

Figure A.6.1. Shares and trends in NO_x emissions per IPCC sector 1990-2000

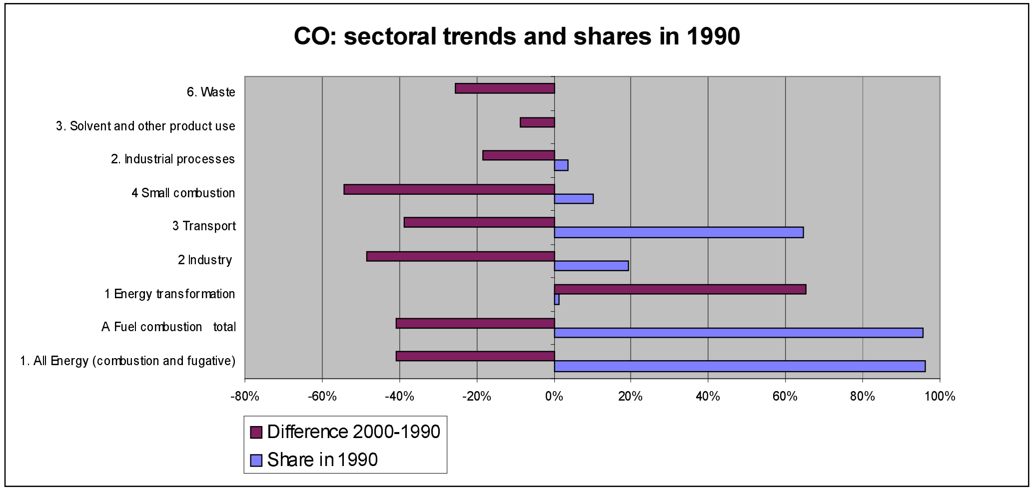

Figure A.6.2. Shares and trends in CO emissions per IPCC sector 1990-2000

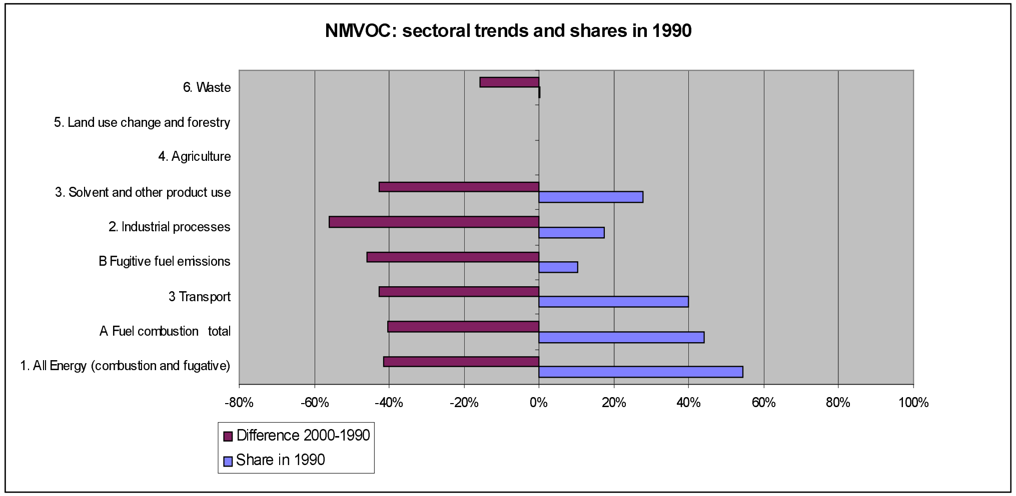

Figure A.6.3. Shares and trends in NMVOC emissions per IPCC sector 1990-2000

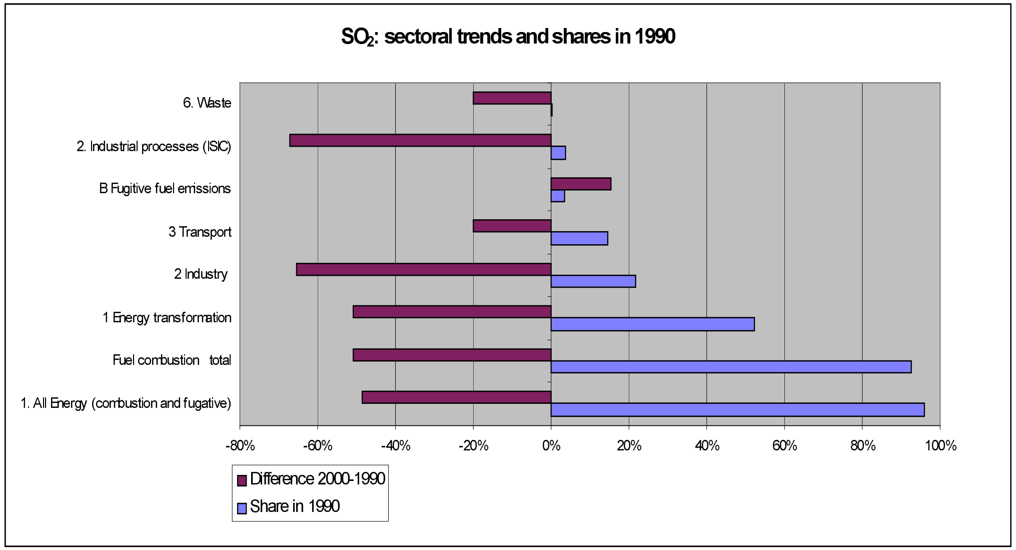

Figure A.6.4. Shares and trends in SO_2 emissions per IPCC sector 1990-2000