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NATIONAL INSTITUTE OF PUBLIC HEALTH AND THE ENVIRONMENT

RIVM report 773201 005

Greenhouse Gas Emissions in the Netherlands 1990-1999. National Inventory Report 2001

J.G.J. Olivier, R. Thomas, L.J. Brandes,
J.A.H.W. Peters and P.W.H.G. Coenen[1]

April 2001

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

[1] Netherlands Organisation for Applied Scientific Research (TNO)
P.O. Box 342, NL-7300 Apeldoorn

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

RIVM, P.O. Box 1, NL-3720 BA Bilthoven; phone: 31 - 30 - 274 3035; fax: 31 - 30 - 274 44 17

Abstract

This report documents the 2001 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 1999 by about 6% relative to 1990 (1995 for fluorinated gases). This increase would be a half per cent less when comparing temperature-corrected emissions. The uncertainty in total *annual* CO_2-equivalent emissions is estimated at 5%; the uncertainty in the 1990/95-1999 *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 1999 by about 8% and 15%, respectively, while in the same period CH_4 emissions have decreased by 20%, effectively to a level 0.5% point below N_2O emissions. Of the fluorinated greenhouse gases, for which 1995 is the reference year, emissions of HFCs and PFCs increased by 20 and 40% in 1999, respectively, while SF_6 emissions (completely recalculated) decreased by about 20%. 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 ±20% points, respectively.

Contents

Summary

This report documents the 2001 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 the trends in greenhouse gas emissions for the period 1990-1999, 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*, documentation of methods, data sources and emission factors applied, and 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 1990-1999 (all 1999 data are preliminary), Recalculation and Explanations Tables 8 and Completeness Tables from the CRF files.

The emissions data reported in these tables differ slightly from the data reported in the previous report, mainly due to revisions in energy consumption data of chemical waste gas used for cogeneration by autoproducers and in energy consumption by off-road vehicles and for inland shipping; in CH_4 emissions from oil and gas production; in CH_4 and N_2O emissions from road transport; and in F-gas emissions, in particular for PFCs and SF_6, but also for HFC-23. In total, emissions of CO_2 and N_2O in 1990 have decreased by 0.2 and 0.6 Mton CO_2-eq., respectively, and PFCs and SF_6 in 1995 by 0.2 and 1.2 Mton CO_2-eq., respectively.

In *Table 9.1* trends in national total (net) emissions are summarised for 1990-1999 (uncorrected for temperature). Total CO_2 equivalent emissions of the six greenhouse gases together increased in 1999 by about 6% relative to 1990 (1995 for fluorinated gases). This increase would be a half per cent less when comparing temperature-corrected emissions. Emissions of CO_2 and N_2O have increased from 1990 to 1999 by about 8% and 15%, respectively, while in the same period CH_4 emissions have decreased by 20%, effectively to a level 0.5% point below N_2O emissions. This makes N_2O emissions the second largest greenhouse gas in the Netherlands in 1999 (when refraining from the uncertainties in the annual emission estimates). Of the fluorinated greenhouse gases, for which 1995 is the reference year, emissions of HFCs and PFCs increased by 20 and 40% in 1999, respectively, while SF_6 emissions (completely recalculated) decreased by about 20%.

In the period 1990-1999 the largest sectoral growth of CO_2 emissions occurred in the transport sector (19% or 5.7 Mton). In 1999, total CO_2 emissions decreased by 7 Mton compared to 1998. This was mainly caused by: (a) an inconsistency in the time series for CO_2 due to elimination of the statistical differences in 1999 (2-4 Mton); (b) a net increase in imported electricity of 55%, accounting for 17% of gross domestic electricity consumption (2-3 Mton); (c) a shift in the fuel mix for electricity generation (1 Mton). In addition, the relative warm winter of 1999 caused uncorrected CO_2 emissions to decrease another 1.5 Mton compared to 1998. In 1999, temperature-corrected CO_2 emissions were 5.2 Mton or 3% higher than total national uncorrected CO_2 emissions. The results of a provisional *CO_2 Reference Approach* calculation showed that on average the sum of annual sectoral emissions differs 1.0% from the reference calculation.

In 1999, total CH_4 emissions have decreased by 20% compared to the 1990 level. Sectors that contributed most to the decrease were the waste sector (-24%) and the agricultural sector (-16%) with 2.9 and 1.7 Mton CO_2-eq., respectively. In 1999, total N_2O emissions increased by about 15% compared to 1990, mainly due to the increase of the emission from industrial processes (15%) and from agriculture (16%) with 1.4 and 1.1 Mton CO_2-eq., respectively. As said above, in 1999, the N_2O emissions have become the second important greenhouse gas in the Netherlands, above CH_4. In 1999, total emissions of all F-gases increased by about 30% compared to the 1995 level (50% compared to 1990), which is equivalent to 2.8 Mton CO_2-eq.

The uncertainty in total *annual* CO_2 equivalent emissions is estimated at 5%; the uncertainty in the 1990/95-1999 *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% for HFCs and PFCs and -10% to +100% for SF_6 (the latter because of missing sources). 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 ±20% points, respectively.

Samenvatting (Dutch)

Dit rapport over de Nederlandse inventarisatie van broeikasgasemissies is geschreven om te voldoen aan de nationale rapportageverplichtingen in 2001 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 1990-1999; 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 1990-1999 (alle cijfers voor 1999 zijn voorlopig), alsmede tabellen over herberekeningen en compleetheid van emissiebronnen.

De emissiecijfers zoals hier gerapporteerd verschillen enigszins van de vorige rapportage, met name als het gevolg van wijzigingen in het energiegebruik van chemisch restgas voor decentrale warmte-kracht-koppeling, van overige mobiele werktuigen en van binnenlandse scheepvaart; in de CH_4-emissies van olie- en gasproduktie; in CH_4 en N_2O van wegtransport; en in de emissies van F-gassen, met name van PFK's en SF_6, maar ook van HFK-23. In totaal zijn de emissies van CO_2 en N_2O resp. 0,2 en 0,6 Mton CO_2-equivalent lager geworden; voor PFK's en SF_6 in 1995 is dat resp. 0,2 en 1,2 Mton CO_2-eq.

In *Tabel 9.1* zijn de totale emissietrends 1990-1999 samengevat (zonder temperatuurcorrectie). De totale netto CO_2-eq.-emissies waren in 1999 6% hoger dan in 1990 (1995 voor de F-gassen). Dit wordt een half procent minder na temperatuurcorrectie. In die periode zijn de emissies van CO_2 en N_2O met resp. 8% en 15% gestegen, terwijl de CH_4-emissies met 20% daalden tot een niveau dat 0.5% onder dat van de N_2O-emissies in 1999 ligt. Dit maakt N_2O in 1999 tot het tweede broeikasgas van Nederland (afgezien van de onzekerheden). Van de zgn. F-gassen, waarvoor 1995 het referentiejaar is, stegen de HFK- en PFK-emissies met resp. 20% and 40% in 1999 ten opzichte van 1995, terwijl de emissies van SF_6 (geheel herberekend) met 20% daalden.

In de periode 1990-1999 vond de grootste sectorale groei in de CO_2-emissies plaats in de transportsector (19% of 5.7 Mton). In 1999 zijn de totale CO_2-emissies met 7 Mton gedaald ten opzicht van 1998. Dit werd met name veroorzaakt door: (a) een inconsistentie in de tijdreeks voor CO_2 als gevolg van de eliminatie van het statistisch verschil in 1999 (2-4 Mton); (b) een toename van 55% in de netto import van elektriciteit, die 17% van het bruto binnenlandse stroomgebruik dekt (2-3 Mton); (c) een verschuiving in de brandstofmix van centrales (1 Mton). Daarnaast zorgde de relatief warme winter van 1999 t.o.v. 1998 voor een afname van ca. 1,5 Mton in de ongecorrigeerde emissies. 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 1999 waren de methaanemissies 20% lager dan in 1990. De afvalsector (-24%) en de landbouwsector (-16%) droegen hieraan het meest bij (resp. 2,9 en 1,7 Mton CO_2-eq.). De N_2O-emissies zijn in 1999 ca. 15% gestegen ten opzichte van 1990, vooral als gevolg van een stijging van emissies door industriële processen (15%) en uit de landbouw (16%) (resp. 1,4 en 1,1 Mton CO_2-eq.) Zoals hierboven opgemerkt werd N_2O in 1999 het tweede broeikasgas van Nederland. De actuele emissies van F-gassen zijn in de periode 1995-1999 met 30% gestegen (50% t.o.v. 1990), hetgeen overeenkomt met 2,8 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 en PFK's: ±50%; en voor SF_6: -10% tot +100% (in verband met ontbrekende bronnen). De trendonzekerheid wordt voor CO_2, CH_4, N_2O en voor alle F-gassen als groep geschat op resp. ±3%, ±7%, ±12% and ±20%-punten.

Chemical compounds

CFCs	Chlorofluorocarbons
CF_4	Perfluoromethane (tetrafluoromethane)
C_2F_6	Perfluoroethane (hexafluoroethane)
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CTC	Carbon tetrachloride (tetrachloromethane)
FICs	Fluoroiodocarbons
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
HNO_3	Nitric Acid
MCF	Methyl Chloroform (1,1,1-Trichloroethane)
NO_x	Nitrogen oxide (NO and NO_2), expressed as NO_2
N_2O	Nitrous oxide
NMVOC	Non-Methane Volatile Organic Compounds
PFCs	Perfluorocarbons
SO_2	Sulphur dioxide
SF_6	Sulphur hexafluoride
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)
mln	million (= 10^6)
mld	milliard (= 10^9)

Conversion factors for emissions

From element basis to full molecular mass:		From full molecular mass to element basis:	
$C \rightarrow CO_2$:	x 44/12 = 3.67	$CO_2 \rightarrow C$:	x 12/44 = 0.27
$C \rightarrow CH_4$:	x 16/12 = 1.33	$CH_4 \rightarrow C$:	x 12/16 = 0.75
$C \rightarrow CO$:	x 28/12 = 2.33	$CO \rightarrow C$:	x 12/28 = 0.43
$N \rightarrow N_2O$:	x 44/28 = 1.57	$N_2O \rightarrow N$:	x 28/44 = 0.64
$N \rightarrow NO$:	x 30/14 = 2.14	$NO \rightarrow N$:	x 14/30 = 0.47
$N \rightarrow NO_2$:	x 46/14 = 3.29	$NO_2 \rightarrow N$:	x 14/46 = 0.30
$N \rightarrow NH_3$:	x 17/14 = 1.21	$NH_3 \rightarrow N$:	x 14/17 = 0.82
$N \rightarrow HNO_3$:	x 63/14 = 4.50	$HNO_3 \rightarrow N$:	x 14/63 = 0.22
$S \rightarrow SO_2$:	x 64/32 = 2.00	$SO_2 \rightarrow S$:	x 32/64 = 0.50

1. Introduction

This report documents the 2001 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. The report comprises explanations of the trends in greenhouse gas emissions for the period 1990-1999 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. 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 Trend Tables 10 and the IPCC Summary Tables 7A for the period 1990-1999 (1999 data are preliminary), Recalculation and Explanation Tables 8 and Completeness Tables from the CRF files.

Country-specific definitions and changes

Country-specific definitions of source categories are provided in Chapter 2. This includes a summary of identified missing sources. The emission data for 1990 and 1997-1998 as reported in the CRF tables differ slightly from the data reported in the previous report (Olivier *et al*., 2000) mainly due to:

- revisions in energy consumption data of chemical waste gas used for cogeneration by autoproducers;
- revised estimates for energy consumption by off-road vehicles and for inland shipping;
- revisions of CH_4 emissions from oil and gas production and from CH_4 and N_2O from road transport;
- correction for 1997 and 1998 of the division of CO_2 from waste incineration into fossil-originated and biogenic-originated carbon;
- revisions of the F-gas emissions, in particular for PFCs and SF_6, but also for HFC-23.

In total, emissions of CO_2 and N_2O in 1990 have decreased by 0.2 and 0.6 Tg CO_2-eq., respectively, and HFCs and SF_6 in 1995 by 0.2 and 1.2 Tg CO_2-eq., respectively. In addition, to improve the consistency of times series, changes have been made in the source allocation for the period 1991-1997. These changes are discussed briefly in Chapter 3. This also includes a summary of the degree of completeness of the CRF data files:

- data for 1990, 1998 and 1999 are now almost complete, due to an effort to include the emissions by fuel type for all fuel combustion sectors, also for the hundreds of individually reported sources;
- data for F-gases are complete for the whole time series 1990-1999, however, excluding the distribution of HFCs over various consumption categories.

Next, in Chapter 4 the emission calculation methods and data sources are briefly described and documented.

Key source and uncertainty assessments

The uncertainty in the emission estimates per gas is now 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 5 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	-10%; +100%

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 ±20% points, respectively.

For precursor gases the uncertainty in national *annual* total emissions are estimated at (RIVM, 1999):

CO	±25%
NO_x	±25%
NMVOC	±50%
SO_2	±25% (possibly ±10%)

In the remainder of Chapter 5 a preliminary assessment of key sources has been made using the Tier 1 and Tier 2 approach of the *IPCC Good Practice Guidance* report. Chapters 6 describes the Quality Assurance/Quality Control activities performed, including the results of comparison with a provisional *CO_2 Reference Approach* calculation for the 1990-1999 period. On average the sum of annual sectoral CO_2 emissions differ by 1.0% from the reference calculation (range of -0.4% to +2.5%).

Trend assessments

Next, in Chapters 7 and 8 the trends in emissions of greenhouse gas and of precursor gases are described and explained. The report concludes in Chapter 9 with a description of the trends and the contribution of emissions per greenhouse gas to annual CO_2-eq. emissions. In the appendices to this report a copy is included of the trend tables 10 and the IPCC summary tables 7A for the period 1990-1999 (1999 data are preliminary), recalculation and explanations tables 8 and completeness tables from the CRF files.

The analysis of trends and uncertainty estimates in emissions of the various sources has been made in cooperation with the following RIVM experts: Mr. Dick Beker (waste handling); Mr. Robert M.M. van den Brink (transport); Mr. Klaas W. van der Hoek (agriculture), Mrs. Johanna A. Montfoort (fugitive emissions of CH_4); Mr. Kees J. Peek (industry); and Mr. Durk S. Nijdam (small combustion). In addition, Mr. Ed A. 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.

Print out of CRF summary tables

Finally, in the appendices a description of the temperature correction method and a printed summary version of the CRF files is provided:

- IPCC Summary Tables 7A for 1990-1999 (CRF Summaries 1);
- Trend Tables 10 for each gas individually and for all gases and source in CO_2-eq.;

- Trend Tables 10 for precursor gases;
- Recalculation Tables and Explanation Table 8.a and 8.b for 1990 and 1997;
- Completeness Table 9 for 1990.

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 5 for information about the uncertainty in sectoral and national total emissions.

2. Country-specific definitions and circumstances

2.1. 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.

2.2. 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).

2.2.1. 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 2.1*). 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 2.1 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'*.

2.2.2. 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 7.4*).

2.2.3. 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.

2.2.4. Allocation of emissions from military activities

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

- Emissions of mobile military sources are 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) are 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 are available.

2.3. Completeness

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

- CO_2 emissions from agricultural soils (category 4D) are not estimated/reported;
- 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.

Furthermore, within the *Land Use Change and Forestry* (LUCF) Sector, IPCC source category 5, only CO_2 emissions (in this case: sinks) from category *5A: 'Changes in forest and other woody biomass stocks'* have been calculated for a number of years up to 1994 and kept constant thereafter. Awaiting further decisions and recommendations from the *Conference of Parties* on this subject, no attempt was made to estimate emissions or sinks in the other LUCF categories 5B, 5C and 5D in conformity with the IPCC Guidelines. This subject, however, has been discussed at length at a national workshop held in 1999 (Van Amstel, 2000b).

In addition, when verifying the trend data in the CRF files, it was found that no correction - i.e. no supplementary emission estimate - has been made for the following sources:

- CO_2 from cement clinker production is missing for 1990-1992; this accounts for about 0.3 Tg CO_2;
- CO_2 from flaring/venting from oil and gas production for 1998-1999; this accounts for a small amount;
- In addition, it has been observed that CH_4 from horses 1998-1999 is missing (about 4 Gg CH_4).

These accidentally errors will be improved in the next update of the inventory. In addition, for the next update of the national energy balance a revision is planned of the statistical differences in the energy statistics for the years 1990 and 1995-1998. This will then also allow a recalculation of the CO_2 related to statistical differences in the greenhouse gas emission inventory.

Recently a survey made to check for possibly unidentified sources of non-CO_2 emissions in the Netherlands did reveal 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.
- SF_6: notably production of sound-insulating windows; 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.

3. Changes in methodology and definitions

In this chapter we outline the key differences compared with the previous submission reported by Olivier *et al.* (2000). Because most changes are only of a minor nature and since recalculations have not been performed for all years prior to 1997, but mostly only to 1990 and 1995 (see Chapter 5), emission figures of all gases have been kept unchanged for the years 1991-1996 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 1990-1999. In addition, for 1990 emissions have been updated, including the changes already announced in the two previous reports (Olivier *et al.*, 1999, 2000), but not yet implemented in the 1990 inventory for reasons of time series consistency.

3.1. Differences due to changes in methodology or data

Changes in activity data since the previous submission:

- Starting for 1999, the statistical difference in the annual energy statistics, which is by definition the difference between the apparent national energy consumption (indigenous production + import - export - bunkers ± stock change) and the bottom-up sum of all sectoral energy use, has been redefined and effectively eliminated (see Chapter 4);
- Starting in 1999, the definition of non-energy use of coal/lignite and coke in the iron and steel industry has changed considerably (about 10 times as high). Therefore, it was decided in calculation of carbon storage of coal/lignite and coke feedstocks in the CO_2 Reference Approach of 1999 not to include these new feedstock figures.
- The consumption of gasoline and diesel fuel in road transport has been revised for 1995 onwards. For 1997 this revision corresponds with a decrease of 5.6 PJ for gasoline and 10.5 PJ for diesel.
- The use of chemical waste gas in 1998 and 1999 by privately owned cogeneration facilities has been corrected.

In addition, for 1990 changes announced in the previous report have now been implemented for 1990:

- Due to revised estimates for energy consumption by off-road vehicles, energy consumption allocated to the transport sector increased by about 7.9 PJ in 1990; this change corresponds to about 0.5 Tg CO_2.
- Energy consumption for *inland shipping* is now based on information on shipping routes and velocities per type of ship; this resulted in a higher fuel consumption, in particular for freight transport; for 1990 the change amounts to less than 0.1 Tg CO_2.
- Recently a census was made of the number of open fireplaces and wood stoves and their use (fuelwood and charcoal consumption is not part of the official energy balances of the Netherlands). This has lead to the revision of the degree of penetration and a decrease in the assumed use. As a result the biofuel consumption data have decreased about 40% for all years.

Changes in greenhouse gas emissions since the previous submission:

- CO_2 emissions from fuel use in 1990 and 1998 due to the changes in energy consumption data mentioned above;
- CO_2 emissions from waste incineration in 1997 and 1998 due to a correction of the division of CO_2 into fossil-originated and biogenic-originated carbon;

- CH_4 emissions from oil and gas production have been recalculated for 1995-1998 based on information from the gas producing companies.
- CH_4 and N_2O emission factors for road transport are now based on the results of a semi-continuous monitoring programme by TNO, in which emission factors are measured for samples of cars.
- Actual emissions of HFC-134a have been updated for 1996 onwards based on new information about the shares of various application types for HFC-134a. Total change in HFC emissions in 1995 is negligible.
- The preliminary figure for HFC-23 emissions in 1998 from the previous submission has been revised substantially, as the newly installed abatement technology appeared not as effective as expected, resulting in an increase of about 2.0 Tg CO_2-eq. of HFC-23 emissions in 1998.
- PFC emissions from aluminium production have been recalculated using plant-specific production data and measured emission factors based on recent measurement studies at the two producing companies. The new measured emission factors have been applied for all years (assuming no technological change). For one plant we used a (measured) emission factor for $C_2F_6 \neq 1/10\ CF_4$, which is the default ratio recommended by IPCC. For the other plant new emission factors - based on the ratio of 1/10 for C_2F_6 to CF_4 - were used, based on a reported emission factor for 'total PFCs'. The total change for 1995 is a decrease from 2.09 to 1.86 Tg CO_2-eq. (including emissions from PFC usage, mentioned below).
- For PFC and SF_6 emissions from the use of PFCs and SF_6 in semiconductor manufacture, now plant-specific (confidential) emissions data have been used, which were calculated in conformity with the *IPCC Good Practice Guidance*, instead of using the annual KPMG reporting of total consumption of fluorinated compounds.
- For SF_6 now *actual* emissions have been calculated for the whole period 1990-1999 in conformity with the *IPCC Good Practice Guidance*. In the previous submission it was assumed that (raw estimates of) SF_6 consumption are equal to actual emissions. As of this year this estimate has been replaced by more detailed estimate of only most important sources. Consumption figures are now based on data from the industry sector (partly Confidential Business Information) and estimates for the existing stock of Gas Insulated Switchgear (GIS) equipment, addition of new GIS equipment and manufacturing of GIS equipment, and for semiconductor manufacture (see above). For 1995 the actual emissions of SF_6 are now 0.17 Tg CO_2-eq., replacing the old value of 1.46 Tg CO_2-eq.

In total, emissions of CO_2 and N_2O in 1990 have decreased by 0.2 and 0.6 Mton CO_2-eq., respectively, and PFCs and SF_6 in 1995 by 0.2 and 1.2 Mton CO_2-eq., respectively.

Changes in ozone precursors and SO_2 since the previous submission:
- Emissions from fossil fuel use in 1990 and 1998 due to the changes in energy consumption data mentioned above;
- Emissions from changes in amounts of biofuel use mentioned above;
- Emissions from road transport based on a new measurement programme of emission factors from passenger cars.

The figures reported here comply with the *Environmental Balance 2000* (RIVM, 2000a,b) and with the *Annual emissions and waste report 2000* describing emissions and waste in 1997, 1998 and 1999 (Van Harmelen *et al.,* 2000), except some minor differences, mainly source allocations, due to different production dates. We recall that all data in this report presented for 1999 are preliminary.

3.2. Differences due to revised source allocation

Emissions in the Netherlands 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) along with an updated correspondence table for emissions from Target Groups and IPCC source categories.

As a next step towards reporting at the more detailed source category level of the Common Reporting Format as requested by the Parties, 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 course of this definition process, a few improvements of the current 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.

Furthermore, due to different inventory datasets used for reporting data for the 1991-1996 period as opposed to the years 1990, 1997-1999, some changes in source allocations were made harmonise the reporting to the same IPCC subcategories for all years, thereby increasing the consistency of time series at those levels. In addition, for 1990 the source allocation was also updated according to the latest correspondence table, including the changes mentioned in the two previous reports but not yet implemented at that time:

- CO_2: reallocation between categories 1A1-1A4 in 1990 and 1996-1998, mainly due to revision of energy consumption for off-road transport (7.9 PJ or 0.5 Tg CO_2 in 1990; about 4 PJ in recent years);
- CO_2: reallocation within category 2 for 1990 and 1996-1998, to achieve a better match with the corresponding IPCC industry categories;
- CO_2: reallocation between categories 6D and 1A1 for 1995-1998, mainly due to correction of misallocation of emissions from waste incineration (with energy production) in 6D to 1A1;
- CH_4: reallocation within categories 4A and 4B for 1990 and 1996-1998 to achieve a better split into the animal subcategories;
- N_2O: reallocation within category 2 for 1990-1995, mainly to allocate all N_2O in this sector to the nitric acid production although a small amount is emitted from other process sources;

Finally, we recall that due to data processing limitations for a few sub-categories we used a somewhat different definition than described in the *Revised IPCC Guidelines* (see Section 2.2).

3.3. Changes in CRF files compared to previous submission

Accompanying this report are 10 Common Reporting Format (CRF) data files, named "crf-nld-2001-NN.xls" with NN = 90 .. 99, compressed into three files: **crf-nld-90-93.zip; crf-nld-94-97.zip; crf-nld-98-99.zip**. The tables included in the Appendices represent the *printed summary version* of the 2001 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 1990-1999 (CRF Summaries 1);
- Trend Tables 10 for each gas individually and for all gases and source in CO_2-eq.;
- Trend Tables 10 for precursor gases;
- Recalculation Tables and Explanation Table 8.a and 8.b for 1990 and 1997;
- Completeness Table 9 for 1990.

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

- Data for 1997 and 1998 were updated (1998 data were preliminary in the previous submission)
- Data for 1999 has been added (all figures for 1999 are preliminary data)
- Data for 1990 were updated (according to the last data and methodology including changes announced in the previous two inventory reports);
- Also for these years more detailed data have been added to the set of CRF files that accompany this report. In particular for fuel combustion by the Energy Sector and Manufacturing Industries (IPCC categories *1A1* and *1A2*) an attempt was made for 1990, 1998 and 1999 to split the emissions data per sector by fuel type. This could be only done for approximately 80% of the CO_2 emissions due to limited detail in the reports of the individual companies that make up the largest part of these source categories;
- For HFCs, PFCs and SF_6 the complete time series 1990-1999 has been revised. For HFCs for 1995 onwards only; PFC emissions are now partly based on measurement in one aluminium production plant; SF_6 emissions are now actual emissions estimates instead of only potential emissions acting as such, changing the emissions substantially.

The other data for 1991-1996 had been prepared last year and remained essentially unchanged compared to the previous submission, except for some error corrections and reallocations to improve the time series consistency. This refers mainly to precursors in 1991, N_2O from chemical industrial processes in 1990-1995, a movement of CO_2 emissions from waste incineration with energy production from category *6* to category *1A1* for 1995-1998, and to a split of CH_4 from agriculture into enteric fermentation and manure management.

Status reports on recalculations

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

- *Recalculations for 1990:*

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 1991-1996: only for F-gases (for other compounds only source allocation improvements).*

- *Recalculations for 1997:*

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 1998: full recalculation, since previous data had status 'preliminary' status, which is now '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, 1998 and 1999 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). 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 accounts for about 20% of fossil-fuel related emissions, i.e. 20% could not be allocated to a specific fuel type.

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 3.1*). 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 6.2). 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 3.1 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. The limited completeness for the years 1991-1995/1997 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 again a more complete data will be provided.

Table 3.1. Summary of completeness of Common Reporting Format files 1990-1999.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
1. Energy										
A. Fuel Combustion	IEF[1]								IEF[1]	IEF[1]
1. Energy Industries	IEF[1]								IEF[1]	IEF[1]
2. Manufacturing Industries and Construction	IEF								IEF	IEF
3. Transport	IEF						IEF	IEF	IEF	IEF
4. Other Sectors	IEF								IEF	IEF
5. Other	IEF								IEF	IEF
B. Fugitive Emissions from Fuels										
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	IEF							IEF	IEF	IEF
2. Industrial Processes										
A. Mineral Products										
1. Cement Production	NE	NE	NE	IE	IEF	IE	IEF	IEF	IEF	IEF
3. Limestone and Dolomite Use	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. Metal Production										
D. Other Production [3]										
E. Production of Halocarbons and SF_6										
1. By-product Emissions HCFC-22 production	C	C	C	C	C	C	C	C	C	C
F. Consumption of Halocarbons and SF_6										
1 Refrigeration										
2 Foam Blowing										
8 Other (please specify)	2)	2)	2)	2)	2)	2)	2)	2)	2)	2)
G. Other *(emissions only)*	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
3. Solvent and Other Product Use										
4. Agriculture										
A. Enteric Fermentation	IEF						IEF	IEF	IEF	IEF
B. Manure Management	IEF						IEF	IEF	IEF	IEF
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	IEF						IEF	IEF	IEF	IEF
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other *(emissions only)*	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	EM	IEF	IEF	EM	EM	EM	EM	EM	EM
B. Forest and Grassland Conversion	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
D. CO_2 Emissions and Removals from Soil	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Other *(emissions only)*	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Waste										
A. Solid Waste Disposal on Land	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF	IEF
B. Wastewater Handling										
C. Waste Incineration										
D. Other *(emissions only)*	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
7. Other *(please specify) (emissions only)*										
Solvents and other product use	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
Polluted surface water	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM
International Bunkers										
Aviation	IEF[3]	IEF[3]	IEF[3]	IEF[3]	IEF[3]	IEF[3]	IEF[3]	IEF[3]	IEF[3]	IEF[3]
Marine	IEF[3]	IEF[3]	IEF[3]	IEF[3]	IEF[3]	IEF[3]	IEF[3]	IEF[3]	IEF[3]	IEF[3]
Multilateral Operations	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE

1) Due to limited data quality and completeness of point source data, about 20% of fossil fuel consumption is not reported as gas, oil or coal but included under 'other fuels'.
2) EM (when activity data are confidential, as in the case of PFC and SF_6 use); AD (when not confidential).
3) Only for CO_2 (CH_4 and N_2O not estimated).

Abbreviations:
IEF = Implied Emission Factor; EM = Emissions (no IEF);
NO = Not Occurring; NE = Not Estimated; IE = Included Elsewhere;
C = Confidential Business Information (only emissions).

4. Methodology and data sources

The general methodology for calculating emissions to air and water in the Netherlands' Emission Registration is described in Van der Most *et al.* (1998) [in Dutch]. The methodology for calculating emissions of greenhouse gases is described in more detail in Spakman *et al.* (1997) [in Dutch]. 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). 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.

Carbon dioxide
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.

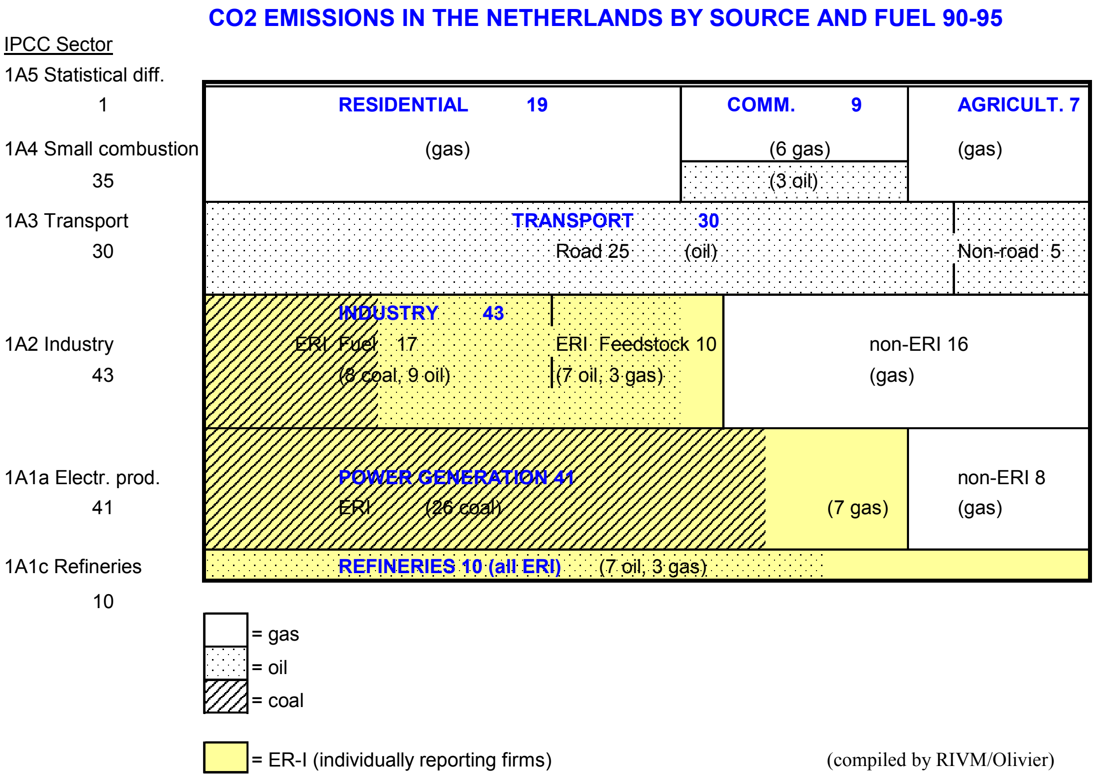


Figure 4.1. Schematic overview of CO_2 emissions from fuel combustion (Tg) (IPCC category 1A), showing the relative shares of sub-sectors as well as main fuel types and the total contribution of individually reporting firms (ER-I). Data are representative for the period 1990 to 1995 (source: Van Amstel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

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, the *Revised IPCC Guidelines* ask countries to report greenhouse gas emissions from combustion on the basis of fuel consumption within the national territory. Therefore, a correction is made to convert emissions related to vehicle-km to emissions related to statistics for fuel sales. Thus, next, to meet the IPCC definition for 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 7.1.4. (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.).

Carbon storage in products like plastics and bitumen is estimated from an analysis of petrochemical products, half products and feedstock use (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*). 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.

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).

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 of (Jager and Blok, 1993). In recent years this amounted about 2 Mton).

The energy statistics show a small, but growing, 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 fuel use related to *statistical differences* (in the Netherlands typically less than 1%, except for recent years) 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 enduse sectors. The statistical difference between supply and demand is usually smaller than 2%. Per energy carrier, however, the difference may vary both in sign and size, as is shown in *Table 7.9*.

This approach had to be abandoned in 1999, since it was decided by the Central Bureau of Statistics to revise for the 1999 national energy balance the method for establishing the statistical difference. The statistics difference was eliminated through incorporation of (formerly remaining) differences into other parts of the energy balance: for coal by adjustment of exports; for gas by adjusting distribution losses; and for oil products by adjustments of industrial energy use (partly domestic; mainly for non-energetic purposes). Since the energy balances for previous years have not been revised, it is currently not possible to provide a consistent time series for this 'category' for the whole period 1990-1999. For the next update of the national energy balance a revision is planned of the statistical differences in the energy statistics for the years 1990 and 1995-1998. This will then also allow a recalculation of the CO_2 related to statistical differences in the greenhouse gas emission inventory.

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 Appendix A.

Methane

Methane from combustion is estimated using the energy statistics and emission factors from the Annual Emissions and Waste Report, with figures provided by the Emission Registration system. 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 the Netherlands' Central Bureau for Statistics (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 sub-categories within dairy and non-dairy cattle, respectively. Methane emissions from landfills are estimated with a database on landfills maintained at RIVM and a time dependent first order decay function. 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.

Nitrous oxide

The nitrous oxide emissions estimate is based on the methods described in the nitrous oxide background document by Kroeze (1994). The calculation of animal manure production and waste management systems is described in Van der Hoek *et al.* (1997). Emissions from the production of chemicals include N_2O from nitric acid, acrylonitril and caprolactam production as included in the Netherlands' Emission Registration system (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 7.3.1.

HFCs, PFCs and SF_6

Emissions from HFC consumption are calculated using Tier 2 methodologies 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. As of this year, emissions of SF_6 are now 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 (instead of an extrapolation of a very old estimate of national total SF_6 consumption), and for semiconductor manufacture.

Data sources

The following primary data sources are used for the activity data used in the emission calculations:

- energy data: (a) annual inventory reports by individual firms; (b) national energy statistics from CBS (National Energy Statistics; Energy Monitor); (c) biofuel consumption data from consumers based on annual survey of fuel use in residential fireplaces by the Stove and Stack Association (in Dutch: *Vereniging van Haard en Rookkanaal*)
- 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, PFCs and SF_6: annual reports by accountant firm KPMG (only HFC data are used due to inconsistency for PFCs and SF_6 with emissions reported otherwise (e.g. 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: Foundation for Forests and Wood
- waste production and handling: Working Group on Waste Registration (WAR).

Table 4.2. Summary table 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 Construction	CS	PS, CS	CS	PS, CS	CS	PS, D
3. Transport	CS	CS	CS	CS	CS	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	T1/CS	D/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	

Table 4.2 Summary table on methods and emission factors applied (continued).

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)
3. Solvent and Other Product Use	**CS**	**CS**			**CS**	**CS**
4. Agriculture						
A. Enteric Fermentation			cattle 90: T2; rest: T1	cattle: CS; rest: D		
B. Manure Management			CS	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	NO (IE)		NO (IE)		NO (IE)	
D. Other	CS	CS	CS	CS	CS	CS
7. Other *(please specify)*						
Solvents/polluted surface water	NA		CS	CS	CS	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	PS	NO		NO	
F. Consumption of Halocarbons and SF_6	CS/T2	CS	T2	D	T2	CS
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. Uncertainty and Assessment of Key Sources

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.

5.1. Uncertainty assessment (IPCC Tier 1)

For estimating the uncertainty in activity data and emission factors, the following information sources were used:

- 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 1999 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 1999 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* is summarised in *Table 5.1*. The Tier 1 calculation of annual uncertainty in CO_2-eq. emissions results in 2%, 15%, 35% and 22% 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 (notably for SF_6). 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_2	±3%	HFCs	±50%
CH_4	±25%	PFCs	±50%
N_2O	±50%	SF_6	-10; +100%

Table 5.1. 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. 1999	AD unc	EF unc	EM unc
1A	Emissions from stationary combustion: coal	34934	30001	3%	3%	4%
1A	Emissions from stationary combustion: gas	66888	75247	3%	1%	3%
1A	Emissions from stationary combustion: oil	17600	17842	3%	2%	4%
1A	Feedstock coal	481	400	5%	10%	11%
1A	Feedstock gas	5262	6507	5%	10%	11%
1A	Feedstock oil	4273	5922	20%	50%	54%
1A	Mobile combustion: road vehicles	25374	31111	2%	2%	3%
1A	Mobile combustion: water-borne navigation	877	807	100%	2%	100%
1A	Mobile comustion: aircraft	492	420	50%	2%	50%
1A	Mobile combustion: other	2352	2362	50%	2%	50%
2	Emissions from cement production	300	376	5%	10%	11%
2	Other industrial: CO2	1601	1408	20%	5%	21%
7	Misc. CO2	735	1722	20%	50%	54%
	Total CO2	**161,169**	**174,124**			**2%**
						-> 3%
1A	Emissions from stationary combustion: non-CO2	567	525	3%	50%	50%
1A	Mobile combustion: road vehicles	164	105	5%	60%	60%
1B	Fugitive emissions from oil and gas: gas production	2092	1723	1%	25%	25%
1B	Fugitive emissions from oil and gas: gas distribution	1657	1306	5%	50%	50%
2	Other industrial: CH4	71	52	10%	50%	51%
4A	CH4 emissions from enteric fermentation: cattle	7678	6280	5%	20%	21%
4A	CH4 emissions from enteric fermentation: swine	439	427	5%	50%	50%
4A	CH4 emissions from enteric fermentation: sheep	286	235	5%	30%	30%
4A	CH4 emissions from enteric fermentation: other	40	26	5%	30%	30%
4B	Emissions from manure management : cattle	897	766	10%	100%	100%
4B	Emissions from manure management : swine	1033	925	10%	100%	100%
4B	Emissions from manure management : poultry	216	200	10%	100%	100%
4B	Emissions from manure management : other	17	21	10%	100%	100%
6A	CH4 emissions from solid waste disposal sites	11804	8994	15%	30%	34%
6B	Emissions from wastewater handling	132	79	20%	25%	32%
7	Misc. CH4	42	41	20%	25%	32%
	Total CH4	**27,134**	**21,705**			**17%**
						-> 25%
1A	Emissions from stationary combustion: non-CO2	217	145	2%	50%	50%
1A	Mobile combustion: road vehicles	1407	1629	5%	50%	50%
1A	Mobile combustion: other	230	225	50%	100%	112%
2	Emissions from nitric acid production	9773	11206	10%	50%	51%
4B	Emissions from manure management	217	198	10%	100%	100%
4D	Direct N2O emissions from agricultural soils	5208	6296	10%	60%	61%
4D	Indirect N2O emissions from nitrogen used in agriculture	1457	1460	50%	200%	206%
6B	Emissions from wastewater handling	155	164	20%	50%	54%
7	Polluted surface water	1178	1178	50%	200%	206%
7	Misc. N2O	155	188	50%	50%	71%
	Total N2O	**19,997**	**22,690**			**33%**
						-> 50%
2	HFC-23 emissions from HCFC-22 manufacture	6464	7519	15%	25%	29%
2	HFC Emissions from substitutes for ODS substitutes	260	1317	10%	50%	51%
2	PFC emissions form aluminium production	1799	2471	5%	20%	21%
2	PFC emissions from PFC use	68	118	5%	25%	25%
2	SF6 emissions from SF6 use	174	137	100%	25%	103%
	Total F-gases	**8,765**	**11,562**			**22%**
	-> 50% for HFCs and PFCs; -> -10%; +100% for SF6					
	Total Netherlands (CO2-eq.)	**217065**	**230082**			**4%**
						-> 5%

Note: Based on preliminary version of CRF data files. Please note that 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.

Table 5.2. Preliminary Tier 1 trend uncertainty assessment 1990-1999 (for F-gases with base year 1995) with the categories of the IPCC potential key source list (without adjustment for correlations between sources).

	Source category	Gas	1990	1999	AD unc	EF unc	EM unc	Unc as %nat in yr Y	Sens. A:	Sens. B:	Trend unc due to EF unc	Trend unc due to AD unc	Combined unc in trend	EF unc based on:	AD unc based on:	Expert judgement ref no.	
1A	Emissions from stationary combustion: gas	CO2	66,888	75,247	3%	1%	3%	**1.0%**	2%	35%	0.0%	1.5%	**1.5%**	R	R	1	
1A	Emissions from stationary combustion: oil	CO2	17,600	17,842	3%	2%	4%	0.3%	0%	8%	0.0%	0.3%	0.3%	R	R	2	
1A	Emissions from stationary combustion: coal	CO2	34,934	30,001	3%	3%	4%	0.6%	-3%	14%	-0.1%	0.6%	**0.6%**	R	R	3	
1A	Mobile combustion: road vehicles	CO2	25,374	31,111	2%	2%	3%	0.4%	2%	14%	0.0%	0.4%	0.4%	R	R	4	
1A	Mobile combustion: water-borne navigation	CO2	877	807	100%	2%	100%	0.4%	0%	0%	0.0%	0.5%	0.5%	R	R	5	
1A	Mobile comustion: aircraft	CO2	492	420	50%	2%	50%	0.1%	0%	0%	0.0%	0.1%	0.1%	R	R	6	
1A	Mobile combustion: other	CO2	2,352	2,362	50%	2%	50%	0.5%	0%	1%	0.0%	0.8%	**0.8%**	R	R	7	
1A	Feedstock gas	CO2	5,262	6,507	5%	10%	11%	0.3%	0%	3%	0.0%	0.2%	0.2%	R	R	8	
1A	Feedstock oil	CO2	4,273	5,922	20%	50%	54%	**1.4%**	1%	3%	0.3%	0.8%	0.8%	R	R	9	
1A	Feedstock coal	CO2	481	400	5%	10%	11%	0.0%	0%	0%	0.0%	0.0%	0.0%	R	R	10	
2	Emissions from cement production	CO2	*300*	376	5%	10%	11%	0.0%	0%	0%	0.0%	0.0%	0.0%	R	D	11	
2	Other industrial: CO2	CO2	1,601	1,408	20%	5%	21%	0.1%	0%	1%	0.0%	0.2%	0.2%	R	R	12	
7	Misc. CO2	CO2	735	1,722	20%	50%	54%	**0.4%**	0%	1%	0.2%	0.2%	**0.3%**	R	R	13	
	Total CO_2		**161,169**	**174,124**										3% unc. in trend of			8%
1A	Emissions from stationary combustion: non-CO2	CH4	567	525	3%	50%	50%	0.1%	0%	0%	0.0%	0.0%	0.0%	R	R	14	
1A	Mobile combustion: road vehicles	CH4	164	105	5%	60%	60%	0.0%	0%	0%	0.0%	0.0%	0.0%	R	R	15	
1A	Mobile combustion: other	CH4	IE	IE	50%	100%	112%				0.0%		0.0%	R	R	16	
1B	Fugitive emissions from oil and gas: gas productior	CH4	2,092	1,723	1%	25%	25%	0.2%	0%	1%	-0.1%	0.0%	0.1%	R	R	17	
1B	Fugitive emissions from oil and gas: gas distributio	CH4	1,657	1,306	5%	50%	50%	0.3%	0%	1%	-0.1%	0.0%	0.1%	R	R	18	
1B	Fugitive emissions from oil and gas operations: oth	CH4	IE	IE	20%	50%	54%				0.0%		0.0%	R	R	19	
2	Other industrial: CH4	CH4	71	52	10%	50%	51%	0.0%	0%	0%	0.0%	0.0%	0.0%	R	R	20	
4A	CH4 emissions from enteric fermentation: cattle	CH4	7,678	6,280	5%	20%	21%	0.6%	-1%	3%	-0.2%	0.2%	0.3%	R	R	21	
4A	CH4 emissions from enteric fermentation: swine	CH4	439	427	5%	50%	50%	0.1%	0%	0%	0.0%	0.0%	0.0%	D	R	22	
4A	CH4 emissions from enteric fermentation: sheep	CH4	286	235	5%	30%	30%	0.0%	0%	0%	0.0%	0.0%	0.0%	D	R	23	
4A	CH4 emissions from enteric fermentation: other	CH4	40	26	5%	30%	30%	0.0%	0%	0%	0.0%	0.0%	0.0%	D	R	24	
4B	Emissions from manure management : cattle	CH4	897	766	10%	100%	100%	0.3%	0%	0%	-0.1%	0.0%	0.1%	D	R	25	
4B	Emissions from manure management : swine	CH4	1,033	925	10%	100%	100%	0.4%	0%	0%	-0.1%	0.1%	0.1%	D	R	26	
4B	Emissions from manure management : poultry	CH4	216	200	10%	100%	100%	0.1%	0%	0%	0.0%	0.0%	0.0%	D	R	27	
4B	Emissions from manure management : other	CH4	17	21	10%	100%	100%	0.0%	0%	0%	0.0%	0.0%	0.0%	D	R	28	
6A	CH4 emissions from solid waste disposal sites	CH4	11,804	8,994	15%	30%	34%	**1.3%**	-2%	4%	-0.5%	0.9%	**1.0%**	R	R	29	
6B	Emissions from wastewater handling	CH4	132	79	20%	25%	32%	0.0%	0%	0%	0.0%	0.0%	0.0%	R	R	30	
7	Misc. CH4	CH4	42	41	20%	25%	32%	0.0%	0%	0%	0.0%	0.0%	0.0%	R	R	31	
	Total CH_4		**27,134**	**21,705**										7% unc. in trend of			-20%
1A	Emissions from stationary combustion: non-CO2	N2O	217	145	2%	50%	50%	0.0%	0%	0%	0.0%	0.0%	0.0%	R	R	32	
1A	Mobile combustion: road vehicles	N2O	1,407	1,629	5%	50%	50%	0.4%	0%	1%	0.0%	0.1%	0.1%	R	R	33	
1A	Mobile combustion: other	N2O	230	225	50%	100%	112%	0.1%	0%	0%	0.0%	0.1%	0.1%	R	R	34	
2	Emissions from nitric acid production	N2O	9,773	11,206	10%	50%	51%	**2.5%**	0%	5%	0.2%	0.7%	**0.8%**	R	R	35	
2	Other industrial: N2O	N2O	IE		10%	20%	22%	0.0%		0%	0.0%	0.0%	0.0%	R	R	36	
4B	Emissions from manure management	N2O	217	198	10%	100%	100%	0.1%	0%	0%	0.0%	0.0%	0.0%	D	R	37	
4D	Direct N2O emissions from agricultural soils	N2O	5,208	6,296	10%	60%	61%	**1.7%**	0%	3%	0.2%	0.4%	0.5%	D	D	38	
4D	Indirect N2O emissions from nitrogen used in agric	N2O	1,457	1,460	50%	200%	206%	**1.3%**	0%	1%	-0.1%	0.5%	0.5%	D	R	39	
6B	Emissions from wastewater handling	N2O	155	164	20%	50%	54%	0.0%	0%	0%	0.0%	0.0%	0.0%	R	R	40	
7	Polluted surface water	N2O	1,178	1,178	50%	200%	206%	**1.1%**	0%	1%	-0.1%	0.4%	0.4%	R	R	41	
7	Misc. N2O	N2O	155	188	50%	50%	71%	0.1%	0%	0%	0.0%	0.1%	0.1%	R	R	42	
	Total N_2O		**19,997**	**22,690**										12% unc. in trend of			13%
2	HFC-23 emissions from HCFC-22 manufacture	HFC	6,464	7,519	15%	25%	29%	**1.0%**	0%	3%	0.1%	0.7%	**0.7%**	M, R	D	43	
2	Emissions from substitutes for ODS substitutes: HF	HFC	260	1,317	10%	50%	51%	0.3%	0%	1%	0.2%	0.1%	0.3%	D	D	44	
2	PFC emissions form aluminium production	PFC	1,799	2,471	5%	20%	21%	0.2%	0%	1%	0.1%	0.1%	0.1%	M, R	D	45	
2	PFC emissions from PFC use	PFC	68	118	5%	25%	25%	0.0%	0%	0%	0.0%	0.0%	0.0%	M, R	D	46	
2	SF6 emissions from SF6 use	SF6	174	137	100%	25%	103%	0.1%	0%	0%	0.0%	0.1%	0.1%	R	R	47	
	Total F-gases		**8,765**	**11,562**										20% unc. in trend of			32%
	TOTAL CO_2-eq.		**217,065**	**230,082**				**4%**	= uncertainty in annual emissions				**2.7%**	uncertainty in *trend* of			6.1%

Note: Based on preliminary version of CRF data files. 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

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 middle column in *Table 5.2*), the sources contributing most to total *annual uncertainty* in 1990 (1995 for F-gases) are:

IPCC	Source category	Uncertainty (as % of total national emissions in 1999)
2	N_2O Emissions from nitric acid production	2.5%
4D	Direct N_2O emissions from agricultural soils	1.7%
1A	CO_2 from Feedstock: oil	1.4%
6A	CH_4 Emissions from solid waste disposal sites	1.3%
4D	Indirect N_2O emissions from nitrogen used in agriculture	1.3%
7	*N_2O from polluted surface water*	*1.1%*
1A	CO_2 Emissions from stationary combustion: gas	1.0%
2	HFC-23 Emissions from HCFC-22 manufacture	1.0%
4A	*CH_4 Emissions from enteric fermentation: cattle*	*0.6%*
1A	CO_2 Emissions from stationary combustion: coal	0.6%

In *Table 5.2* the estimate of the *trend uncertainty 1990-1999* 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 1990-1999 (1995 for F-gases) of ±3% points. This means that the increase in total CO_2-eq. emissions between 1990 and 1999, which is calculated to be 6%, will lie between 3 and 9%. 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 ±20% points, respectively. Sources contributing most to *trend uncertainty* in the national total are:

IPCC	Source category	Uncertainty (as % into trend in total national emissions)
1A	CO_2 Emissions from stationary combustion: gas	1.5%
6A	CH_4 emissions from solid waste disposal sites	1.0%
1A	CO_2 Feedstock oil	0.8%
1A	*CO_2 Mobile combustion: other*	*0.8%*
2	N_2O Emissions from nitric acid production	0.8%
2	HFC-23 emissions from HCFC-22 manufacture	0.7%
1A	CO_2 Emissions from stationary combustion: coal	0.6%
1A	*CO_2 Mobile combustion: water-borne navigation*	*0.5%*
4D	Indirect N_2O emissions from nitrogen used in agriculture	0.5%
4D	Direct N_2O emissions from agricultural soils	0.5%

When we compare this list with the 10 largest contributors to annual uncertainty, we can conclude that except for CO_2 from other mobile combustion and from inland shipping, N_2O from polluted surface water and CH_4 from enteric fermentation of cattle (*printed in italic*), all 8 others are included both lists.

Limitations

The uncertainty estimates presented in *Table 5.1* 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 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 5.1*, 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 4.1*). 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).

5.2. Preliminary assessment of key source categories

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 5.3* and *Table 5.4*, respectively. The grey areas in the tables are the largest sources of which the total adds to 95% of the national total: 15 sources for annual level assessment and 17 sources for the trend assessment out of a total of 51 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 5.5*. 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 51, 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 5.5*. 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.

Limitations

We recall that Tier 2 key source assessments are subject to the limitations of the Tier 1 uncertainty estimates as discussed in Section 5.1. 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 5.3. Source ranking using IPCC Tier 1 level assessment (amounts in Gg CO_2-eq.)

IPCC	Category	Gas	CO_2-eq	Share	Cumulative share
1A	Emissions from stationary combustion: gas	CO2	66,888	31%	31%
1A	Emissions from stationary combustion: coal	CO2	34,934	16%	47%
1A	Mobile combustion: road vehicles	CO2	25,374	12%	59%
1A	Emissions from stationary combustion: oil	CO2	17,600	8%	67%
6A	CH4 emissions from solid waste disposal sites	CH4	11,804	5%	72%
2	Emissions from nitric acid production	N2O	9,773	5%	77%
4A	CH4 emissions from enteric fermentation in domestic livesto	CH4	7,678	4%	80%
2	HFC-23 emissions from HCFC-22 manufacture	HFC	6,464	3%	83%
1A	Feedstock gas	CO2	5,262	2%	86%
4D	Direct N2O emissions from agricultural soils	N2O	5,208	2%	88%
1A	Feedstock oil	CO2	4,273	2%	90%
1A	Mobile combustion: other	CO2	2,352	1.1%	91%
1B	Fugitive emissions from oil and gas operations: gas productic	CH4	2,092	1.0%	92%
2	PFC emissions form aluminium production	PFC	1,799	0.8%	93%
1B	Fugitive emissions from oil and gas operations: gas distributi	CH4	1,657	0.8%	94%
2	Other industrial: CO2	CO2	1,601	0.7%	94%
4D	Indirect N2O emissions from nitrogen used in agriculture	N2O	1,457	0.7%	95%
1A	Mobile combustion: road vehicles	N2O	1,407	0.6%	96%
7	Polluted surface water	N2O	1,178	0.5%	96%
4B	Emissions from manure management : swine	CH4	1,033	0.5%	97%
4B	Emissions from manure management : cattle	CH4	897	0.4%	97%
1A	Mobile combustion: water-borne navigation	CO2	877	0.4%	97%
7	Misc. CO2	CO2	735	0.3%	98%
1A	Emissions from stationary combustion: non-CO2	CH4	567	0.3%	98%
1A	Mobile comustion: aircraft	CO2	492	0.2%	98%
1A	Feedstock coal	CO2	481	0.2%	99%
4A	CH4 emissions from enteric fermentation in domestic livesto	CH4	439	0.2%	99%
2	Emissions from cement production	CO2	300	0%	99%
4A	CH4 emissions from enteric fermentation in domestic livesto	CH4	286	0%	99%
2	Emissions from substitutes for ozone depleting substances (O	HFC	260	0%	99%
1A	Mobile combustion: other	N2O	230	0%	99%
	Emissions from stationary combustion: non-CO2	N2O	217	0%	99%
4B	Emissions from manure management	N2O	217	0%	99%
4B	Emissions from manure management : poultry	CH4	216	0%	100%
2	SF6 emissions from SF6 use	SF6	174	0%	100%
1A	Mobile combustion: road vehicles	CH4	164	0%	100%
6B	Emissions from wastewater handling	N2O	155	0%	100%
7	Misc. N2O	N2O	155	0%	100%
6B	Emissions from wastewater handling	CH4	132	0%	100%
2	Other industrial: CH4	CH4	71	0%	100%
2	PFC emissions from PFC use	PFC	68	0%	100%
7	Misc. CH4	CH4	42	0%	100%
4A	CH4 emissions from enteric fermentation in domestic livesto	CH4	40	0%	100%
4B	Emissions from manure management : other	CH4	17	0%	100%
			217,065		
Included elsewhere or not occuring:					
2	Other industrial: N2O	N2O	IE		
1B	Fugitive emissions from oil and gas operations: other	CH4	IE		
2	Emissions from iron and steel industry	CO2	IE		
2	Emissions from lime consumption	CO2	IE		
2	Other industrial: N2O	N2O	IE		
2	PFC, HFC, SF6 emissions from semiconductor manufacturin;	PFC	IE		
4B	Emissions from agricultural residue burning	n-CO2	NO		
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.

Note: Based on preliminary version of CRF data files.

Table 5.4. Source ranking using IPCC Tier 1 trend assessment (amounts in Gg CO_2-eq.).

IPCC	Source category	Gas	CO_2-eq. 90/95	CO_2-eq. 1999	Level assess-ment 90/95	Level assess-ment 99	Trend assessment	% Contr. to trend	Cumu-lative total
1A	Emissions from stationary combustion: coal	CO2	34934	30001	16%	13%	3.6%	26%	26%
6A	CH4 emissions from solid waste disposal sites	CH4	11804	8994	5%	4%	2.0%	15%	41%
1A	Emissions from stationary combustion: gas	CO2	66888	75247	31%	33%	1.7%	12%	53%
1A	Mobile combustion: road vehicles	CO2	25374	31111	12%	14%	1.5%	11%	64%
4A	CH4 emissions from enteric fermentation: cattle	CH4	7678	6280	4%	3%	1.0%	7%	71%
1A	Feedstock oil	CO2	4273	5922	2%	3%	0.4%	3%	74%
1A	Emissions from stationary combustion: oil	CO2	17600	17842	8%	8%	0.3%	3%	77%
1A	Feedstock gas	CO2	5262	6507	2%	3%	0.3%	2%	79%
2	Emissions from nitric acid production	N2O	9773	11206	5%	5%	0.3%	2%	82%
4D	Direct N2O emissions from agricultural soils	N2O	5208	6296	2%	3%	0.3%	2%	84%
1B	Fugitive emissions from oil and gas: gas production	CH4	2092	1723	1%	1%	0.3%	2%	86%
2	HFC-23 emissions from HCFC-22 manufacture	HFC	6464	7519	3%	3%	0.2%	2%	87%
1B	Fugitive emissions from oil and gas: gas distribution	CH4	1657	1306	1%	1%	0.2%	2%	89%
2	PFC emissions form aluminium production	PFC	1799	2471	1%	1%	0.2%	1%	91%
7	Misc. CO2	CO2	735	1722	0%	1%	0.2%	1%	92%
2	Other industrial: CO2	CO2	1601	1408	1%	1%	0.14%	1%	93%
4B	Emissions from manure management : cattle	CH4	897	766	0%	0%	0.09%	1%	94%
2	Emissions from substitutes for ODS substitutes: HFC	HFC	260	1317	0%	1%	0.09%	1%	94%
4B	Emissions from manure management : swine	CH4	1033	925	0%	0%	0.08%	1%	95%
1A	Mobile combustion: water-borne navigation	CO2	877	807	0%	0%	0.06%	0%	95%
1A	Feedstock coal	CO2	481	400	0%	0%	0.06%	0%	96%
1A	Mobile combustion: other	CO2	2352	2362	1%	1%	0.06%	0%	96%
1A	Emissions from stationary combustion: non-CO2	N2O	217	145	0%	0%	0.06%	0%	96%
1A	Mobile comustion: aircraft	CO2	492	420	0%	0%	0.05%	0%	97%
1A	Mobile combustion: road vehicles	N2O	1407	1629	1%	1%	0.05%	0%	97%
1A	Mobile combustion: road vehicles	CH4	164	105	0%	0%	0.05%	0%	98%
6B	Emissions from wastewater handling	CH4	132	79	0%	0%	0.04%	0%	98%
4D	Indirect N2O emissions from nitrogen used in agriculture	N2O	1457	1460	1%	1%	0.04%	0%	98%
1A	Emissions from stationary combustion: non-CO2	CH4	567	525	0%	0%	0.04%	0%	98%
4A	CH4 emissions from enteric fermentation: sheep	CH4	286	235	0%	0%	0.04%	0%	99%
7	Polluted surface water	N2O	1178	1178	1%	1%	0.03%	0%	99%
2	SF6 emissions from SF6 use	SF6	174	137	0%	0%	0.03%	0%	99%
2	Emissions from cement production	CO2	300	376	0%	0%	0.02%	0%	99%
4A	CH4 emissions from enteric fermentation: swine	CH4	439	427	0%	0%	0.02%	0%	99%
4B	Emissions from manure management	N2O	217	198	0%	0%	0.02%	0%	99%
2	Other industrial: CH4	CH4	71	52	0%	0%	0.01%	0%	100%
4B	Emissions from manure management : poultry	CH4	216	200	0%	0%	0.01%	0%	100%
2	PFC emissions from PFC use	PFC	68	118	0%	0%	0.01%	0%	100%
4A	CH4 emissions from enteric fermentation: other	CH4	40	26	0%	0%	0.01%	0%	100%
7	Misc. N2O	N2O	155	188	0%	0%	0.01%	0%	100%
1A	Mobile combustion: other	N2O	230	225	0%	0%	0.01%	0%	100%
7	Misc. CH4	CH4	42	41	0%	0%	0.00%	0%	100%
4B	Emissions from manure management : other	CH4	17	21	0%	0%	0.00%	0%	100%
6B	Emissions from wastewater handling	N2O	155	164	0%	0%	0.00%	0%	100%
	TOTAL		217,065	230082	100%	100%	14%	100%	

NO = Not Occuring; NA = Not Applicable; IE = Included Elsewhere: see *Table 5.2*.
Sources: Van Amstel *et al.* (2000a), IPCC (2000) and own RIVM expert judgement of uncertainties.
Note: Based on preliminary version of CRF data files.

Table 5.5. 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, T	Key	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				CS	CS
1A	CO2	Mobile comustion: aircraft				CS	CS
1A	CO2	Mobile combustion: other				CS	CS
1A	CO2	Feedstock gas	L	L, T	Key (L)	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 (T,T2)	CS, T2	CS
1A	N2O	Emissions from stationary combustion: non-CO2				CS	PS, D
1A	N2O	Mobile combustion: road vehicles	L, Q	Q	Key (L,T1;Q)	CS, T2	CS
1B	CH4	Fugitive emissions from oil and gas: gas production	L, T	L, T	Key	CS	CS
1B	CH4	Fugitive emissions from oil and gas: gas distribution	L, T	L, T	Key	CS, T1	CS
		INDUSTRIAL PROCESSES					
2	CO2	Emissions from cement production	T		Key (T, T1)	CS	PS, CS
2	CO2	Other industrial: CO2	T	L, 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	T1, CS	D/PS
2	F-gas	HFC-23 emissions from HCFC-22 manufacture	L, T	L, T	Key	CS	M, PS
2	F-gas	Emissions from substitutes for ODS substitutes: HFC	T	T	Key (T)	CS, T2	CS
2	F-gas	PFC emissions from aluminium production	L, T	L, T	Key (L,T)	CS	M, PS
2	F-gas	PFC emissions from PFC use	L, T		Key (T1)	T2	D
2	F-gas	SF6 emissions from SF6 use				T2	CS
		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	L, T		Key (T1)	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		T	Key (T,T2)	CS	CS (=D, corrected)
4B	CH4	Emissions from manure management : swine		T	Key (T,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	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				CS	CS
6B	N2O	Emissions from wastewater handling				CS	CS
		OTHER					
7	CO2	Misc. CO2	T	T	Key (T)	CS	CS
7	CH4	Misc. CH4				CS	CS
7	N2O	Polluted surface water				CS	CS
7	N2O	Misc. N2O				CS	CS
			21	22	of 47		
	Included elsewhere or not occuring:					CS = country-specific	
1B	CH4	Fugitive emissions from oil and gas operations: other	IE			T1 = IPCC Tier 1	
2	N2O	Other industrial: N2O	IE			T2 = IPCC Tier 2	
2	CO2	Emissions from iron and steel industry	IE		Key (L)	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 manufacturin	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	

Q : Trend in N_2O from road transport is contrary to what most countries report.

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

6. Quality Assurance/Quality Control

6.1. Introduction

The national *Pollutant Emission Register* (PER), also called the Emission Inventory System, compromises the registration, analysis, localisation and presentation of emission data of both industrial and non-industrial sources in the Netherlands. Agreement on definitions, methods and emission factors, based on reports by expert groups, is established in the *Co-ordination Committee for Monitoring of Target Groups* (CCDM). The 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)
- 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).

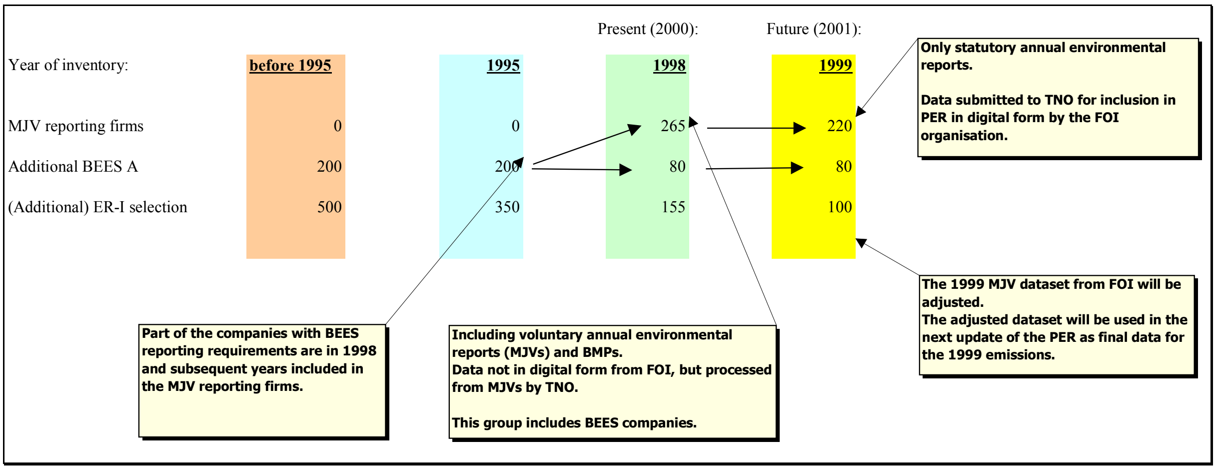
The emissions of large industrial point sources are registered individually, based upon detailed information of each individual plant. This process, however, has been changed substantially in the last years (see *Box 6.1* and *Figure 6.1*). The emissions of small and medium-sized enterprises as well as non-industrial sources are calculated collectively with statistical activity data and emission factors. So-called *Task Groups* collect the data required and perform the emission calculations. 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 2000 emissions were (re)calculated for 1990, 1995, 1997, 1998 and 1999.

6.2. Quality Assurance

The Inspectorate of the Ministry of VROM commissions TNO to draft a detailed plan for the compilation of the emission inventory for next 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.

Formal Quality Assurance system for the Netherlands' PER

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 calculations by the Task Groups are not yet part of the formal ISO quality assurance program.



Note: For abbreviations see Box 6.1.

Figure 6.1. Changes in time in data sources used for the individually registered point sources in the PER

Box 6.1: 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 6.1*). 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. The Pollutant Emission Register (PER) has used these reports since 1996 for more and more companies.

For the 1998 PER, a large group of companies had already voluntarily reported their emissions in the format of the *annual environmental reports* (*MJVs*). These were processed by TNO and included in the ER-I database. Furthermore, also in previous years, companies within the framework of covenants already voluntarily reported emissions in a less-detailed format than the annual environmental reports (so-called *BMP tables*). The two formerly mentioned groups of large companies totalled a number of 265. In addition, information on fuel consumption and NO_x and SO_2 emissions was submitted by all companies required to do so under the *'BEES A' regulation* (large combustion plants). The fuel consumption and emissions data of this group was also used for compiling the ER-I dataset. In addition TNO collected data from 155 industries according to the 'old' method. This data set was used to compile the CRF data for 1998 (final data) and was also used to make the preliminary estimate for the CRF data for 1999.

At present (2000), the PER from 1999 onwards will be based on annual environmental reports of the large companies (220), which are, by virtue of statutory obligation, prepared by the companies themselves. The regulating authorities such as the provinces must approve the emissions in these reports. In addition, data from 80 large combustion plants (not covered by the law on environmental reports) are incorporated in the PER. Moreover, continuing the old method, activity and emissions data will still be collected by TNO from another 100 industries that have emissions of sizeable amounts for one or more compounds covered in the PER.

Experience from the 1998 and 1999 annual environmental reports revealed flaws in some of the environmental reports of individual companies, in particular in the division of emissions into combustion and non-combustion ('process') emissions as well as in the fuel consumption data. This could only be partially resolved in the 1998 dataset by adjustments using data from earlier years, because the underlying information (e.g. production volume and technology used for reduction of emissions) was often not present in the reports.

For the 1999 dataset these problems appeared to be even larger. Therefore, at the end of 2000 the Ministry of VROM started an extensive programme to improve the quality of the 1999 dataset, the results of which will be reported in the National Inventory Report of 2002. Enhancing the data quality of the point sources will also improve the quality of the (supplementary) emissions estimate made by the ER Task Group for the remaining (non-ER-I) sources within the industry sector.

For the emissions of 1999 and subsequent years, the annual environmental reports will be collected and, after approval by the provinces, processed and included in a database by the *Facilitating Organisation for Industry* (FOI). Subsequently, the resulting dataset will be included in the PER. Quality control in this new system is still subject of discussion.

Documentation of methodologies

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.* (2000) [in Dutch]. These reports also summarise the quality of national total emissions of several compounds by a qualitative classification based on expert judgement in terms of shares of quality classes A to E in conformity with EMEP/CORINAIR and EPA methods. A summary of these reports is also published in English, e.g. Koch *et al.* (2001);
- a set of source category reports documenting or summarising the methodology used by the Task Groups is in preparation (so-called meta-data files).

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

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:

- 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.
- A UNFCCC Review Team has reviewed the second National Communication of the Netherlands, including the Chapter on greenhouse gas emissions and sinks. The final report has not yet been published.
- 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).

In addition, 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). In general, this wider group endorsed the quality assessments made by ER Task Group members. These discussions also resulted in various recommendations for improvement.

Inventory improvement programme

The preparation of the greenhouse gas emissions inventory 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).

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. To initiate this process, two national workshops were held in September and November 1999, where experts of Dutch research institutes discussed the uncertainties of the inventory of greenhouse gas emissions and CO_2 sinks, respectively, and where areas for improvement were identified (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 be fed into the regular ER project activities. The WEB and its Project Groups on CO_2, non-CO_2 and Sinks are composed of persons from the same ministries and institutes involved in the Emission Registration project in order to include the appropriate expertise and for optimal communication with the parties of the ER project.

6.3. Quality Control

The Quality Control (QC) activities of the Dutch Emission Inventory in 2000 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 'EAJR report'.

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 1997, 1998 and 1999 and for the years 1995 and 1990. The emission file is checked by the chairmen of the Task Groups and then sent to TNO at the end of May.

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 in the middle of June 2000 the new file to the chairmen.

At the end of June 2000, for the first time a workshop was held at the RIVM 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 carbon dioxide, methane and nitrous oxide emissions of all sectors for all years 1990, 1995, 1997, 1998 and 1999. Firstly, the totals for the sectors are compared with the 1999 inventory. 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 are 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 are 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 are 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 the inventory compilation of 2001.

Box 6.2 Results of the trend verification workshop

Task Group Residential, Commercial and Construction sectors:
Results and actions at the workshop:
- Corrected TNO: combustion emissions of households contain doublings.
- Corrected RIVM, TNO: emission figures are missing for some years

Task Group Energy, Industry and Waste Handling:
Criteria for the checks were:
- 1990 and 1995 emissions must be the same compared to the previous inventory
- Differences between 1997 and 1998 must be explainable

For the sectors were differences are found, the emissions were checked in more detail. These differences were communicated with TNO. Results and actions at the workshop:
- Action: trend analysis was difficult because information about changes in methods is not fully documented. The Task Group concluded that all Task Groups should document changes in methods and delivered together with the emission spreadsheet.
- Action ER-collective: track changes in the participating companies
- Action TNO, RIVM: Process emissions of the agricultural sector may not be complete
- Action TNO, RIVM: check difference between emission files for carbon dioxide emissions of refineries
- Action TNO: check emissions of processing of waste, these may contain doublings
- Action TNO, RIVM: check methods for emission estimations of nitrous oxide of the fertiliser industry
- Action TNO: methane emissions of the energy sector are missing for some years

Task group Agriculture:
Results and actions at the workshop:
- Decision: no recalculation of nitrous oxide emissions is needed based on new insights in historical ammonia emissions because no significant changes are expected.
- Action TNO: check nitrous oxide emissions of the agricultural sector for 1998, 1999.

Task group Traffic and Transport:
- No bottlenecks observed.

Verification at IPCC source category level after finalising the new inventory

The annually published national emissions report (Van Harmelen *et al.,* 2000) contains the IPCC Summary Tables 7A for the last three years (1997 to 1999). 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:

- the levels for 1997 and 1998 are compared with the table published last year;
- annual trends for 98/97 and 99/98 are calculated as percentages.

The NIR co-ordinator summarises 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 is all 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.

6.4. CO_2 Reference Approach

Included in the CRF files is a *provisional* calculation of the *IPCC Reference Approach* (RA) for CO_2 from energy 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 6.1* the results of the Reference Approach calculation are presented for 1990-1999 and compared with the official national totals. The difference varies between -0.4% and +2.5% with an average of 1.0%. For most years the difference is below 2%, except for 1994 and 1995, where the difference with the preliminary RA data is 2.5% and 2.0%, respectively. For 1990 the difference is 0.6%.

We recall, that for 1990-1998 CO_2 emissions associated with statistical differences in coal, oil and gas consumption are included in the national approach, whereas for 1999 the statistical difference has been effectively eliminated from the national energy balance (see Chapter 4 and Section 7.1.6).

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). Currently, 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. This study is part of the greenhouse gas inventory improvement programme.

Table 6.1. Trend in CO_2 emissions according to the Reference Approach and to the National Approach (Gg)*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Liquids	50554	52156	51866	50499	51492	56304	56557	58838	58228	56338
Solids	35415	32119	31346	32794	33156	37156	36766	36215	36353	30401
Gaseous	71693	80204	77740	80092	77964	79621	87597	82459	81538	80592
Total	**157662**	**164478**	**160952**	**163386**	**162612**	**173082**	**180920**	**177512**	**176119**	**167331**
National Approach	**158536**	**164860**	**163430**	**165890**	**166750**	**172950**	**180121**	**178266**	**177395**	**170619**
Difference	0.6%	0.2%	1.5%	1.5%	2.5%	-0.1%	-0.4%	0.4%	0.7%	2.0%

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

7. Trends in greenhouse gas emissions

In this chapter the trends in emissions are presented per IPCC category in tabular and graphic form. We recall that the data for 1999 are all preliminary data. The figures show both percentage change of emissions between 1999 and 1990 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 5 for the uncertainty estimate in annual emissions and in the overall trend.

7.1. Emissions and Sinks of CO_2

Trends in emissions per IPCC sector have been summarised in *Table 7.1*. In 1999 net total CO_2 emissions increased by about 8% compared to 1990 (7% when comparing temperature-corrected emissions; see Section 7.1.1). We have to note, however, that the emissions in 1999 are not completely consistent with the previous years, due to the exclusion of the CO_2 from statistical differences reported under category *1A5: 'Other'* (see Section 7.1.6). In addition, in 1999 the emissions from the electric power generation sector decreased by 5% due to the much higher import of electricity (and to a shift in the fuel mix). The largest increase of emissions (5.6 Tg) occurred by the transport sector (*Figure 7.1*). 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 5). 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.

Figures for CO_2 sequestration in sinks (IPCC category 5) have just been kept constant in view of future changes to comply with Kyoto Protocol definition.

Table 7.1. CO_2 emissions and sinks per IPCC sector 1990-1999 (no T-correction) (1000 Gg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL NET NATIONAL EMISSIONS	**161.2**	**166.9**	**165.2**	**167.5**	**168.4**	**177.1**	**184.7**	**181.2**	**180.9**	**174.1**
1. All Energy (combustion and fugitive)	**159.2**	**165.3**	**163.8**	**166.2**	**166.9**	**175.2**	**183.0**	**179.3**	**178.9**	**172.1**
A Fuel combustion total	158.5	164.9	163.4	165.9	166.8	174.2	182.0	178.3	177.4	170.6
1 a Electricity and heat production	41.2	41.6	43.3	43.2	44.8	45.0	47.0	45.9	47.8	44.9
1 c Other transformation	10.9	10.6	10.9	10.6	11.2	12.3	11.9	12.0	12.2	12.2
2 Industry	41.9	42.7	42.5	39.9	41.0	43.4	42.1	44.5	44.0	43.5
3 Transport	29.1	28.6	29.8	30.5	30.8	32.0	33.8	33.1	34.0	34.7
4 a Commercial / Institutional	7.1	10.3	9.4	10.6	10.1	9.4	10.9	8.6	9.2	8.5
4 b Residential	19.8	21.6	19.5	20.6	19.6	20.6	24.0	20.1	19.1	19.1
4 c Agriculture / Forestry / Fishing	7.4	8.5	8.5	8.8	8.8	8.9	10.3	7.7	7.5	7.8
5 Other	1.1	1.1	-0.4	1.7	0.6	2.5	2.0	6.3	3.6	0.0
B Fugitive fuel emissions	0.6	0.5	0.4	0.4	0.2	1.0	1.0	1.0	1.6	1.5
2 Crude oil and natural gas	0.6	0.5	0.4	0.4	0.2	1.0	1.0	1.0	1.6	1.5
2. Industrial processes (ISIC)	**1.9**	**1.5**	**1.3**	**1.2**	**1.4**	**1.6**	**1.7**	**1.7**	**1.8**	**1.8**
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**
5. Land use change and forestry	**(-1.50)**	**(-1.60)**	**(-1.60)**	**(-1.60)**	**(-1.70)**	**(-1.70)**	**(-1.70)**	**(-1.70)**	**(-1.70)**	**(-1.70)**
6. Waste	**0.1**	**0.0**	**0.0**	**0.0**	**0.0**	**0.4**	**0.0**	**0.1**	**0.2**	**0.2**

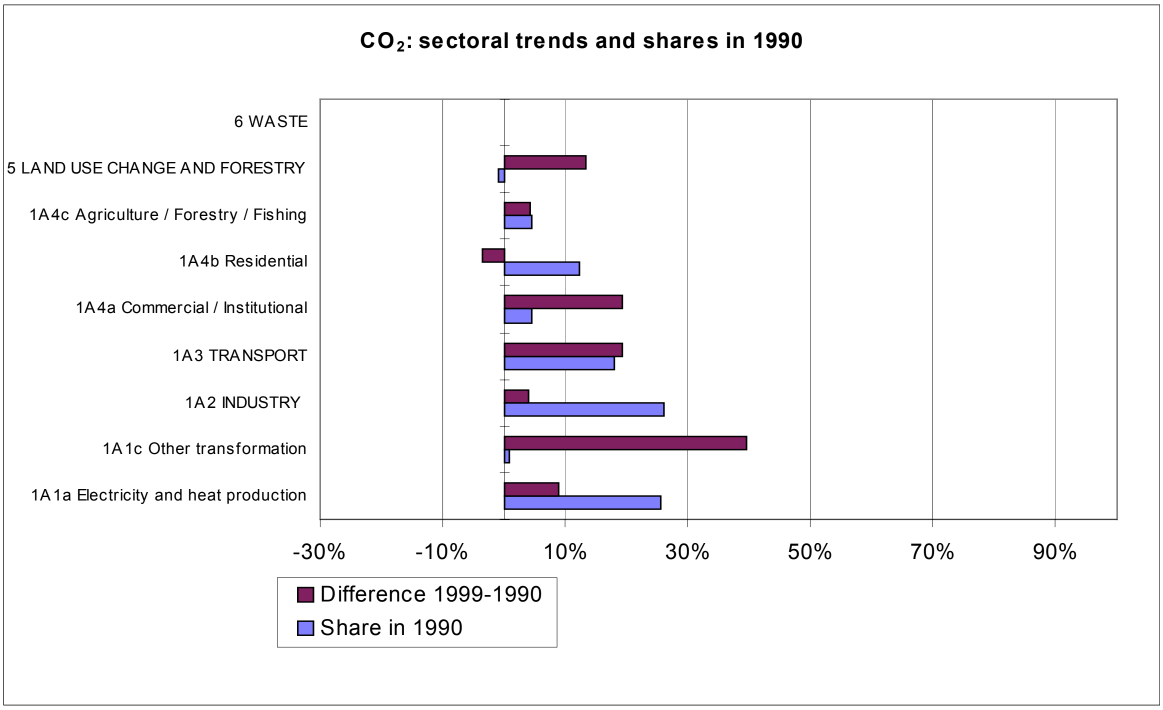


Figure 7.1 CO_2 emission shares and trends per IPCC sector 1990-1999 (no T-corr.)

7.1.1. 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 and 1999 winters were relatively warm, whereas the winter of 1996 was relatively cold.

Table 7.2. Temperature-correction values for energy and CO_2 emissions per IPCC sector 1990-1999.

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Heating degree days (HDD-t) [HDD]		2677	3163	2829	3076	2835	2917	3504	2929	2821	2676
HDD: 30-year moving average (HDD-av)		3211	3198	3203	3177	3156	3140	3124	3135	3133	3118
T correction factor (= HDD-av/HDD-t)		**1.199**	**1.011**	**1.132**	**1.033**	**1.113**	**1.076**	**0.892**	**1.07**	**1.111**	**1.165**
Space heating natural gas [PJ]											
1A1a	electricity and heat production	2.9	0.2	2	0.5	2	1.4	-2.2	1.2	2.0	3.7
1A2a-e	industry	13.8	0.9	8	2.1	7.1	5	-5.4	2.9	7.2	10.5
1A4a	commercial / institutional	22.5	1.4	16.1	4.3	14.3	9.6	-16.6	9.1	15.7	18.2
1A4b	households	51.8	3.2	36.1	9.1	29.8	20	-36.1	20	29.1	41.9
1A4c	agriculture / forestry / fishing	21	1.3	15	3.9	13.6	9.1	-15.8	8.8	12.0	19.0
TOTAL correction gas consumption [PJ]		**111.9**	**7**	**77.1**	**19.9**	**66.8**	**45.1**	**-76.1**	**41.9**	**66.0**	**93.3**
Emissions CO2 [Gg]											
1A1a	electricity and heat production	160	10	110	30	110	80	-120	60	110	210
1A2a-e	industry	770	50	450	120	400	280	-300	160	400	590
1A4a	commercial / institutional	1260	80	900	240	800	540	-930	510	880	1020
1A4b	households	2900	180	2020	510	1670	1120	-2020	1120	1630	2340
1A4c	agriculture / forestry / fishing	1180	70	840	220	760	510	-880	490	670	1060
TOTAL correction CO2 emissions [Gg]		**6270**	**390**	**4320**	**1110**	**3740**	**2530**	**-4260**	**2350**	**3690**	**5220**

For policy purposes, trends in CO_2 emissions are therefore corrected for climate variation of fuel consumption for space heating. In *Table 7.2* we present the temperature correction used by RIVM in the trend analysis of sectoral CO_2 emission trends, which is only applied to natural gas consumption since the amount of other fuels used for space heating is negligible. A description of the methodology for this correction is provided in Appendix A. 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 varies between -11% in 1996 to +20% in 1990. In 1999, CO_2 emissions were corrected by 5.2 Tg or 3.0% of total national emissions, while 1990 emissions have been corrected by 6.3 Tg or 3.9%.

7.1.2. CO_2 emissions from the energy sector

The trend in emissions of CO_2 from the energy sector is summarised in *Table 7.3*. Between 1990 and 1999 the emission increased with 9% from 52.1 to 57.0 Tg. The increase is almost completely due to the increase of the emission from the public electricity sector. This trend corresponds with the increase of the use of fuel by power plants, the shift from solid fuels (coal) to gaseous fuels (natural gas), and the increase of the efficiency of power plants.

As can be seen from *Table 7.3* the emissions of CO_2 increase up to 1998. In 1999 however the emissions are 5% lower than in 1998, while the use of electricity in the Netherlands in 1999 is 2% higher than in 1998 (*Table 7.4*). This difference in trends is due to the increased import in 1999, which almost doubled compared with 1998, and to a relatively large shift from coal to natural gas and oil in 1999 (*Figure 7.2*). The higher import corresponds with an emission of 2 to 3 Tg CO_2; the shift from coal to natural gas and oil with about 1 Tg CO_2.

Table 7.3. CO_2 emissions from the energy sector in the Netherlands 1990-1999 (Tg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total	**52.1**	**52.2**	**54.1**	**53.8**	**56.0**	**57.3**	**57.0**	**57.9**	**60.0**	**57.0**
Public Electricity and Heat Production	41.2	41.6	43.3	43.2	44.8	45.0	45.1	45.9	47.8	44.9
Liquid Fuels	0.2								0.1	0.1
Solid Fuels	25.5								26.7	23.0
Gaseous Fuels	13.8								19.0	19.8
*Other Fuels/Unspecified emissions**	1.7								1.9	1.9
Petroleum Refining and Other Energy Industries	10.9	10.6	10.9	10.6	11.2	12.3	10.4	10.4	10.3	10.5

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 7.2*.

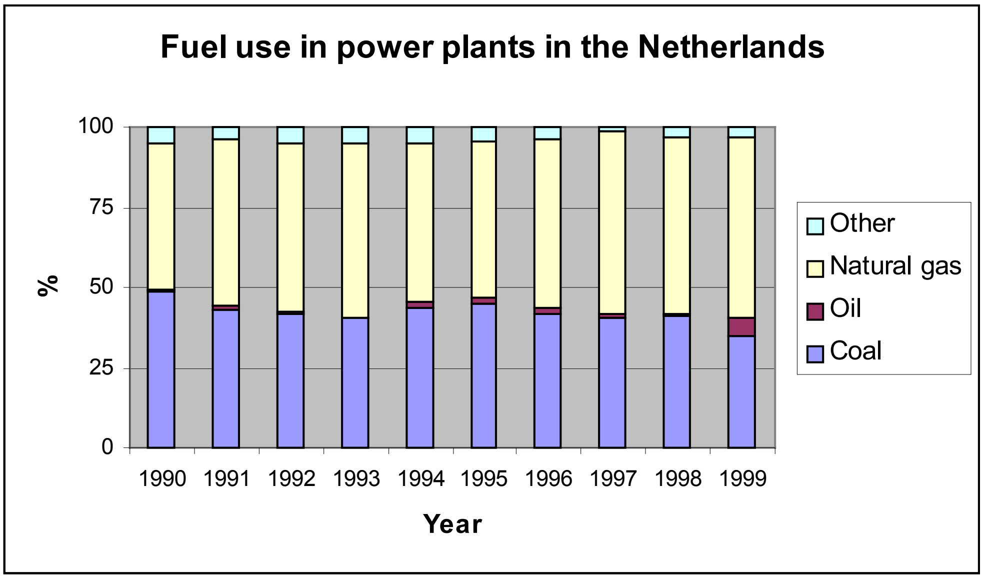


Figure 7.2. Fuel use by power plants in the Netherlands 1990-1999 (CBS, several years)

Table 7.4. Gross production, import, export, and gross consumption of electricity in the Netherlands (mln kWh). Source: CBS, 2000a.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gross production	71853	74352	77196	76943	79677	81043	85234	86659	90981	86669
Fossil fuel, non-CHP	56080	58272	58963	56770	57743	56752	56716	58234	58443	51294
Nuclear	3502	3329	3800	3948	3967	4018	4160	2408	3814	3832
CHP and other	12271	12752	14434	16225	17967	20273	24358	25927	28724	31543
Import	9679	9778	8904	10572	10850	11979	11288	13107	12234	22408
Export	471	623	227	269	289	586	699	475	420	3968
Gross domestic use	81061	83508	85874	87246	90238	92436	95823	99201	102795	105109

7.1.3. CO_2 emissions from industry

Between 1990 and 1999 the emissions of CO_2 due to fossil fuel use by industry has increased from 41.8 to 43.5 Gg (+4%). This includes actual emissions of CO_2 from feedstock use of energy carriers of 9.1 and about 9.5 Tg, respectively (*Table 7.5*). Compared to the growth of industrial production in this period of 21% (in monetary units), the increase of 4% is relatively low. This difference can be explained by energy conservation and by a shift from the use of coal to natural gas. Between 1989 and 1998, the Netherlands' industry has attained an improvement of its energy efficiency of about 16%, which is equivalent with an energy conservation of 137 PJ (EZ, 1999) or 8 to 13 Tg CO_2 emissions (depending on the fuel mix assumed). The shift from coal to natural gas (67 PJ) is equivalent to 2 Tg CO_2. 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 2.2.2 on allocation CHP to either the industry or the energy sector).

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 7.5* and *7.6* the CO_2 emitted and stored in feedstock products as included in the *Reference Calculation for CO_2*. We stress however, that the amounts actually included in the sectoral approach, which is to a large extent based on reports by individual companies, may differ substantially. According to this *Reference Calculation* the feedstock emissions can vary substantially from year to year, but overall they remain at the same level. In the 1990-1999 period between 14 and 18 Tg CO_2 is annually stored in the products (*Table 7.6*).

Table 7.5. Trend in CO_2 emitted by feedstock use of energy carriers according to the CO_2 Reference Approach (Gg)*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Liquids	3858	4207	3835	3065	3182	3515	2559	3070	3209	3796
Solids	481	416	417	372	1788	386	433	417	408	NE**
Gaseous	4803	5144	5102	4866	5172	5510	5283	5667	5390	5345
Total	**9142**	**9767**	**9353**	**8303**	**10141**	**9411**	**8275**	**9154**	**9008**	**9141**

* 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 according to the old definition.

Table 7.6. Trend in CO_2 storage in feedstocks according to the default CO_2 Reference Approach (Gg)*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Liquids	17299	18008	16790	14265	14536	15662	12152	12622	12960	17299
Solids	610	610	550	702	558	680	710	749	754	610
Gaseous	534	534	567	541	575	612	587	630	599	534
Total	**18443**	**19152**	**17907**	**15508**	**15669**	**16954**	**13449**	**14001**	**14313**	**18443**

* Using country-specific carbon storage factors.

7.1.4. CO_2 emissions from transport

By far the largest contributor to this sector is road transport, which accounted in 1990 for 87% (*Table 7.7*). Next are off-road vehicles, contributing about 8% in 1990. These are used in agriculture and for building and road construction. CO_2 emissions from total transport have increased by 19% in the period 1990-1999.

Table 7.7. CO_2 emissions from transport in 1990 and 1999, by transport mode (Tg)

Transport mode	Emissions 1990	Share	Emissions 1999	Increase 99/90	99/90 (%)
Road Transportation	25.4	87%	31.1	5.7	23%
Other Transportation (off-road vehicles)	2.3	8%	2.3	0.0	0%
Internal Navigation	0.9	3%	0.8	-0.1	-8%
Civil aviation	0.5	2%	0.4	-0.1	-15%
Railways	0.1	0%	0.1	0.0	3%
Total	**29.1**	**100%**	**34.7**	**5.6**	**19%**

This increase is predominantly caused by an increase in energy consumption by road transport, of which fuel consumption increased by 22% in this period. In *Table 7.8* 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 from 45% in 1990 to 51% in 1999.

Another observation that can be made from *Table 7.8* 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 +3%, with an average of 1.6%, but rather by diesel and LPG figures, which differ annually up to -25%, with an average of about -12 and -16% for diesel and LPG, respectively (*Figure 7.3*). 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 7.4*, per fuel type the annual differences have the same sign for the whole period and for LPG the discrepancy tends to increase in the last five years. However, it can be concluded that by and large, both methods show similar trends in fuel consumption by fuel type over the last 10 years.

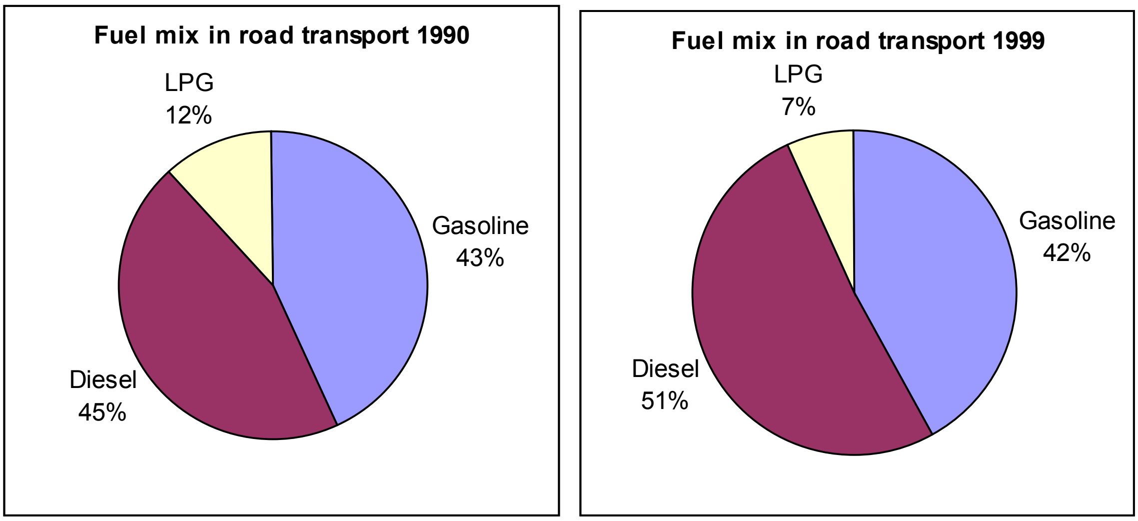


Figure 7.3 Shares of gasoline, diesel and LPG in fuel consumption for road transport 1990 and 1999.

Table 7.8. Fuel consumption by road transport 1990-1999: fuel supply versus fuel consumption based on road transport statistics

A. Fuel supply for road transport (IPCC Approach)											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**99/90**
Gasoline (supply)	152.0	152.4	158.3	167.2	169.8	175.1	177.1	176.5	178.2	180.7	19%
Diesel (supply)	159.1	163.2	174.9	176.4	180.4	183.8	192.8	198.4	207.0	219.9	38%
LPG (supply)	41.0	39.8	39	37.2	35.3	34.1	33.5	33.3	32.8	29.1	-29%
Total (supply)	**352.1**	**355.4**	**372.2**	**380.8**	**385.5**	**393.0**	**403.4**	**408.2**	**418.0**	**429.6**	**22%**

B. Fuel consumption based on vehicle-km (National Approach)											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**99/90**
Gasoline (consumption)	151.6	154.1	162.9	167.1	173.0	176.9	181.1	182.3	180.6	185.6	22%
Diesel (consumption)	135.6	143.8	150.9	149.1	154.0	164.5	167.3	175.2	186.4	201.8	49%
LPG (consumption)	36.1	36.6	34.5	31.0	31.4	30.0	26.2	26.7	24.5	23.4	-35%
Total (consumption)	**323.2**	**334.5**	**348.3**	**347.2**	**358.4**	**371.3**	**374.5**	**384.3**	**391.4**	**410.8**	**27%**

C. Difference between approaches [(B-A)/A]											
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**Average**
Gasoline	0%	1%	3%	0%	2%	1%	2%	3%	1%	3%	1.6%
Diesel	-15%	-12%	-14%	-15%	-15%	-11%	-13%	-12%	-10%	-8%	-12.4%
LPG	-12%	-8%	-12%	-17%	-11%	-12%	-22%	-20%	-25%	-19%	-15.8%
Total (consumption)	**-8%**	**-6%**	**-6%**	**-9%**	**-7%**	**-6%**	**-7%**	**-6%**	**-6%**	**-4%**	**-6.6%**

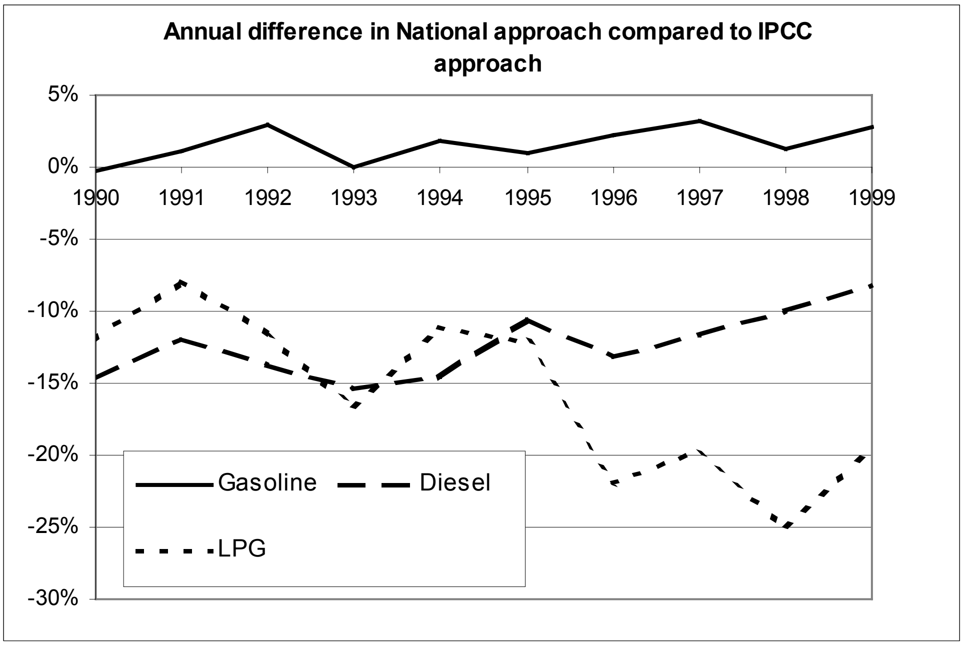


Figure 7.4. Annual differences per fuel type between fuel consumption according to the national approach (based on v-km statistics) and the IPCC approach (based on fuel deliveries to fuelling stations).

7.1.5. CO_2 emissions from the other sectors

This sector comprises the residential sector, commercial/institutional services and agriculture. As can be observed from the temperature correction data in *Table 7.2*, 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. Without temperature correction, the emissions in these sectors changed by -4, +19 and +4% in the 1990-1999 period (*Table 7.1*); with temperature correction these changes are -6, +14, and +2% (*Table 7.9*).

Table 7.9. Temperature-corrected CO_2 emissions from the residential, commercial and agricultural sectors (Tg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Residential sector	22.7	21.8	21.5	21.2	21.2	21.8	22.0	21.2	20.8	21.4
Commercial sector	8.4	10.4	10.3	10.9	10.9	10.0	10.0	9.1	10.1	9.5
Agriculture	8.6	8.5	9.3	9.0	9.5	9.4	9.4	8.2	8.2	8.8
Total	**39.7**	**40.7**	**41.1**	**41.0**	**41.7**	**41.1**	**41.4**	**38.5**	**39.0**	**39.7**

The decrease of 6% in the residential sector seems incompatible with the increase of the number of inhabitants and households in the Netherlands (*Figure 7.5*), but can be explained by the increase of energy conservation by households in the past decades. 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, 2000a).

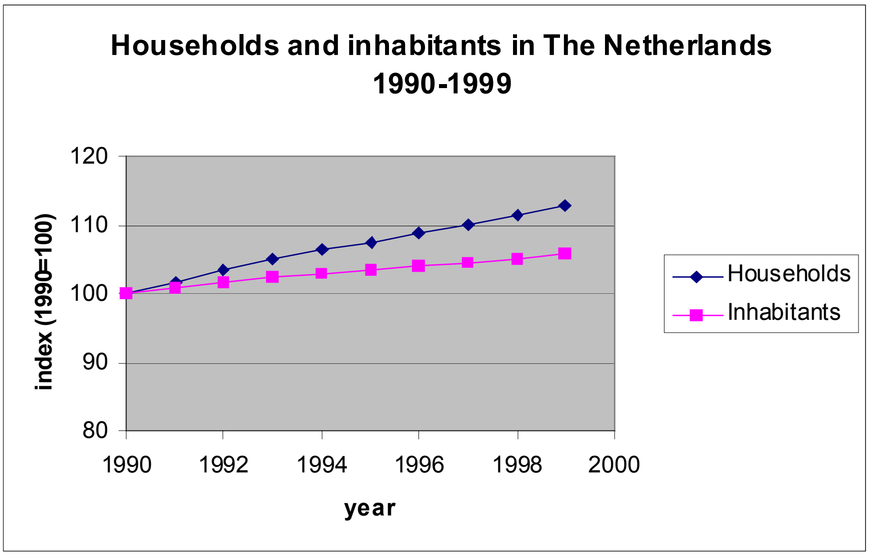


Figure 7.5. Development of the number of inhabitants and households in the Netherlands (1990-1999)

For the commercial/institutional sector the increase between 1990 and 1999 of persons employed of 31% is significantly higher than the 14% increase of the temperature-corrected CO_2 emissions (RIVM/CBS, 2000b). Part of this difference is due to energy conservation measures implemented in the sector.

Temperature-corrected CO_2 emissions from the agricultural sector increased by 4% in the last ten years. This is mainly due to energy consumption 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) 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 cogeneration facilities, which may also provide electricity to the public grid.

7.1.6. CO_2 emissions related to statistical differences

As was mentioned in Chapter 4, the fuel use related to statistical differences is included in the Netherlands' inventory as a source of CO_2, since it has been assumed that the associated fuel use is real but not accounted for in individual enduse sectors. The statistical difference between supply and demand is usually smaller than 2%. Per energy carrier, however, the difference may vary both in sign and size, as is shown in *Table 7.10*. In recent years the statistical differences for coal and oil products have increased substantially, probably due to the decrease of administrative burden for importing and exporting goods between EU countries.

However, this approach had to be abandoned in 1999, because in the 1999 national energy balance the statistical difference was effectively eliminated through incorporation in either export or domestic consumption/loss figures. Since the energy balances for previous years have not been revised, it is currently not possible to provide a consistent time series for this 'category' for the whole period 1990-1999. For the next update of the national energy balance a revision is planned of the statistical differences in the energy statistics for the years 1990 and 1995-1998. This will then also allow a recalculation of the CO_2 related to statistical differences in the greenhouse gas emission inventory.

Table 7.10. CO_2 emissions from statistical differences 1990-1999.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999 [1)]
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 (TJ)										
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	**1.1**	**1.0**	**-0.4**	**1.6**	**0.5**	**2.5**	**3.4**	**6.4**	**3.6**	**0.0**

[1)] Since 1999, the method for calculating the statistical differences has been changes; i.e. the differences have been removed methodologically by new assumptions regarding the export of coal, the distribution losses of natural gas and the consumption of oil products.
Source: CBS, 1990-1999 (NEH/Energy Monitor).

7.1.7. CO_2 emissions from international bunkers

In *Table 7.11* both energy consumption and CO_2 emissions from international air transport and international shipping are presented per fuel type. In 1999, bunker emissions of CO_2 have increased by about 11.2 Tg or 28% compared to 1990. In particular international aviation has shown a very high growth of about 125%, whereas international shipping increased by 16%. Because the majority of bunkers emissions stem from marine bunkers, international shipping and aviation contributed both about equally to this increase of 11.2 Tg CO_2. Due to the much higher growth of international air traffic its share in international bunkers emissions has doubled from about 10% in 1990 to about 20% in 1999.

Table 7.11. International bunkers: energy consumption and related CO_2 emissions 1990-1999

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Energy consumption [PJ]										
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*
- gasoil	*80*	*80*	*80*	*84*	*88*	*102*	*95*	*89*	*88*	*86*
Aviation Bunkers	**61**	**68**	**81**	**89**	**92**	**105**	**113**	**123**	**131**	**138**
- jetfuel (kerosine)	*61*	*68*	*81*	*89*	*92*	*105*	*113*	*123*	*131*	*138*
- aircraft gasoline	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
TOTAL Bunkers	**527**	**544**	**559**	**585**	**566**	**584**	**601**	**641**	**648**	**697**
Emissions [Gg]										
Marine bunkers *	**35 560**	**36 330**	**36 490**	**37 780**	**36 140**	**36 480**	**37 200**	**39 530**	**39798**	**40757**
- heavy fuel oil	*29 720*	*30 490*	*30 650*	*31 650*	*29 720*	*29 030*	*30 260*	*33 030*	*33015*	*34494*
- gasoil	*5 840*	*5 840*	*5 840*	*6 130*	*6 420*	*7 450*	*6 940*	*6 500*	*6392*	*6263*
Aviation Bunkers	**4 450**	**4 960**	**5 910**	**6 500**	**6 720**	**7 670**	**8 250**	**8 980**	**9521**	**10066**
- jetfuel (kerosine)	*4 450*	*4 960*	*5 910*	*6 500*	*6 720*	*7 670*	*8 250*	*8 980*	*9521*	*10066*
TOTAL Bunkers	**40 010**	**41 290**	**42 400**	**44 280**	**42 860**	**44 150**	**45 450**	**48 510**	**49319**	**50823**

Source: CBS, 1990-1998 (NEH/Energy Monitor, Table 1.1)
* For 1999, in the CRF also an amount of lubricant consumption in marine bunkers is reported of 5.3 PJ, which is equivalent to 0.4 Tg CO_2.

7.2. Emissions of CH_4

In 1999 total methane emission has decreased by 20% compared to the 1990 level (*Table 7.11*). Sectors that contributed most to the decrease were the waste sector, the agricultural sector, and the energy sector (*Figure 7.6*). Lowe quantities of landfilled waste 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 5). The Tier 1 *trend* uncertainty in total CH_4 emissions has been calculated at ±7% points.

Table 7.12. CH_4 emissions per IPCC sector 1990-1999 (Gg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL NET NATIONAL EMISSIONS	**1292.7**	**1308.7**	**1256.2**	**1224.7**	**1203.1**	**1172.4**	**1163.1**	**1102.8**	**1061.8**	**1033.5**
1. All Energy (combustion and fugative)	**214.1**	**223.8**	**199.1**	**192.4**	**202.3**	**209.3**	**214.4**	**186.6**	**176.8**	**174.1**
A Fuel combustion total	35.0	35.7	36.0	34.4	33.8	35.3	36.9	30.1	30.7	29.9
1 Energy	1.3	3.2	3.8	3.4	3.7	4.9	5.7	3.1	4.4	4.1
2 Industry	5.8	3.5	4.9	3.2	2.6	2.8	1.5	1.6	1.8	1.6
3 Transport	7.9	6.9	6.8	6.4	6.3	6.3	5.7	5.3	4.9	4.6
4 a Commercial / Institutional	1.0	1.1	1.0	0.9	1.4	0.6	1.4	0.6	1.1	1.1
4 b Residential	16.7	18.3	16.8	17.7	17.0	17.9	19.9	17.2	16.1	16.1
4 c Agriculture / Forestry / Fishing	2.3	2.7	2.7	2.8	2.8	2.8	2.8	2.4	2.4	2.5
B Fugitive fuel emissions	179.1	188.1	163.1	158.0	168.5	174.0	177.5	156.5	146.1	144.2
2 Crude oil and natural gas: process emissions	179.1	188.1	163.1	158.0	168.5	174.0	177.5	156.5	146.1	144.2
2. Industrial processes (ISIC)	**3.4**	**3.5**	**3.7**	**4.9**	**5.3**	**4.9**	**5.7**	**2.7**	**2.4**	**2.5**
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**
4. Agriculture	**504.9**	**517.0**	**505.0**	**497.0**	**483.0**	**475.7**	**463.4**	**446.2**	**432.4**	**422.9**
A Enteric fermentation	401.9	412.0	401.0	393.0	382.0	376.7	365.3	352.6	339.4	331.8
B Manure management	103.0	105.0	104.0	104.0	101.0	99.0	98.1	93.6	93.0	91.0
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
6. Waste	**568.4**	**562.4**	**546.4**	**528.4**	**510.2**	**480.5**	**477.6**	**465.3**	**448.3**	**432.1**
7. Other	**2.0**	**2.0**	**2.0**	**2.0**	**2.3**	**2.0**	**2.0**	**2.0**	**1.9**	**1.9**

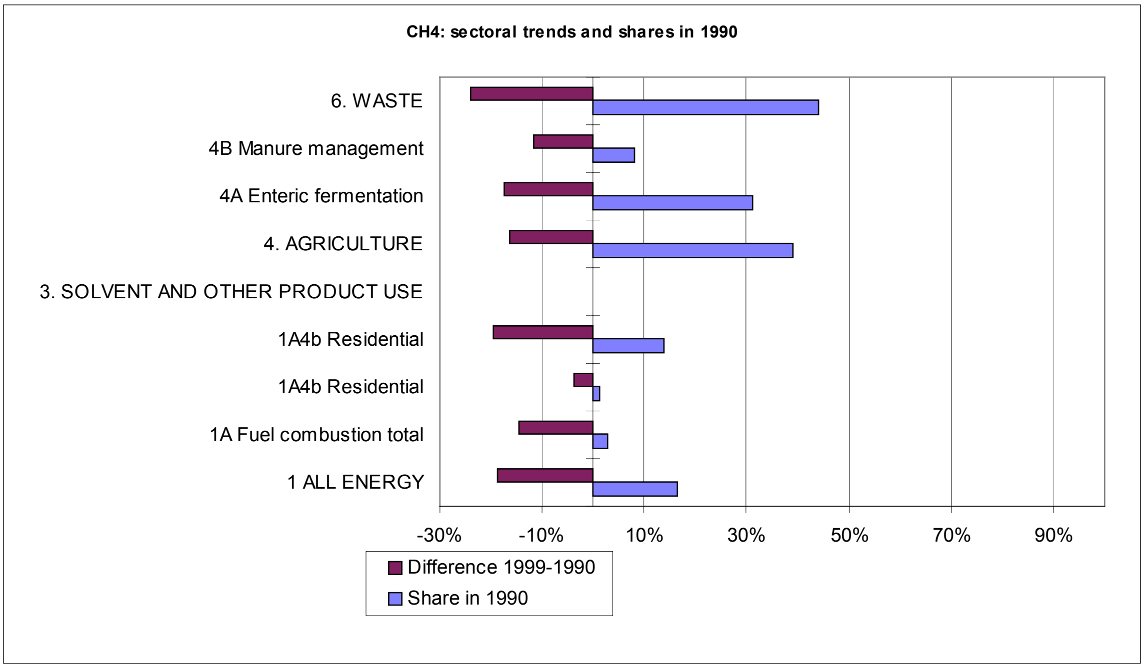


Figure 7.6. CH_4 emission shares and trends per IPCC sector 1990-1999.

7.2.1. Fugitive emissions of CH_4 from oil and natural gas

The fugitive emission of CH_4 is almost completely due to the production, transmission and distribution of natural gas. The emission trend is summarised in *Table 7.13*. In the period 1990-1999 the emission of CH_4 decreased from 179 to 144 Gg per year (-20%). This decrease is not the result of a decrease in activity data (*Table 7.14*), but mainly of measures to prevent the venting of natural gas during the production (NOGEPA, 1996, 1999; NAM, 1999a, 1999b). These measures have been applied in order to comply with the Dutch Emission Regulations 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 7.7* the trends of the distribution and production of natural gas as well as the related emission of CH_4 are shown.

Table 7.13. CH_4 emissions due to production, transmission and distribution of natural gas in the Netherlands 1990-1999 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Total	**164.2**							**156.1**	**145.8**	**144.0**
Production/Processing	85.3							86.7	80.7	81.8
Transmission	6.3							4.9	3.8	3.5
Distribution	72.6							64.6	61.4	58.7

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

Table 7.14. Production, transmission and distribution of natural gas in the Netherlands (EZ, 1998; Gasunie; 2001)

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gas production	mld m^3	72.4	82.4	83.0	84.0	78.4	78.3	89.7	81.8	79.9	72.0
Gas transport	mld m^3	72.4	82.4	83.8	84.0	78.4	79.3	93.8	84.0	79.8	75.4
Gas distribution	mld m^3	20.8	24.0	23.1	24.8	22.7	23.9	27.8	24.1	23.9	22.9

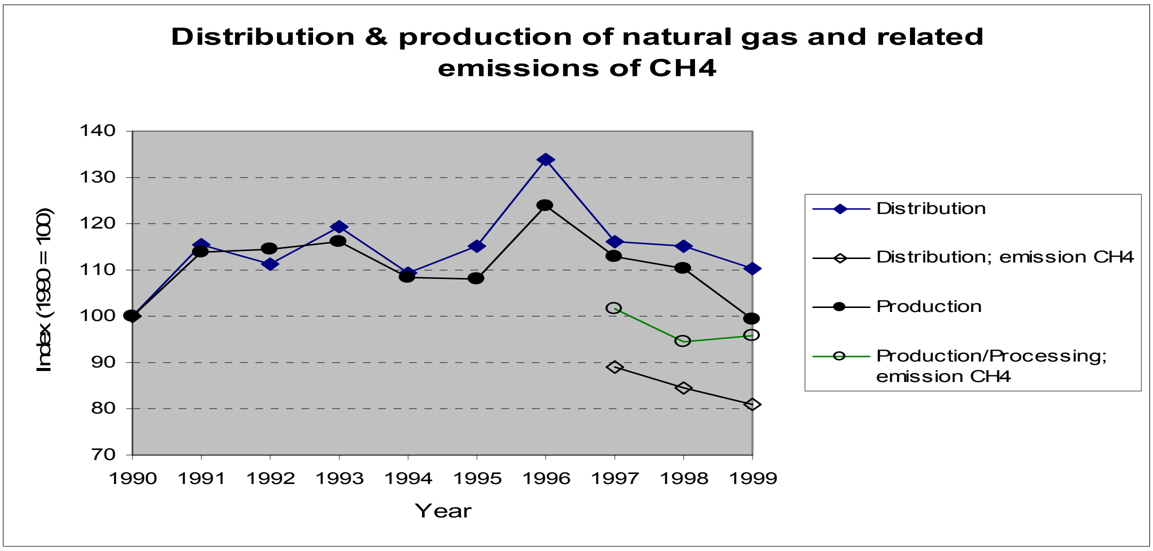


Figure 7.7. Trends of the production and distribution of natural gas as well as the related CH_4 emissions in the period 1990-1999 in the Netherlands.

7.2.2. Emissions of CH_4 due to enteric fermentation

The trend in CH_4 emissions due to enteric fermentation is summarised in *Table 7.15*. 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 3.9 to 3.0 million animals (-18%) and from 1.32 to 1.23 animals (-7%), respectively (*Table 7.16)*. It is obvious that these smaller numbers of cattle are the main cause of the decrease of the CH_4 emissions.

In *Figure 7.8* 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.

Table 7.15. CH_4 emissions due to enteric fermentation in the Netherlands 1990-1999 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL	**401.9**	**412.0**	**401.0**	**393.0**	**382.0**	**376.7**	**365.3**	**352.6**	**339.4**	**331.8**
Cattle	365.6						328.3	315.2	307.0	299.0
Dairy Cattle	*290.7*						*262.2*	*252.1*	*247.8*	*241.6*
Non-Dairy Cattle	*74.9*						*66.1*	*63.0*	*59.2*	*57.4*
Sheep	13.6						13.0	11.7	11.2	11.2
Goats	0.5						0.8	1.0	1.1	1.2
Horses	1.3						1.6	2.0	0.0	0.0
Swine	20.9						21.6	22.8	20.2	20.4
Poultry	0.0						0.0	0.0	0.0	0.0

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

Table 7.16. Number of animals in the Netherlands 1990-1999 (1000 head) (CBS/RIVM, 2000)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Cattle	4927	5063	4919	4798	4716	4654	4551	4412	4283	4206
Dairy Cattle	*3607*	*3628*	*3490*	*3361*	*3277*	*3298*	*3276*	*3151*	*3061*	*2972*
Non-Dairy Cattle	*1320*	*1435*	*1429*	*1437*	*1439*	*1356*	*1275*	*1261*	*1222*	*1233*
Sheep	1702	1882	1954	1916	1766	1674	1627	1465	1394	1401
Goats	61	70	63	57	64	76	102	119	132	153
Horses	70	77	86	92	97	100	107	112	114	115
Pigs	13915	13217	14161	14964	14565	14397	14418	15189	13446	13567

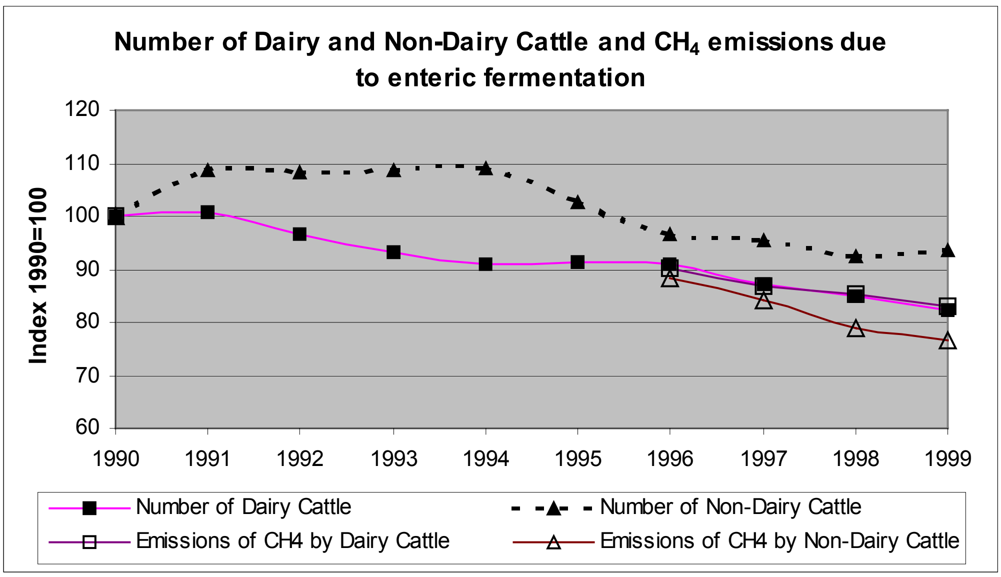


Figure 7.8. Number of cattle and emissions of CH_4 due to enteric fermentation from cattle.

7.2.3. Emissions of CH_4 due to manure management

The trend in emissions of CH_4 due to manure management is summarised in *Table 7.17*. In the period 1990-1999 the emission of CH_4 decreased from 103 to 91 GJ (-12%). As can be seen from *Table 7.17* this decrease is mainly due too the decrease of emissions from the management manure of swine (5.2 Gg), dairy cattle (4.6 Gg), and non-dairy cattle (1.9 Gg).

Table 7.17. Trend in emission of CH_4 due to manure management in the Netherlands (Gg).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	99/90
TOTAL	**103.0**						**98.1**	**93.6**	**93.0**	**91.0**	
Cattle	42.7						39.0	38.2	37.3	36.5	
Dairy Cattle	25.5						29.3	22.1	21.6	20.8	-18%
Non-Dairy Cattle	17.3						9.7	16.2	15.7	15.6	-10%
Sheep	0.8						0.9	0.7	0.7	0.7	
Goats								0.2	0.3	0.3	
Swine	49.2						48.6	45.1	45.6	44.0	-11%
Poultry	10.3						9.6	9.3	9.1	9.5	

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

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 15% in the period 1990-1999. This decrease is reflected in the amount of stable manure and the related emissions of CH_4.

Table 7.16 also shows that the number of swine has hardly changed between 1990 and 1999. However for swine the decrease of the CH_4 emissions from to manure management (-11%) 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 7.18* and *Figure 7.9*).

Table 7.18. Number of swine and manure from swine in the Netherlands 1990-1999 (CBS/RIVM, 2000)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Number[1] 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
Sows	1.7	1.7	1.7	1.8	1.7	1.7	1.7	1.8	1.8	1.6
Total	8.7	8.8	8.9	9.3	9.0	8.8	8.8	9.2	8.4	8.3
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

[1] When piglets are included the amount of swine is considerably higher (cf. *Table 7.15*). Since the manure produced by piglets is attributed to the sows, piglets are not relevant for the calculation of the amount of manure.

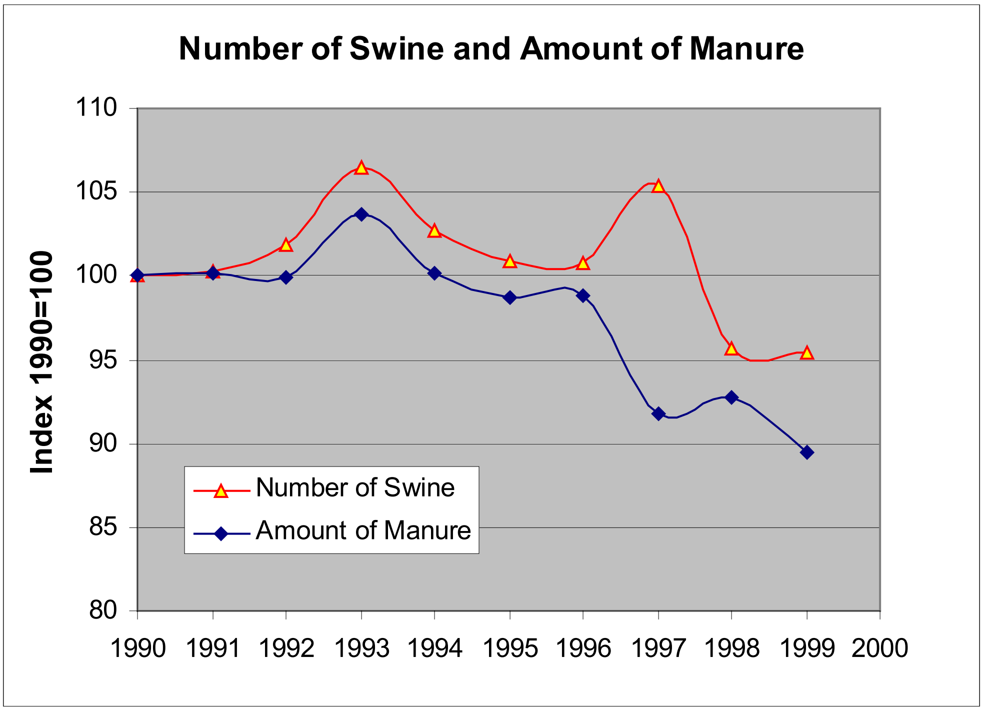


Figure 7.9. Trend of the number of swine and the amount of manure from swine between 1990 and 1999 in the Netherlands.

7.2.4. Emissions of CH_4 from solid waste disposal sites

The emission trend for landfills is summarised in *Table 7.19*. In this table also the amount of CH_4 is shown that has been recovered (mostly for energy use). In the period 1990-1999 the emissions of CH_4 have decreased from 562 to 428 Gg per year (-24%). This decrease is due to the threefold increase of the amount of CH_4 recovered from about 5% in 1990 to 15% in 1999 (*Table 7.19*), 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 are the *amount* of waste disposed of on land and the *concentration* of C (carbon) in that waste. Since in the period 1990-1999, the amount of waste as well as the concentration of C have decreased, and thus the quantity of CH_4 produced has decreased too.

The amount of waste that is disposed of in landfills decreased from 13.9 to 5 Tg (VVAV, CBS, 2000b,c; Elzenga *et al.,* 1996; Van den Brink *et al*., 2000) (*Figure 7.10*). This decrease is the result of environmental policy in the Netherlands to minimise the disposal of waste in landfills and to increase recycling and incineration of waste.

The concentration of C decreased from approximately 130 to 120 g C/kg waste (Spakman *et al.,* 1997; De Jager and Blok, 1993; Cornelissen and Beker, 2000). This change in composition is due to the trend to separate and recycle waste as much as possible (*Figure 7.10*). In the past years the quantity of useful fractions collected such as paper, organic compounds, glass, metals has increased considerably (RIVM/CBS, 2000b).

Table 7.19. Net CH_4 emissions and CH_4 recovered from solid waste disposal sites in the Netherlands 1990-1999 (Gg)

	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
CH_4 emissions (net)	562	556	540	522	505	479	477	464	445	428
CH_4 recovered	27	37	47	58	68	78	73	73	76	76
% of gross emissions	4%	6%	7%	9%	11%	13%	12%	12%	13%	14%

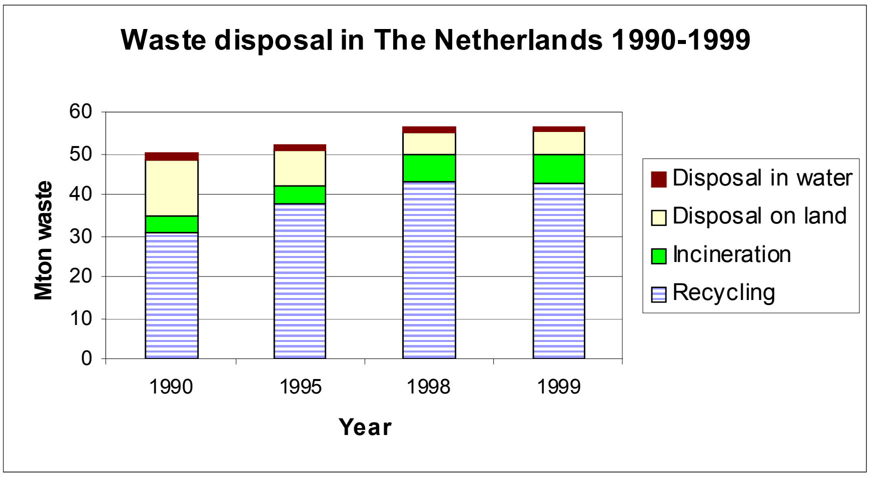


Figure 7.10. Trends in waste handling in the Netherlands 1990-1999.

7.3. Emissions of N_2O

In 1999 total N_2O emissions increased by about 15% compared to 1990 (*Table 7.20*), mainly due to an increase in the industrial sector of about 15% (mainly from nitric acid production) and in the agricultural sector of about 16% (*Figure 7.11*). In the next section the emission trend for the agricultural sector is discussed in more detail. In road transport, increasing emissions due to the further penetration of catalyst-equipped petrol cars were compensated by decreasing N_2O emissions from diesel vehicles resulting in emissions in this sector effectively decreasing from 1998. In the next sections we will discuss the trends in road transport and the agricultural sector 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 5). The Tier 1 *trend* uncertainty in total N_2O emissions has been calculated at ±12% points.

Table 7.20. N_2O emissions per IPCC sector 1990-1999 (Gg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL NET NATIONAL EMISSIONS	**63.7**	**66.9**	**69.3**	**68.9**	**70.8**	**72.2**	**71.8**	**73.7**	**72.8**	**73.2**
1. All Energy (combustion and fugative)	**5.2**	**6.9**	**7.9**	**7.9**	**8.0**	**8.2**	**7.7**	**7.8**	**6.8**	**6.5**
A Fuel combustion total	5.2	6.9	7.9	7.9	7.6	8.2	7.7	7.8	6.8	6.5
1 Energy transformation	0.5	0.5	0.5	0.5	0.2	0.6	0.4	0.5	0.5	0.4
2 Industry	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
3 Transport	4.5	6.2	7.2	7.2	7.2	7.4	7.1	7.2	6.2	6.0
4 Small combustion	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
B Fugitive fuel emissions	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0
2. Industrial processes	**31.5**	**32.3**	**30.4**	**30.0**	**31.6**	**31.6**	**31.7**	**35.0**	**36.0**	**36.1**
3. Solvent and other product use	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.6**	**0.5**	**0.5**
4. Agriculture	**22.2**	**22.9**	**26.2**	**26.2**	**26.4**	**27.6**	**27.5**	**25.9**	**25.1**	**25.7**
5. Land use change and forestry	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	-	-	-	-
6. Waste	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.5**	**0.6**	**0.6**	**0.5**	**0.5**
7. Other (specified)	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**	**3.8**

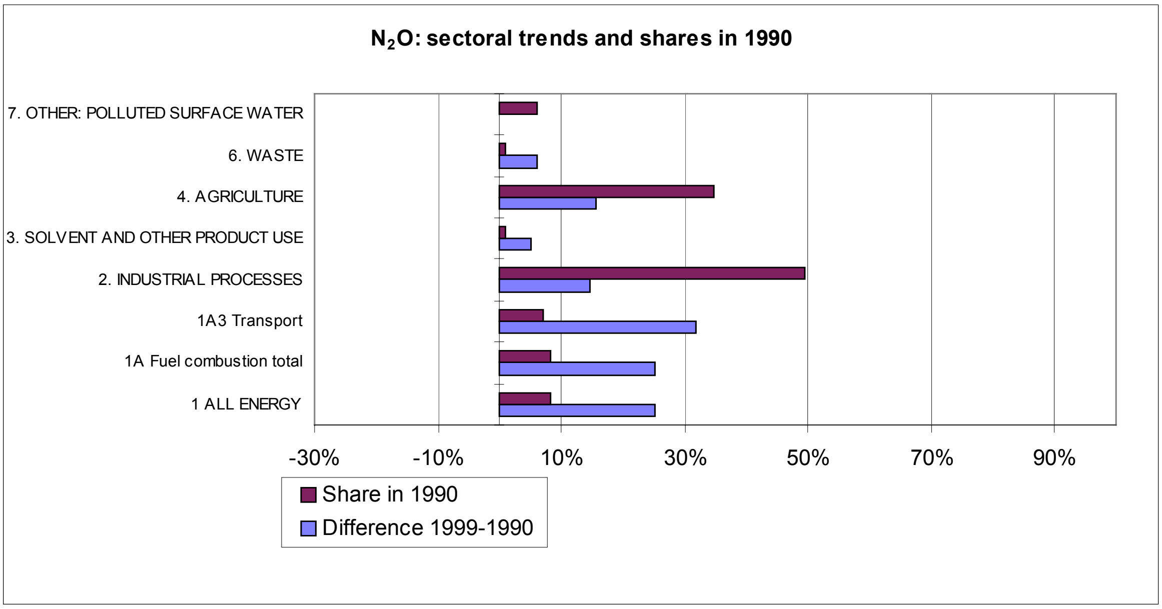


Figure 7.11. N_2O emission shares and trends per IPCC sector 1990-1999.

7.3.1. Emissions of N_2O from road transport

The N_2O emissions from transport have increased from 1990 to 1997 from 4.5 Gg to 7.2 Gg. Thereafter, emissions have been calculated to decrease to a level of 6.0 Gg in 1999. The increasing trend could be expected from the increasing shares of gasoline cares equipped with a catalytic converter, which has a much higher emission factor than cars without this emissions control technology (*Table 7.21*). The Netherlands uses for N_2O emissions from road transport a model that assumes that there is a fixed ratio for emissions of N_2O : NO_x (Klein, 1998).
The recent decreasing trend, however, can be explained from a mix of developments:

- the N_2O emission factor for a specific technology is assumed to depend linearly on the NO_x emission factor, which is decreasing in time;
- subsequent generations of catalytic converters (the second was introduced in 1996) have lower NO_x emission factors, thus also lower N_2O factors;
- the N_2O factor for catalytic converters is assumed to increase substantially after 3 years of use;
- the share of diesel cars in road passenger transport, which are assumed to have a lower emission factor than uncontrolled gasoline cars, has increased considerably over the last years.

These trends have been summarised in *Table 7.21*. Both the decreasing emission factor for catalyst equipped cars (related to developments in NO_x control technology) 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 decrease after 1997. This has been visualised in *Figures 7.12* and *7.13*. Both effects cause total N_2O emissions from transport to start decreasing from 1997.

Table 7.21. Trend in N_2O-emission factors for passenger cars 1990-1999 (g/km).

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
A. By fuel type:										
Gasoline total	0.031	0.034	0.037	0.037	0.039	0.042	0.040	0.048	0.037	0.035
o.w. Gasoline without cat.	0.013	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.013
o.w. Gasoline with cat.	0.095	0.079	0.072	0.064	0.062	0.061	0.054	0.063	0.045	0.041
Share of cars with cat.	*22%*	*32%*	*41%*	*48%*	*53%*	*59%*	*64%*	*69%*	*73%*	*78%*
Diesel	0.015	0.015	0.015	0.015	0.015	0.015	0.014	0.014	0.013	0.011
LPG	0.031	0.042	0.047	0.055	0.061	0.071	0.068	0.072	0.064	0.059
B. Average factor for all passenger cars:										
Share gasoline	*64%*	*64%*	*66%*	*68%*	*68%*	*68%*	*69%*	*69%*	*68%*	*67%*
Share diesel	*19%*	*20%*	*19%*	*18%*	*19%*	*19%*	*19%*	*20%*	*22%*	*24%*
Share LPG	*16%*	*16%*	*15%*	*14%*	*14%*	*13%*	*11%*	*11%*	*10%*	*9%*
Total passenger cars	0.028	0.032	0.035	0.036	0.038	0.040	0.038	0.044	0.034	0.031

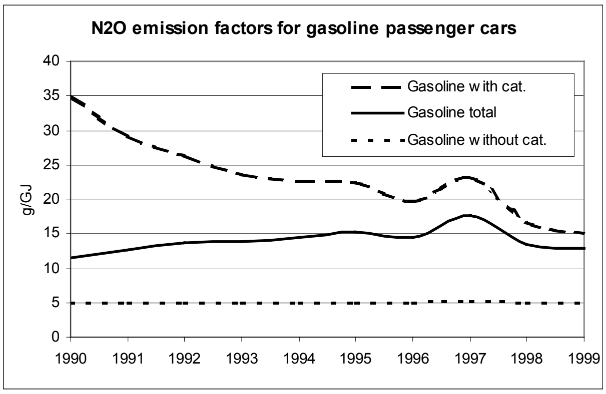


Figure 7.12. Trend in emission factors for N_2O from gasoline passenger cars in the Netherlands 1990-1999 due to increasing shares of cars equipped with a catalytic converter.

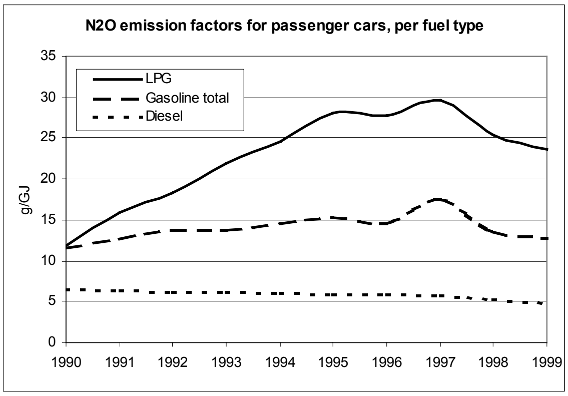


Figure 7.13. Trend in emission factors for N_2O from passenger cars in the Netherlands 1990-1999 by fuel type (gasoline, diesel, LPG).

We note that the calculation methodology is presently under discussion, also in view of recent results of a measurement campaign of N_2O emission factors from passenger cars in the Netherlands (Oonk, 2001). The results of this study confirm the decrease of emission factors for newer generations of catalytic converters.

7.3.2. Emissions of N_2O from agricultural soils

The trend in N_2O emissions from agricultural soils is summarised in *Table 7.22.* In the period 1990-1999 the emission of N_2O has increased from 21.5 to 25.0 Gg (+16%). 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 1990-1999 the amount of nitrogen in manure that has been applied to agricultural soils decreased with approximately 3%, 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 7.22. Emissions of N_2O from agricultural soils in the Netherlands 1990-1999 (Gg N_2O).*

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL	**21.5**	**22.2**	**25.5**	**25.4**	**25.6**	**26.8**	**26.8**	**25.3**	**24.5**	**25.0**
Direct Soil Emissions	13.0							17.0	16.4	17.0
Synthetic Fertilisers	*7.0*							*6.7*	*6.8*	*6.8*
Animal Wastes Applied to Soils	*5.8*							*10.0*	*9.4*	*10.0*
N-fixing Crops	*0.2*							*0.2*	*0.2*	*0.2*
Animal Production	3.8							3.6	3.4	3.4
Background agricultural soils	4.7							4.7	4.7	4.7

Note: To reflect the degree of completeness, only emissions reported in the CRF files have been included here.
* Excluding emissions from animal houses, which are included in IPCC category *4*: *Agriculture* in *Table 7.20.*

7.4. Emissions of fluorinated halocarbons

Trends in *potential emissions* (or so-called *apparent consumption*) from 1990 onwards are presented in *Table 7.23*, whereas *actual emissions* (this year also for SF_6) are shown in *Table 7.24*. It shows that HFC emissions have increased in 1999 by 30% compared to 1995, largely because of an increase in HFC consumption as a substitute for CFC use, in particular of HFC-134a as well as a limited increase of by-product emissions of HFC-23 from the manufacture of HCFC-22. The latter was limited by control measures implemented in the last years to reduce HFC-23 emissions from the facility. Also PFC emissions from aluminium production increased by about 35% in this period due to an increase of aluminium production, whereas the relatively very low SF_6 emissions tend to vary from year to year, according to actual GIS equipment installed, maintained and manufactured and amounts used for semiconductor manufacture. Compared to the 1995 level, total emissions of all F-gases increased by about 30% (50% compared to 1990) (*Figure 7.14*).

We recall that this year emissions of SF_6 have been completely recalculated. These new emissions are a factor of 10 lower than reported previously, which were based on an old potential emissions estimate. For 1995 the actual emissions of SF_6 are now 0.17 Tg CO_2-eq., replacing the old value of 1.46 Tg CO_2-eq. Actual emissions of HFC-134a for 1995 onwards have been recalculated due to new information on the shares of various applications. Also, PFC emissions from aluminium production have been updated based on recent measurement studies at two producing companies. The total change for 1995 is a decrease from 2.09 to 1.86 Tg CO_2-eq. As a result total CO_2-eq. emissions in 1995 from the F-gases decreased by about 1.5 Gg CO_2-eq. to 8.7 Tg CO_2-eq.

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. However, for PFCs from aluminium production, the uncertainty in the emission factors of 1995 is currently estimated at 20%, since the recent measurements had to be extrapolated back in time. Also the uncertainty estimate related to by-product emissions of HCFC-22 production has been revised. The new methodology for calculation actual SF_6 emissions is much more appropriate than the old 'potential emissions' approach, but recent research has shown the some sources may still be missing presently. Therefore the uncertainty estimate for SF_6 is assumed to be a-symmetrical. The uncertainty in the overall *annual* totals is now estimated to be in the order of 50% for HFCs and PFCs and -10% to +100% for SF_6, (each with order of magnitude-factor of 1.5) (see Chapter 5). The Tier 1 *trend* uncertainty in total F-gas emissions has been calculated at ±20% points.

Table 7.23. Potential emissions per compound from the use of HFCs, PFCs and SF_6 1990-1999 (Gg CO_2-eq.)

Compound	IPCC	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
HFC-134a	2F	0	0	0	0	356	590	1,187	1,398	1,365	1,366
HFC-143a	2F	0	0	0	0	0	129	315	350	456	642
HFC-125	2F	0	0	0	0	0	140	286	274	333	543
HFC-23	2E	0	0	0	0	0	0	0	0	0	0
HFC (unspecified)	2E	0	0	0	0	0	69	168	138	147	57
HFC-TOTAL		**0**	**0**	**0**	**0**	**356**	**928**	**1,956**	**2,160**	**2,301**	**2,609**
CF_4 (PFC-14) **	2C	0	0	0	0	0	0	0	0	0	0
C_2F_6 (PFC-116) **	2C	0	0	0	0	0	0	0	0	0	0
PFC use	2F	C	C	C	C	C	C	C	C	C	C
PFC-TOTAL		**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**	**C**
SF_6 use	2F	C	C	C	C	C	C	C	C	C	C
TOTAL HFC/PFC/SF6		**0**	**0**	**0**	**0**	**356**	**928**	**1,956**	**2,160**	**2,301**	**2,609**

Note: C = Confidential Business Information.

** Emissions from aluminium production are not related to the *use* of this compound, but by are a *by-product* of primary aluminium production.

Table 7.24. Actual emissions per compound of HFCs, PFCs and SF_6 1990-1999 (Gg CO_2-eq.)

Compound	IPCC	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
HFC-134a	2F	12	12	23	7	96	340	620	900	934	1,003
HFC-143a	2F	10	10	10	10	24	35	69	107	190	228
HFC-125	2F	20	20	20	20	55	67	100	132	145	169
HFC-23 *	2E	5,101	4,820	4,540	5,066	6,271	6,271	6,709	6,709	7,387	7,387
HFC-152a	2E	1	1	1	4	3	3	6	4	0	0
Other HFCs	2F	0	0	0	0	0	6	20	32	39	49
HFC-TOTAL		**5,144**	**4,863**	**4,594**	**5,107**	**6,449**	**6,724**	**7,524**	**7,884**	**8,695**	**8,836**
CF_4 (PFC-14) **	2C	1,957	1,957	1,677	1,690	1,482	1,450	1,606	1,697	1,924	2,002
C_2F_6 (PFC-116) **	2C	442	442	377	377	350	350	359	368	442	469
PFC use	2F	34	39	44	51	59	68	78	89	103	118
PFC-TOTAL		**2,432**	**2,437**	**2,098**	**2,118**	**1,891**	**1,867**	**2,042**	**2,154**	**2,469**	**2,589**
SF_6 use	2F	**145**	**100**	**106**	**110**	**148**	**174**	**160**	**182**	**132**	**137**
TOTAL HFC/PFC/SF_6		**7,720**	**7,400**	**6,799**	**7,335**	**8,488**	**8,765**	**9,727**	**10,219**	**11,296**	**11,562**

* Mainly by-product from HCFC-22 production.
** From aluminium production.

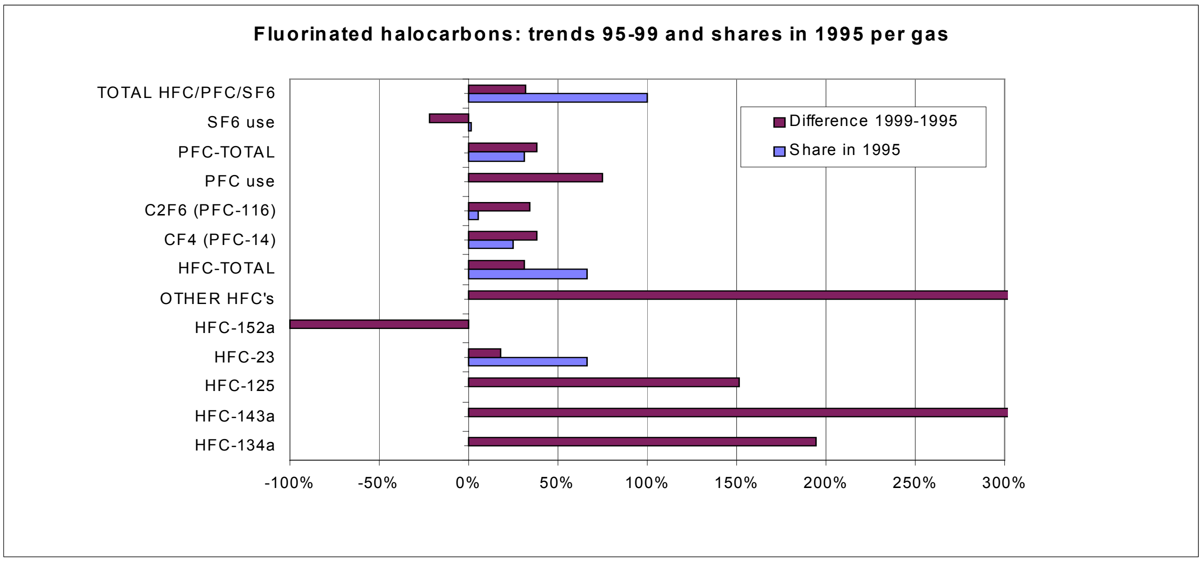


Figure 7.14. Shares and trends in actual emissions of fluorinated gases 1995-1999.

8. Trends in emissions of precursor gases

Trends in sectoral emissions of CO, NO_x, NMVOC, and SO_2 are presented in *Tables 8.2* to *8.5*, respectively, whereas the trends and shares per sector are also graphically shown in *Figures 8.2* to *8.5*. In *Table 8.1* and *Figure 8.1* the trends in total emissions are summarised. It clearly shows that the CO and NMVOC emissions are in 1999 reduced by about 40% compared to 1990, for SO_2 even 50%, but for NO_x, the 1999 emissions are about 30% lower than the 1990 level. We recall that in contrast with the direct greenhouse gases, emissions of precursors from road transport have not been corrected for fuel sales according to the national energy statistics but are directly related to transport statistics on vehicle-km, which differ to some extent from the IPCC approach (see Section 7.1).

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 order of 25%. For emission factors for SO_2 from fuel combustion (basically the sulphur content of the fuels) the uncertainty is estimated at about 25% (possibly 10%). 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, NO_x and SO_2 and about 50% for NMVOC (uncertainty factor of 1.5). However, results of recent research indicate that the uncertainty in SO_2 emissions may be considerably lower, of the order of ±10%.

Table 8.1. Trend in emissions of precursors in the Netherlands 1990-1999.

Indirect greenhouse gases and SO_2	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Emissions in Gg										
Total NO_x	563.2	551.4	539.0	518.9	493.2	497.4	480.8	459.5	422.9	408.4
Total CO	1139.2	1022.5	966.3	948.6	905.1	909.0	835.9	791.5	721.8	679.4
Total NMVOC	500.0	460.6	436.2	403.2	387.7	369.7	347.9	323.4	297.6	281.6
Total SO_2	193.3	163.5	157.2	150.4	136.5	144.7	132.2	117.5	106.8	100.4
Index (1990-100)										
Index Total NO_x	100.0	97.9	95.7	92.1	87.6	88.3	85.4	81.6	75.1	72.5
Index Total CO	100.0	89.8	84.8	83.3	79.5	79.8	73.4	69.5	63.4	59.6
Index Total NMVOC	100.0	92.1	87.2	80.6	77.5	73.9	69.6	64.7	59.5	56.3
Index Total SO_2	100.0	84.6	81.3	77.8	70.6	74.9	68.4	60.8	55.2	51.9

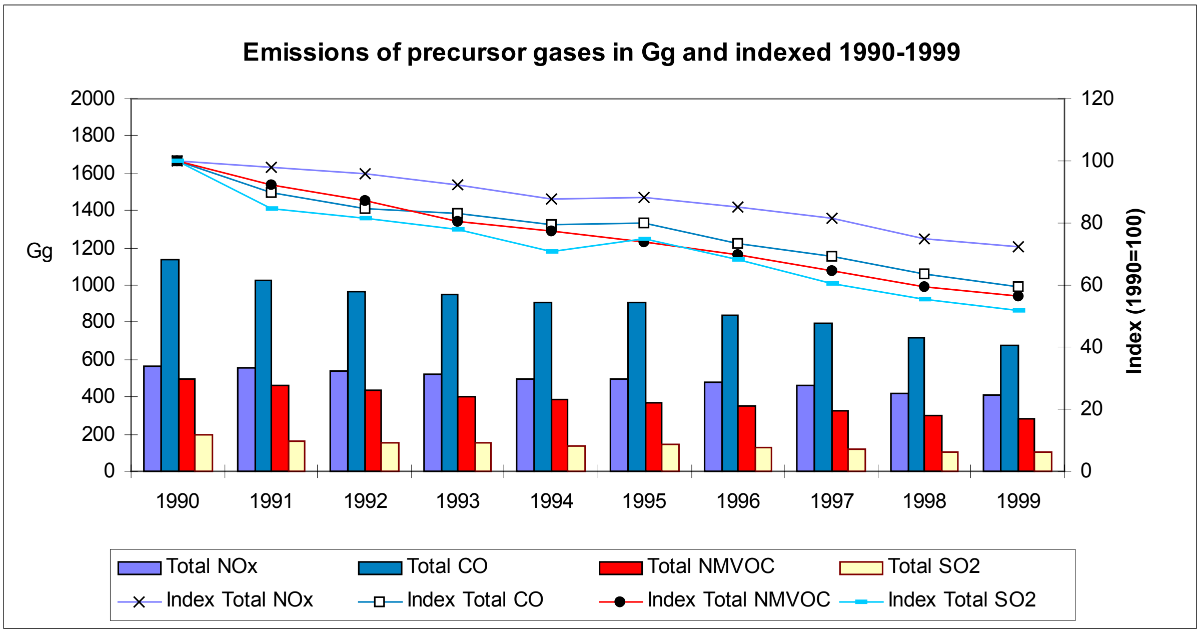


Figure 8.1. Trends in total emissions of NO_x, CO, NMVOC and SO_2 1990-1999.

Table 8.2. CO emissions per IPCC sector 1990-1999 (Gg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL NET NATIONAL EMISSIONS	**1139.2**	**1022.5**	**966.3**	**948.6**	**905.1**	**909.0**	**835.9**	**791.5**	**721.8**	**679.4**
1. All Energy (combustion and fugative)	**981.8**	**891.3**	**861.6**	**846.1**	**799.9**	**811.6**	**661.6**	**649.0**	**577.5**	**547.1**
A Fuel combustion total	975.6	883.1	855.9	840.1	792.3	802.1	653.5	642.4	571.3	541.5
1 Energy transformation	16.6	18.9	16.4	15.4	17.0	17.3	45.5	21.5	22.5	28.2
2 Industry	114.2	108.3	114.8	139.1	114.3	120.5	31.3	33.4	20.4	17.0
3 Transport	748.9	658.4	626.4	582.3	559.9	563.7	510.9	525.0	472.4	440.8
4 Small combustion	95.9	97.5	98.3	103.3	101.1	100.6	65.8	62.4	56.0	55.6
5 Other	-	-	-	-	-	-	-	-	-	-
B Fugitive fuel emissions	6.2	8.2	5.7	6.0	7.6	9.5	8.1	6.6	6.2	5.6
2. Industrial processes	**153.6**	**127.4**	**101.1**	**99.1**	**101.7**	**94.8**	**171.7**	**139.9**	**141.5**	**129.5**
3. Solvent and other product use	**2.4**	**2.4**	**2.2**	**2.0**	**2.1**	**2.1**	**1.9**	**2.0**	**2.0**	**2.1**
4. Agriculture	-	-	-	-	-	-	-	-	-	-
5. Land use change and forestry	-	-	-	-	-	-	-	-	-	-
6. Waste	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**0.5**	**0.7**	**0.7**	**0.7**	**0.7**

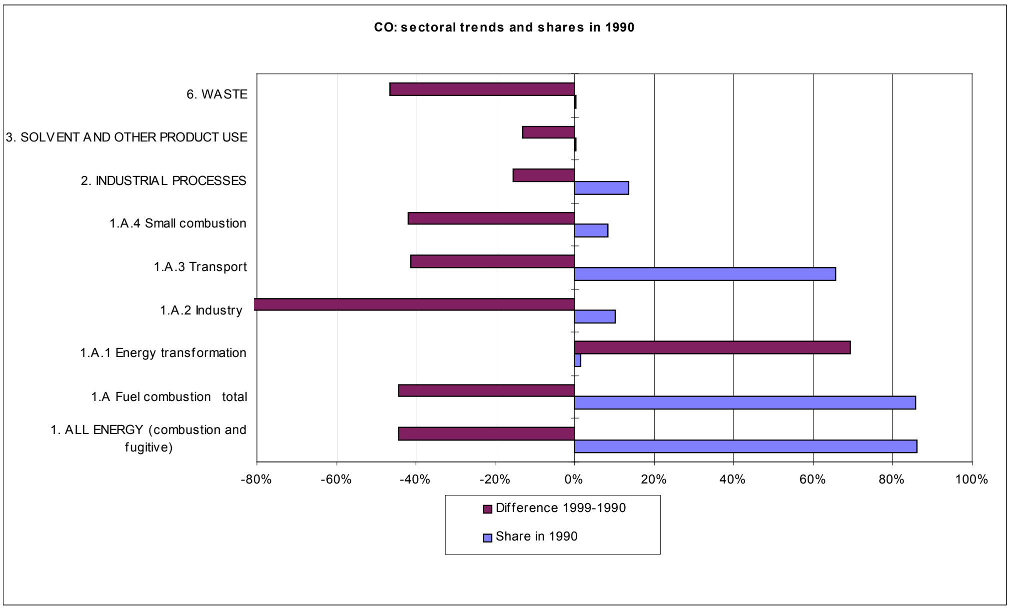


Figure 8.2. Shares and trends in CO emissions per IPCC sector 1990-1999.

Table 8.3. NO_x emissions per IPCC sector 1990-1999 (Gg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL NET NATIONAL EMISSIONS	**563.2**	**551.4**	**539.0**	**518.9**	**493.2**	**497.4**	**480.8**	**459.5**	**422.9**	**408.4**
1. All Energy (combustion and fugative)	**549.3**	**537.9**	**525.9**	**505.1**	**482.4**	**485.4**	**461.1**	**442.5**	**407.9**	**390.7**
A Fuel combustion total	548.2	536.7	524.6	504.1	481.9	484.7	460.6	441.6	407.1	390.4
1 Energy transformation	102.8	95.6	95.9	91.8	81.4	75.7	70.7	62.3	56.7	52.0
2 Industry	65.7	60.4	61.4	54.6	54.4	52.4	44.2	42.6	36.9	32.1
3 Transport	336.9	336.2	325.5	311.8	304.4	314.9	300.0	299.6	275.9	269.1
4 Small combustion	42.8	44.5	41.8	45.9	41.7	41.7	45.7	37.2	37.6	37.2
5 Other										
B Fugitive fuel emissions	1.1	1.2	1.3	1.0	0.5	0.7	0.5	0.9	0.8	0.3
2. Industrial processes	**13.5**	**13.1**	**12.7**	**13.4**	**10.4**	**9.2**	**17.8**	**15.0**	**13.0**	**15.6**
3. Solvent and other product use	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**
4. Agriculture										
5. Land use change and forestry										
6. Waste	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**2.7**	**1.8**	**1.9**	**2.0**	**2.0**

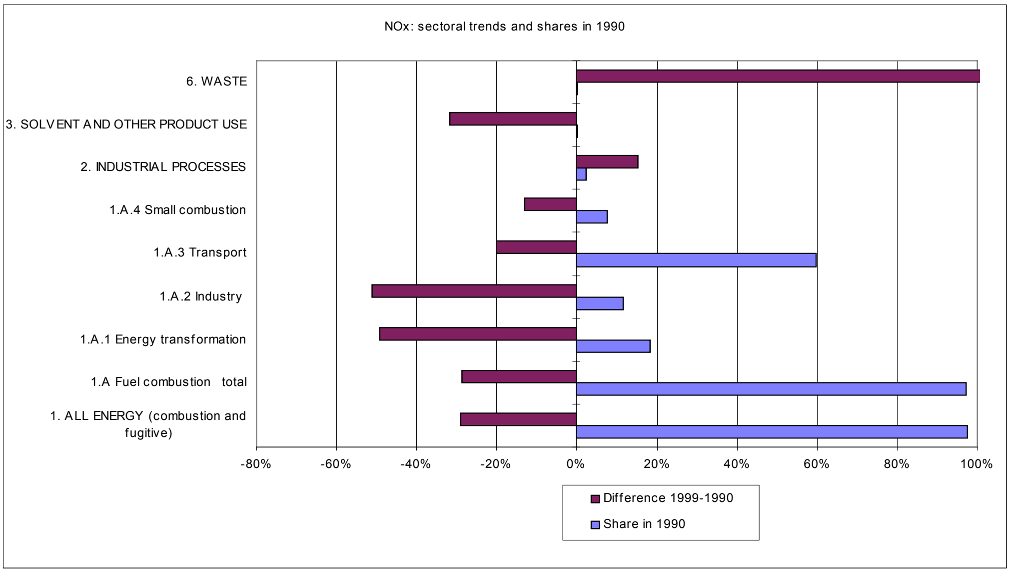


Figure 8.3. Shares and trends in NO_x emissions per IPCC sector 1990-1999

Table 8.4. NMVOC emissions per IPCC sector 1990-1999 (Gg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL NET NATIONAL EMISSIONS	**500.0**	**460.6**	**436.2**	**403.2**	**387.7**	**369.7**	**347.9**	**323.4**	**297.6**	**281.6**
1. All Energy (combustion and fugitive)	**267.8**	**247.6**	**237.6**	**223.0**	**216.8**	**216.6**	**200.3**	**188.5**	**170.6**	**163.2**
A Fuel combustion total	220.2	200.2	194.2	181.1	174.5	173.8	158.3	151.8	139.5	132.6
1 Energy transformation	3.9	4.1	4.3	3.6	3.9	5.0	7.0	2.8	3.2	3.1
2 Industry	4.7	4.3	5.8	2.9	2.6	2.8	1.3	2.3	2.5	2.1
3 Transport	200.5	180.3	172.4	162.0	156.5	154.2	134.9	133.1	121.7	115.4
4 Small combustion	11.1	11.5	11.7	12.6	11.5	11.8	15.1	13.6	12.1	12.1
5 Other	-	-	-	-	-	-	-	-	-	-
B Fugitive fuel emissions	47.6	47.4	43.4	41.9	42.3	42.8	42.0	36.7	31.1	30.6
2. Industrial processes	**130.4**	**120.9**	**115.4**	**100.0**	**88.2**	**79.5**	**73.4**	**71.8**	**67.4**	**60.1**
3. Solvent and other product use	**101.4**	**91.7**	**82.8**	**79.8**	**82.3**	**71.7**	**72.3**	**61.4**	**57.8**	**56.4**
4. Agriculture	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**		**0.2**	**0.2**	**0.2**
5. Land use change and forestry	-	-	-	-	-	-	-	-	-	-
6. Waste	**0.2**	**0.2**	**0.2**	**0.2**	**0.2**	**1.7**	**1.9**	**1.7**	**1.7**	**1.7**

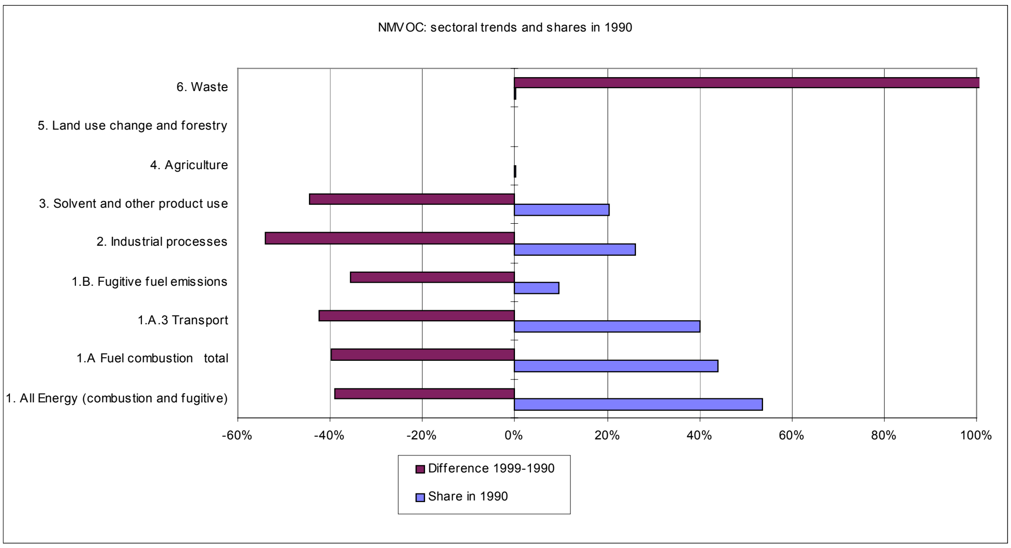


Figure 8.4. Shares and trends in NMVOC emissions per IPCC sector 1990-1999

Table 8.5. SO_2 emissions per IPCC sector 1990-1999 (Gg)

IPCC Sector	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
TOTAL NET NATIONAL EMISSIONS	**193.3**	**163.5**	**157.2**	**150.4**	**136.5**	**144.7**	**132.2**	**117.5**	**106.8**	**100.4**
1. All Energy (combustion and fugative)	**167.0**	**140.9**	**138.3**	**133.6**	**120.1**	**129.0**	**113.2**	**100.4**	**92.8**	**86.1**
A Fuel combustion total	159.2	131.2	126.7	122.1	109.5	118.7	102.7	90.3	84.8	78.7
1 Energy transformation	108.7	88.6	81.1	77.4	66.2	67.9	63.7	54.8	52.6	48.3
2 Industry	26.2	17.5	20.0	17.6	16.2	15.7	10.9	11.5	7.8	6.2
3 Transport	20.0	21.0	21.4	21.3	21.7	31.0	26.7	22.6	23.2	23.1
4 Small combustion	4.3	4.1	4.2	5.8	5.4	4.1	1.4	1.4	1.2	1.1
5 Other	-	-	-	-	-	-	-	-	-	-
B Fugitive fuel emissions	7.8	9.7	11.6	11.5	10.6	10.3	10.5	10.1	8.0	7.4
2. Industrial processes (ISIC)	**26.0**	**22.4**	**18.8**	**16.7**	**16.2**	**14.8**	**17.9**	**16.0**	**13.2**	**13.5**
3. Solvent and other product use	**0.3**	**0.2**	**0.1**	**0.1**	**0.2**	**0.0**	**0.2**	**0.2**	**0.0**	**0.0**
4. Agriculture	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
5. Land use change and forestry	-	-	-	-	-	-	-	-	-	-
6. Waste	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.9**	**0.9**	**0.8**	**0.7**	**0.7**

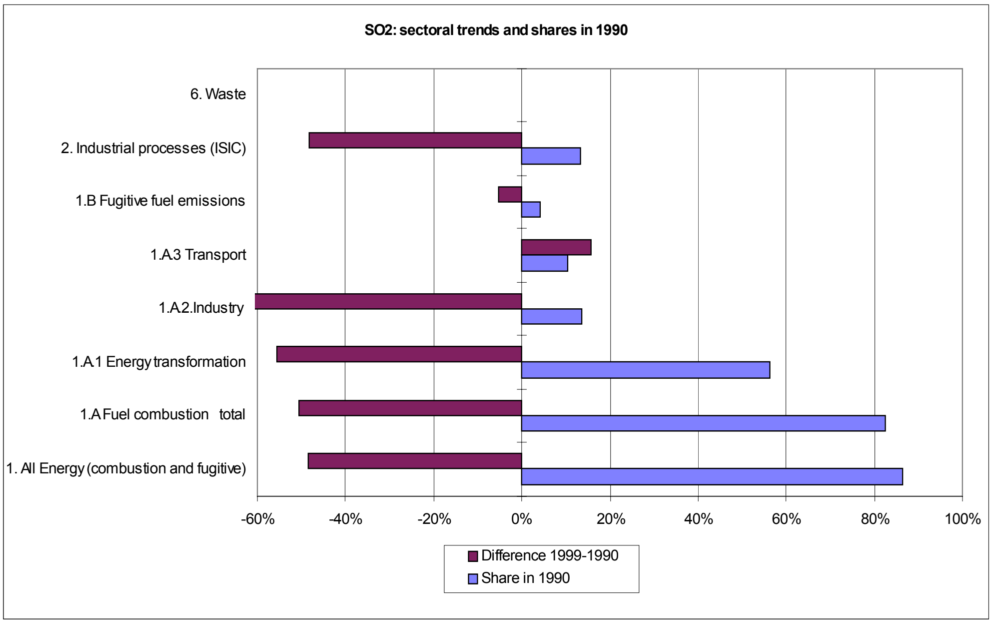


Figure 8.5. Shares and trends in SO_2 emissions per IPCC sector 1990-1999.

9. 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 9.1* trends in national total (net) emissions are summarised for 1990-1999. The trends are also visualised in *Figures 9.1* and *9.2*, showing the relative contribution of each gas to annual total emissions. Emissions of CO_2 and N_2O have increased from 1990 to 1999 by about 8% and 15%, respectively, while in the same period CH_4 emissions have decreased by 20%, effectively to a level 0.5% below N_2O emissions (see *Figure 9.1*). Of the fluorinated greenhouse gases, for which 1995 is the reference year, emissions of HFCs and PFCs increased by 20 and 40% in 1999, respectively, while SF_6 emissions (completely recalculated) decreased by about 20%.

Table 9.1. Total greenhouse gas emissions in CO_2-eq. and indexed (no T-corr.) 1990-1999

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Emissions (Tg CO_2-eq)										
CO_2	161.2	166.9	165.2	167.5	168.4	177.1	184.7	181.2	180.9	174.1
CH_4	27.1	27.5	26.4	25.7	25.3	24.6	24.4	23.2	22.3	21.7
N_2O	19.8	20.7	21.5	21.4	21.9	22.4	22.2	22.8	22.6	22.7
HFCs	5.1	4.9	4.6	5.1	6.4	6.7	7.5	7.9	8.7	8.8
PFCs	2.4	2.4	2.1	2.1	1.9	1.9	2.0	2.2	2.5	2.6
SF_6	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1
Total [group of six]	**215.8**	**222.5**	**219.8**	**221.9**	**224.1**	**232.9**	**241.1**	**237.4**	**237.1**	**230.1**
Index (1990=100)										
Index CO_2	100	103.6	102.5	103.9	104.5	109.9	114.6	112.4	112.2	108.0
Index CH_4	100	101.2	97.2	94.7	93.1	90.7	90.0	85.3	82.1	79.9
Index N_2O	100	105.0	108.7	108.1	111.1	113.3	112.6	115.6	114.3	114.8
Total [group of three]	**100**	**103.4**	**102.4**	**103.1**	**103.6**	**107.7**	**111.2**	**109.2**	**108.5**	**105.0**
Index HFCs	100	94.5	89.3	99.3	125.4	130.7	146.3	153.3	169.0	171.8
Index PFCs	100	100.2	86.3	87.1	77.7	76.8	84.0	88.5	101.5	106.5
Index SF_6	100	69.4	73.6	76.0	102.3	120.7	110.9	125.8	91.6	94.5
Index [group of six]	**100**	**103.1**	**101.9**	**102.8**	**103.8**	**107.9**	**111.7**	**110.0**	**109.9**	**106.6**
Index (1995 = 100)										
Index HFCs	76.5	72.3	68.3	76.0	95.9	*100*	111.9	117.3	129.3	131.4
Index PFCs	130.3	130.5	112.4	113.4	101.3	*100*	109.4	115.3	132.2	138.7
Index SF_6	82.9	57.5	61.0	63.0	84.8	*100*	91.9	104.2	75.9	78.4
Index [group of F-gases]	**88.1**	**84.4**	**77.6**	**83.7**	**96.8**	**100**	**111.0**	**116.6**	**128.9**	**131.9**
Index ('90; F-gases '95)										
Index [group of six composite]	**99.5**	**102.6**	**101.4**	**102.3**	**103.3**	**107.4**	**111.2**	**109.5**	**109.3**	**106.1**

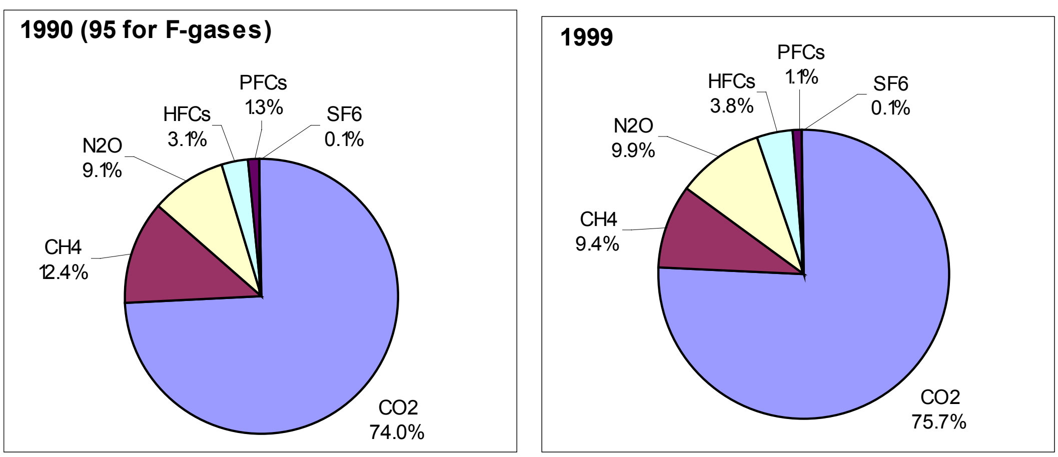


Figure 9.1. Shares of greenhouse gases in total emissions in 1990 (left) and 1999 (right).

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 ±20% points, respectively (*Figure 9.3*).

Total CO_2-equivalent emissions of the six greenhouse gases together increased in 1999 by about 6% relative to 1990 (1995 for fluorinated gases). The uncertainty in this trend is about ±3% points, based on the *IPCC Tier 1 trend uncertainty assessment*. From *Table 9.1* and *Figure 9.1* it can also be concluded that at present the CO_2-eq. emissions of N_2O are now slightly higher than the CH_4 emissions. However, it should be kept in mind that 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 and PFCs ±50% and for SF_6 -10% to +100% (the latter because of missing sources).

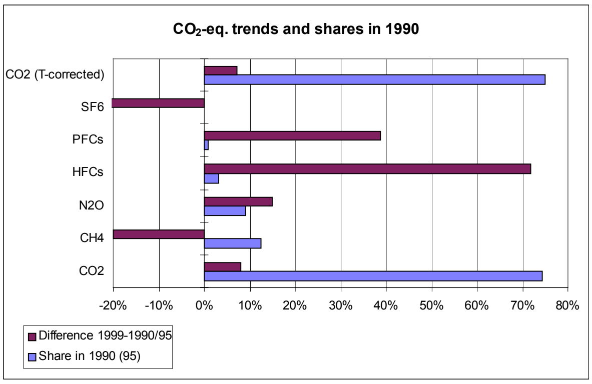


Figure 9.2. Shares and trends in greenhouse gas emissions per gas 1990-1999 (1995-1999 for new gases) (also showing CO_2 with temperature correction)

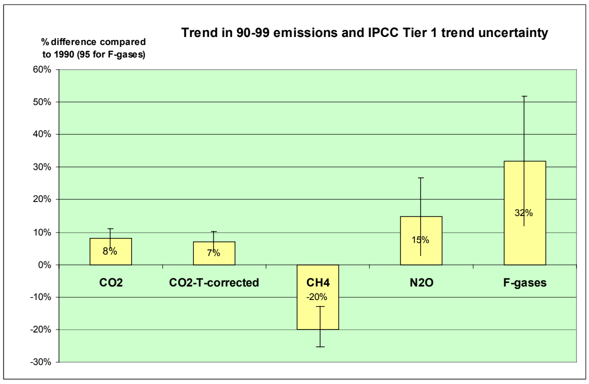


Figure 9.3. Trends in greenhouse gas emissions per gas 1990-1999 (1995-1999 for new gases) and their uncertainty according to the IPCC Tier 1 trend uncertainty analysis (also showing CO_2 with temperature correction)

We recall that in 1999 total CO_2 emissions decreased by 7 Mton compared to 1998. This was mainly caused by: (a) an inconsistency in the time series for CO_2 due to elimination of the statistical differences in 1999 (2-4 Mton); (b) a net increase in imported electricity of 55%, accounting for 17% of gross domestic electricity consumption (2-3 Mton); (c) a shift in the fuel mix for electricity generation (1 Mton). In addition, the relative warm winter of 1999 caused uncorrected CO_2 emissions to decrease another 1.5 Mton compared to 1998. In 1999, temperature-corrected CO_2 emissions were 5.2 Mton or 3% higher than total national uncorrected CO_2 emissions.

In 1996 CO_2 emissions peaked due to a very cold winter, whereas the winters of 1998 and especially 1999 were relative mild (see *Table 9.1* and residential CO_2 emissions in *Table 7.1*). In *Table 9.2* the same emissions 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 1999-1990 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 9.5*, can indeed be traced back by annual variation in residential, commercial and agricultural emissions as presented in *Figure 9.5*. 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 7.1.1.

In 1999, total CH_4 emissions have decreased by 20% compared to the 1990 level. Sectors that contributed most to the decrease were the waste sector (-24%) and the agricultural sector (-16%) with 2.9 and 1.7 Mton CO_2-eq., respectively. In 1999, total N_2O emissions increased by about 15% compared to 1990, mainly due to the increase of the emission from industrial processes (15%) and from agriculture (16%) with 1.4 and 1.1 Mton CO_2-eq., respectively. As said above, in 1999, the N_2O emissions have become the second important greenhouse gas in the Netherlands, above CH_4. In 1999, total emissions of all F-gases increased by about 30% compared to the 1995 level (50% compared to 1990), which is equivalent to 2.8 Mton CO_2-eq.

In *Figures 9.4* and *9.6* the trend in *total* CO_2-eq. emissions (i.e. for all six gases jointly) is presented per IPCC source category. From *Figure 9.4* it can be concluded that the sector that showed

Table 9.2. Total greenhouse gas emissions with temperature correction, in CO_2-eq. and indexed, 1990-1999

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Emissions (Tg CO2-eq)										
CO_2 (T-corrected)	167.4	167.3	169.5	168.6	172.1	179.7	180.5	183.5	184.6	179.3
CH_4	27.1	27.5	26.4	25.7	25.3	24.6	24.4	23.2	22.3	21.7
N_2O	19.8	20.7	21.5	21.4	21.9	22.4	22.2	22.8	22.6	22.7
HFCs	5.1	4.9	4.6	5.1	6.4	6.7	7.5	7.9	8.7	8.8
PFCs	2.4	2.4	2.1	2.1	1.9	1.9	2.0	2.2	2.5	2.6
SF_6	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2	0.1	0.1
Total [group of six]	**222.1**	**222.9**	**224.2**	**223.0**	**227.8**	**235.4**	**236.9**	**239.7**	**240.8**	**235.3**
Index (1990 = 100)										
Index CO_2 (T-corrected)	*100*	99.9	101.2	100.7	102.8	107.3	107.8	109.6	110.2	107.1
Index CH_4	*100*	101.2	97.2	94.7	93.1	90.7	90.0	85.3	82.1	79.9
Index N_2O	*100*	105.0	108.7	108.1	111.1	113.3	112.6	115.6	114.3	114.8
Total [group of three]	**100**	**100.6**	**101.4**	**100.6**	**102.3**	**105.7**	**106.0**	**107.1**	**107.1**	**104.4**
Index ('90; F-gases '95)										
Index [group of six composite]	**99.5**	**99.9**	**100.5**	**99.9**	**102.1**	**105.5**	**106.2**	**107.4**	**107.9**	**105.5**

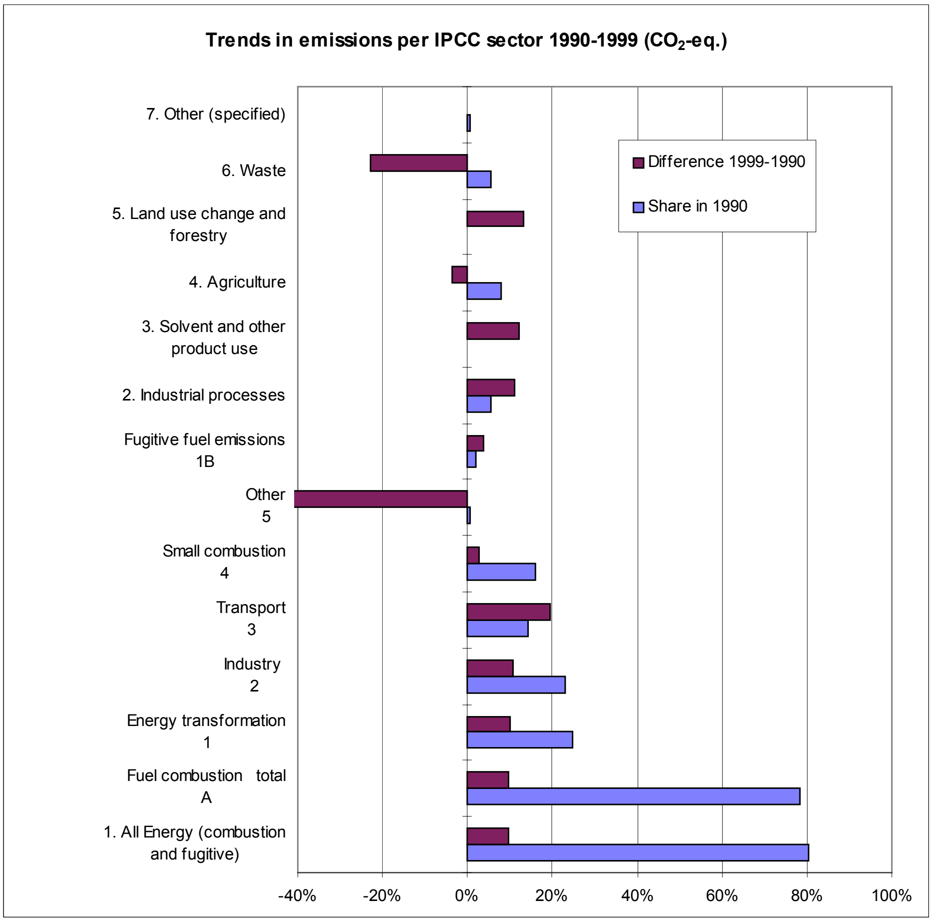


Figure 9.4. Shares and trends in CO_2-eq. emissions per sector 1990-1999 (1995-1999 for new gases) (no T-correction)

the largest growth in CO_2-eq. emissions in the past ten years is the transport sector (about 19%), whereas most other sectors showed a growth of about 10%. Clear exceptions are the waste sector and agriculture, which showed a *decrease* in CO_2-eq. emissions of more than 20% and 4%, respectively. Emissions from the residential and service sectors increased by 3%, but these are substantially influenced by climatic effect: when including the temperature correction these emissions *decreased* by about 10%.

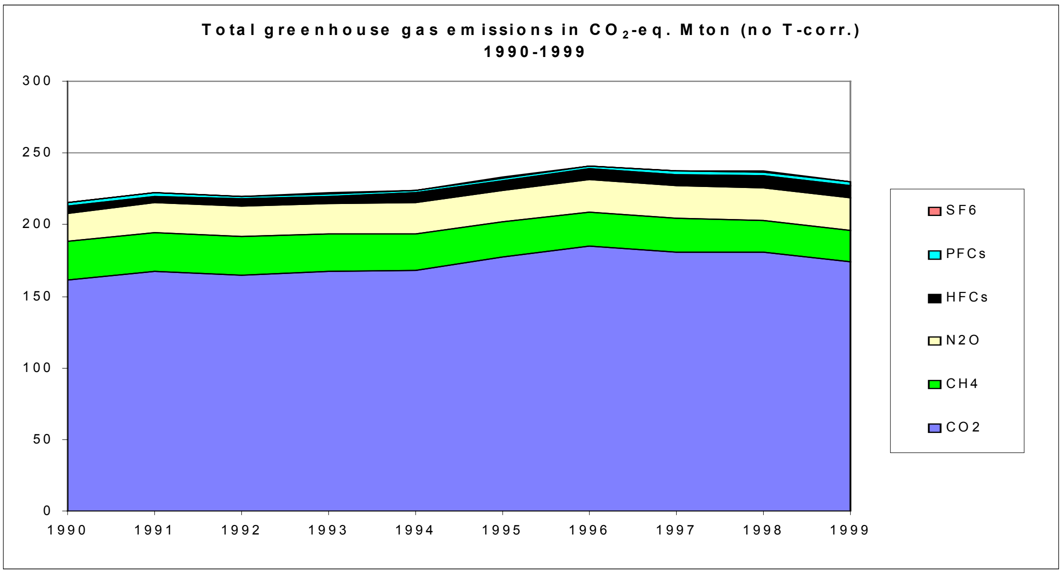


Figure 9.5. Trend in greenhouse gas emissions per gas 1990-1999 (no T-correction)

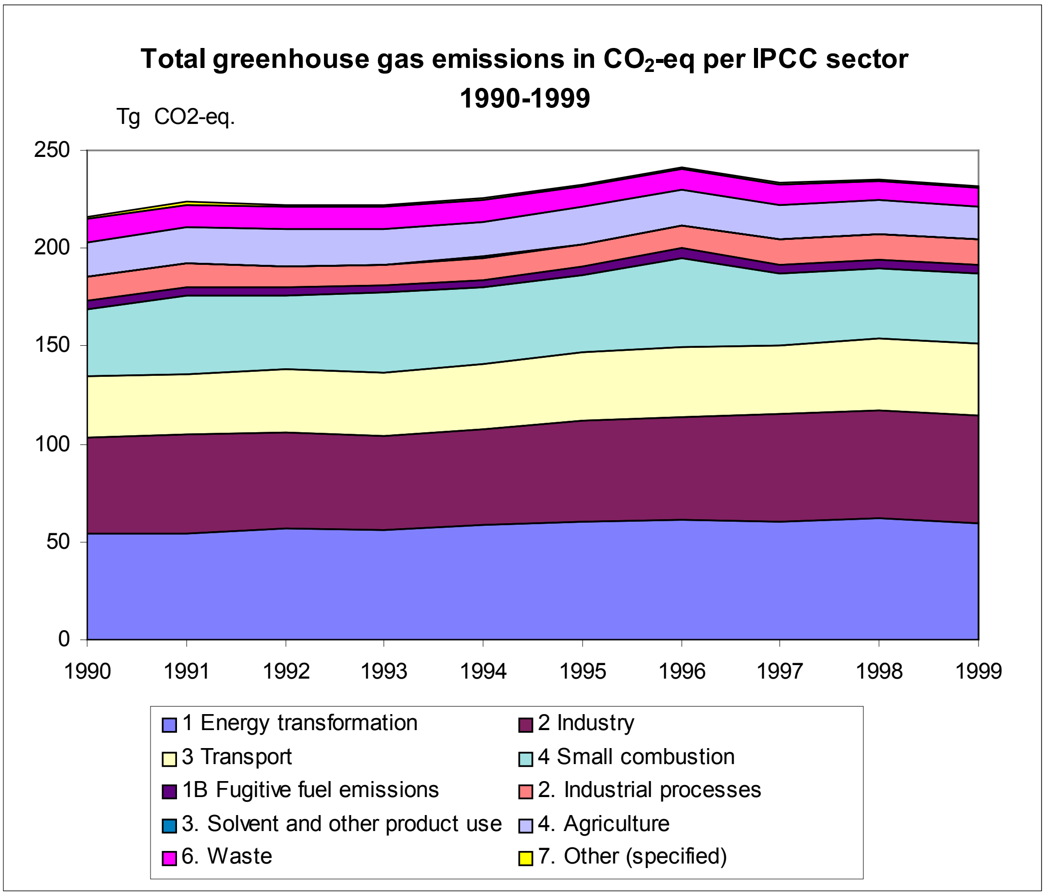


Figure 9.6. Trend in CO_2-eq. emissions per sector 1990-1999 (no T-correction)

References

CBS, 2000a: *Energy Monitor 2000-4* (in Dutch). CBS, Voorburg/Heerlen.

CBS, 2000b: *Statistics on waste from industry, several years* (in Dutch). CBS, Voorburg/Heerlen.

CBS, 2000c: *Statistics on waste from municipalities, several years* (in Dutch). CBS, Voorburg/Heerlen.

CBS, several years: *Statistics on energy supply in the Netherlands, several years*. CBS, Voorburg/Heerlen.

Cornelissen, A.A.J. and D. Beker, 2000: Investigation of the physical composition of household waste in the Netherlands. Results for 1997 (in Dutch). RIVM, Bilthoven. Report no. 776221 004.

DHV, 2000: *Overview and explanation of results of project 'Identification of unknown sources of other greenhouse gases'* (in Dutch). NOVEM, Utrecht, December 2000. Project no. 3743990070.

Elzenga, H.E., Smit, J.R.K. and H. Verhagen, 1996: Industrial waste 1985-1994 (in Dutch). RIVM, Bilthoven. Report no. 776202 004.

EnergieNed, 1995: *Results of the Environmental Action of the energy distribution sector 1994* (in Dutch). EnergieNed, Arnhem.

EZ, 1999: *Agreements on energy-efficiency, results 1998* (in Dutch), Ministry of Economic Affairs, The Hague.

EZ, 1998: *Oil and Gas in the Netherlands. Exploration and Production 19971998* (in Dutch), Ministry of Economic Affairs, The Hague.

Gasunie, 2001: *Yearly Report, 2000,* Groningen.

Gielen, D.J., 1996: *Potential CO_2 emissions in the Netherlands due to carbon storage in materials and products*. Netherlands Energy Research Centre (ECN), Petten. Draft November 1996.

IPCC, 1997: *Revised* 1996 *IPCC Guidelines for National Greenhouse Gas Emission Inventories.* Three volumes: Reference manual, Reporting Guidelines and Workbook. IPCC/OECD/IEA. IPCC WG1 Technical Support Unit, Hadley Centre, Meteorological Office, Bracknell, UK.

IPCC, 2000: *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories,* IPCC-TSU NGGIP, Japan.

Jager, D. de, and K. Blok, 1993: *Carbon balance of the waste system in the Netherlands* (in Dutch). Ecofys, Utrecht.

Klein, J.A.P., 1998: *Description of methodology for calculation of emissions from mobile sources in the Netherlands. In the framework of the Annual Emission Report. First Draft* (in Dutch). Central Bureau for Statistics (CBS), Voorburg.

Koch, W.R.R., Van Harmelen, A.K., Draaijers, G.P.J. and G. van Grootveld, 2001: *Emission data for the Netherlands; 1998 and estimates for 1999*. Ministry VROM/HIMH, The Hague, January. Report Series Target Group Monitoring, no. 7.

Kroeze, C., 1994: *Nitrous oxide (N_2O). Emission inventory and options for control in the Netherlands.* RIVM, Bilthoven. Report no. 773001 004.

Mareckova, K., 2000: *Report on existing system for preparing national GHG inventories in the Netherlands*. UNFCCC secretariat, Bonn.

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.

NAM, 1999a: *Environmental Report (in Dutch).* Nederlandse Aardolie Maatschappij B.V., Assen.

NAM, 1999b: *Preliminary Environmental Policy Plan 1999-2002* (in Dutch). Nederlandse Aardolie Maatschappij B.V, Assen.

NER, 1996: *Special regulation 3.5/28.3 Installations for production of natural gas and oil* (in Dutch). Netherlands Emission Guidelines (NER), Bilthoven.

NOGEPA, 1996, 1997: *Industry Environmental Plan. Implementation environmental plan for production of oil and natural gas 1995-1998* (in Dutch). NOGEPA, The Hague.

NOGEPA, 1999: *Preliminary Industry Environmental Plan. Implementation environmental plan for production of oil and natural gas, No. 2*, *1999-2002* (in Dutch). NOGEPA, The Hague.

Olivier, J.G.J., Spakman, J. and J.C. van den Berg, 1999: *Greenhouse gas emissions in the Netherlands 1990-1997 (IPCC Tables 7A).* RIVM, Bilthoven, February. Report no. 728001 009.

Olivier, J.G.J., van den Berg, J.C. and J.A.H.W. Peters, 2000: *Greenhouse gas emissions in the Netherlands: Summary Report 1990-1999 (IPCC Tables 1-7)*. RIVM, Bilthoven, July. Report no. 773201 002.

Oonk, H., 2001: Monitoring: more than only measuring. N_2O emissions from three-way catalytic converters drastically reduced. TNO-MEP, Apeldoorn. *Sustainable News, Newsletter*, **6:1**, January 2001.

RIVM, 1999: *Measuring, Modelling and Uncertainty* (in Dutch). RIVM, Bilthoven, February. Report no. 408129 005 (main report and addendum).

RIVM, 2000a: *Environmental Balance 2000* (in Dutch). Samson H.D. Tjeenk Willink Publishers. Alphen aan de Rijn.

RIVM/CBS, 2000b: *Environmental Compendium 2000. The environment in figures* (tables in English). RIVM, Bilthoven. Background data to the Environmental Balance 2000.

Also on http://www.rivm.nl/milieucompendium/index.html.

Spakman, J., Olivier, J.G.J. and A.R. van Amstel, 1996: Greenhouse gas emissions in the Netherlands 1990-1995. Methodology and data for 1994 and provisional data for 1995. RIVM, Bilthoven. Report no. 773001 011.

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* (in Dutch). VROM-HIMH, The Hague. Report Emission Registration no. 37, July 1997.

Turkenburg, W. and J. van der Sluijs, 1999: *Review RIVM instruments for the CO_2 emissions inventory used for the Environmental Balance* (in Dutch). NW&S-99047. In: Onderdelinden, D. (ed.), Review of RIVM instruments used for Environmental Balance 1999 [in Dutch]. RIVM, Bilthoven. Report no. 251701037, September 1999.

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.

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. (ed.), 2000b: *Monitoring CO_2 Sinks in the Netherlands: Priorities for Improvement*. Proceedings of a National Workshop held in Wageningen, The Netherlands, 24 November 1999. Wageningen University Environmental Sciences report, Wageningen

Van den Brink, R.M.M., Duvoort, G.L., Meijer, P.J.,Stein, D. and H. Verhagen (eds.), 2000: *Monitoring priority waste streams, data 1998.* RIVM, Bilthoven. Report no. 776205 005

Van der Hoek, K.W. *et al*., 1997: *Emissions of nitrogen compounds, methane, phosphorus, and heavy metals from agriculture 1980-1994* (in Dutch). RIVM/IKC-Landbouw/LEI-DLO. Draft RIVM report no. 773004 xxx.

Van der Most, P.F.J., Van Loon, M.M.J., Aulbers, J.A.W. and H.J.A.M. van Daelen, 1998: *Methods for calculation of emissions to air and water* (in Dutch). VROM-HIMH, The Hague, 1997. Report Emission Registration no. 49, December 1999.

Van Harmelen, A.K, Coenen, P.W.H.G., Draaijers, G.P.J., Leneman, H., Nagelhout,D, Rood, G.A., De Vries, D.J. and E.A. Zonneveld, 2000: *Emissions and waste in the Netherlands, Annual Report for 1998 and estimates for 1999* (in Dutch), Ministry VROM/HIMH, The Hague, November. Report Series Target Group Monitoring, no. 6.

VROM, 1998: *Second Netherlands' National Communication on Climate Change Policies*. Ministry of Housing, Spatial Planning and the Environment, The Hague, April 1997.

VVAV, 2000: *Annual report*, several years (in Dutch). Utrecht, Vereniging van Afvalverwerkers.

Wg EAJR CCDM, 2001: *Project Plan Annual Emission and Waste Report 2001.* Ministry VROM/HIMH, The Hague, November.

Wieleman, F., 1994: *Gross NMP Method: CO_2 calculations including temperature correction* (draft, in Dutch). Ministry of Economic Affairs, The Hague.

Appendices

Appendix A: Temperature correction for CO_2 from energy consumption for space heating

Appendix B: IPCC Tables 7A for 1990-1999

Appendix C: CRF Trend Tables 10 for greenhouse gases (per gas and all gases and source categories in CO_2-eq.)

Appendix D: Trend Tables for precursors

Appendix E: Recalculation and Completeness Tables for 1990 and 1997

Appendix A: 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 5%. 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 number 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 18º C. The number of HDDs for a specific day is defined as the number of degrees Centigrade of the mean daily temperature below the 18º C threshold. If, for example, the mean daily temperature for a specific day is 12º C, the number of HDDs for that day is 18-12 = 6. For a normal year the total number of HDD is about 3200; for a calendar year with relatively cold winter months, it is higher (e.g. 3717 in 1963) and for years with relatively warm winter months, it is lower (e.g. 2677 in 1990). The total annual number of HDDs is calculated by EnergieNed using data on mean daily temperature provided by the (see *Table A.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.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 1970-1996 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	1983	2999	3232	1.078
1971	3133	3239	1.034	1984	3177	3229	1.016
1972	3379	3228	0.955	1985	3487	3226	0.925
1973	3234	3221	0.966	1986	3333	3228	0.969
1974	3033	3226	1.046	1987	3372	3219	0.955
1975	3083	3221	1.045	1988	2823	3231	1.144
1976	3097	3225	1.041	1989	2729	3219	1.179
1977	2997	3218	1.074	1990	2677	3211	1.199
1978	3304	3209	0.971	1991	3163	3198	1.011
1979	3476	3217	0.926	1992	2829	3203	1.132
1980	3301	3235	0.980	1993	3076	3177	1.033
1981	3244	3238	0.998	1994	2835	3156	1.113
1982	3005	3244	1.080	1995	2917	3140	1.076
1983	2999	3232	1.078	1996	3504	3123	0.891

Source: EnergieNed, 1995 (pers. comm.)

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 1988 to 1995, 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 3.3%, from 3231, to 3123 between 1988 and 1996 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 1995. 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.3*). Other sectors use fixed application factors provided by the Ministry of Economic Affairs (see *Table A.2*) (Wieleman, 1994).

Table A.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.3 Application factors for dwellings in the period 1980-1995

1980	1981	1982	1983	1984	1985	86	1987	1988	1989	1990	1991	1992	1993	1994	1995
0.88	0.88	0.87	0.87	0.87	0.87	0.86	0.81	0.80	0.79	0.79	0.78	0.77	0.76	0.76	0.76

Source: EnergieNed, 1995.

Example calculation of temperature correction in 1990

As an example in *Table A.4* the calculation of the temperature correction of sectoral CO_2 emissions for 1990 has been summarised. In addition, *Table A.5* presents the variation of this correction over the last five years, showing that in this period a difference up to 6 Mton occurs between the maximum and the minimum correction. Compared to the Netherlands total of about 167.6 Mton in 1990, this is about 4% of the total.

Table A.4 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]	Application factor	HDD correction factor	Addition factor	Correction of gas consump-tion [PJ]	Correction of CO_2 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).

Evaluation of the methodology

From *Table A.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. Recently, 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., 2000).

Table A.5 Temperature correction of carbon dioxide emissions [in Mton] per sector 1990-1995.

Sector	1990***	1991	1992	1993	1994	1995*
Residential sector	3.1	0.2	2.1	0.6	1.8	1.2
Commercial and public services	1.2	0.1	0.9	0.2	0.8	0.6
Agriculture	1.2	0.1	0.9	0.2	0.7	0.4
Industry	0.6	0.0	0.4	0.1	0.3	0.2
Energy sector **	0.1	0.0	0.1	0.0	0.1	0.1
Total CO_2 correction	**6.4**	**0.4**	**4.5**	**1.2**	**3.8**	**2.5**
Correction as % of uncorrected total	3.8	0.2	2.6	0.7	2.2	1.3

Source: Spakman *et al.* (1996).
* Data for 1995 are preliminary figures.
** Electric power plants and refineries.
*** Figures for 1990 may differ slightly from results presented in *Table A.4* due to revised data used in Spakman *et al.* (1997) for calculating sectoral temperature corrections.

Appendix B: IPCC Tables 7A for 1990-1999

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 Chapter 5). Please note that all data for 1999 are preliminary.

We 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 Trned Table C.10 in Appendix C.

Table B.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	**161,173.12**	**-1,500.00**	**1,292.73**	**63.73**	**0.00**	**5,143.69**	**0.00**	**2,431.78**	**0.00**	**0.01**	**563.20**	**1,139.20**	**500.00**	**193.30**
1. Energy	**159,160.92**		**214.05**	**5.22**							**549.30**	**981.80**	**267.80**	**167.00**
A. Fuel Combustion — Reference Approach[2]	157,661.53													
Sectoral Approach[2]	158,535.67		34.97	5.22							548.20	975.60	220.20	159.20
1. Energy Industries	52,117.15		1.26	0.45							102.80	16.60	3.90	108.70
2. Manufacturing Industries and Construction	41,880.84		5.78	0.13							65.70	114.20	4.70	26.20
3. Transport	29,095.35		7.92	4.54							336.90	748.90	200.50	20.00
4. Other Sectors	34,320.11		20.00	0.09							42.80	95.90	11.10	4.30
5. Other	1,122.23		0.00	0.00							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	625.26		179.08	0.00							1.10	6.20	47.60	7.80
1. Solid Fuels	IE		IE	IE							IE	IE	IE	0.00
2. Oil and Natural Gas	625.26		179.08	0.00							1.10	6.20	47.60	7.80
2. Industrial Processes	**1,901.47**		**3.40**	**31.53**	**0.00**	**5,143.69**	**0.00**	**2,431.78**	**0.00**	**0.01**	**13.50**	**153.60**	**130.40**	**26.00**
A. Mineral Products	746.73		0.00	0.00							0.00	0.00	0.00	0.00
B. Chemical Industry	0.00		0.00	31.53	0.00	0.00	0.00	0.00	0.00	0.00	IE	IE	IE	IE
C. Metal Production	0.62		0.00	0.00				2,398.10		0.00	0.00	0.00	0.00	0.00
D. Other Production[3]	209.51										IE	IE	IE	IE
E. Production of Halocarbons and SF_6						5,143.69		0.00		0.00				
F. Consumption of Halocarbons and SF_6					0.00	0.00	0.00	33.68	0.00	0.01				
G. Other	944.61		3.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.50	153.60	130.40	26.00

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
					P	A	P	A	P	A				
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**0.00**			**0.50**							**0.10**	**2.40**	**101.40**	0.30
4. Agriculture	**0.00**	**0.00**	**504.88**	**22.19**							0.00	0.00	0.20	0.00
A. Enteric Fermentation			401.90											
B. Manure Management			102.98	0.66									0.00	
C. Rice Cultivation			NO										0.00	
D. Agricultural Soils	(4) IE	(4)	IE	21.53									0.20	
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) **-1,500.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	(5) 0.00	(5) -1,500.00												
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	**110.73**		**568.40**	**0.50**							**0.30**	**1.40**	**0.20**	**0.00**
A. Solid Waste Disposal on Land	(4) 0.00		562.10									0.00	0.00	
B. Wastewater Handling			6.30	0.50							0.00	0.00	0.00	
C. Waste Incineration	(4) IE		IE	IE							IE	IE	IE	IE
D. Other	110.73		0.00	0.00							0.30	1.40	0.20	0.00
7. Other *(please specify)*	**0.00**	**0.00**	**2.00**	**3.80**	**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			2.00											
Polluted surface water				3.80										

Table B.2. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1991***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1] P	HFCs[1] A	PFCs[1] P	PFCs[1] A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals	**166,920.00**	**-1,600.00**	**1,308.70**	**66.90**	**0.00**	**4,862.89**	**0.00**	**2,436.78**	**0.00**	**0.00**	**551.40**	**1,022.50**	**460.60**	**163.50**
1. Energy	**165,320.00**		**223.80**	**6.90**							**537.90**	**891.30**	**247.60**	**140.90**
A. Fuel Combustion — Reference Approach[2]	164,478.31													
Sectoral Approach[2]	164,860.00		35.70	6.90							536.70	883.10	200.20	131.20
1. Energy Industries	52,190.00		3.20	0.50							95.60	18.90	4.10	88.60
2. Manufacturing Industries and Construction	42,660.00		3.50	0.10							60.40	108.30	4.30	17.50
3. Transport	28,550.00		6.90	6.20							336.20	658.40	180.30	21.00
4. Other Sectors	40,390.00		22.10	0.10							44.50	97.50	11.50	4.10
5. Other	1,070.00		0.00	0.00							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	460.00		188.10	0.00							1.20	8.20	47.40	9.70
1. Solid Fuels	IE		IE	IE							IE	IE	IE	IE
2. Oil and Natural Gas	460.00		188.10	0.00							1.20	8.20	47.40	9.70
2. Industrial Processes	**1,500.00**		**3.50**	**32.30**	**0.00**	**4,862.89**	**0.00**	**2,436.78**	**0.00**	**0.00**	**13.10**	**127.40**	**120.90**	**22.40**
A. Mineral Products	700.00		0.00	0.00							0.00	0.00	0.00	0.00
B. Chemical Industry	0.00		0.00	32.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Metal Production	0.00		0.00	0.00				2,398.10		0.00	0.00	0.00	0.00	0.00
D. Other Production[3]	0.00										0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6						4,862.89		0.00		0.00				
F. Consumption of Halocarbons and SF_6					0.00	0.00	0.00	38.68	0.00	0.00				
G. Other	800.00		3.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.10	127.40	120.90	22.40

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1] P	HFCs[1] A	PFCs[1] P	PFCs[1] A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
3. Solvent and Other Product Use	**100.00**			**0.50**							**0.10**	**2.40**	**91.70**	0.20
4. Agriculture	**0.00**	**0.00**	**517.00**	**22.90**							0.00	0.00	0.20	0.00
A. Enteric Fermentation			412.00											
B. Manure Management			105.00	0.70									0.00	
C. Rice Cultivation			NO										0.00	
D. Agricultural Soils	[4]	[4]	IE	22.20									0.20	
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] **-1,600.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0.00	[5] -1,600.00												
B. Forest and Grassland Conversion	NO		NO	NO							0.00	0.00		
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	**0.00**		**562.40**	**0.50**							**0.30**	**1.40**	**0.20**	**0.00**
A. Solid Waste Disposal on Land	[6] 0.00		556.10									0.00	0.00	
B. Wastewater Handling			6.30	0.50							0.00	0.00	0.00	
C. Waste Incineration	[6] IE		IE	IE							IE	IE	IE	IE
D. Other	0.00		0.00	0.00							0.30	1.40	0.20	0.00
7. Other *(please specify)*	**0.00**	**0.00**	**2.00**	**3.80**	**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			2.00											
Polluted surface water				3.80										

Table B.3. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1992***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES		CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1] P	HFCs[1] A	PFCs[1] P	PFCs[1] A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
		(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals		**165,170.00**	**-1,600.00**	**1,256.20**	**69.30**	**0.00**	**4,594.49**	**0.00**	**2,098.69**	**0.00**	**0.00**	**539.00**	**966.30**	**436.20**	**157.20**
1. Energy		**163,800.00**		**199.10**	**7.90**							**525.90**	**861.60**	**237.60**	**138.30**
A. Fuel Combustion	Reference Approach[2]	160,952.33													
	Sectoral Approach[2]	163,430.00		36.00	7.90							524.60	855.90	194.20	126.70
1. Energy Industries		54,130.00		3.80	0.50							95.90	16.40	4.30	81.10
2. Manufacturing Industries and Construction		42,510.00		4.90	0.10							61.40	114.80	5.80	20.00
3. Transport		29,830.00		6.80	7.20							325.50	626.40	172.40	21.40
4. Other Sectors		37,330.00		20.50	0.10							41.80	98.30	11.70	4.20
5. Other		-370.00		0.00	0.00							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels		370.00		163.10	0.00							1.30	5.70	43.40	11.60
1. Solid Fuels		IE		IE	IE							IE	IE	IE	IE
2. Oil and Natural Gas		370.00		163.10	0.00							1.30	5.70	43.40	11.60
2. Industrial Processes		**1,270.00**		**3.70**	**30.40**	**0.00**	**4,594.49**	**0.00**	**2,098.69**	**0.00**	**0.00**	**12.70**	**101.10**	**115.40**	**18.80**
A. Mineral Products		750.00		0.00	0.00							0.00	0.00	0.00	0.00
B. Chemical Industry		0.00		0.00	30.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Metal Production		0.00		0.00	0.00				2,054.20		0.00	0.00	0.00	0.00	0.00
D. Other Production[3]		0.00										0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6							4,594.49		0.00		0.00				
F. Consumption of Halocarbons and SF_6						0.00	0.00	0.00	44.49	0.00	0.00				
G. Other		520.00		3.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	12.70	101.10	115.40	18.80

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1] P	HFCs[1] A	PFCs[1] P	PFCs[1] A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**100.00**			**0.50**							**0.10**	**2.20**	**82.80**	0.10
4. Agriculture	**0.00**	**0.00**	**505.00**	**26.20**							0.00	0.00	0.20	0.00
A. Enteric Fermentation			401.00											
B. Manure Management			104.00	0.70									0.00	
C. Rice Cultivation			NO										0.00	
D. Agricultural Soils	[4]	[4]	IE	25.50									0.20	
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							0.00	0.00	0.00	
5. Land-Use Change and Forestry	[5] **0.00**	[5] **-1,600.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0.00	[5] -1,600.00												
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	**0.00**		**546.40**	**0.50**							**0.30**	**1.40**	**0.20**	**0.00**
A. Solid Waste Disposal on Land	[4] 0.00		540.10									0.00	0.00	
B. Wastewater Handling			6.30	0.50							0.00	0.00	0.00	
C. Waste Incineration	[4] IE		IE	IE							IE	IE	IE	IE
D. Other	0.00		0.00	0.00							0.30	1.40	0.20	0.00
7. Other *(please specify)* ---	**0.00**	**0.00**	**2.00**	**3.80**	**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			2.00											
Polluted surface water				3.80										

Table B.4. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1993***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs(1) P	HFCs(1) A	PFCs(1) P	PFCs(1) A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**167,450.00**	**-1,600.00**	**1,224.70**	**68.90**	**0.00**	**5,106.90**	**0.00**	**2,118.36**	**0.00**	**0.00**	**518.90**	**948.60**	**403.20**	**150.40**
1. Energy	**166,240.00**		**192.40**	**7.90**							**505.10**	**846.10**	**223.00**	**133.60**
A. Fuel Combustion — Reference Approach (2)	163,385.57													
Sectoral Approach (2)	165,890.00		34.40	7.90							504.10	840.10	181.10	122.10
1. Energy Industries	53,800.00		3.40	0.50							91.80	15.40	3.60	77.40
2. Manufacturing Industries and Construction	39,920.00		3.20	0.10							54.60	139.10	2.90	17.60
3. Transport	30,460.00		6.40	7.20							311.80	582.30	162.00	21.30
4. Other Sectors	40,060.00		21.40	0.10							45.90	103.30	12.60	5.80
5. Other	1,650.00		0.00	0.00							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	350.00		158.00	0.00							1.00	6.00	41.90	11.50
1. Solid Fuels	IE		IE	IE							IE	IE	IE	IE
2. Oil and Natural Gas	350.00		158.00	0.00							1.00	6.00	41.90	11.50
2. Industrial Processes	**1,210.00**		**4.90**	**30.00**	**0.00**	**5,106.90**	**0.00**	**2,118.36**	**0.00**	**0.00**	**13.40**	**99.10**	**100.00**	**16.70**
A. Mineral Products	1,050.00		0.00	0.00							0.00	0.00	0.00	0.00
B. Chemical Industry	0.00		0.00	30.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Metal Production	0.00		0.00	0.00				2,067.20		0.00	0.00	0.00	0.00	0.00
D. Other Production (3)	0.00										0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6						5,106.90		0.00		0.00				
F. Consumption of Halocarbons and SF_6					0.00	0.00	0.00	51.16	0.00	0.00				
G. Other	160.00		4.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	13.40	99.10	100.00	16.70

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs (1) P	HFCs (1) A	PFCs(1) P	PFCs(1) A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**0.00**			**0.50**							**0.10**	**2.00**	**79.80**	0.10
4. Agriculture	**0.00**	**0.00**	**497.00**	**26.20**							0.00	0.00	0.20	0.00
A. Enteric Fermentation			393.00											
B. Manure Management			104.00	0.80									0.00	
C. Rice Cultivation			NO										0.00	
D. Agricultural Soils	(4)	(4)	IE	25.40									0.20	
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) **-1,600.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	(5) 0.00	(5) -1,600.00												
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	**0.00**		**528.40**	**0.50**							**0.30**	**1.40**	**0.20**	**0.00**
A. Solid Waste Disposal on Land	(4) 0.00		522.10									0.00	0.00	
B. Wastewater Handling			6.30	0.50							0.00	0.00	0.00	
C. Waste Incineration	(4) IE		IE	IE							IE	IE	IE	IE
D. Other	0.00		0.00	0.00							0.30	1.40	0.20	0.00
7. Other *(please specify)*	**0.00**	**0.00**	**2.00**	**3.80**	**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			2.00											
Polluted surface water				3.80										

Table B.5. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1994***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs(1) P	HFCs(1) A	PFCs(1) P	PFCs(1) A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**168,380.00**	**-1,700.00**	**1,203.10**	**70.80**	**356.20**	**6,449.27**	**0.00**	**1,890.43**	**0.00**	**0.01**	**493.20**	**905.10**	**387.70**	**136.50**
1. Energy	**166,940.00**		**202.30**	**8.00**							**482.40**	**799.90**	**216.80**	**120.10**
A. Fuel Combustion — Reference Approach (2)	162,612.30													
Sectoral Approach (2)	166,750.00		33.80	7.60							481.90	792.30	174.50	109.50
1. Energy Industries	55,980.00		3.70	0.20							81.40	17.00	3.90	66.20
2. Manufacturing Industries and Construction	40,950.00		2.60	0.10							54.40	114.30	2.60	16.20
3. Transport	30,800.00		6.30	7.20							304.40	559.90	156.50	21.70
4. Other Sectors	38,460.00		21.20	0.10							41.70	101.10	11.50	5.40
5. Other	560.00		0.00	0.00							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	190.00		168.50	0.40							0.50	7.60	42.30	10.60
1. Solid Fuels	IE		IE	IE							IE	IE	IE	IE
2. Oil and Natural Gas	190.00		168.50	0.40							0.50	7.60	42.30	10.60
2. Industrial Processes	**1,440.00**		**5.30**	**31.60**	**356.20**	**6,449.27**	**CBI**	**1,890.43**	**CBI**	**0.01**	**10.40**	**101.70**	**88.20**	**16.20**
A. Mineral Products	1,050.00		0.00	0.00							0.00	0.00	0.00	0.00
B. Chemical Industry	0.00		0.00	31.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Metal Production	0.00		0.00	0.00				1,831.60		0.00	0.00	0.00	0.00	0.00
D. Other Production (3)	0.00										0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6						6,367.37		0.00		0.00				
F. Consumption of Halocarbons and SF_6					0.00	81.90	0.00	58.83	0.00	0.01				
G. Other	390.00		5.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	10.40	101.70	88.20	16.20

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs (1) P	HFCs (1) A	PFCs(1) P	PFCs(1) A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**0.00**			**0.50**							**0.10**	**2.10**	**82.30**	0.20
4. Agriculture	**0.00**	**0.00**	**483.00**	**26.40**							0.00	0.00	0.20	0.00
A. Enteric Fermentation			382.00											
B. Manure Management			101.00	0.80									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	(4)	(4)	IE	25.60									0.20	
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							0.00	0.00	0.00	
5. Land-Use Change and Forestry	(5) **0.00**	(5) **-1,700.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	(5) 0.00	(5) -1,700.00												
B. Forest and Grassland Conversion	NO		NO	NO							0.00	0.00		
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	**0.00**		**510.20**	**0.50**							**0.30**	**1.40**	**0.20**	**0.00**
A. Solid Waste Disposal on Land	(6) 0.00		505.10									0.00	0.00	
B. Wastewater Handling			5.10	0.50							0.00	0.00	0.00	
C. Waste Incineration	(6) IE		IE	IE							IE	IE	IE	IE
D. Other	0.00		0.00	0.00							0.30	1.40	0.20	0.00
7. Other *(please specify)*	**0.00**	**0.00**	**2.30**	**3.80**	**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			2.30											
Polluted surface water				3.80										

Table B.6. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1995***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs(1) P	HFCs(1) A	PFCs(1) P	PFCs(1) A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**177,130.00**	**-1,700.00**	**1,172.40**	**72.20**	**928.40**	**6,723.62**	**0.00**	**1,866.76**	**0.00**	**0.01**	**497.40**	**909.00**	**369.70**	**144.70**
1. Energy	**175,194.00**		**209.30**	**8.16**							**485.40**	**811.60**	**216.60**	**129.00**
A. Fuel Combustion — Reference Approach (2)	173,081.81													
Sectoral Approach (2)	174,224.00		35.30	8.16							484.70	802.10	173.80	118.70
1. Energy Industries	57,314.00		4.90	0.56							75.70	17.30	5.00	67.90
2. Manufacturing Industries and Construction	43,430.00		2.80	0.10							52.40	120.50	2.80	15.70
3. Transport	32,030.00		6.30	7.40							314.90	563.70	154.20	31.00
4. Other Sectors	38,930.00		21.30	0.10							41.70	100.60	11.80	4.10
5. Other	2,520.00		0.00	0.00							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	970.00		174.00	0.00							0.70	9.50	42.80	10.30
1. Solid Fuels	IE		IE	IE							IE	IE	IE	IE
2. Oil and Natural Gas	970.00		174.00	0.00							0.70	9.50	42.80	10.30
2. Industrial Processes	**1,570.00**		**4.90**	**31.60**	**928.40**	**6,723.62**	**0.00**	**1,866.76**	**CBI**	**0.01**	**9.20**	**94.80**	**79.50**	**14.80**
A. Mineral Products	1,130.00		0.00	0.00							0.00	0.00	0.00	0.00
B. Chemical Industry	0.00		0.00	31.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Metal Production	0.00		0.00	0.00				1,799.10		0.00	0.00	0.00	0.00	0.00
D. Other Production (3)	0.00										0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6						6,463.96		0.00		0.00				
F. Consumption of Halocarbons and SF_6					0.00	259.66	0.00	67.66	0.00	0.01				
G. Other	440.00		4.90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9.20	94.80	79.50	14.80

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs (1) P	HFCs (1) A	PFCs(1) P	PFCs(1) A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**0.00**			**0.50**							**0.10**	**2.10**	**71.70**	0.00
4. Agriculture	**0.00**	**0.00**	**475.70**	**27.60**							0.00	0.00	0.20	0.00
A. Enteric Fermentation			376.70											
B. Manure Management			99.00	0.80									0.00	
C. Rice Cultivation			NO										0.00	
D. Agricultural Soils	(4)	(4)	IE	26.80									0.20	
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) **-1,700.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	(5) 0.00	(5) -1,700.00												
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	**366.00**		**480.50**	**0.54**							**2.70**	**0.50**	**1.70**	**0.90**
A. Solid Waste Disposal on Land	(6) 0.00		479.00									0.00	0.00	
B. Wastewater Handling			1.50	0.50							0.00	0.00	0.00	
C. Waste Incineration	(6) IE		IE	IE							IE	IE	IE	IE
D. Other	366.00		0.00	0.04							2.70	0.50	1.70	0.90
7. Other *(please specify)* ---	**0.00**	**0.00**	**2.00**	**3.80**	**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			2.00											
Polluted surface water				3.80										

Table B.7. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1996***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1] P	HFCs[1] A	PFCs[1] P	PFCs[1] A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**184,721**	**-1,700.0**	**1,163.1**	**71.8**	**1,955.90**	**7,524.23**	**0.00**	**2,042.11**	**0.00**	**0.01**	**480.8**	**835.9**	**347.9**	**132.2**
1. Energy	**183,021**		**214.4**	**7.7**							**461.1**	**661.6**	**200.3**	**113.2**
A. Fuel Combustion – Reference Approach[2]	180,920													
Sectoral Approach[2]	182,021		36.9	7.7							460.6	653.5	158.3	102.7
1. Energy Industries	58,900		5.7	0.4							70.7	45.5	7.0	63.7
2. Manufacturing Industries and Construction	42,100		1.5	0.1							44.2	31.3	1.3	10.9
3. Transport	33,821		5.7	7.1							300.0	510.9	134.9	26.7
4. Other Sectors	45,200		24.0	0.1							45.7	65.8	15.1	1.4
5. Other	2,000		0.0	0.0							0.0	0.0	0.0	0.0
B. Fugitive Emissions from Fuels	1,000		177.5	0.0							0.5	8.1	42.0	10.5
1. Solid Fuels	IE		IE	IE							IE	IE	IE	IE
2. Oil and Natural Gas	1,000		177.5	0.0							0.5	8.1	42.0	10.5
2. Industrial Processes	**1,700**		**5.7**	**31.7**	**1,955.90**	**7,524.23**	**0.00**	**2,042.11**	**CBI**	**0.01**	**17.8**	**171.7**	**73.4**	**17.9**
A. Mineral Products	900		0.1	0.0							1.2	1.1	0.4	2.8
B. Chemical Industry	0		5.2	31.7	0	0	0	0	0	0	8.9	32.4	17.9	4.5
C. Metal Production	0		0.3	0.0				1,964		0	7.3	132.8	3.1	10.1
D. Other Production[3]	0										0.0	0.0	0.0	0.0
E. Production of Halocarbons and SF_6						6,904		0		0				
F. Consumption of Halocarbons and SF_6					0	620	0	78	0	0				
G. Other	800		0.1	0.0	0	0	0	0	0	0	0.4	5.4	52.0	0.5

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1] P	HFCs[1] A	PFCs[1] P	PFCs[1] A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**0**			**0.5**							**0.1**	**1.9**	**72.3**	0.2
4. Agriculture	**0**	**0**	**463.4**	**27.5**							0.0	0.0	0.0	0.0
A. Enteric Fermentation			365.3											
B. Manure Management			98.1	0.7									0.0	
C. Rice Cultivation			NO										0.0	
D. Agricultural Soils	[4]	[4]	IE	26.8									0.0	
E. Prescribed Burning of Savannas			NO	NO							0.0	0.0	0.0	
F. Field Burning of Agricultural Residues			NO	NO							0.0	0.0	0.0	
G. Other			NO	NO							0.0	0.0	0.0	
5. Land-Use Change and Forestry	[3] **0**	[3] **-1,700**	**0.0**	**0.0**							**0.0**	**0.0**	**0.0**	**0.0**
A. Changes in Forest and Other Woody Biomass Stocks	[3] 0	[3] -1,700												
B. Forest and Grassland Conversion	NO		NO	NO							0.0	0.0		
C. Abandonment of Managed Lands	[3] NO	[3] 0												
D. CO_2 Emissions and Removals from Soil	[3] NE	[3] 0												
E. Other	[3] 0	[3] 0	0.0	0.0							0.0	0.0		
6. Waste	**0**		**477.6**	**0.6**							**1.8**	**0.7**	**1.9**	**0.9**
A. Solid Waste Disposal on Land	[4] 0		477.0									0.0	0.8	
B. Wastewater Handling			0.6	0.6							0.0	0.0	0.0	
C. Waste Incineration	[4] IE		IE	IE							IE	IE	IE	IE
D. Other	0		0.0	0.0							1.8	0.7	1.1	0.9
7. Other *(please specify)* ---	**0**	**0**	**2.0**	**3.8**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
Solvents and other product use			2.0											
Polluted surface water				3.8										

Table B.8. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1997***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1] P	HFCs[1] A	PFCs[1] P	PFCs[1] A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
Total National Emissions and Removals	**181,165.50**	**-1,700.00**	**1,102.77**	**73.67**	**2,159.50**	**7,884.10**	**0.00**	**2,153.98**	**0.00**	**0.01**	**459.49**	**791.54**	**323.45**	**117.45**
1. Energy	**179,283.44**		**186.56**	**7.81**							**442.49**	**648.97**	**188.45**	**100.38**
A. Fuel Combustion — Reference Approach[2]	177,511.99													
Sectoral Approach[2]	178,265.58		30.10	7.81							441.64	642.37	151.80	90.30
1. Energy Industries	57,901.63		3.06	0.48							62.31	21.53	2.84	54.84
2. Manufacturing Industries and Construction	44,534.66		1.59	0.06							42.56	33.43	2.31	11.46
3. Transport	33,059.66		5.28	7.19							299.57	525.01	133.05	22.65
4. Other Sectors	36,431.30		20.17	0.08							37.20	62.41	13.60	1.35
5. Other	6,338.33		0.00	0.00							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	1,017.86		156.46	0.00							0.85	6.60	36.65	10.08
1. Solid Fuels	IE		IE	IE							IE	IE	IE	IE
2. Oil and Natural Gas	1,017.86		156.46	0.00							0.85	6.60	36.65	10.08
2. Industrial Processes	**1,726.54**		**2.73**	**34.98**	**2,159.50**	**7,884.10**	**CBI**	**2,153.98**	**CBI**	**0.01**	**15.04**	**139.90**	**71.77**	**16.02**
A. Mineral Products	1,087.17		0.14	0.00							0.00	0.00	0.00	0.00
B. Chemical Industry	277.22		2.46	34.98	0	0	0	0	0	0	0.00	0.00	0.00	0.00
C. Metal Production	0.00		0.00	0.00				2,065		0	0.00	0.00	0.00	0.00
D. Other Production[3]	0.00										0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6						6,902		0		0				
F. Consumption of Halocarbons and SF_6					0	982	0	89	0	0				
G. Other	362.15		0.12	0.00	0	0	0	0	0	0	15.04	139.90	71.77	16.02

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1] P	HFCs[1] A	PFCs[1] P	PFCs[1] A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)				(Gg)					
3. Solvent and Other Product Use	**10.54**			**0.57**							**0.08**	**2.02**	**61.40**	0.23
4. Agriculture	**0.00**	**0.00**	**446.23**	**25.94**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			352.64											
B. Manure Management			93.59	0.68									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	(4)	(4)	IE	25.26									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) **-1,700.00**	**0.00**	**0.00**							**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	(5) 0.00	(5) -1,700.00												
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	**144.98**		**465.29**	**0.57**							**1.88**	**0.65**	**1.66**	**0.82**
A. Solid Waste Disposal on Land	(6) 0.00		463.98									0.00	0.78	
B. Wastewater Handling			1.30	0.57							0.00	0.00	0.00	
C. Waste Incineration	(6) IE		IE	IE							IE	IE	IE	IE
D. Other	144.98		0.01	0.00							1.88	0.65	0.88	0.82
7. Other *(please specify)*	**0.00**	**0.00**	**1.97**	**3.80**	**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			1.97											
Polluted surface water				3.80										

Table B.9. Emissions of greenhouse gases in the Netherlands; IPCC Table 7A; ***Year: 1998***

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1] P	HFCs[1] A	PFCs[1] P	PFCs[1] A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**180,912.64**	**-1,700.00**	**1,062**	**72.82**	**1,881.20**	**8,695.17**	**0.00**	**2,468.50**	**0.00**	**0.01**	**422.94**	**721.79**	**297.61**	**106.78**
1. Energy	**178,948.69**		**176.78**	**6.82**							**407.89**	**577.55**	**170.58**	**92.81**
A. Fuel Combustion — Reference Approach[2]	176,118.95													
Sectoral Approach[2]	177,395.37		30.69	6.82							407.08	571.31	139.50	84.80
1. Energy Industries	59,957.39		4.40	0.48							56.68	22.49	3.23	52.56
2. Manufacturing Industries and Construction	43,981.62		1.81	0.06							36.86	20.42	2.45	7.79
3. Transport	33,998.61		4.86	6.21							275.94	472.42	121.73	23.25
4. Other Sectors	35,852.14		19.62	0.08							37.60	55.99	12.10	1.20
5. Other	3,605.61		0.00	0.00							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	1,553.32		146.10	0.00							0.81	6.23	31.07	8.01
1. Solid Fuels	IE		IE	IE							IE	IE	IE	IE
2. Oil and Natural Gas	1,553.32		146.10	0.00							0.81	6.23	31.07	8.01
2. Industrial Processes	**1,767.75**		**2.41**	**35.99**	**1,881.20**	**8,695.17**	**CBI**	**2,468.50**	**CBI**	**0.01**	**13.01**	**141.47**	**67.39**	**13.21**
A. Mineral Products	1,048.50		0.13	0.00							1.00	1.58	0.27	2.24
B. Chemical Industry	257.23		2.22	35.99	0	0	0	0	0	0	5.60	23.27	13.78	2.75
C. Metal Production	22.61		0.00	0.00				2,366		0	6.20	114.82	3.02	7.61
D. Other Production[3]	0.00										0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6						7,519		0		0				
F. Consumption of Halocarbons and SF_6					0	1,177	0	103	0	0				
G. Other	439.42		0.06	0.00	0	0	0	0	0	0	0.21	1.81	50.32	0.61

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 emissions	CO_2 removals	CH_4	N_2O	HFCs[1] P	HFCs[1] A	PFCs[1] P	PFCs[1] A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**11.40**			**0.54**							**0.08**	**2.04**	**57.79**	0.02
4. Agriculture	**0.00**	**0.00**	**432.35**	**25.13**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			339.35											
B. Manure Management			93.00	0.65									0.00	
C. Rice Cultivation			NO										0.00	
D. Agricultural Soils	[4]	[4]	IE	24.48									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] **-1,700.00**	**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0.00	[5] -1,700.00												
B. Forest and Grassland Conversion	NO		NO	NO							0.00	0.00		
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	**184.80**		**448.30**	**0.53**							**1.96**	**0.74**	**1.69**	**0.74**
A. Solid Waste Disposal on Land	[6] 0.00		444.50									0.00	0.75	
B. Wastewater Handling			3.78	0.53							0.00	0.00	0.00	
C. Waste Incineration	[6] IE		IE	IE							IE	IE	IE	IE
D. Other	184.80		0.02	0.00							1.96	0.74	0.94	0.74
7. Other *(please specify)*	**0.00**	**0.00**	**1.93**	**3.80**	**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			1.93											
Polluted surface water				3.80										

Table B.10. 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] P	HFCs[1] A	PFCs[1] P	PFCs[1] A	SF_6 P	SF_6 A	NO_x	CO	NMVOC	SO_2
	(Gg)				CO$_2$ equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**174,125.64**	**-1,700.00**	**1033.501333**	**73.19**	**2,017.20**	**8,835.73**	**0.00**	**2,593.78**	**#VALUE!**	**0.01**	**408.35**	**679.40**	**281.62**	**100.36**
1. Energy	**172,145.96**		**174.119258**	**6.53**							**390.69**	**547.07**	**163.24**	**86.12**
A. Fuel Combustion – Reference Approach [2]	167,330.53													
Sectoral Approach [2]	170,618.58		29.889144	6.53							390.39	541.52	132.61	78.72
1. Energy Industries	57,040.60		4.107297	0.41							52.00	28.16	3.10	48.32
2. Manufacturing Industries and Construction	43,549.41		1.592106	0.05							32.12	17.00	2.11	6.18
3. Transport	34,699.54		4.568323	5.98							269.11	440.76	115.35	23.12
4. Other Sectors	35,300.67		19.611440	0.08							37.15	55.61	12.05	1.10
5. Other	28.37		0.009977	0.00							0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	1,527.37		144.230115	0.00							0.30	5.56	30.63	7.40
1. Solid Fuels	IE		IE	IE							IE	IE	IE	IE
2. Oil and Natural Gas	1,527.37		144.230115	0.00							0.30	5.56	30.63	7.40
2. Industrial Processes	**1,784.38**		**2.477658**	**36.14943**	**2,017.20**	**8,835.73**	**0.00**	**2,593.78**	**#VALUE!**	**0.01**	**15.61**	**129.52**	**60.08**	**13.48**
A. Mineral Products	1,075.36		0.127763	0.00							1.05	1.72	0.27	2.31
B. Chemical Industry	257.23		2.291063	36.15	0	0	0	0	0	0	8.91	24.71	13.58	3.94
C. Metal Production	21.50		0.003538	0.00				2,471		0	5.44	101.28	3.00	6.61
D. Other Production [3]	0.00										0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6						7,519		0		0				
F. Consumption of Halocarbons and SF_6					0	1,317	0	123	0	0				
G. Other	430.29		0.055295	0.00	0	0	0	0	0	0	0.21	1.81	43.23	0.61
3. Solvent and Other Product Use	**10.86**			**0.53**							**0.08**	**2.06**	**56.41**	0.03
4. Agriculture	**0.00**	**0.00**	**422.86**	**25.66**							0.00	0.00	0.16	0.00
A. Enteric Fermentation			331.82											
B. Manure Management			91.05	0.64									0.00	
C. Rice Cultivation			NO										NO	
D. Agricultural Soils	[4]	[4]	IE	25.02									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] **-1,700.00**	**NO**	**NO**							**NO**	**NO**	**NO**	**NO**
A. Changes in Forest and Other Woody Biomass Stocks	[5] 0.00	[5] -1,700.00												
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	**184.45**		**432.10**	**0.53**							**1.97**	**0.74**	**1.71**	**0.74**
A. Solid Waste Disposal on Land	[4] 0.00		428.30									0.00	0.72	
B. Wastewater Handling			3.78	0.53							0.00	0.00	0.00	
C. Waste Incineration	[4] IE		IE	IE							IE	IE	IE	IE
D. Other	184.45		0.02	0.00							1.97	0.74	0.99	0.74
7. Other *(please specify)*	**0.00**	**0.00**	**1.94**	**3.80**	**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				3.80										

Appendix C: 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 Chapter 4). Please note that all data for 1999 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 C.1. 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
	(Gg)										
1. Energy	**159,160.92**	**159,160.92**	**165,320.00**	**163,800.00**	**166,240.00**	**166,940.00**	**175,194.00**	**183,021.10**	**179,283.44**	**178,948.69**	**172,145.96**
A. Fuel Combustion (Sectoral Approach)	158,535.67	158,535.67	164,860.00	163,430.00	165,890.00	166,750.00	174,224.00	182,021.10	178,265.58	177,395.37	170,618.58
1. Energy Industries	52,117.15	52,117.15	52,190.00	54,130.00	53,800.00	55,980.00	57,314.00	58,900.00	57,901.63	59,957.39	57,040.60
2. Manufacturing Industries and Construction	41,880.84	41,880.84	42,660.00	42,510.00	39,920.00	40,950.00	43,430.00	42,100.00	44,534.66	43,981.62	43,549.41
3. Transport	29,095.35	29,095.35	28,550.00	29,830.00	30,460.00	30,800.00	32,030.00	33,821.10	33,059.66	33,998.61	34,699.54
4. Other Sectors	34,320.11	34,320.11	40,390.00	37,330.00	40,060.00	38,460.00	38,930.00	45,200.00	36,431.30	35,852.14	35,300.67
5. Other	1,122.23	1,122.23	1,070.00	-370.00	1,650.00	560.00	2,520.00	2,000.00	6,338.33	3,605.61	28.37
B. Fugitive Emissions from Fuels	625.26	625.26	460.00	370.00	350.00	190.00	970.00	1,000.00	1,017.86	1,553.32	1,527.37
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	625.26	625.26	460.00	370.00	350.00	190.00	970.00	1,000.00	1,017.86	1,553.32	1,527.37
2. Industrial Processes	**1,901.47**	**1,901.47**	**1,500.00**	**1,270.00**	**1,210.00**	**1,440.00**	**1,570.00**	**1,700.00**	**1,726.54**	**1,767.75**	**1,784.38**
A. Mineral Products	746.73	746.73	700.00	750.00	1,050.00	1,050.00	1,130.00	900.00	1,087.17	1,048.50	1,075.36
B. Chemical Industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	277.22	257.23	257.23
C. Metal Production	0.62	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.61	21.50
D. Other Production	209.51	209.51	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	944.61	944.61	800.00	520.00	160.00	390.00	440.00	800.00	362.15	439.42	430.29
3. Solvent and Other Product Use	**0.00**	**0.00**	**100.00**	**100.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.54**	**11.40**	**10.86**
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 [2]	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	IE	IE	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 [3]	**-1,500.00**	**-1,500.00**	**-1,600.00**	**-1,600.00**	**-1,600.00**	**-1,700.00**	**-1,700.00**	**-1,700.00**	**-1,700.00**	**-1,700.00**	**-1,700.00**
A. Changes in Forest and Other Woody Biomass Stocks	-1,500.00	-1,500.00	-1,600.00	-1,600.00	-1,600.00	-1,700.00	-1,700.00	-1,700.00	-1,700.00	-1,700.00	-1,700.00
B. Forest and Grassland Conversion	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
D. CO_2 Emissions and Removals from Soil	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
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	**110.73**	**110.73**	**0.00**	**0.00**	**0.00**	**0.00**	**366.00**	**0.00**	**144.98**	**184.80**	**184.45**
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. Waste-water 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	110.73	110.73	0.00	0.00	0.00	0.00	366.00	0.00	144.98	184.80	184.45
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**
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Emissions/Removals with LUCF [4]	**159,673.12**	**159,673.12**	**165,320.00**	**163,570.00**	**165,850.00**	**166,680.00**	**175,430.00**	**183,021.10**	**179,465.50**	**179,212.64**	**172,425.64**
Total Emissions without LUCF [4]	**161,173.12**	**161,173.12**	**166,920.00**	**165,170.00**	**167,450.00**	**168,380.00**	**177,130.00**	**184,721.10**	**181,165.50**	**180,912.64**	**174,125.64**
Memo Items:											
International Bunkers	**40,010.00**	**40,010.00**	**41,290.00**	**42,400.00**	**44,280.00**	**42,860.00**	**44,150.00**	**45,500.00**	**48,509.00**	**49,318.78**	**51,209.85**
Aviation	4,450.00	4,450.00	4,960.00	5,910.00	6,500.00	6,720.00	7,670.00	8,300.00	8,979.00	9,520.95	10,066.43
Marine	35,560.00	35,560.00	36,330.00	36,490.00	37,780.00	36,140.00	36,480.00	37,200.00	39,530.00	39,797.83	41,143.42
Multilateral Operations	0.00	**0.00**	**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**	**3,100.00**	**2,700.00**	**2,600.00**	**3,300.00**	**3,500.00**	**3,600.00**	**4,500.00**	**5,313.85**	**5,350.00**	**5,447.45**

Table C.2. 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
					(Gg)						
Total Emissions	**1,292.73**	**1,292.73**	**1,308.70**	**1,256.20**	**1,224.70**	**1,203.10**	**1,172.40**	**1,163.14**	**1,102.77**	**1,061.77**	**1,033.50**
1. Energy	**214.05**	**214.05**	**223.80**	**199.10**	**192.40**	**202.30**	**209.30**	**214.44**	**186.56**	**176.78**	**174.12**
A. Fuel Combustion (Sectoral Approach)	34.97	34.97	35.70	36.00	34.40	33.80	35.30	36.90	30.10	30.69	29.89
1. Energy Industries	1.26	1.26	3.20	3.80	3.40	3.70	4.90	5.70	3.06	4.40	4.11
2. Manufacturing Industries and Construction	5.78	5.78	3.50	4.90	3.20	2.60	2.80	1.51	1.59	1.81	1.59
3. Transport	7.92	7.92	6.90	6.80	6.40	6.30	6.30	5.67	5.28	4.86	4.57
4. Other Sectors	20.00	20.00	22.10	20.50	21.40	21.20	21.30	24.02	20.17	19.62	19.61
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
B. Fugitive Emissions from Fuels	179.08	179.08	188.10	163.10	158.00	168.50	174.00	177.54	156.46	146.10	144.23
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	179.08	179.08	188.10	163.10	158.00	168.50	174.00	177.54	156.46	146.10	144.23
2. Industrial Processes	**3.40**	**3.40**	**3.50**	**3.70**	**4.90**	**5.30**	**4.90**	**5.74**	**2.73**	**2.41**	**2.48**
A. Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.14	0.13	0.13
B. Chemical Industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.20	2.46	2.22	2.29
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
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
E. Production of Halocarbons and SF_6											
F. Consumption of Halocarbons and SF_6											
G. Other	3.40	3.40	3.50	3.70	4.90	5.30	4.90	0.13	0.12	0.06	0.06
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**
4. Agriculture	**504.88**	**504.88**	**517.00**	**505.00**	**497.00**	**483.00**	**475.70**	**463.39**	**446.23**	**432.35**	**422.86**
A. Enteric Fermentation	401.90	401.90	412.00	401.00	393.00	382.00	376.70	365.30	352.64	339.35	331.82
B. Manure Management	102.98	102.98	105.00	104.00	104.00	101.00	99.00	98.09	93.59	93.00	91.05
C. Rice Cultivation	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
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	**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
B. Forest and Grassland Conversion	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
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	**568.40**	**568.40**	**562.40**	**546.40**	**528.40**	**510.20**	**480.50**	**477.57**	**465.29**	**448.30**	**432.10**
A. Solid Waste Disposal on Land	562.10	562.10	556.10	540.10	522.10	505.10	479.00	477.00	463.98	444.50	428.30
B. Waste-water Handling	6.30	6.30	6.30	6.30	6.30	5.10	1.50	0.57	1.30	3.78	3.78
C. Waste Incineration	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	0.01	0.02	0.02
7. Other *(please specify)* ---	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.30**	**2.00**	**2.00**	**1.97**	**1.93**	**1.94**
Solvent and other product use	2.00	2.00	2.00	2.00	2.00	2.30	2.00	2.00	1.97	1.93	1.94
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:											
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**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 C.3. 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
	(Gg)										
Total Emissions	**63.73**	**63.73**	**66.90**	**69.30**	**68.90**	**70.80**	**72.20**	**71.76**	**73.67**	**72.82**	**73.19**
1. Energy	**5.22**	**5.22**	**6.90**	**7.90**	**7.90**	**8.00**	**8.16**	**7.70**	**7.81**	**6.82**	**6.53**
A. Fuel Combustion (Sectoral Approach)	5.22	5.22	6.90	7.90	7.90	7.60	8.16	7.70	7.81	6.82	6.53
1. Energy Industries	0.45	0.45	0.50	0.50	0.50	0.20	0.56	0.44	0.48	0.48	0.41
2. Manufacturing Industries and Construction	0.13	0.13	0.10	0.10	0.10	0.10	0.10	0.07	0.06	0.06	0.05
3. Transport	4.54	4.54	6.20	7.20	7.20	7.20	7.40	7.12	7.19	6.21	5.98
4. Other Sectors	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.07	0.08	0.08	0.08
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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
1. Solid Fuels	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
2. Industrial Processes	**31.53**	**31.53**	**32.30**	**30.40**	**30.00**	**31.60**	**31.60**	**31.70**	**34.98**	**35.99**	**36.15**
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
B. Chemical Industry	31.53	31.53	32.30	30.40	30.00	31.60	31.60	31.70	34.98	35.99	36.15
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
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
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	0.00
3. Solvent and Other Product Use	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.57**	**0.54**	**0.53**
4. Agriculture	**22.19**	**22.19**	**22.90**	**26.20**	**26.20**	**26.40**	**27.60**	**27.50**	**25.94**	**25.13**	**25.66**
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	0.66	0.66	0.70	0.70	0.80	0.80	0.80	0.70	0.68	0.65	0.64
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	21.53	21.53	22.20	25.50	25.40	25.60	26.80	26.80	25.26	24.48	25.02
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	**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
B. Forest and Grassland Conversion	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
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	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.54**	**0.56**	**0.57**	**0.53**	**0.53**
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. Waste-water Handling	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.56	0.57	0.53	0.53
C. Waste Incineration	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	0.04	0.00	0.00	0.00	0.00
7. Other *(please specify)*	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**
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
Polluted surface water	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80
	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**
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 C.4. 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	Chemical	GWP
	(Gg)												
Emissions of HFCs(5) - CO_2 equivalent (Gg)	**6,723.62**	**5,143.69**	**4,862.89**	**4,594.49**	**5,106.90**	**6,449.27**	**6,723.62**	**7,524.23**	**7,884.10**	**8,695.17**	**8,835.73**	HFCs	
HFC-23	536.00	436.00	412.00	388.00	433.00	536.00	536.00	573.40	573.40	631.36	631.36	HFC-23	11700
HFC-32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-32	650
HFC-41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-41	150
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	HFC-43-10mee	1300
HFC-125	24.04	7.18	7.18	7.18	7.18	19.74	24.04	35.54	47.24	51.80	60.50	HFC-125	2800
HFC-134	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-134	1000
HFC-134a	261.80	9.00	9.00	18.00	5.43	73.70	261.80	477.30	692.60	718.40	771.40	HFC-134a	1300
HFC-152a	24.00	4.96	4.96	9.93	26.02	24.00	24.00	41.60	26.00	0.00	0.00	HFC-152a	140
HFC-143	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-143	300
HFC-143a	9.32	2.63	2.63	2.63	2.63	6.22	9.32	18.22	28.22	50.00	60.00	HFC-143a	3800
HFC-227ea	0.00											HFC-227ea	2900
HFC-236fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-236fa	6300
HFC-245ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-245ca	560
HFC Unspecified	2.00	0.00	0.00	0.00	0.00	0.00	2.00	6.80	10.60	13.10	16.20	HFC Unspecified	3000
Emissions of PFCs(5) - CO_2 equivalent (Gg)	**1,866.76**	**2,431.78**	**2,436.78**	**2,098.69**	**2,118.36**	**1,890.43**	**1,866.76**	**2,042.11**	**2,153.98**	**2,468.50**	**2,589.56**	PFCs	
CF_4	223.00	301.00	301.00	258.00	260.00	228.00	223.00	247.00	261.00	296.00	308.00	CF_4	6500
C_2F_6	38.00	48.00	48.00	41.00	41.00	38.00	38.00	39.00	40.00	48.00	51.00	C_2F_6	9200
C_3F_8												C_3F_8	7000
C_4F_{10}												C_4F_{10}	7000
$c\text{-}C_4F_8$												$c\text{-}C_4F_8$	8700
C_5F_{12}												C_5F_{12}	7500
C_6F_{14}												C_6F_{14}	7400
PFC unspecified	8.06	4.01	4.61	5.30	6.09	7.00	8.06	9.26	10.65	12.25	14.09	PFC unspecified	8400
Emissions of SF_6(5) - CO_2 equivalent (Gg)	**174.47**	**144.60**	**100.38**	**106.36**	**109.94**	**147.94**	**174.47**	**160.37**	**181.88**	**132.41**	**136.71**	SF_6	23900
SF_6	7.30	6.05	4.20	4.45	4.60	6.19	7.30	6.71	7.61	5.54	5.72		

Table C.5. 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
	CO_2 equivalent (Gg)										
Net CO_2 emissions/removals	159,673.12	159,673.12	165,320.00	163,570.00	165,850.00	166,680.00	175,430.00	183,021.10	179,465.50	179,212.64	172,425.64
CO_2 emissions (without LUCF) (4)	161,173.12	161,173.12	166,920.00	165,170.00	167,450.00	168,380.00	177,130.00	184,721.10	181,165.50	180,912.64	174,125.64
CH_4	27,147.24	27,147.24	27,482.70	26,380.20	25,718.70	25,265.10	24,620.40	24,425.94	23,158.18	22,297.19	21,703.53
N_2O	19,757.25	19,757.25	20,739.00	21,483.00	21,359.00	21,948.00	22,382.00	22,245.29	22,839.13	22,572.98	22,689.87
HFCs	6,723.62	5,143.69	4,862.89	4,594.49	5,106.90	6,449.27	6,723.62	7,524.23	7,884.10	8,695.17	8,835.73
PFCs	1,866.76	2,431.78	2,436.78	2,098.69	2,118.36	1,890.43	1,866.76	2,042.11	2,153.98	2,468.50	2,589.56
SF_6	174.47	144.60	100.38	106.36	109.94	147.94	174.47	160.37	181.88	132.41	136.71
Total (with net CO_2 emissions/removals)	**215,342.46**	**214,297.68**	**220,941.76**	**218,232.73**	**220,262.90**	**222,380.74**	**231,197.25**	**239,419.04**	**235,682.76**	**235,378.89**	**228,381.04**
Total (without CO_2 from LUCF) (6)	**216,842.46**	**215,797.68**	**222,541.76**	**219,832.73**	**221,862.90**	**224,080.74**	**232,897.25**	**241,119.04**	**237,382.76**	**237,078.89**	**230,081.04**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year(1)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)										
1. Energy	165,273.14	165,273.14	172,158.80	170,430.10	172,729.40	173,668.30	182,118.28	189,911.03	185,623.36	184,776.23	177,825.98
2. Industrial Processes	20,510.92	19,466.14	18,986.56	17,571.23	17,948.10	19,834.94	20,233.75	21,374.25	22,847.46	24,271.99	24,604.73
3. Solvent and Other Product Use	155.00	155.00	255.00	255.00	155.00	155.00	155.00	155.00	187.79	179.04	173.92
4. Agriculture	17,481.28	17,481.28	17,956.00	18,727.00	18,559.00	18,327.00	18,545.70	18,256.19	17,412.13	16,869.65	16,834.66
5. Land-Use Change and Forestry (7)	-1,500.00	-1,500.00	-1,600.00	-1,600.00	-1,600.00	-1,700.00	-1,700.00	-1,700.00	-1,700.00	-1,700.00	-1,700.00
6. Waste	12,202.13	12,202.13	11,965.40	11,629.40	11,251.40	10,869.20	10,624.52	10,202.57	10,092.65	9,763.44	9,422.95
7. Other	1,220.00	1,220.00	1,220.00	1,220.00	1,220.00	1,226.30	1,220.00	1,220.00	1,219.37	1,218.53	1,218.80

Appendix D: Trend Tables for precursors

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 4). Please note that all data for 1999 are preliminary. Sheets are presented for, respectively:

- NO_x
- CO
- NMVOC
- SO_2

Table D.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
					(Gg)						
Total National Emissions and Removals		**563.50**	**551.40**	**539.00**	**518.90**	**493.20**	**497.40**	**480.80**	**459.49**	**422.94**	**408.35**
1. Energy		**549.30**	**537.90**	**525.90**	**505.10**	**482.40**	**485.40**	**461.10**	**442.49**	**407.89**	**390.69**
A. Fuel Combustion	Reference Approach (2)										
	Sectoral Approach (2)	548.20	536.70	524.60	504.10	481.90	484.70	460.60	441.64	407.08	390.39
1. Energy Industries		102.80	95.60	95.90	91.80	81.40	75.70	70.70	62.31	56.68	52.00
2. Manufacturing Industries and Construction		65.70	60.40	61.40	54.60	54.40	52.40	44.20	42.56	36.86	32.12
3. Transport		336.90	336.20	325.50	311.80	304.40	314.90	300.00	299.57	275.94	269.11
4. Other Sectors		42.80	44.50	41.80	45.90	41.70	41.70	45.70	37.20	37.60	37.15
5. Other		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		1.10	1.20	1.30	1.00	0.50	0.70	0.50	0.85	0.81	0.30
1. Solid Fuels		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas		1.10	1.20	1.30	1.00	0.50	0.70	0.50	0.85	0.81	0.30
2. Industrial Processes		**13.50**	**13.10**	**12.70**	**13.40**	**10.40**	**9.20**	**17.80**	**15.04**	**13.01**	**15.61**
A. Mineral Products		0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00	1.00	1.05
B. Chemical Industry		IE	0.00	0.00	0.00	0.00	0.00	8.90	0.00	5.60	8.91
C. Metal Production		0.00	0.00	0.00	0.00	0.00	0.00	7.30	0.00	6.20	5.44
D. Other Production (3)		IE	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		13.50	13.10	12.70	13.40	10.40	9.20	0.40	15.04	0.21	0.21
3. Solvent and Other Product Use		**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**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
A. Enteric Fermentation		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
C. Rice Cultivation		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
E. Prescribed Burning of Savannas		0.00	0.00	0.00	0.00	NO	0.00	0.00	0.00	0.00	NO
F. Field Burning of Agricultural Residues		NO	0.00	NO	0.00	NO	0.00	0.00	NO	NO	NO
G. Other		NO	0.00	0.00	0.00	0.00	0.00	0.00	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**
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
B. Forest and Grassland Conversion		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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
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
E. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste		**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**2.70**	**1.80**	**1.88**	**1.96**	**1.97**
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
B. Wastewater Handling		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
D. Other		0.30	0.30	0.30	0.30	0.30	2.70	1.80	1.88	1.96	1.97
7. Other *(please specify)*		**0.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Solvents and other product use		0.30	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
Memo Items: (7)											
International Bunkers		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**NE**	**NE**	**NE**
Aviation		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
CO_2 Emissions from Biomass											

Table D.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
				(Gg)						
Total National Emissions and Removals	**1,140.60**	**1,022.50**	**966.30**	**948.60**	**905.10**	**909.00**	**835.90**	**791.54**	**721.79**	**679.40**
1. Energy	**981.80**	**891.30**	**861.60**	**846.10**	**799.90**	**811.60**	**661.60**	**648.97**	**577.55**	**547.07**
A. Fuel Combustion — Reference Approach (2)										
Sectoral Approach (2)	975.60	883.10	855.90	840.10	792.30	802.10	653.50	642.37	571.31	541.52
1. Energy Industries	16.60	18.90	16.40	15.40	17.00	17.30	45.50	21.53	22.49	28.16
2. Manufacturing Industries and Construction	114.20	108.30	114.80	139.10	114.30	120.50	31.30	33.43	20.42	17.00
3. Transport	748.90	658.40	626.40	582.30	559.90	563.70	510.90	525.01	472.42	440.76
4. Other Sectors	95.90	97.50	98.30	103.30	101.10	100.60	65.80	62.41	55.99	55.61
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	6.20	8.20	5.70	6.00	7.60	9.50	8.10	6.60	6.23	5.56
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	6.20	8.20	5.70	6.00	7.60	9.50	8.10	6.60	6.23	5.56
2. Industrial Processes	**153.60**	**127.40**	**101.10**	**99.10**	**101.70**	**94.80**	**171.70**	**139.90**	**141.47**	**129.52**
A. Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	1.10	0.00	1.58	1.72
B. Chemical Industry	IE	0.00	0.00	0.00	0.00	0.00	32.40	0.00	23.27	24.71
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	132.80	0.00	114.82	101.28
D. Other Production (3)	IE	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
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
G. Other	153.60	127.40	101.10	99.10	101.70	94.80	5.40	139.90	1.81	1.81
3. Solvent and Other Product Use	**2.40**	**2.40**	**2.20**	**2.00**	**2.10**	**2.10**	**1.90**	**2.02**	**2.04**	**2.06**
4. Agriculture	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
B. Manure Management	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
D. Agricultural Soils	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
F. Field Burning of Agricultural Residues	NO	0.00	NO	0.00	NO	0.00	0.00	NO	NO	NO
G. Other	NO	0.00	0.00	0.00	0.00	0.00	0.00	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**
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
B. Forest and Grassland Conversion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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
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
E. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste	**1.40**	**1.40**	**1.40**	**1.40**	**1.40**	**0.50**	**0.70**	**0.65**	**0.74**	**0.74**
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
B. Wastewater Handling	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
D. Other	1.40	1.40	1.40	1.40	1.40	0.50	0.70	0.65	0.74	0.74
7. Other *(please specify)*	**1.40**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Solvents and other product use	1.40	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
Memo Items: (7)										
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**NE**	**NE**	**NE**
Aviation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass										

Table D.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
				(Gg)						
Total National Emissions and Removals	**500.20**	**460.60**	**436.20**	**150.40**	**387.70**	**369.70**	**347.90**	**323.45**	**297.61**	**281.62**
1. Energy	**267.80**	**247.60**	**237.60**	**223.00**	**216.80**	**216.60**	**200.30**	**188.45**	**170.58**	**163.24**
A. Fuel Combustion — Reference Approach (2)										
Sectoral Approach (2)	220.20	200.20	194.20	181.10	174.50	173.80	158.30	151.80	139.50	132.61
1. Energy Industries	3.90	4.10	4.30	3.60	3.90	5.00	7.00	2.84	3.23	3.10
2. Manufacturing Industries and Construction	4.70	4.30	5.80	2.90	2.60	2.80	1.30	2.31	2.45	2.11
3. Transport	200.50	180.30	172.40	162.00	156.50	154.20	134.90	133.05	121.73	115.35
4. Other Sectors	11.10	11.50	11.70	12.60	11.50	11.80	15.10	13.60	12.10	12.05
5. Other	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	47.60	47.40	43.40	41.90	42.30	42.80	42.00	36.65	31.07	30.63
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	47.60	47.40	43.40	41.90	42.30	42.80	42.00	36.65	31.07	30.63
2. Industrial Processes	**130.40**	**120.90**	**115.40**	**100.00**	**88.20**	**79.50**	**73.40**	**71.77**	**67.39**	**60.08**
A. Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.27	0.27
B. Chemical Industry	IE	0.00	0.00	0.00	0.00	0.00	17.90	0.00	13.78	13.58
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	3.10	0.00	3.02	3.00
D. Other Production (3)	IE	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
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
G. Other	130.40	120.90	115.40	100.00	88.20	79.50	52.00	71.77	50.32	43.23
3. Solvent and Other Product Use	**101.40**	**91.70**	**82.80**	**79.80**	**82.30**	**71.70**	**72.30**	**61.40**	**57.79**	**56.41**
4. Agriculture	0.20	0.20	0.20	0.20	0.20	0.20	0.00	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
B. Manure Management	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
D. Agricultural Soils	0.20	0.20	0.20	0.20	0.20	0.20	0.00	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
F. Field Burning of Agricultural Residues	NO	0.00	NO	0.00	NO	0.00	0.00	NO	NO	NO
G. Other	NO	0.00	0.00	0.00	0.00	0.00	0.00	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**
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
B. Forest and Grassland Conversion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	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
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
E. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**1.70**	**1.90**	**1.66**	**1.69**	**1.71**
A. Solid Waste Disposal on Land	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.78	0.75	0.72
B. Wastewater Handling	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
D. Other	0.20	0.20	0.20	0.20	0.20	1.70	1.10	0.88	0.94	0.99
7. Other *(please specify)*	**0.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Solvents and other product use	0.20	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
Memo Items: (7)										
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**NE**	**NE**	**NE**
Aviation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass										

Table D.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
		(Gg)									
Total National Emissions and Removals		**193.60**	**163.50**	**157.20**	**150.40**	**136.50**	**144.70**	**132.20**	**117.45**	**106.78**	**100.36**
1. Energy		**167.00**	**140.90**	**138.30**	**133.60**	**120.10**	**129.00**	**113.20**	**100.38**	**92.81**	**86.12**
A. Fuel Combustion	Reference Approach (2)										
	Sectoral Approach (2)	159.20	131.20	126.70	122.10	109.50	118.70	102.70	90.30	84.80	78.72
1. Energy Industries		108.70	88.60	81.10	77.40	66.20	67.90	63.70	54.84	52.56	48.32
2. Manufacturing Industries and Construction		26.20	17.50	20.00	17.60	16.20	15.70	10.90	11.46	7.79	6.18
3. Transport		20.00	21.00	21.40	21.30	21.70	31.00	26.70	22.65	23.25	23.12
4. Other Sectors		4.30	4.10	4.20	5.80	5.40	4.10	1.40	1.35	1.20	1.10
5. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels		7.80	9.70	11.60	11.50	10.60	10.30	10.50	10.08	8.01	7.40
1. Solid Fuels		0.00	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas		7.80	9.70	11.60	11.50	10.60	10.30	10.50	10.08	8.01	7.40
2. Industrial Processes		**26.00**	**22.40**	**18.80**	**16.70**	**16.20**	**14.80**	**17.90**	**16.02**	**13.21**	**13.48**
A. Mineral Products		0.00	0.00	0.00	0.00	0.00	0.00	2.80	0.00	2.24	2.31
B. Chemical Industry		IE	0.00	0.00	0.00	0.00	0.00	4.50	0.00	2.75	3.94
C. Metal Production		0.00	0.00	0.00	0.00	0.00	0.00	10.10	0.00	7.61	6.61
D. Other Production (3)		IE	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
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
G. Other		26.00	22.40	18.80	16.70	16.20	14.80	0.50	16.02	0.61	0.61
3. Solvent and Other Product Use		0.30	0.20	0.10	0.10	0.20	0.00	0.20	0.23	0.02	0.03
4. Agriculture		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
B. Manure Management		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
D. Agricultural Soils		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
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
G. Other		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**
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
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
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
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
E. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.90**	**0.90**	**0.82**	**0.74**	**0.74**
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
B. Wastewater Handling		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
D. Other		0.00	0.00	0.00	0.00	0.00	0.90	0.90	0.82	0.74	0.74
7. Other *(please specify)*		**0.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Solvents and other product use		0.30	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
Memo Items: (7)											
International Bunkers		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**NE**	**NE**	**NE**
Aviation		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass											

Appendix E: Recalculation and Completeness Tables for 1990 and 1997

This appendix shows information from sheets from the CRF data files of 1990 and 1997. In principle, all figures for 1998 have been revised, due to the provisional status in the previous submission. Total emission figures of CO_2, CH_4 and N_2O for 1991-1996 have not been changed, only the source allocation has been improved to achieve greater consistency for the whole time series:

E.1. CRF Recalculation Table 8.a for 1990

E.2. CRF Recalculation Explanation Table 8.b for 1990

E.3. CRF Recalculation Table 8.a for 1997

E.4. CRF Recalculation Explanation Table 8.b for 1997

E.5. CRF Completeness Table 9 for 1990

Table E.1. 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		**161,340.00**	**161,173.12**	**-0.10**	**27,142.50**	**27,147.24**	**0.02**	**20,398.00**	**19,757.25**	**-3.14**
1. Energy		**159,460.00**	**159,160.92**	**-0.19**	**4,487.70**	**4,495.06**	**0.16**	**2,263.00**	**1,617.15**	**-28.54**
1.A.	Fuel Combustion Activities	159,040.00	158,535.67	-0.32	732.90	734.34	0.20	2,263.00	1,617.15	-28.54
1.A.1.	Energy Industries	52,550.00	52,117.15	-0.82	65.10	26.45	-59.37	155.00	140.78	-9.17
1.A.2.	Manufacturing Industries and Construction	41,440.00	41,880.84	1.06	84.00	121.47	44.61	31.00	41.59	34.18
1.A.3.	Transport	28,560.00	29,095.35	1.87	163.80	166.41	1.59	2,046.00	1,407.56	-31.20
1.A.4.	Other Sectors	35,360.00	34,320.11	-2.94	20.00	20.00	0.00	31.00	27.18	-12.31
1.A.5.	Other	1,130.00	1,122.23	-0.69	0.00	0.01	0.00	0.00	0.03	0.00
1.B.	Fugitive Emissions from Fuels	420.00	625.26	48.87	3,754.80	3,760.72	0.16	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	420.00	625.26	48.87	3,754.80	3,760.72	0.16	0.00	0.00	0.00
2. Industrial Processes		**1,880.00**	**1,901.47**	**1.14**	**71.40**	**71.40**	**0.00**	**9,765.00**	**9,773.19**	**0.08**
2.A.	Mineral Products	730.00	746.73	2.29	0.00	0.00	0.00	0.00	0.00	0.00
2.B.	Chemical Industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9,773.19	0.00
2.C.	Metal Production	0.00	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2.D.	Other Production	0.00	209.51	0.00	0.00	0.00		0.00	0.00	
2.G.	Other	1,150.00	944.61	-17.86	71.40	71.40	0.00	9,765.00	0.00	-100.00
3. Solvent and Other Product Use		**0.00**	**0.00**	**0.00**	0.00	**0.00**		**155.00**	**155.00**	**0.00**
4. Agriculture		**0.00**	**0.00**	**0.00**	**10,605.00**	**10,602.38**	**-0.02**	**6,882.00**	**6,878.90**	**-0.05**
4.A.	Enteric Fermentation		0.00		10,605.00	8,439.90	-20.42	0.00	0.00	
4.B.	Manure Management		0.00		0.00	2,162.48	0.00	217.00	204.60	-5.71
4.C.	Rice Cultivation		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	6,665.00	6,674.30	0.14
4.E.	Prescribed Burning of Savannas		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
4.G.	Other		0.00		0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry (net)		**-1,500.00**	**-1,500.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks			0.00	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 E.1. CRF Recalculation table 8.a for 1990 (continued).

6. Waste		**0.00**	**110.73**	**0.00**	**11,936.40**	**11,936.40**	**0.00**	**155.00**	**155.00**	**0.00**
6.A.	Solid Waste Disposal on Land	0.00	0.00	0.00	11,804.10	11,804.10	0.00	0.00	0.00	
6.B.	Wastewater Handling				132.30	132.30	0.00	155.00	155.00	0.00
6.C.	Waste Incineration	0.00	IE	0.00	0.00	#VALUE!	0.00	0.00	#VALUE!	0.00
6.D.	Other	0.00	110.73	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**
				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**	**40,010.00**	**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		**3,100.00**	**3,100.00**	**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		**5,144.00**	**5,143.69**	**-0.01**	**2,456.00**	**2,431.78**	**-0.99**	**1,386.00**	**144.60**	**-89.57**
2.C.3.	Aluminium Production					2,398.10	0.00			0.00
2.E.	Production of Halocarbons and SF_6		5,143.69	0.00			0.00			0.00
2.F.	Consumption of Halocarbons and SF_6		0.00	0.00		33.68	0.00		144.60	0.00
	Other			0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6		**0.00**	**0.00**		**0.00**	**CBI**		**1,386.00**	**CBI**	

	Previous submission	**Latest submission**	**Difference(1)**
	CO_2 equivalent (Gg)		**(%)**
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry (3)	215,146.50	214,297.68	-0.39
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (3)	216,646.50	215,797.68	-0.39

Table E.2. CRF Recalculation explanation table 8.b for 1990.

Specify the sector and source/sink category[1] where changes in estimates have occurred:		GHG	RECALCULATION DUE TO			
			CHANGES IN:			Addition/removal/ replacement of source/sink categories
			Methods [2]	Emission factors [2]	Activity data [2]	
1.A.1	**Energy Industries**	CO_2	Change in source allocation (see 1.A.2)			
1.A.2	**Manufacturing Industries**	CO_2	Change in source allocation (see 1.A.1 and 1.A.3)			
1.A.3	**Transport**	CO_2	Change in source allocation (see 1.A.2 and 1.A.5)		Amount of fuel consumption revised for off-road vehicles (about 4 PJ higher) and for inland shipping (higher)	
1.A.4	**Other Sectors**	CO_2	Change in source allocation (see 1.A.3)			
1.A.5	**Other**	CO_2	Rounding			
1.B.2	**Oil and Natural Gas**	CO_2	Change in source allocation			
2.C/D/G	**Industrial Processes**	CO_2	Change in source allocation / rounding			
6.D	**Waste / Other**	CO_2	Change in source allocation			
1.A.1	**Energy Industries**	CH_4	Change in source allocation (see 1.A.2)			
1.A.2	**Manufacturing Industries**	CH_4	Change in source allocation (see 1.A.1)			
1.A.3	**Transport**		Change in source allocation (see 1.A.2 and 1.A.5)	Data adjusted		
4.A	**Enteric fermentation**	CH_4	Split into source allocations 4.A and 4.B / rounding			
4.B	**Manure management**	CH_4	Separate source allocation (previously included in 4.A)			
1.A.1	**Energy Industries**	N_2O	Change in source allocation (see 1.A.2)			
1.A.2	**Manufacturing Industries**	N_2O	Change in source allocation (see 1.A.1)			
1.A.3	**Transport**	N_2O	Change in source allocation (see 1.A.2 and 1.A.5)	Data adjusted		
1.A.4	**Other Sectors**	N_2O	Change in source allocation (see 1.A.3)		Amount of biofuel consumption revised (decreased)	
2.B	**Industrial processes**	N_2O	Change in source allocation (see 2.G)			
2.G	**Industrial processes**	N_2O	Change in source allocation (see 2.B)			
4.B	**Manure management**	N_2O			Data adjusted	
4.D	**Agricultural soils**	N_2O			Data adjusted	
2.C.3	**Aluminium production**	PFCs	Recalculation, using plant=specific activity data and emission factors and using partly different emission factor ratio than 1/10.	1) One plant: New, measured emission factors applied for all years 1990-1999 (with emission factor C_2F_6 <> 1/10 CF_4 (assumed no technological change); 2) Other plant: new emission factors (1/10 for CF_4 and C_2F_6) based on reported total PFC emission factor	Use of plant-specific production data	
2.F	**Consumption of halocarbons and SF6**	HFCs	-	-	Subdivision modified for HFC-134a	
2.F	**Consumption of halocarbons and SF6**	PFCs	Now actual emission calculation cf. IPCC Good Practice Guidance	cf. IPCC Good Practice Guidance	Plant-specific CBI instead of KPMG report of total consumption per compound	
2.F	**Consumption of halocarbons and SF6**	SF_6	Now actual emission calculation cf. IPCC Good Practice Guidance (previous submission assumed that [raw estimated] consumption = actual emissions).	cf. IPCC Good Practice Guidance	1) Estimate replaced by more detailed estimate of only most important sources; 2) Consumption figures based on CBI and estimate of stock and stock additions of electrical equipment.	

Table E.3. 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		**183,033.00**	**181,165.50**	**-1.02**	**23,211.68**	**23,158.18**	**-0.23**	**22,757.10**	**22,839.13**	**0.36**
1. Energy		**178,833.00**	**179,283.44**	**0.25**	**3,972.15**	**3,917.77**	**-1.37**	**2,374.60**	**2,422.16**	**2.00**
1.A.	Fuel Combustion Activities	177,833.00	178,265.58	0.24	634.83	632.19	-0.42	2,374.60	2,422.16	2.00
1.A.1.	Energy Industries	56,100.00	57,901.63	3.21	64.05	64.24	0.29	127.10	148.92	17.17
1.A.2.	Manufacturing Industries and Construction	44,400.00	44,534.66	0.30	33.60	33.43	-0.51	18.60	19.80	6.44
1.A.3.	Transport	34,333.00	33,059.66	-3.71	112.77	110.85	-1.70	2,179.30	2,229.97	2.33
1.A.4.	Other Sectors	36,700.00	36,431.30	-0.73	20.21	20.17	-0.18	49.60	23.44	-52.75
1.A.5.	Other	6,300.00	6,338.33	0.61	0.00	0.01	0.00	0.00	0.03	0.00
1.B.	Fugitive Emissions from Fuels	1,000.00	1,017.86	1.79	3,337.32	3,285.58	-1.55	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	1,000.00	1,017.86	1.79	3,337.32	3,285.58	-1.55	0.00	0.00	0.00
2. Industrial Processes		**1,700.00**	**1,726.54**	**1.56**	**55.86**	**57.23**	**2.46**	**10,850.00**	**10,843.73**	**-0.06**
2.A.	Mineral Products	1,100.00	1,087.17	-1.17	2.94	2.94	0.00	0.00	0.00	0.00
2.B.	Chemical Industry	300.00	277.22	-7.59	50.40	51.73	2.63	10,850.00	10,843.63	-0.06
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	300.00	362.15	20.72	2.52	2.57	1.82	0.00	0.10	0.00
3. Solvent and Other Product Use		**0.00**	**10.54**	**0.00**	0.00	**0.00**		**124.00**	**177.25**	**42.95**
4. Agriculture		**0.00**	**0.00**	**0.00**	**9,370.16**	**9,370.73**	**0.01**	**8,038.30**	**8,041.40**	**0.04**
4.A.	Enteric Fermentation		0.00		7,405.40	7,405.44	0.00	0.00	0.00	
4.B.	Manure Management		0.00		1,964.76	1,965.29	0.03	207.70	210.80	1.49
4.C.	Rice Cultivation		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	7,830.60	0.00
4.E.	Prescribed Burning of Savannas		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
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**	**-1,700.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
5.A.	Changes in Forest and Other Woody Biomass Stocks			0.00	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 E.3. 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	**2,500.00**	**144.98**	**-94.20**	**9,771.51**	**9,771.08**	**0.00**	**192.20**	**176.59**	**-8.12**
6.A. Solid Waste Disposal on Land	2,500.00	0.00	-100.00	9,744.00	9,743.62	0.00	0.00	0.00	
6.B. Wastewater Handling				27.51	27.21	-1.08	192.20	176.51	-8.16
6.C. Waste Incineration	0.00	IE	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6.D. Other	0.00	144.98	0.00	0.00	0.25	0.00	0.00	0.08	0.00
7. Other *(please specify)*	**0.00**	**0.00**	**0.00**	**42.00**	**41.37**	**-1.50**	**1,178.00**	**1,178.00**	**0.00**
Solvents and other product use	0.00	0.00	0.00	42.00	41.37	-1.50	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	**48,530.00**	**48,509.00**	**-0.04**	**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	**5,000.00**	**5,313.85**	**6.28**	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	**7,876.00**	**7,884.10**	**0.10**	**2,168.00**	**2,153.98**	**-0.65**	**1,458.00**	**181.88**	**-87.53**
2.C.3. Aluminium Production					2,064.50	0.00			0.00
2.E. Production of Halocarbons and SF_6		6,901.82	0.00			0.00			0.00
2.F. Consumption of Halocarbons and SF_6		982.28	0.00		89.48	0.00		181.88	0.00
Other		0.00	0.00			0.00			0.00
Potential Emissions from Consumption of HFCs/PFCs and SF_6	**2,160.00**	**2,159.50**		**94.00**	**CBI**		**1,458.00**	**CBI**	

	Previous submission	Latest submission	Difference(1)
	CO_2 equivalent (Gg)		(%)
Total CO_2 Equivalent Emissions with Land-Use Change and Forestry (3)	237,583.78	235,682.76	-0.80
Total CO_2 Equivalent Emissions without Land-Use Change and Forestry (3)	239,283.78	237,382.76	-0.79

Table E.4. 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.1	**Energy industries**	CO2			Data adjusted	
1.A.2	**Manufacturing industries**	CO2			Data adjusted	
1.A.3	**Transport**	CO2			Data adjusted	
1.A.4	**Other sectors**	CO2			Data adjusted	
1.A.5	**Other**	CO2			Data adjusted	
1.B.2	**Oil and Natural Gas**	CO2	Method changed	Data source changed into data reported by State Supervisor of Mines (SODM)	Data source changed into data reported by State Supervisor of Mines (SODM)	
2.A/B/G	**Industrial processes**	CO2	Change in (reported) emissions and different source allocation			
3	**Solvent and other product use**	CO2			Data adjusted	
6.A	**Solid waste disposal**	CO2	Change in source allocation (see 6.D)			
6.D	**Other sectors**	CO2	Change in (reported) emissions and different source allocation (see 6.A)		Data adjusted	
	International bunkers	CO2			Rounding	
	CO2 from biomass	CO2			Data adjusted	
1.A.1	**Energy industries**	CH4			Rounding	
1.A.2	**Manufacturing industries**	CH4			Rounding	
1.A.3	**Transport**	CH4			Data adjusted	
1.A.4	**Other sectors**	CH4			Rounding	
1.B.2	**Oil and Natural Gas**	CH4	Method changed	Data source changed into data reported by State Supervisor of Mines (SODM)	Data source changed into data reported by State Supervisor of Mines (SODM)	
2.B	**Industrial processes**	CH4	Change in (reported) emissions			
2.C	**Industrial processes**	CH4			Rounding	
4.B	**Manure management**	CH4			Data adjusted/rounding	
6.B	**Waste water handling**	CH4			Rounding	
6.D	**Other**	CH4	Change in source allocation			
7	**Solvents CH4**	CH4			Data adjusted	
3	**Solvent and other product use**	N2O			Data adjusted	
1.A.3	**Transport**	N2O			Data adjusted	
1.A.4	**Other sectors**	N2O			Data adjusted	
4.C	**Manure management**	N2O			Data adjusted	
6.B	**Waste water handling**	N2O	Change in source allocation (see 6.D)			
6.D	**Other sectors**	N2O	Change in (reported) emissions and different source allocation (see 6.B)			
2.C.3	**Aluminium production**	PFCs	Recalculation, using plant=specific activity data and emission factors and using partly different emission factor ratio than 1/10.	1) One plant: New, measured emission factors applied for all years 1990-1999 (with emission factor C2F6 <> 1/10 CF4 (assumed no technological change); 2) Other plant: new emission factors (1/10 for CF4 and C2F6) based on reported total PFC emission factor	Use of plant-specific production data	
2.F	**Consumption of halocarbons and SF6**	HFCs	-	-	Subdivision modified for HFC-134a	
2.F	**Consumption of halocarbons and SF6**	PFCs	Now actual emission calculation cf. IPCC Good Practice Guidance	cf. IPCC Good Practice Guidance	Plant-specific CBI instead of KPMG report of total consumption per compound	
2.F	**Consumption of halocarbons and SF6**	SF6	Now actual emission calculation cf. IPCC Good Practice Guidance (previous submission assumed that [raw estimated] consumption = actual emissions).	cf. IPCC Good Practice Guidance	1) Estimate replaced by more detailed estimate of only most important sources; 2) Consumption figures based on CBI and estimate of stock and stock additions of electrical equipment.	

Table E.5. CRF Completeness table 9 for 1990.

Sources and sinks not reported (NE)(1)				
GHG	**Sector(2)**	**Source/sink category (2)**	**Explanation**	
CO_2				
	4. Agriculture	Agricultural Soils	Not estimated/monitored	
	5. Land-Use Change and Forest	Forest and Grassland Conversion	Not estimated/monitored	
		D. CO2 Emissions and Removals fro	Not estimated/monitored	
CH_4	4. Agriculture	Agricultural Soils		Emissions deceased in last 40 years due to drainage and lowering of water tables; emissions included in natural total; thus no net (positive) anthropogenic emissions
	Various			A recent survey identified some minor sources (notably large-scale compost production from organic waste and waste water treatment); to be included when monitored regularly and when not already included in the present emission inventory.
		International bunkers	Not estimated	
N_2O	Various			A recent survey identified some minor sources (notably large-scale compost production from organic waste and waste water treatment); to be included when monitored regularly and when not already included in the present emission inventory.
		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.
SF_6				
	2. Industrial Processes			A recent survey identified some minor sources (notably production of sound-insulating windows); to be included when monitored regularly and when not already included in the present emission inventory.

Sources and sinks reported elsewhere (IE)(3)				
GHG	**Source/sink category**	**Allocation as per IPCC Guidelines**	**Allocation used by the Party**	**Explanation**
CO_2	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	Possibly incorrect allocation in 1995-1999 due to aggregation of sources
	Biogas combustion	CO2 from biomass	1.A Fuel combustion	Accidental allocation error in the national system
CH_4				
N_2O				
HFCs				
PFCs				
SF_6				