SECOND NETHERLANDS' NATIONAL COMMUNICATION ON CLIMATE CHANGE POLICIES

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CHEMICAL COMPOUNDS

CFCs	Chlorofluorocarbons
CF_4	Perfluoromethane (tetrafluoromethane)
C_2F_6	Perfluoroethane (hexafluoroethane)
CH_4	Methane
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2-eq.	Carbon dioxide equivalent (in this report using a GWP-100)
CTC	Carbon tetrachloride (tetrachloromethane)
FICs	Fluoroiodocarbons
HCFCs	Hydrochlorofluorocarbons
HFCs	Hydrofluorocarbons
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

mln	million
mld	1,000 million
bbl	barrel (of oil)
GJ	Giga Joule (10^9 Joule)
TJ	Tera Joule (10^{12} Joule)
PJ	Peta Joule (10^{15} Joule)
kW	kilo Watt (10^3 Watt)
MW_e	Mega Watt electricity (10^6 Watt)
Gg	Giga gramme (10^9 gramme)
Tg	Tera gramme (10^{12} gramme)
Pg	Peta gramme (10^{15} gramme)
kton	kilo ton (= 1,000 metric ton = 1 Gg)
Mton	Mega ton (= 1,000,000 metric ton = 1 Tg)
ha	hectare
NLG	Dutch Guilder
US$	US Dollar

CONVERSION FACTORS FOR EMISSION FACTORS

From element basis to full molecular mass:

$C \rightarrow CO_2$:	x 44/12 = 3.6666
$C \rightarrow CH_4$:	x 16/12 = 1.3333
$C \rightarrow CO$:	x 28/12 = 2.3333
$N \rightarrow N_2O$:	x 44/28 = 1.5714
$N \rightarrow NO$:	x 30/14 = 2.1428
$N \rightarrow NO_2$:	x 46/14 = 3.2857
$S \rightarrow SO_2$:	x 64/32 = 2

From full molecular mass to element basis:

CO_2	$\rightarrow$C :	x 12/44 = 0.2727
CH_4	$\rightarrow$C :	x 12/16 = 0.75
CO	$\rightarrow$C :	x 12/28 = 0.4286
N_2O	$\rightarrow$N :	x 28/44 = 0.6363
NO	$\rightarrow$N :	x 14/30 = 0.4667
NO_2	$\rightarrow$N :	x 14/46 = 0.3043
SO_2	$\rightarrow$S :	x 32/64 = 0.5

ABBREVIATIONS

AFEAS	Alternative Fluorocarbons Environmental Acceptibility Study
AIJ	Activities Implemented Jointly
BaU	Business-as-Usual
BMT	Subsidy Framework for Clean Technology
BPM	Tax on Passenger Cars and Motor Vehicles
BUZA	Ministry of Foreign Affairs
CBS	Central Bureau for Statistics
CCOP	Committee for Coastal and Off-shore Geoscience Programmes
CHP	Combined Heat and Power
CKO	Netherlands Centre for Climate Research
CoP	Conference of Parties (to the Climate Convention)
CPB	Central Planning Bureau
CPO	Core Project Office
CZMC	Coastal Zone Management Centre
DOC	Degradable Organic Carbon
ECN	Netherlands Energy Research Centre
EDGAR	Emission Database for Global Atmospheric Research
EET	Economy/Ecology/Technology programme
EJR	Annual Emissions Report
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EPA	Environmental Protection Act
EPICA	European Project for Ice Coring in Antarctica
EPS	Energy Performance Standard
ER	Emission Registration
ESA	European Space Agency
ESAMI	Subsidy Scheme for Energy Conservation and Consultancy
ESCAP	Economic and Social Commission for Asia and the Pacific
ESF	European Science Foundation
ESMAP	Energy Sector Management Assistance Programme
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
ESF	European Science Foundation
EZ	Ministry of Economic Affairs
FACE	Forests Absorbing Carbondioxide Emission (Foundation)
FAO	Food and Agriculture Organisation of the United Nations
FCCC	Framework Convention on Climate Change
FINESSE	Financing Energy Services for Small Scale Energy Users
FTP	File Transfer Protocol
GB	Green Bond
GCM	Global Circulation Model
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GEIA	Global Emissions Inventory Activity
GOOS	Global Ocean Observing System
GCOS	Global Climate Observing System
GOME	Global Ozone Monitoring Experiment
GOA	Foundation for Earth Sciences
GTOS	Global Terrestrial Observing System
GWP	Global Warming Potential
HDD	Heat Degree Day
HE	High Efficiency
HST	High Speed Transport
HYDE	Hundred Year Database of the Environment
ICAO	International Civil Aviation Organisation
IEA	International Energy Agency
IEI	International Energy Initiative
IGAC	International Global Atmospheric Chemistry Programme
IGBP	International Geosphere-Biosphere Programme

IGFA	International Group of Funding Agencies (for Global Change Research)
IHDP	International Human Dimensions Programme (of Global Environmental Change)
IMAGE	Integrated Model to Assess the Greenhouse Effect
IMAU	Institute for Marine and Atmospheric Research
IMO	International Maritime Organisation
INC	Intergovernmental Negotiating Committee
IPCC	Intergovernmental Panel on Climate Change
ISSC	International Social Science Council
JIN	Foundation for the Joint Implementation Network
JIRC	Joint Implementation Registration Centre
KNAW	Royal Netherlands' Academy of Arts and Sciences
KNMI	Royal Netherlands Meteorological Institute
KZRZ	'Buy ecowise, drive econice' (in Dutch)
LDV	Light Duty Vehicle
LNV	Ministry of Agriculture, Nature Management and Fisheries
LOICZ	Land-Ocean Interaction in the Coastal Zone
LPG	Liquefied Petroleum Gas
LTA	Long-Term Agreement
LTO	Landing and Take-Off
LULU	Luchtverontreiniging en Luchtvaart (Dutch acronym for 'Air pollution and air traffic')
MAB	Man and Biosphere
MAP	Environmental Action Plan (in Dutch)
MATRA	Social Transformation Eastern Europe Programme
MEC	Memorandum on Energy Conservation
MINT	Multiannual Programme on Intersectoral New Technologies
MPI	Environmental Plan for Industry
NEO	National Environmental Outlook
NEPP	National Environmental Policy Plan
NEPPP	National Environmental Policy Plan Plus
NEPP 2	National Environmental Policy Plan 2
NEPP 3	National Environmental Policy Plan 3
NGO	Non-Governmental Organisation
NIOZ	Netherlands Institute for Sea Research
NIOO-CEMO	Netherlands Institute for Ecological Research-Centre for Estuarine and Marine Research
NOVEM	Netherlands Organisation for Energy and Environment
NOGEPA	Netherlands Oil and Gas Exploration and Production Association
NRP	National Research Programme
NRP-MLK	National Research Programme on Global Air Pollution and Climate Change
NSRP	National Remote Sensing Programme
NWO	Netherlands Organisation for Scientific Research
NWS	Department of Natural Science and Society
OCW	Ministry of Education, Arts and Science
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
PB W/K	Project-Bureau for Cogeneration
PIN	International Nature Policy Project
PPP	Pilot Phase Programme (of AIJ)
PPC	Project Preparation Committee
PSO	Programme of Eastern European Cooperation
RIKZ	National Institute for Coastal and Marine Management
RIM+	Environmental Information and Accounting System 'plus'
RIVM	National Institute of Public Health and the Environment
R&D	Research & Development
R,D&D	Research, Development &Demonstration
RUU	State University of Utrecht
RWEDP	Regional Wood Energy Development Programme
RWS	Directorate General of Public Works and Water Management
SADC	Southern African Development Community
SARCS	South-East Asia Research Committee on START
SBSTA	Subsidiary Body for Scientific and Technical Advice (of the FCCC)
SCAR	Scientific Committee on Antarctic Research

SCIAMACHY	Scanning Imaging Absorption Spectrometer for Atmospheric Cartography
SCORE	Supporting the Cooperational Organisation of Rational Energy use
SCOPE	Scientific Committee on Problems of the Environment
SEP	Electricity Generating Board
SGR	Regional Scheme for Green Areas
SRON	Space Research Organisation Netherlands
START	Global Change System for Analysis, Research and Training
SMEC	Second Memorandum on Energy Conservation
TFAP	Tropical Forest Action Plan
TIEP	Tender Scheme for Industrial Energy Conservation
TNO	Netherlands Organisation for Applied Scientific Research
TPES	Total Primary Energy Supply
UN	United Nations
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNFSTD	United Nations Fund for Science and Technology Development
VAMIL	Accelerated Depreciation of Environmental Investment Scheme
VAT	Value Added Tax
VINEX	Fourth Policy Plan on Spatial Planning ‘Extra’
VNO/NCW	Confederation of Netherlands Industry and Employers
VOGM	Second Scheme for the Development of Municipal Environmental Policy
VROM	Ministry of Housing, Spatial Planning and the Environment
VvAN	Association of Waste Processors
VW	Ministry of Transport, Public Works and Water Management
WCRP	World Climate Research Programme
WMO	World Meteorological Organisation
WOTRO	NWO Foundation for the Advancement of Tropical Research
WREB	Act on Regulating Energy Taxes
WWF	World Wildlife Fund

EXECUTIVE SUMMARY

1. Introduction

The *Second Netherlands' National Communication on Climate Change Policies* has been prepared in a period in which important national policy developments and policy decisions have taken place. National developments started unfolding in 1996 in connection with the *Third White Paper on Energy Policy* and the *Second Memorandum on Climate Change*, documents presenting the Netherlands' strategy for long-term climate change policies at an international level and the Netherlands' contribution to policies. September 1997, the Government will present to Parliament an estimate of the impacts of current policies and measures based on the results of new scenarios recently developed *(National Environmental Outlook 1995-2020, NEO 4*). This will constitute an important contribution to the *Third National Environmental Policy Plan* (NEPP 3), scheduled for the end of 1997. Because the new scenarios are not yet available, in this *Second National Communication* future greenhouse gas emissions are presented on the basis of projections made in 1993 and 1995. The new scenario calculations may have a considerable effect on the figures used in this *National Communication.*

2. National circumstances

Between 1990 and 1995 the Gross Domestic Product (GDP) of the Netherlands increased by 10%, the number of vehicle-km of passenger cars by 12.5%. In the same period the total livestock in the Netherlands decreased by 5%. The annual increase of energy consumption was about 0.8% in this period, except for 1995 when it was 3.4% due to revival of the organic chemistry, increased electricity consumption by households and further increase of traffic. Since 1980 natural gas production in the Netherlands has been about 80,000 mln m^3 per year, of which about half is consumed domestically.

Energy intensity in the Netherlands is somewhat higher than the EU average, but slightly lower than the OECD average. This can be explained by the structure of the Netherlands economy, in particular the share of the basic materials processing industry. Total energy use includes a relatively high share of natural gas and a low share of coal. The share of electricity in total energy demand has increased from 13% to 16% in the last 15 years. Electricity use increased by 16% in the period 1990-1995, mainly supplied by increased cogeneration. Imported electricity, mainly from Germany and France, contributes about 12% to domestic electricity demand.

In the period 1990-1995 CO_2-equivalent emissions of CO_2, CH_4 and N_2O increased by 6.2% (uncorrected for temperature 8.3%), mainly due to a growth of 6.8% (uncorrected 9.4%) in CO_2 emissions. The energy-related CO_2 emissions per capita in the Netherlands is similar to that of Germany and Denmark. The average for the 15 EU-countries is about 25% lower; however, the Netherlands’ emissions per person are slightly below the OECD average. The CO_2 emissions per capita increased in the period 1990-1995 by 3.2% from 11,700 kg/cap in 1990 to 12,100 kg/cap in 1995 (uncorrected increasing by 5.7% from 11,300 kg/cap in 1990 to 11,900 kg/cap in 1995).

The Netherlands climate-change policy had been already been established before the FCCC was signed in 1992. In 1989 and 1990 targets and measures were announced by the Government in the *National Environmental Policy Plan* (NEPP) and subsequent policy documents. In 1995 and 1996, these policies were redefined in the *Third White Paper on Energy Policy* as well as in the *Second Netherlands Memorandum on Climate Change*.

In 1996 a special *Temporary Commission on Climatic Change* of the Second Chamber of Parliament held public hearings and made other investigations to review the issue of climate change, resulting in a report to Parliament.

Table ES.1 Inventory of greenhouse gases in the Netherlands in 1990 [Gg/year full molecular mass] (also indicating temperature corrected for CO_2)

Greenhouse gas emissions (Gg = 10^9 g)	CO_2 not corrected	*CO_2 temp.corrected*	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Total net national emissions	**167550**	***173950***	**1103.8**	**51.2**	**573.9**	**1071.8**	**444.3**	**202.5**
1. All Energy (combustion and fugitive)	**164800**	***171200***	**211.7**	**5.5**	**556.6**	**951.6**	**242.6**	**174.5**
1A. Fuel combustion total ****	**164800**	***171200***	**33.2**	**5.5**	**556.6**	**951.6**	**207.5**	**174.5**
1A1a. Electricity and heat production	38100	*38300*	IE	0.4	81.1	12.2	IE	48.1
1A1c. Other transformation **	13300	*13300*	0.3	0.1	18.8	4.9	IE	69.9
1A2. Industry (only energy) **	33400	*34100*	2.7	0.1	63.2	131.4	IE	25.0
1A2f. Actual from feedstocks	14800	*14800*	NE	NE	NE	NE	NE	NE
1A3. Transport ***	26800	*26800*	7.2	4.9	350.9	706.4	196.9	26.5
1A4a. Commercial/Institutional	10600	*11800*	7.6	0.0	11.5	3.0	IE	3.4
1A4b. Residential	19200	*22300*	11.6	0.0	18.9	6.0	IE	0.9
1A4c. Agriculture/forestry/fishing	7500	*8700*	0.1	NE	10.1	2.9	1.2	0.5
1A5. Other	0	*0*	NA	NA	NA	NA	3.5	NA
1A5c. Statistical differences	1100	*1100*	NE	NE	NE	NE	NE	NE
1A6. Biomass burned for energy	(1600)*	*(1600)**	3.7	0.0	2.1	84.7	5.9	0.2
1B. Fugitive fuel emissions	**NA**	***NA***	**178.5**	**NA**	**NA**	**NA**	**35.1**	**NE**
1B1. Coal mining	NA	*NA*	NA	NA	NA	NA	NA	NA
1B2a. Crude oil	NE	*NE*	14.3	NA	NA	NA	14.3	NE
1B2b. Natural gas	NE	*NE*	164.2	NA	NA	NA	20.8	NE
2. Industrial processes (ISIC)	**1850**	***1850***	**5.8**	**18.6**	**12.7**	**116.1**	**101.5**	**25.0**
2.A. Iron and steel	700	*700*	IE	NA	IE	IE	IE	IE
2.B. Non-ferrous metals	IE	*IE*	IE	NA	IE	IE	IE	IE
2.C. Chemicals (inorganic)	IE	*IE*	IE	18.6	IE	IE	IE	IE
2.D. Chemicals (organic)	IE	*IE*	IE	IE	IE	IE	IE	IE
2.E. Non-metallic mineral products	1000	*1000*	IE	NE	IE	IE	IE	IE
2.F. Other	150	*150*	5.8	NE	12.7	116.1	101.5	25.0
3. Solvents and other product use *****	**NE**	***NE***	**NE**	**0.5**	**IE**	**2.0**	**100.1**	**NA**
4. Agriculture	**0**	***0***	**504.9**	**22.2**	**NA**	**NA**	**NA**	**NA**
4A. Enteric fermentation	0	*0*	401.9	NA	NA	NA	NA	NA
4B. Manure management	0	*0*	103.0	IE	NA	NA	NA	NA
4C. Rice cultivation	NA	*NA*	NA	NA	NO	NO	NO	NO
4D. Agricultural soils	0	*0*	0.0	22.2	NA	NA	NA	NA
4E. Savanna burning	NA	*NA*	NA	NA	NA	NA	NA	NA
4F. Agricultural waste burning	0	*0*	NE	NE	NE	NE	NE	NE
5. Land use change and forestry	**(-1500)***	***(-1500)****	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
5A. Forest clearing	NE	*NE*	NE	NE	NE	NE	NE	NE
5A2. Plantation establishment	(-1500)*	*(-1500)**	NE	NE	NE	NE	NE	NE
5B. Conversion of grass to cult. land	NE	*NE*	NE	NE	NE	NE	NE	NE
5C. Abandonment of managed lands	NE	*NE*	NE	NE	NE	NE	NE	NE
5D. Other	NE	*NE*	NE	NE	NE	NE	NE	NE
6. Waste	**900**	***900***	**379.4**	**0.6**	**4.6**	**2.2**	**0.1**	**3.0**
6A. Landfills (solid waste disposal)	NE	*NE*	376.4	NE	NA	NA	0.1	NA
6B. Wastewater treatment (sewage)	NE	*NE*	3.0	0.5	IE	IE	IE	IE
6C. Waste incineration	900	*900*	0.0	0.1	4.6	2.2	0.0	3.0
6D. Other waste	NE	*NE*	NE	NE	NE	NE	NE	NE
7. Other (specified)	**IE**	***IE***	**2.0**	**3.8**	**NA**	**NA**	**NA**	**NA**
7A. Drinking-water treatment	IE	*IE*	2.0	NE	NA	NA	NA	NA
7B. Polluted surface water	NA	*NA*	NE	3.8	NA	NA	NA	NA
NATURE *	**..**	**..**	**125.0**	**1.5**	**16.3**	**26.7**	**3.7**	**..**

Notes: see next page.

Table ES.1 Inventory of greenhouse gases in the Netherlands in 1990 [Gg/year full molecular mass] (continued)

Notes:

a. NMVOC = Non-Methane Volatile Organic Compounds (as defined acc. 'KWS-2000')

b. ISIC = International Standard Industrial Classification

c. CO_2 from biomass burning is not included in the energy category total. If net CO2 emissions result from unsustainable bioenergy use, this will appear in the land-use change categories

d. NE = not estimated, small

e. NA = not applicable

f. IE = included elsewhere, NO = not occuring

* Not included in national total. Methane emissions include 50 Gg natural background emissions from agricultural soils.

** For CO_2, coke oven emissions are included under 'Other transformation'; for non-CO_2 gases, the emissions of coke ovens are included under 'Industry'.

*** NMVOC emissions from combustion in transport include 48 Gg from evaporation (about 24% of total).

**** Emissions from cogeneration (CHP) are included in the sectors in which it is applied.

***** N_2O emissions from anaesthesia use and CO emissions from tabacco smoking.

Other greenhouse gas emissions (Gg = 10^9 g)

Halocarbons (Gg)	Consumption	Emission
HFCs	0.000	0.489
HFC-23		0.410
HFC-32		0.000
HFC-125		0.020
HFC-134a	0.000	0.030
HFC-143a		0.004
HFC-152a		0.025
HFC-227ea		0.000
PFCs	0.022	0.363
CF_4		0.310
C_2F_6		0.031
Other PFC use	0.022	0.022
FICs	0.000	0.000
SF_6	0.058	0.058

International bunkers (Gg):	40400
CO_2 from marine bunkers	35900
CO_2 from aviation bunkers	4500

Uncertainty:

CO_2: 2%; CH_4: 25%; N_2O: 50%

CO, NO_x, NMVOC: 50%; SO_2: 25%

HFCs: 50%, PFCs:100%, FICs: NA, SF_6: 50%

3. Emission inventories

The Netherlands’ inventory of greenhouse gas emissions includes CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, as well as CO, NO_x NMVOC and SO_2. A breakdown of total Netherlands’ emissions and removals per sector is provided for 1990 in *Table ES.1*. In addition, *Table ES.2* shows the breakdown for CO_2 for the period 1990-1995. Expressed in *Global Warming Potentials* (GWP) (100 year), in 1995, CO_2 (temperature corrected) contributed about 78%, CH_4 and N_2O 9% and 8%, respectively, and HFCs, PFCs and SF_6 as a whole 5%.

In the Netherlands the most important anthropogenic source of CO_2 is the combustion of fossil fuels, contributing to 98% of the Netherlands’ total, of which the largest sources are the energy and transformation sector (60 Mton, including refineries), industry (48 Mton, of which 14 Mton are from feedstocks), transport (30 Mton) and the residential sector (20 Mton). The largest sources of CH_4 emissions in the Netherlands are waste in landfills (374 Gg), agriculture (ruminants 382 Gg and animal waste 101 Gg), as well as the production, transmission and distribution of oil and gas (169 Gg). A minor source is fuel combustion (31 Gg). The largest N_2O sources are agricultural soils (27 Gg), industrial processes (18 Gg), road transport (7 Gg) and polluted surface water (4 Gg). The latter source is additional to the standard reporting categories of IPCC.

Between 1990 and 1995 temperature-corrected carbon dioxide emissions increased by 6.8% (uncorrected 9.4%). The most important sectors responsible for this growth were the energy and transformation sector (+16%), the transport sector (+12%) and the residential and agricultural sectors (+8%). This last figure is partly due to increased capacity in cogeneration of which the emissions here are reported in the sector where the facilities are located. Total CH_4 emissions show a slowly decreasing trend of 4% in the last five years mainly caused by a decrease in agricultural emissions as a result of decreasing livestock numbers. Total N_2O emissions show an increasing trend of 14% in the last five years mainly due to the increase of 21% in emissions from agriculture and of about 50% in emissions from road transport as a result of a rapidly increasing penetration of catalytic converters. Direct incorporation of manure in the soil since 1991, leading to 100% direct incorporation as of 1995, resulted in a sharp increase of N_2O emissions from agriculture.

The uncertainty in the overall total emission estimate is a few per cent for CO_2, roughly about 25% and 50% for CH_4 and N_2O emissions, respectively, and of the order of 50% for HFCs and SF_6 and roughly 100% for PFCs.

Temperature correction

A significant part of the energy consumption in the Netherlands is used for space heating. 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 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. In the last five years 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 ES.2 Carbon dioxide emissions and removals [in Mton] per IPCC sector 1990-1995

IPCC sector	1990	1991	1992	1993	1994	1995*
1. All energy combustion and fugitive emissions	**164.8**	**171.2**	**169.3**	**173.1**	**172.2**	**180.4**
1A. Fuel combustion total	164.8	171.2	169.3	173.1	172.2	180.4
1A1 Energy and transformation	51.5	52.9	53.2	54.6	57.6	59.7
1A2a Industry: combustion	33.5	32.4	34.4	34.2	31.9	33.5
1A2b Industry: actual from feedstocks	14.8	15.6	14.9	12.7	14.3	14.0
1A3 Transport	26.8	26.9	28.0	28.5	29.0	30.1
1A4a Commercial/Institutional	10.6	12.3	11.5	12.3	10.9	11.3
1A4b Residential	19.2	21.7	19.5	20.6	19.6	20.7
1A4c Agriculture/Forestry	7.5	8.4	8.5	8.7	8.7	9.0
1A5 Statistical differences	1.1	1.0	-0.4	1.6	0.6	2.5
(temperature correction)	(6.4)	(0.4)	(4.5)	(1.2)	(3.8)	(2.5)
2. Industrial processes	**1.9**	**1.8**	**1.8**	**1.9**	**2.0**	**2.1**
A. Iron and steel	0.7	0.7	0.7	0.8	0.8	0.8
B. Non-metallic mineral products	1.0	0.9	1.0	1.0	1.0	1.0
F. Other	0.2	0.2	0.1	0.1	0.2	0.3
5. Land-use change and forestry	**(-1.5)**	**(-1.6)**	**(-1.6)**	**(-1.6)**	**(-1.7)**	**(-1.7)**
A. Temperate forest biomass change	(-1.5	(-1.6)	(-1.6)	(-1.6)	(-1.7)	(-1.7)
6. Waste	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**
C. Waste incineration	0.9	0.9	0.9	0.9	0.9	0.9
Total CO_2 emissions (= 1+2+6)	**167.6**	**174.1**	**172.1**	**175.9**	**175.1**	**183.4**
Total CO_2 emissions (= 1+2+6), temp. corrected	174.0	174.5	176.6	177.1	178.9	185.9
Net CO_2 emissions (= 1+2+5+6), temp. corrected	172.5	173.0	175.1	175.5	177.2	184.2
Total CO_2 removals (= -5)	**1.5**	**1.6**	**1.6**	**1.6**	**1.7**	**1.7**

* Data for 1995 are preliminary. (Source: Spakman *et al*, 1996)

4. Policies and measures

The Netherlands' climate policy is to a large extent a combination of different policy areas. It coordinates and reinforces policies already in place. Thus climate policy is basically the sum of a large number of policy areas, however, integrated into policy documents overviewing the total impact on climate-change. Climate objectives have also been integrated into the sectoral policies, addressing other environmental objectives as well. The policy areas most relevant to the Netherlands' climate policy include energy, transport, agriculture and waste.

Box ES.1 Targets for greenhouse-gas emissions

Gas	Base year	Emission base year	Objective	Objective year	Emission objective
CO_2 [1])	1990	173 Mton	-3%	2000	168 Mton
CH_4	1990	1067 kton	-10%	2000	970 kton
N_2O	1990	59.6 kton	0%	2000	59.6 kton
HFCs/PFCs	1990	8.5 Mton CO_2-eq.	-	-	-
NO_x	1988	548 kton	-55%	2000	238-243 kton
NMVOC	1988	520 kton	-60%	2000	193 kton
CO	1990	1030 kton	-50%	2000	502 kton

[1]) Temperature-corrected values (uncorrected value for 1990 is about 6 Mton lower); rounded net values including removals.

CO_2 target

Based on the IPCC method, the CO_2 emission level in 2000 is aimed at 168 Mton. A package of supplementary measures, based on a publication in spring 1995 by the institutes RIVM, CPB and ECN, was announced in the '*CO_2 letter*' of September 1995 concerning the CO_2 target. According to the Government, this would keep the 3% reduction target for CO_2 within reach. Emission figures for 1995 showed again an increase of CO_2 emissions. In order to curb this trend additional policy was announced in September 1996 ('*CO_2 Reduction Plan*'). At present, the Netherlands is in the process of preparing a new *National Environmental Outlook* to 2020 and a new *NEPP*.

Non-CO_2 greenhouse gases

Since 'current' policies in 1991 with respect to agriculture, waste management and energy transmission were expected to result in a 10% decrease of methane emissions in 2000 relative to 1990 in the first *Memorandum on Climate Change* of 1991, this 10% was set as a reduction target. In addition, methane emissions in oil and natural gas production will be reduced further and for N_2O a study has been performed into the means of still achieving the 2000 target via an Action Plan.

Policy for the years beyond 2000

The *Third White Paper on Energy Policy* was introduced by the Government in 1995 with a view to increasing the share of renewable energy to 10% in total energy consumption and to improve energy efficiency by one-third in the year 2020 compared to 1990. As a result of these energy generation and consumption adaptations, on average stabilisation of CO_2 emissions corresponding to the year 2000 will occur in 2020. For the period after 2000 the Netherlands' national policy will be to keep its CO_2 emissions at the 2000 level (which is -3% compared to the 1990 level). The feasibility of this post-2000 commitment will depend especially on realisation of adequate EU climate policies. Furthermore, feasibility depends on the extent sectoral developments in the Netherlands are in line with current prognosis on which this Netherlands' post-2000 commitment has been based. Therefore in this respect these assumptions shall be evaluated in 1997. With respect to other greenhouse gases the national commitment for the post 2000 period is at least to continue - using a comprehensive approach - to stabilise emissions at the level realised in 2000.

March 1997 the Council of EU Ministers of the Environment agreed 'that the EU should propose that Annex X Parties, individually or jointly, in accordance with the Berlin Mandate, shall reduce emission levels for CO_2, CH_4 and N_2O together (weighted total, using GWP with a 100 year time horizon) by 15% by 2010 (reference year 1990).' The Council also discussed emission reduction contribution by member states individually on the basis of the outcome of the protocol negotiations. The Council concluded that current commitments for EU member states, already add up to a 10% reduction. This includes a 10% reduction of greenhouse gases by the Netherlands by 2010. This is subject to the acceptance of comparable commitments by other Annex X Parties, agreement on common and coordinated policies and measures in the Protocol under the FCCC (to be signed in Kyoto in December 1997), joint implementation among Annex X Parties and EU policies and measures.

4.1 Strategy for carbon dioxide

Since 1990, various policy measures have been implemented aiming at the target for 2000, as discussed above. Nevertheless, overall CO_2 emissions increased by 2.8% from 1990 to 1994 and preliminary figures for 1995 compared to 1994 levels suggest a significant increase of 3.9% in 1995 (temperature-corrected figures). In order to curb this trend additional policy was announced in September 1996, which is now included in the existing policies. At present (1997) the Netherlands is in the process of preparing a new *National Environmental Outlook* to 2020 and a new *NEPP 3*. These documents will include the most recent insights into trends in society and the effect of current policies related to the new scenarios. As a result, there might be an update in climate policies in the near future. Main instruments for CO_2 reduction include standards and regulations, financial and fiscal incentives, long term (negotiated) agreements between Government and industrial and non-industrial sectors, the *Environmental Action Plan* of the energy distribution companies, public awareness and research and development.

Cogeneration
Cogeneration makes an important contribution to the energy efficiency improvement target for the year 2000. By then cogeneration will be about 8000 MW_e (40% of total capacity), which is the target for 2000. Depending on developments in the electricity and heating market, a total cogeneration capacity of 14,000 MW_e in 2020 seems feasible. The ambition is to construct new gas-fired electricity generating capacity, predominantly in the form of cogeneration.

Renewable energy
Currently, stimulatory measures will be required to promote the accelerated introduction of this energy source. A number of these have already been applied, but are not sufficient to achieve the 10% target in 2020. The *Renewable Energy Action Plan*, issued March 1997, will promote its further use, amongst others by broadening the range of fiscal instruments, providing extra R&D budgets, and providing adequate payments for delivery of electricity generated from renewable sources by private operators.

Regulatory taxes and fiscal incentives
The regulatory energy tax, which took effect on 1 January 1996, applies to natural gas and electricity consumption and will raise energy prices for small-scale consumption by 15% to 20%; it is now being implemented in three stages. The tax is additional to the environmental tax on all fossil fuels. Since the tax is intended to induce energy conservation, revenues are being recycled back into the economy through relief in other taxes. Use of renewable energy is exempted from the tax. Investments in both energy conservation and renewable energy are encouraged through a number of provisions in the corporate income tax. An energy investment tax credit was introduced in 1996 and free depreciation of certain kinds of energy and environment-related investments has been possible since 1991.

CO_2 Reduction Plan
In 1996 the Government decided to allocate NLG 750 million to a *CO_2 Reduction Plan* for three categories of projects which contribute to a structural reduction in CO_2 emissions.

Budgets
In 1997, the budget for energy conservation and renewable energy from Government is NLG 360 million, mainly for R,D&D, and NLG 270 million for the energy distribution sector. The temporary incentive, *Subsidy Scheme for Sustainable Construction*, applicable to existing dwellings, has a budget of about NLG 30 million. Also other budgets are allocated to R&D programmes and investment schemes, e.g. on transportation, however, the part of the budget related to specific greenhouse gas reduction cannot be singled out.

Electric power generation
For electricity generation the objective is an increase in the average generation efficiency from 40 to 43% in the period 1990-2000 by installing more efficient new plants and by expanding central heat distribution cogenerated in power plants. The *Electricity Generating Board* (SEP), which is responsible for public large-scale electricity generation, takes part in the executing of so-called *Thermal Plans*

aiming at large-scale utilisation of residual heat. In addition, the Government decided that a fuel switch to 10% wood be made in two coal-fired power plants in 1995. Construction of new nuclear capacity is not on the short-term agenda.

Industry

The current three-track approach to energy conservation in the manufacturing industry consists of:

- Long-Term Agreements (LTAs);
- a Light Manufacturing Industry Strategy for small firms where the LTA approach cannot be applied, e.g. energy standards in environmental licences;
- consolidation of the technological base, which by and large will be continued after 2000.

The Long-Term Agreements between the sector and the Government, aiming at covering 90% of the industrial energy consumption, strive for improvement in the energy efficiency of 20%. In addition, Gasunie, which is responsible for the domestic supply of natural gas, is executing an *Environmental Plan for Industry* aiming at improved energy conservation in industry. Energy conservation and accelerated introduction of new technologies will be further encouraged by intensified R&D and application of tax instruments. Besides the desirability of national R&D encouragement, a primary need is a dynamic international strategy, e.g. at European level, designed to support these developments.

Transportation sector

In 1996 three transportation-policy documents *Freight Transport in Balance, Working Together on Accessibility*, and *Memorandum on Vehicle Technology and Fuels* were released. The CO_2 target for road traffic is a reduction of 10% by the year 2010 compared to 1986 levels. Various measures and programmes are carried out with the aim of reducing the number of vehicle-km travelled, with special attention being paid to the improvement of public transport. In order to improve efficiency in freight transport, a joint venture has been set up with sectoral organisations with a view to reaching Long-Term Agreements. Proposals will be introduced for stimulating the purchase of energy-efficient passenger cars. A legislative framework agreed at the European level is required for applying regulatory measures governing CO_2 emissions. Policies on driving behaviour include increase in fuel prices, a stricter control of speed limits, and stimulation of more energy-efficient driving and buying behaviour. Excise duties on motor fuels will be increased per 1 July 1997, while the fixed tax for car owners will be decreased.

The Netherlands is striving for the international control of aircraft emissions as a whole, and seeks an international agreement in this area between the Parties to FCCC and the Chicago Convention (ICAO). The Netherlands will continue to emphasise the importance of a global levy on kerosene and the discontinuance of exemptions on value-added tax for international flights as well as the introduction of CO_2 standards for aircraft. The Netherlands will also request attention for the reduction of greenhouse gas emissions from international shipping.

Residential and service sector

It is intended to further promote energy conservation in new homes and buildings by, for example, improving insulation standards, intensifying the Energy Performance Standard, demonstration projects and fiscal incentives for very energy-efficient construction. Quality improvement in new construction invariably leads to market trends to upgrade existing buildings, including their energy efficiency. Energy conservation in existing dwellings and office buildings will be stimulated through LTAs with rental agencies in the social housing sector and with relevant organisations for renting and maintaining office buildings. Energy-efficient heating systems and appliances, levies, public education and labelling will continue to be a means of inducing energy-conscious (purchasing) behaviour.

Labelling and minimum efficiency standards for appliances have been introduced. Minimum efficiency standards are to be introduced for a wide range of applications, if possible through voluntary agreements with the manufacturing industry, however, if necessary through regulatory measures. The Netherlands Government has requested the European Commission to come with agreements.

Waste treatment

The Netherlands waste policy includes a 'programme for climate and waste', which comprises a package of measures aiming at reducing CO_2 emissions by reducing waste production and other means of waste treatment. The programme aims at using 5.1 million ton of waste for energy purposes by 2000. Also part of this programme is increased recycling of plastics, aluminium, paper and cardboard.

4.2 Strategy for other gases

At present the Netherlands Government expects that CH_4 emissions will be reduced by about 25% in the year 2000, largely exceeding the *NEPP-2* target of -10%. These policies include measures such as recovery of methane from landfills, the manure policy, the European agricultural policy, reduced leakage from gas distribution networks and reduced emissions from offshore gas venting. For N_2O a feasibility study is being performed on reducing industrial N_2O emissions. Although the use of HFCs as substitute for CFCs will increase, emissions will be minimised due to leakage regulations. Also, application of control facilities in HCFC-22 production will reduce by-product HFC emissions.

5. Projections and effects of policies and measures

For estimating future trends in CO_2 emissions in 1995 a new scenario *'Favourable CO_2 Scenario'* was developed based on the so-called sketch scenarios for energy use compiled by ECN as interpreted by the Netherlands Government. This is also the reason that different growth assumptions are used for the CO_2 scenarios and the scenarios for the other gases. The *Trend scenario* is used as a baseline for the development without considering the latest additional measures announced in the *Third White Paper on Energy Policy* and in the *CO_2 Reduction Plan.* One of the CPB scenarios called *'European Renaissance'* was selected as economic scenario for projecting non-CO_2 emissions for the coming decades. Since emissions of non-CO_2 gases are less dependent on energy prices and economic growth than CO_2 emissions, adjustments as made for CO_2 are less relevant for these gases. Key assumptions of the scenarios used for CO_2 and non-CO_2 gases are described in *Boxes ES.2* and *ES.3*, respectively. Existing policies and measures already implemented or committed to, are taken into account in the projections. *Table ES.3* provides a summary of the CO_2 projection according to the *Favourable (average) scenario* and a comparison with the *Trend* and *BaU scenarios*.

At present (1997), a new *National Environmental Outlook 1995-2020* (NEO 4) is in preparation which will include several new economic scenarios with the most recent insights in trends and an independent assessment of the effect of the Netherlands' environmental policies in the context of the new scenarios. Current developments as discussed under Section 3 indicate a rising level of emissions.

In September 1997 the Government will inform the Parliament on the impact of existing policies, including the effect of the *CO_2 Reduction Plan* and other initiatives taken after 1995. This information will also contain the result of an exploration of further reduction policies. Furthermore, the Government is preparing a new *National Environmental Policy Plan 3* (NEPP 3), which will present an integrated update of current policies, as will be elaborated in sectoral policy documents.

Box ES.2 Key assumptions in the CO_2 scenarios for energy supply and demand defined by ECN

Trend scenario:
- economic growth 1990-2020: 2.3% per year;
- population growth 1990-2020: 0.5% per year;
- a very moderate rise in energy prices on the world market (to somewhat below $20/bbl in 2020 for oil);
- growth of industrial production: 3.3% per year.

Additional assumptions in the *Favourable scenarios:*
- a moderate rise in energy prices on the world market (to $25/bbl for oil in 2020).
- *favourably low*: relatively low growth of energy-intensive manufacturing industry and net imports of electricity;
- *favourably high*: relatively high growth of energy-intensive manufacturing industry and net exports of electricity;
- from 2000 onwards a European energy/CO_2 tax of $10/bbl (also for large consumers);
- European efficiency standards for electric appliances;
- a European policy with incentives for recycling and use of less energy-intensive materials;
- favourable European conditions for the introduction of energy-efficient cars;
- (national and European) financial incentives and R&D programmes.

Table ES.3 Summary of projections of anthropogenic emissions and removals of CO_2 (Tg)

	1990*	1995*	2000	2005***	2010***	2015***	2020
Emissions							
Actual/target emissions	173	186	168	168	168	168	168
Without measures (BaU)	173		197	210	222	236.5	251
Trend scenario	173		173.5 (170-177)	181	188	195	202
Favourable CO_2 scenario	173		168	170 (168-172)	170	170	170 (168-172)
Removals							
Afforestation **	-1.5	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7

Notes:
* Actual emissions, not projected; temperature corrected (uncorrected value is about 6 Mton lower for 1990 and about 2.5 Mton for 1995).
** No projection known; assumed to be constant.
*** Interpolated values.

Table ES.4 provides a summary of the other emissions for the period 1990-2020, on the basis of extrapolated projections for 1990-2010. The overall reduction of CH_4 is caused predominantly by a decrease in emissions from landfills, agriculture (in particular from enteric fermentation and to lesser extent animal waste) and oil and gas production (-80%, -30%, and -40%, respectively in 2010-2020 compared to 1990). N_2O emissions from transport and wastewater treatment plants are expected to increase substantially (+150% and +100%, respectively, in 2010-2020 compared with 1990), whereas emissions from polluted surface waters are expected to decrease by about 50% in 2010-2020 relative to 1990. The effects of incorporating manure into the soil as a highly effective means to reduce ammonia emissions means are not included in the projection for agricultural emissions, now estimated to amount to about 3.5 Gg N_2O. For the projection of emissions of HFCs, PFCs and a *Reference Scenario* has been defined, assuming that the *Montreal Protocol* and its subsequent amendments will be fully implemented without additional measures.

Box ES.3 Key assumptions in the scenarios for CH_4, N_2O and other gases

- The European Renaissance scenario with high prices (*ER-High*), which include an annual economic growth rate of 2.7% between 1990 an 2000 and an increase of end-user energy prices of 23% in 2000 compared to 1990;
- Constant natural gas production, export and import;
- Increased use of associated gas on offshore production platforms, which would otherwise be vented;
- For agriculture, the impact of the MacSharry plan as well as the *Integral Paper on Manure and Ammonia Policy*, resulting in a substantial decrease in livestock numbers;
- Specific policies on waste prevention and recycling, leading to an increase in waste incineration and to a decrease in the amounts of waste landfilled, as well as in the fraction of degradable organic carbon of this waste.

Table ES.4 Summary of projections of anthropogenic emissions of non-CO_2 gases [Gg and Tg CO_2-eq.]

Compound	1990	1995**	2000	2005*	2010	2015***	2020***
CH_4	1067	928	788	700	611	600	594
N_2O	62.6	*64*	65.2	*67*	68.1	69.4	70.1
HFCs	490	*754*	1340	*2610*	3890	5160	6440
PFCs	330	330	371	*390*	*410*	*429*	448
FICs	0	0	2	*2*	*3*	*3*	3
SF_6	58	61	68	*75*	*82*	*88*	95
Total non-CO_2 (Tg CO_2-eq.)	**50.3**	***49.6***	**44.4**	***43.3***	***43.5***	***47.0***	**50.5**
CO	1030	*830*	630	*650*	670	*687*	704
NO_x	575	*477*	*379*	*355*	*330*	*312*	293
NMVOC	459	*357*	255	*253*	250	*250*	250
SO_2	207	*150*	92	*94*	95	95	95

Note: Figures for 1990 and 1995 may differ from those in presented *Table ES.2*, since the emission inventories contain more recent estimates than the projections used here.
* Interpolated values (for other years shown in italics).
** Increase or decrease reflecting historical trends described in Chapter 3.
*** Simple extrapolation.

6. Expected impacts of climate change and vulnerability assessment

The natural coast, mainly consisting of dunes and beach flats, is eroding due to the present sea-level rise of approximately 20 cm per year per century and due to human interferences in the coastal system. The expected additional increase in sea level rise will lead to an increased erosion of the coastline. The 1995 evaluation showed that the present structural erosion has been stopped effectively due to beach nourishment programmes. Increased erosion of the fore-shore (minus 7-12 m) has been observed, which in the long run leads to instability of the coastal system. Accelerated sea-level rise and change in storm intensity will exacerbate this process. At present, however, there is no evidence for a changing frequency of storms. Estimates show that due to a changing climate, decisive flood discharges will increase 10% for the Rhine and even 20% for the Meuse in the next century. These expectations, combined with the human interferences, will strongly increase the vulnerability to flooding of the low lying lands in the Netherlands.

The Netherlands assists developing countries in the preparation of a national policy on climate change, including assistance in preparing vulnerability assessments of potential climate-change impacts on natural and socio-economic systems. These projects are now being followed up with assistance in developing integrated planning for coastal zone management, taking into account potential long-term effects of climate change.

7. Adaptation measures

The *Technical Advisory Committee on Water Defence* has recommended reserving space in the dune area to guarantee safety for the next 200 years, with a worst-case scenario of 85 cm sea-level rise and a 10% per century increase in storms. The design of (unavoidable) new engineering works with a long lifetime, like storm surge barriers and dams, will incorporate an expected sea-level rise of 50 cm. The *Flooding Defence Act*, which came into force in 1996, mentions the safety standards for all water defences varying from one in 10,000 to one in 1250 years. International agreements have been made for both the Rhine and the Meuse to reduce and prevent damage due to high floods.

Forest management in the Netherlands focuses on stimulating the stability and options for forest adaptation. Stability is pursued through measures to stimulate mixed-forest planting, and to make conscious choices with respect to different kinds of trees, disease prevention and protection of genetic diversity. The Netherlands has policies to protect groundwater and surface water as a natural resource, thereby also preventing soil desiccation.

The Netherlands with its considerable experience in coastal zone management has strived to share this experience with other countries, in particular the developing countries most vulnerable to the effects of climate change. Support in this respect involves dissemination of information, other knowledge with respect to coastal zone management and through the training of experts.

8. Activities Implemented Jointly

The Netherlands actively advocates the use of joint implementation for the realisation of future obligations under the Climate Convention and is therefore an active participant in the pilot phase of AIJ. A *Pilot Phase Programme* (PPP) will be set up to last until the end of this century, with annual progress reports be sent to the Netherlands Parliament and to the Conference of Parties to the FCCC. This *PPP* aims to carry out a broad range of projects. All greenhouse gases, not only CO_2, will be addressed. Different sources, but also sinks and economic sectors will be considered. Furthermore, the programme aims at projects both in developing countries, and in Central and Eastern Europe (NLG 48 million available). Besides forming positive climate impacts, projects should also have clearly beneficial local environmental and social impacts and be in line with host-country development priorities. At present, the Netherlands has nine AIJ projects in execution, three of which relate to afforestation or reforestation.

9. Financial assistance and technology transfer

In 1995-1996 the Netherlands restructured its foreign policy to reflect a more integrated approach. The Government of the Netherlands has committed itself to allocating 0.8% of the Gross Domestic Product to *Official Development Assistance* (ODA). For 1997 this amounts to approximately NLG 6,000 million. As part of this, in 1996 the Netherlands has also committed itself to spend 0.1% of GDP in 1997 on environmental projects and programmes in developing countries, including climate change activities. These financial resources are channelled through a combination of multilateral and bilateral channels. The Netherlands has set aside a sum of NLG 120 million until the year 2000 out of the budget of development cooperation to contribute to the *Global Environment Facility* (GEF), the interim operating entity of the *Framework Convention on Climate Change*.

In the Netherlands development cooperation with developing countries on a bilateral level, environmental issues are an integral part of the terms of reference. This makes it difficult to specifically extract the programmes and projects which have a component relevant to mitigation and adaptation of climate change issues. In direct technology transfer, the private sector plays a very important role, because the ownership of the climate-friendly technologies generally lies with the private sector rather than with governmental or multilateral institutions. Transfer of 'soft' technology through capacity-building, training and research is a key element of the Dutch development cooperation and an integral part in assisting the technology transfer process.

10. Research and systematic observation

National research activities are supported and to a significant degree steered by the *National Research Programme for Global Air pollution and Climate Change* (NOP-MLK). The first phase of this programme (1990-1995) has now been completed and the second phase will run from 1995-2001. With a budget of NLG 47 million, in Phase II some 80, mostly large, projects will be carried out. In addition, the *Netherlands Organisation for Scientific Research* (NWO) fosters research in the framework of the *Global Change Priority Programme* (1990-1998) which has a wider scope than the climate-focused NOP-MLK. Other national programmes include the *National Remote Sensing Programme* and the *Earth Observation User Support Programme.*

With the support of several Ministries and the University of Utrecht, the *Netherlands Centre for Climate Research* (CKO) was established in 1995 aimed at enhancing the quality and impact of climate research in the Netherlands in general, which is a cooperation between the *Institute for Marine and Atmospheric Research* (IMAU) of Utrecht University, the *National Institute of Public Health and the Environment* (RIVM) and the *Royal Netherlands Meteorological Institute* (KNMI).

In the years to come, the Dutch contribution to international research will also be aimed at finding global and regional strategies in the long term to satisfy the commitments under the *Framework Convention on Climate Change*. Here, global integrated models will play an important role. To support the relevant protocols, scenarios studies, an insight into the cost-effectiveness of measures for emission reduction and adaptation and insight into the effectiveness of administrative instruments are required.

11. Education, training and public awareness

Since 1980, research has been conducted every six months into the involvement of citizens in about 45 social issues of various types including, from 1990, the subject of climate change. The involvement of the public in climate change issues appears to be related to public information campaigns and publicity on current events. The attitude of the Dutch population on the issue itself has changed substantially in the last years. The issue is considered to be of less importance, less threatening, less disastrous and less close at hand. In the last years the communication of the energy distribution companies through their *Environmental Action Plans* (MAPs) has focused on promoting energy conservation in the residential sector. During the winter season 1996/1997 central issues were energy-efficient buying and energy-efficient living. Products which received special attention were energy-saving light bulbs, energy-efficient boilers and insulation materials.

In 1996 the Ministry of the Environment started a long-term mass media information campaign on the greenhouse effect and the subsequent necessity for energy conservation. In 1995 a project was launched aiming at showing the population examples of households which have achieved a substantial reduction in residential energy consumption by changing their lifestyles.

1. INTRODUCTION

The first *Netherlands' National Communication on Climate Change Policies* was prepared in 1994 in a context in which climate change policies and expected impacts had just been decided upon. On the basis of new scenarios developed in 1993, new policies and measures, including a package of measures to realise the CO_2 emission target, were presented in the *Second National Environmental Policy Plan* (NEPP 2). This first *National Communication* presented therefore a current and consistent overview of targets, policies and measures, and emission projections of greenhouse gases for the period 1993-1994.

In 1997, we are facing a very different situation. The *Second Netherlands' National Communication on Climate Change Policies* has been prepared in a period in which important national policy developments and policy decisions have taken place. The developments are consequential to international policy developments and to the high level of political focus in the Netherlands on the problem of climate change. National developments started unfolding in 1996 in connection with the *Third White Paper on Energy Policy* and the *Second Memorandum on Climate Change*, documents presenting the Netherlands' strategy for long-term climate change policies at an international level and the Netherlands' contribution to these policies. Long-term targets were formulated on the basis of adjusted CO_2 scenarios.

In spite of intensifying climate policies in NEPP 2 and thereafter, we are still faced with increasing CO_2 emissions as a result of economic developments, both international and national. For this reason, in 1996 the Netherlands Government decided in addition to existing policies to allocate 750 million Dutch guilders to realise improvements to the energy infrastructure in the context of a *CO_2 Reduction Plan*.

In the thorough investigation of the climate change issue made by the Netherlands Parliament in 1996, substantial reductions of greenhouse gases, both international as well as national, were recommended. Parliament requested the Government to present an estimate by September 1997 of the impacts of current policies and measures, including the *CO_2 Reduction Plan*. Furthermore, the Government was to explore the possibilities for further reductions of greenhouse gas emissions in the light of a possible outcome from the negotiations on the protocol under the *Framework Convention on Climate Change* (FCCC). The conclusions of the European Ministers of the Environment to propose a 15% reduction of greenhouse gas emission by industrialised countries between 1990 and 2010 and to propose burden-sharing differentation within the European Union will be further explored for impacts on the Netherlands.

The report to Parliament in September will be based on the results of new scenarios being developed by our national planning institutes and from present projections of greenhouse gas emissions over the 1990-2020 period. Although the results of these scenarios *(National Environmental Outlook 1995-2020*, NEO 4) are not yet available, they are scheduled for publication in July 1997. This report to Parliament will constitute an important contribution to the *Third National Environmental Policy Plan* (NEPP 3) scheduled for the end of 1997.

And so it was that this *Second Netherlands' National Communication on Climate Change Policies* evolved from within the dynamic context outlined above to the present overview of the current situation (up to April 1997) with respect to climate change policies. This overview presents us with a complete picture of policies and measures on climate change to reduce greenhouse gas emissions, and to provide for adaptation policy, national circumstances, financial assistance and technology transfer, research programmes and education and communication. Also included is a chapter on activities implemented jointly.

Because the new scenarios are not yet available, future greenhouse gas emissions are presented on the basis of projections made in 1993 and 1995. The new scenario calculations may have a considerable effect on the figures used in this *National Communication.*

Finally, a refinement of the greenhouse gas emission calculation methodology for the Netherlands has now been decided upon in February 1997, which will result in a better compliance with IPCC guidelines on estimating greenhouse gas emissions. However, a recalculation of historical emissions has not yet been carried out and thus updated and improved emission inventory figures were not available for presentation in this *Second National Communication.*

2. NATIONAL CIRCUMSTANCES

This chapter provides an overview of background data relevant to this report. Characteristics of the Netherlands are described using basic data and include profiles of the geography, climate, population, society, economy, energy and environment. Policy-making and legislative processes in the Netherlands are then examined, followed by a brief outline of key elements in the development of environmental policies to date.

2.1 Geographical profile

The Netherlands is a low-lying country situated in the delta of the rivers Rhine, IJssel and Meuse. About 24% of the land is below sea level. The soils consist of fluvial and tidal deposits, partially covered by peat. After the ice age, this Holocene peat was formed behind the coastal dunes in the western part of the Netherlands, where polders with controlled water levels have been created. In the eastern part of the Netherlands, Pleistocene ice-pushed ridges covered with windborne sand deposits are found. The south consists mainly of Meuse terraces with loess deposits or windborne sand deposits. The highest point is 321 m above sea level at the border with Belgium and Germany, and the lowest is 7 m below sea level. The surface area of the land, and inland and coastal waters amount to 41,526 km^2. The land surface covers 34,000 km^2. This area consists of 59% agricultural land and 9% forest; 5% is natural land and 27% is destined for urban, infrastructural and other uses. The population concentration is highest in the '*Randstad*' (cities on the western edge of the country), consisting of Amsterdam, Rotterdam, The Hague and Utrecht, and the towns in between. Rotterdam is important for its oil refineries and ports, which are amongst the largest in the world. Schiphol Airport near Amsterdam is important as an air transit point for the rest of Europe. Several geographical features are given in *Fig. 2.1*.

Fig. 2.1 ***Key elements of the Netherlands' geographical profile.***

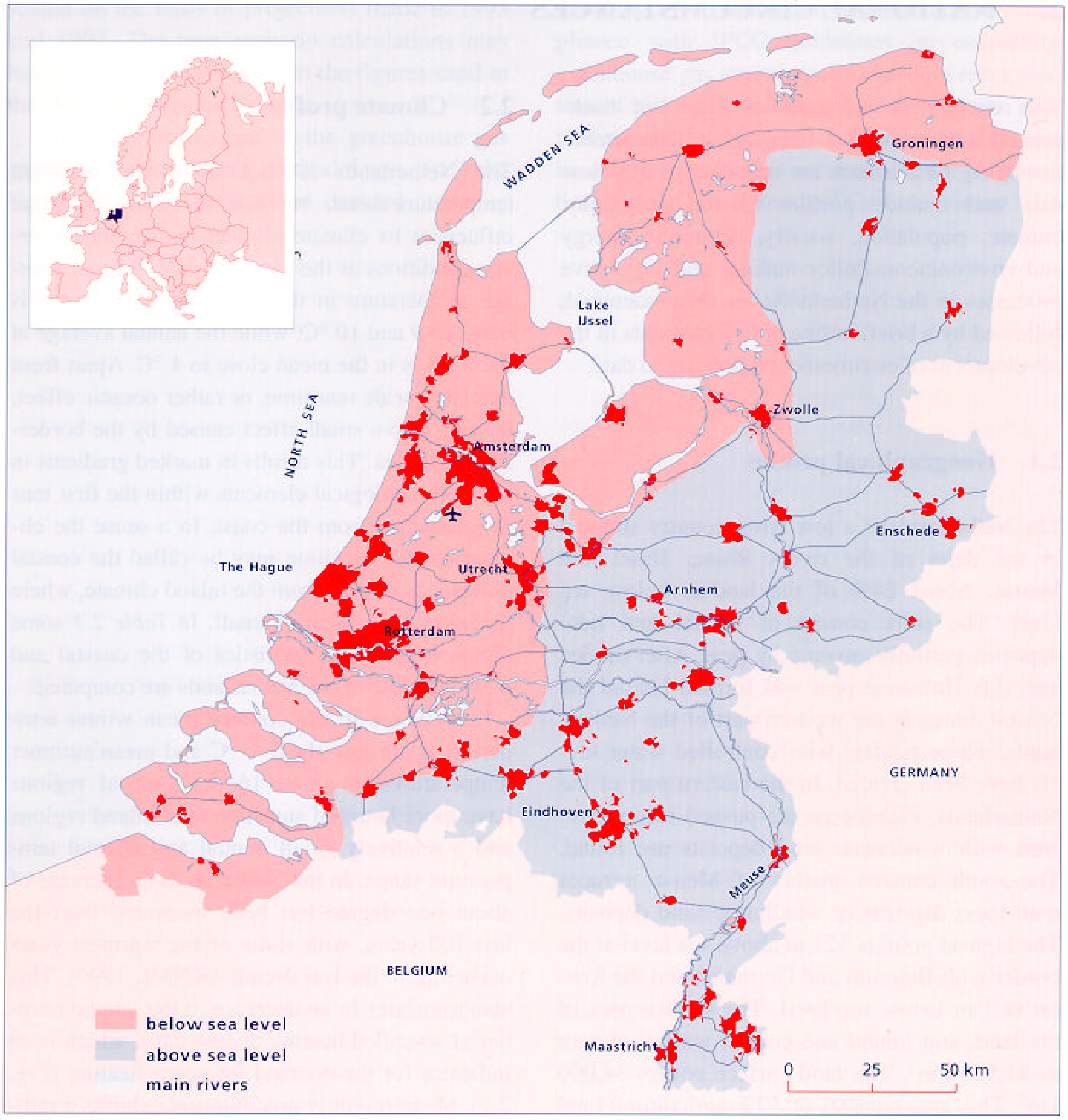


Fig 2.1 ***Key elements of the Netherlands' geographical profile.***

2.2 Climate profile

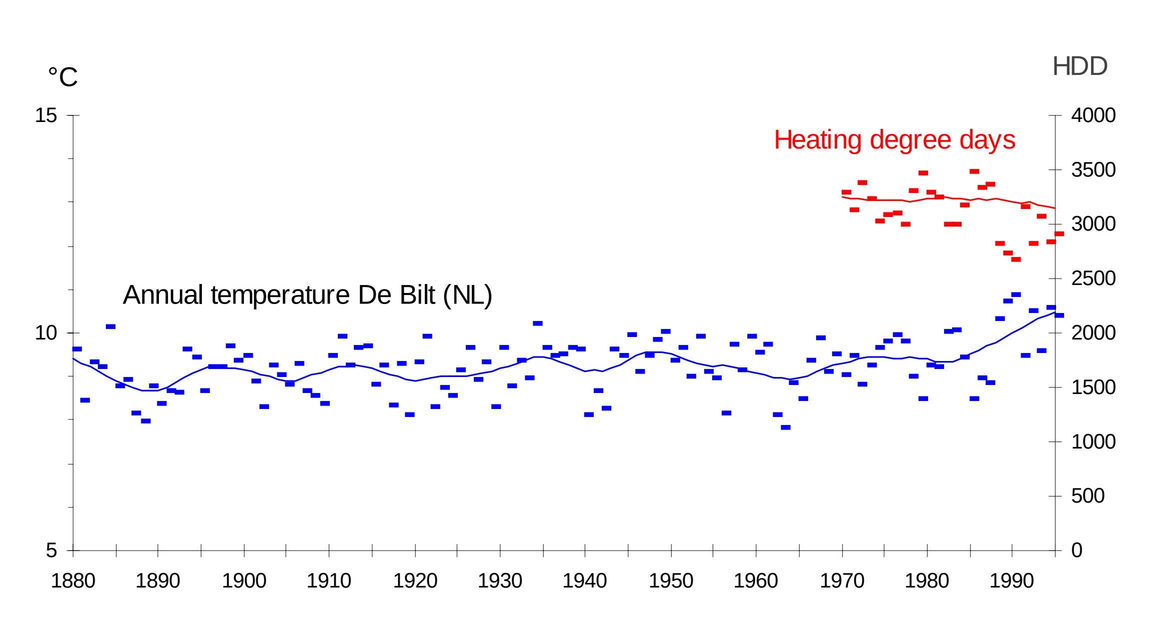
The Netherlands is located in the so-called temperature zone, but due to strong maritime influences its climate is much milder than average conditions at the same latitude. Annual average temperature in the centre of the country is between 9 and 10 °C, while the annual average at the 52 N is in the mean close to 4 °C. Apart from this large scale maritime, or rather oceanic effect, there is also a small effect caused by the bordering North Sea. This results in marked gradients in most climatological elements within the first tens of kilometres from the coast. In a sense the climate of this transition may be called the coastal climate, as distinct from the inland climate, where gradients are generally small. In *Table 2.1* some climatological characteristics of the coastal and inland climate of the Netherlands are compared.

Table 2.1 Some climatological characteristics for De Kooy (coastal station) and Twente Airbase (about 150 km from the coast), based on observations for the period 1961 to 1990 (source: KNMI)

	De Kooy (coastal station)	Twente Airbase (inland station)
Mean temperature (°C)		
- January	2.7	1.5
- July	16.2	16.4
Mean daily temperature amplitude (°C)		
- January	4.2	4.9
- July	5.9	9.9
Mean relative humidity (%)		
- January	88	90
- July	81	79
Mean annual duration of sunshine (hr)	1581	1377
Mean annual wind speed at 10 m over flat open terrain (m/s)	7	4
Mean precipitation (mm)		
- annual	757	769
- driest month	40	46
- wettest month	91	76

Everywhere in the country mean winter temperatures are just above 0 ^{o}C and mean summer temperatures at about 16 ^{o}C. Coastal regions have more hours of sunshine than inland regions and a relatively small annual and diurnal temperature range. In the Netherlands an increase of about one degree has been measured over the last 100 years, with some of the warmest years occurring in the last decade (KNMI, 1996). This also translates in an decrease in the annual number of so-called heating degree days, which is an indicator for the demand for space heating (*Fig. 2.1*). Mean monthly precipitation exhibits a rather strong annual cycle; the driest months are February, March and April, the wettest are July and August. The variation in mean annual precipitation deviates locally by no more than 20% from the nation wide mean of 775 mm (Colenbrander *et al.*,1989).

Fig. 2.2 Development of the average surface temperature and the number of heat degree days (HDD) in the Netherlands in the periods 1880-1995 and 1975-1995, respectively (source: KNMI, 1996; EnergieNed).

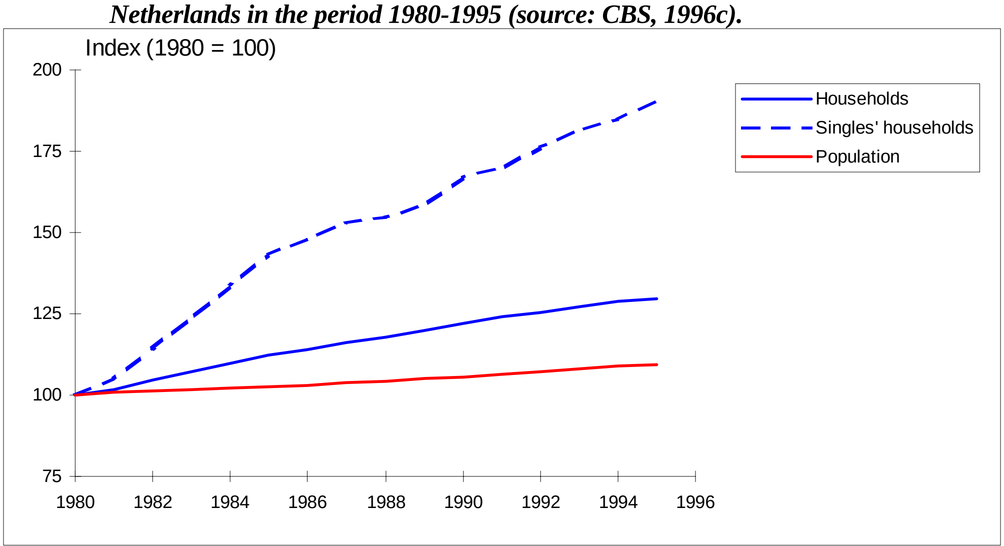


2.3 Population profile

The period 1980-1995 saw a population increase in the Netherlands of 9.5%, going from 14.1 million to 15.4 million (*Fig. 2.2*). The annual growth decreased from 0.8% in 1980 to about 0.5% in 1995. In the same period the population density increased from 415 to 454 persons per km^2 (CBS, 1996a). This is about twice as much as at the beginning of this century. According to recent analyses it is anticipated that the Netherlands will have about 15.9 mln inhabitants in 2000, 16.7 mln by 2010, and 17.1 mln by 2020 (CBS, 1996b). In comparison with most other EU countries, the population increase in the Netherlands can be considered relatively high.

Besides population growth, other demographic factors influence the pressure on the environment, the most important being the number of households. This is affected by a decreasing trend in the number of persons per household (from 2.8 in 1980 to 2.4 in 1995). The number of households increased from 5 mln in 1980 to almost 6.5 mln in 1995, while the share of singles' households increased from 24% to about 30% (CBS, 1996a).

Fig. 2.3 Development of the total population, number of households and the number of singles' households in the Netherlands in the period 1980-1995 (source: CBS, 1996c).

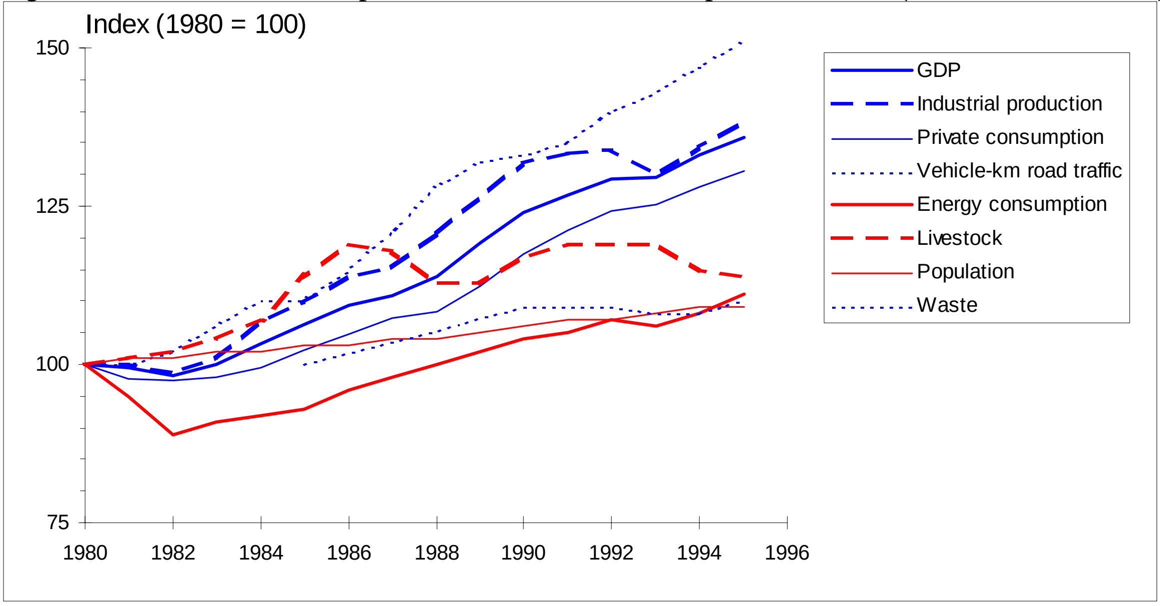


2.4 Economic profile

General

The Gross Domestic Product (GDP) of the Netherlands was NLG 516,000 mln in 1990 and NLG 568,000 (using 1990 prices) in 1995, an increase of 10% (CBS, 1996a). The Netherlands performs well on the world market and ranks relatively high amongst agricultural exporters. From a Netherlands perspective the principal exports are machinery and transport equipment (26 % in 1996), food and other livestock products (19%), and chemicals (20%). The current export quote is 54%. The exports increased by 18 % between 1990 and 1995. This growing export trend is inextricably linked to developments in freight transport. Principal imports to the Netherlands in 1996 included machinery and transport equipment (33%), and manufacturing goods (28%). The transportation sector has been traditionally one of the main economic activity fields (with the share of total GDP being 6.8% in 1995) because of its favourable location for transporting goods from a harbour to the EU inland destinations. The geographical situation also encourages oil refineries in Rotterdam, from which large amounts of oil products are exported. Another characteristic of the Netherlands is the availability of large domestic reserves of natural gas, one of the factors contributing to a relatively large chemical industry (using natural gas as chemical feedstock). The many refineries have also contributed significantly to this large industrial sector.

Fig. 2.4 Trends in volume development in the Netherlands in the period 1980-1995 (source: RIVM, 1996a,b).



Volume trends

During the last few decades the volume of many important variables such as GDP, mobility, livestock, energy consumption and waste production, which strongly influence the development of emissions, has increased in the Netherlands, as illustrated in *Fig. 2.4*. Only the development of livestock numbers deviates from this trend. The largest increase since 1980 occurred in mobility, i.e. road transport, expressed as vehicle-km (passengers and freight). The GDP and consumer expenditure increased faster than the number of inhabitants. In the period 1980-1994 the growth in energy consumption was lower than the growth in GDP; in 1995 energy consumption grew more than GDP. Except for transportation, for a selection of indicators presented in *Table 2.2* the environmental pressure in the Netherlands, in comparison with our neigbouring countries, ranks among the highest..

Table 2.2** **The pressure on the environment per km² and per inhabitant by a number of social developments in the Netherlands compared with neighbouring countries in 1993 (source: RIVM, 1996a,b; IEA)

Index (NL = 100)	Population per km²	GDP per capita	Energy consumption per capita	Passenger cars per capita	Vehicle-km per capita	Fertiliser per km²	Cattle per km²	Pigs per km²
Netherlands	100	100	100	100	100	100	100	100
Belgium	78	101	110	108	91	56	77	55
Germany	55	116	91	109	111	36	34	18
United Kingdom	57	79	82	102	117	52	37	8
Denmark	29	126	83	85	116	33	38	63

Production

In the period 1980-1995 real GDP increased yearly, except for 1981 and 1982 (see *Fig. 2.4*), with annual growth figures between 1% and 4%. Annual growth was highest in 1989 and 1990 (4.7% and 4.1%, respectively). The growth of GDP per capita was about 1% to 1.5% annually at the beginning of the 1990s. In 1993 there was a decrease of 0.5%, whereas in 1994 and 1995 the increase was about 2% annually. The growth in the Netherlands is somewhat higher than the average of the European Union countries. The sectoral structure of the Dutch economy and its development in the last decade is shown in *Table 2.3*. The shifts in sectoral shares in total GDP are minor. Between 1990 and 1995 the share of agriculture decreased from 4.0% to 3.3%, whereas the share of the service sector increased in the course of time from 46.1% to 48.1%. The share of industry as a whole in total GDP is stable, with only minor shifts between industrial sectors. In the last five years total industrial production increased by 3.4%, with the chemical and the food processing industry showing the highest growth figures in this period.

Table 2.3 Development of GDP (in 1990 prices) and the share of economic sectors in GDP in the period 1985-1995 (source: CPB, 1996)

	1985	1990	1991	1992	1993	1994	1995
Real GDP (in 1000 mln NLG)	443	516	528	539	540	555	568
Contribution to GDP (in %)							
Agriculture and fishery	3.9	4	3.9	3.6	3.2	3.3	3.3
Mineral production	8.3	3	3.4	3	2.7	2.6	2.5
Food and tabacco industry	3.1	3.2	3.2	3.1	3.1	3.1	3
Chemical, rubber and synthetic industry	3.1	3.6	3.4	3.4	3.2	3.3	3.4
Metals industry	7.1	7.5	7.2	7.1	6.8	6.9	7
Mineral oil	0.5	0.6	0.6	0.6	0.6	0.7	0.7
Other industry	3.8	4.1	4	3.9	3.8	3.9	3.8
Public utilities	1.8	1.7	1.7	1.6	1.7	1.7	1.7
Construction industry and installation firms	4.6	5.2	5.1	5.1	5.2	5.3	5.2
Trade, hotels, catering and repair shops	13.3	14.8	14.8	14.6	14.6	14.4	14.4
Transport, storage and communications companies	6	6.2	6.4	6.5	6.6	6.7	6.8
Other commercial and public services, other	44.6	46.1	46.5	47.7	48.6	48.2	48.1

Transportation

The volume of transportation is influenced by demographic, economic, spatial and infrastructural factors. Between 1990 and 1995 the number of vehicle-km of passenger cars increased by 12.5 % to almost 90,000 mln vehicle-km, which was higher than the increase of GDP in the same period. However, the trend in heavy-duty vehicle-km in this period was similar to the trend in GDP (*Fig. 2.5*). In contrast, the volume of light-duty vehicles (LDV) or vans in the same period has increased very rapidly, by more than 150%. Since 1993, however, annual increase figures appear to be dropped to a lower growth rate. In comparing trends in road transport with other EU countries, passenger transport in the Netherlands appears to have increased less in the period 1986-1993, while freight transport in the Netherlands increased substantially more than in the other EU countries (mainly due to a high increase in LDV (*Fig. 2.5*) . As illustrated in *Fig. 2.6*, the number of car-km per inhabitant also increased less in the Netherlands than in the other EU countries. This may be explained by the different trends in real fuel prices for end-users, which decreased less in the Netherlands than in the other countries due to the levy policy of the Netherlands Government.

Of total passengers and freight air transport in the Netherlands, 95% is handled at Schiphol Airport. Of the total freight 80% by weight is handled in the port of Rotterdam. A large fraction of the 80% consists of crude oil.

Fig. 2.5 Development of GDP and vehicle-km of passengers and freight in the Netherlands, Belgium, former Western Germany, UK and Denmark (period 1986-1993) (sources: CBS; Eurostat, 1995; OECD, 1995; UBA, 1994).

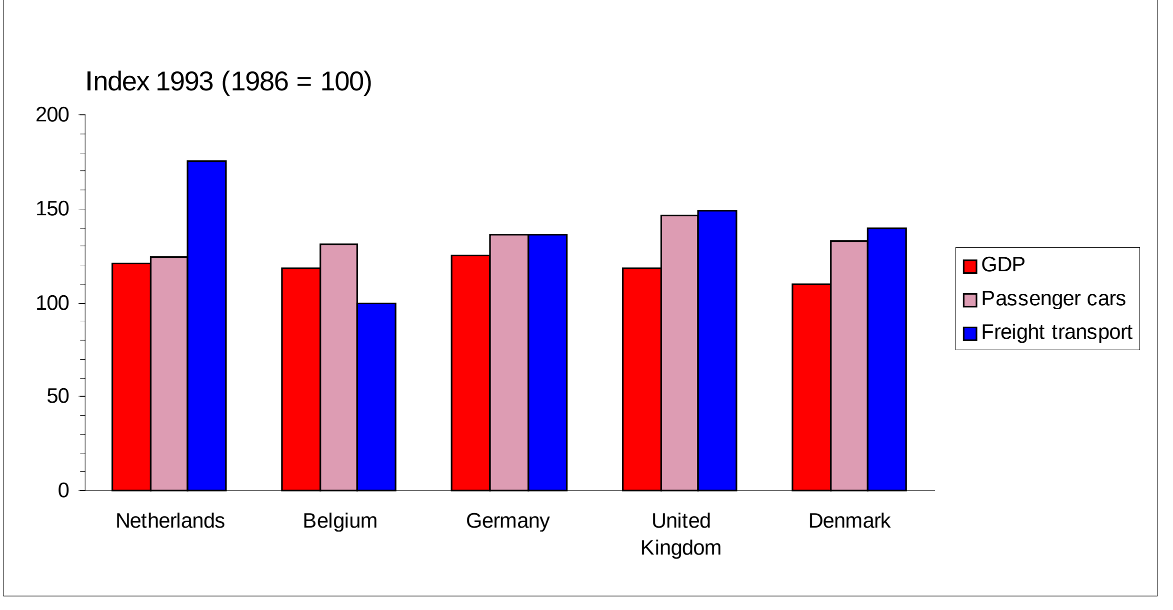
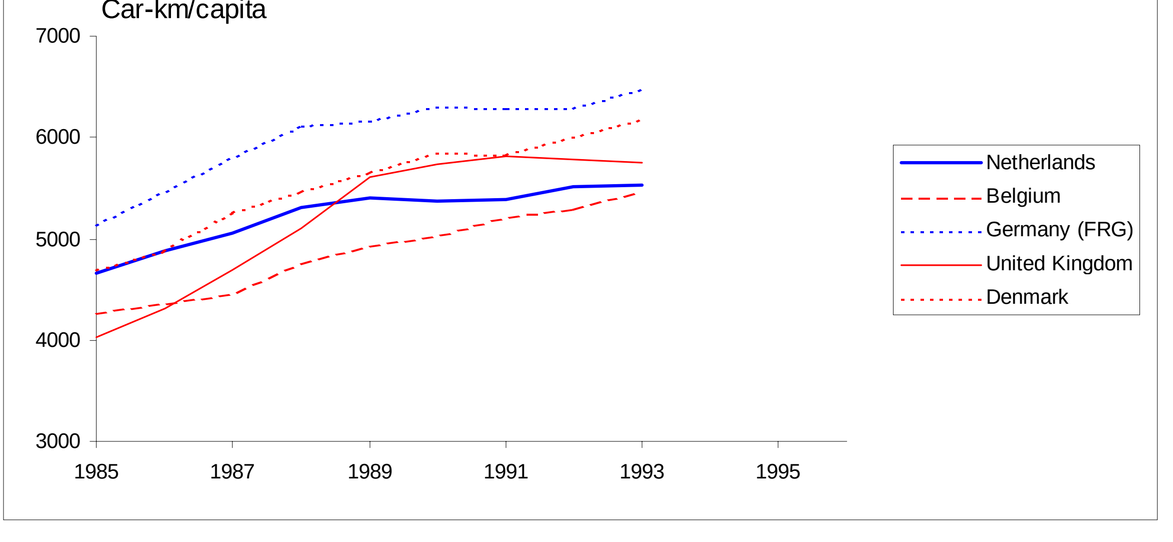


Fig. 2.6 Development of vehicle-km of passenger cars in the Netherlands, Belgium, former Western Germany, UK and Denmark (period 1985-1993) (sources: CBS, 1995b; Eurostat, 1995; OECD, 1995).



Agriculture

After an initial increase of total livestock numbers in the Netherlands up to 1986, the beef cattle numbers, and sheep and goats, have decreased notably due to unfavourable economic conditions for this sector. Between

1990 and 1995 the total livestock in the Netherlands decreased by 5% (in so-called weighted animal units).The number of chickens increased between 1990 and 1995 with 6.5%; the number of pigs remained constant. The most important agricultural crops are cereals, maize for fodder, potatoes and sugar beets. The nitrogen levels on grassland have increased since 1990 due to shifting of animal manure application from maize for fodder to grasslands caused by stricter standards for phosphate application for maize. In addition, a ban on surface spreading of manure and encouragement of manure injection into the soil have resulted in a larger part of the nitrogen being absorbed by grassland. A small fraction of the manure is exported, 80% of which originates from poultry farms (RIVM, 1996a,b).

Consumption

Private consumption increased in the Netherlands by 30% in the period 1980-1995 (*Fig. 2.4*). Since 1993 annual growth has been between 1 and 3%, peaking in 1994 to 4%. Comparison of consumption trends with our neighbouring countries shows the same picture as for production: the growth of private consumption in the Netherlands and Germany (excluding the former DDR) is somewhat higher than the average of the European Union countries. In recent years, households in the Netherlands have purchased a relatively high number of electrical appliances (RIVM, 1996a,b). In 1994, almost all households had a washing machine and a colour TV. The penetration of magnetron or combined magnetron-and-conventional ovens and dryers, (with a relatively high electricity consumption) is increasing rapidly. Combined with the growth in the number of households this has led to a significant growth in residential consumption of electricity.

2.5 Energy profile

General

After a decrease in domestic energy consumption during an economic recession at the beginning of the 1980s, energy consumption in the Netherlands in the period 1985-1990 increased by 2.2% annually. In the period 1990-1995 the annual increase was about 0.8%, except for 1995 when it was 3.4% due to revival of the organic chemistry, increased electricity consumption by households and further increase of traffic. In the period 1990-1995 energy consumption increased in all sectors (see *Table 2.4*): about 2.2% in the residential and service sectors, 8.7% in agriculture, 4.6% in industry, 11% in the transportation sector and 9.8% in the energy sector (mainly public power generation). Since 1990 the energy consumption trends in industry and agriculture have been affected by a high increase in cogeneration in these sectors, resulting in a decrease in fuel consumption in the public power generation sector.

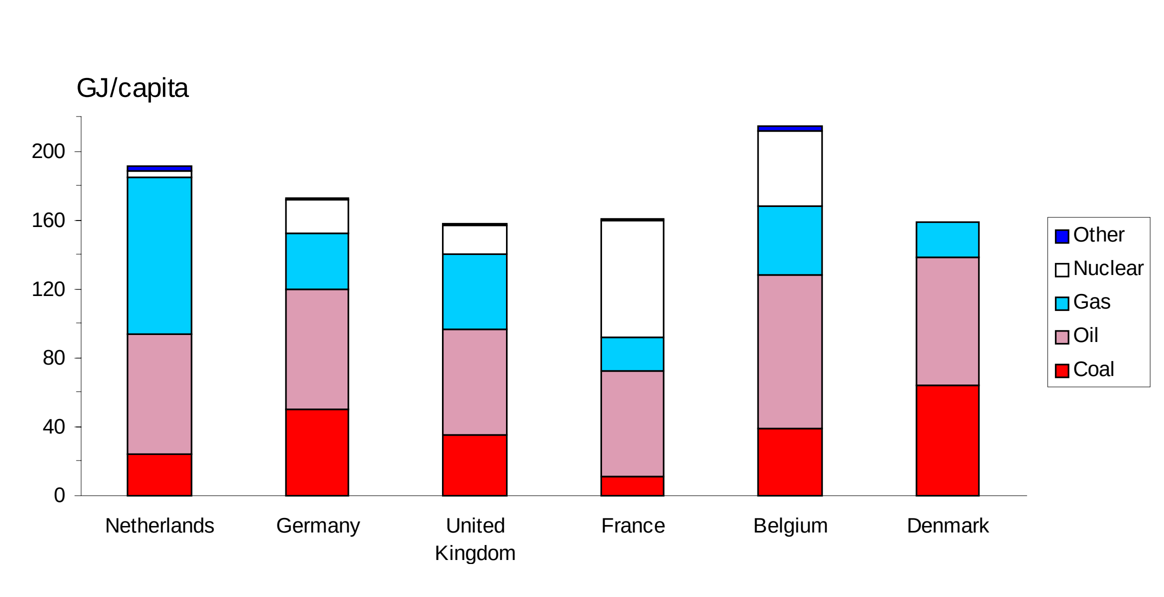
Although the overall energy intensity decreased in the period 1980-1995, electricity use increased by 42% in this period, thus exceeding the growth in GDP, which amounted to 31%. An important cause is the penetration of electrical appliances. In the Netherlands the share of electricity in the total energy demand was about 16% in 1995, which is one of the lowest shares in the European Union (EU). In the period 1985-1990 the growth of electricity use in the service sector was about 10% annually, while the last five years annual growth has been about 2.5%. Also in industry electricity use grew faster than GDP. In the residential sector electricity use was almost constant between 1985 and 1990, increasing by 1.3% annually from 1990 onwards. The share of electricity in total energy demand has increased from 13% to 16% in the last 15 years.

Energy intensity in the Netherlands is somewhat higher than the EU average, but slightly lower than the OECD average. This can be explained by the structure of the Netherlands economy, in particular the share of the basic materials processing industry. The fuel mix in the Netherlands also differs substantially when compared with other countries (*Fig. 2.7*). The share of natural gas in total end use for energy is 45%, which is an extremely high share. In the last 15 years the energy intensity has decreased steadily by 17% (RIVM, 1996a,b) and in the period 1988-1992 about 1% annually. The energy intensity in freight transport (in GJ/ton-km) remained constant since 1990.

Table 2.4 Energy use per sector in PJ (after temperature correction) for the period 1980-1995 (sources: CBS, 1980; 1985; 1990; 1994; 1995)

Target group	1980	1985	1990	1994	1995
Residentials	516	461	458	454	468
Transport	349	350	400	430	444
Agriculture and horticulture	131	102	161	175	175
Industry	985	887	1010	1002	1056
Other	233	289	304	305	311
Energy sector	348	325	350	378	381
Refineries	151	111	151	172	174
Others	8	-27	14	12	20
Total domestic consumption	2721	2498	2848	2928	3029

Fig. 2.7 Energy use per inhabitant by fuel type in the Netherlands compared with other countries (sources: IEA/OECD; World Bank).



Oil and gas production

Since 1980 natural gas production in the Netherlands has been about 80,000 mln m^3 per year, of which about half is consumed domestically. The policy of mitigating the depletion of the large Slochteren field, to extend the use of this field by adapting to variations in demand, has increased particularly the off-shore exploration and exploitation of other relatively small fields. About half the initial reserves have been used up by now, causing a drop of the gas pressure in the fields. To maintain the production rate the number of wells, pumps and compressors is steadily increasing, resulting in an energy use for fuel production of more than 1% of the total amount produced.

Electricity production

Total electricity use in the Netherlands increased by 16% in the period 1990-1995, mainly supplied by increased cogeneration. Boosted by a doubling of the installed capacity, the share of combined heat and power generation increased substantially from 1990 (*Fig. 4.1*), resulting in less fuel consumption for total power generation. Imported electricity, mainly from Germany and France, contributed about 12% to domestic demand (*Table 2.5*). In 1993 and 1994 new coal-fired power plants, one of them a 250 MW_e coal gasification demonstration plant, went into operation. The last ten years the conversion efficiency of conventional gas-fired power plants increased from 40% to 46%; the newest gas-fired STEG power plants have an efficiency of 55%. In the same period the efficiency of coal-fired plants increased from 38 to 41%. In the last decade the production of renewable energy increased substantially, resulting in a 1.6% share in the energy supply, more than half stemming from waste combustion. The installed capacity of wind power amounted to about 250 MW_e by the end of 1995.

Table 2.5 Electricity imports in the Netherlands in the period 1990-1995 (source: EnergieNed)

Electricity (in PJe)		1990	1991	1992	1993	1994	1995
Total final electricity		275.0	282.8	291.2	301.4	311.3	318.4
Netto imports of which:		33.2	33.0	31.2	37.8	38.8	42.6
. France			16.6	14.6	15.4	15.5	19.2
. Germany			16.8	16.2	18.2	20.0	20.8
. Others			-0.5	0.4	4.2	3.3	2.6
As fraction of total	(%)	12	12	11	13	12	13

Refineries

The Netherlands has six large and two smaller refineries. Four large ones are located in Rotterdam. The refineries contribute 10% to the production in Western Europe, whereas the share of the Netherlands in the consumption of oil products in Western Europe is 5% (CONCAWE, 1994). This high production level is related to the high efficiency rate relative to foreign refineries, the proximity of many petrochemical industries and the influence of the German demand. This makes Rotterdam the world's largest supplier by fuel oil bunker and Schiphol Airport Western Europe's largest supplier by jetfuel bunkers. The refineries in the Netherlands produce many relatively light oil products (LPG, naphtha, gasoline) from heavier crude oil with a sulphur content of 1.5%, whereas in other refineries in the region it is 0.9%. Between 1980 and 1990 the energy used to process a barrel of crude oil increased by 30% as a result of deeper conversion to lighter products, the use of heavier crudes and stricter legislation on the composition of the fuel (e.g. sulphur and lead content). Since 1985 the use of refinery gas by the refineries has been increased substantially.

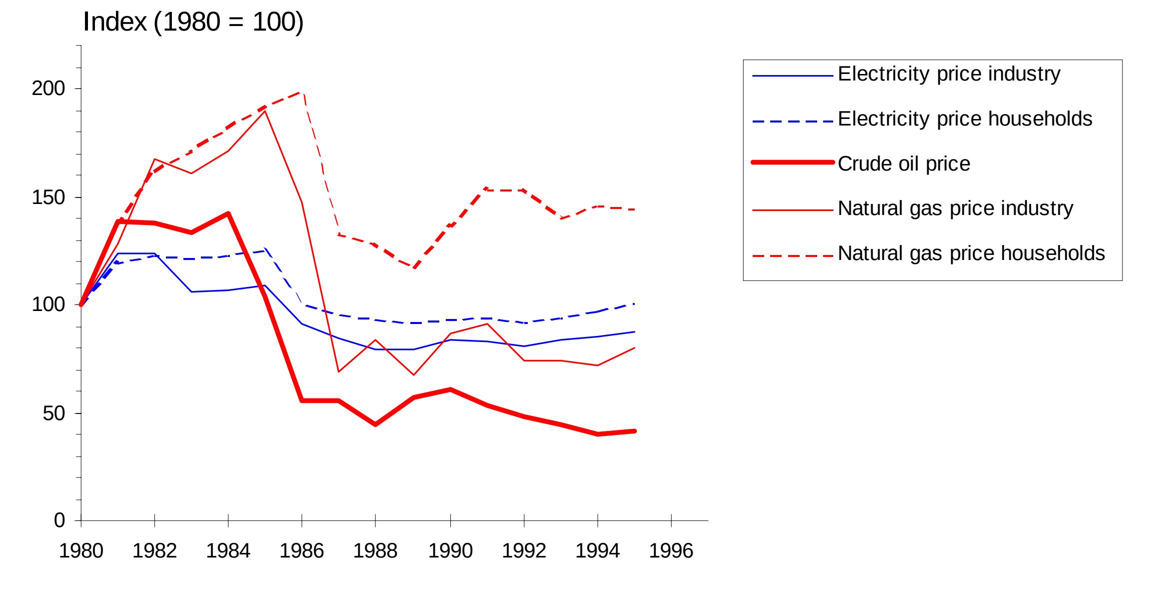
Industry

Compared to other EU countries the industrial structure of the Netherlands is relatively energy-intensive in terms of energy use per dollar production value. This is *inter alia* caused by the chemical industry which, for example, has an energy-intensity three times that of in Germany, the UK and Denmark.

Energy prices

Since the mid 1980s the price of crude oil has been relatively low compared with prices shortly after the oil crises. Crude oil prices were about 30% less in 1995 than in 1990 (when correcting for inflation) (*Fig. 2.8*). Prices for end-users did not follow this trend, as they are also influenced by other costs (e.g. refineries, power generation, distribution, and taxes and other levies). In fact, in the last five years real end-user prices remained at the same level. In comparison with other EU countries, fuel prices for large consumers do not differ much (RIVM, 1996a,b). Except for the UK, energy prices of small consumers are substantially lower in the Netherlands than in other EU countries.

Fig. 2.8 Development of energy prices in the Netherlands in the period 1980-1995 (source: ECN, 1995a).



2.6 Social profile

In public polls the concern for the environment rates almost as high as unemployment and crime (RIVM, 1996a,b). However, in recent years the interest for the environment has declined. In 1995, 60% of the population in the Netherlands was willing to pay higher prices for environmentally friendly products over 40% was willing to pay higher taxes, if necessary, for the environment and was even willing to accept a lower standard of living. In the Netherlands the financial support for NGOs concerned with the environment is greater than in most of our neighbouring countries.

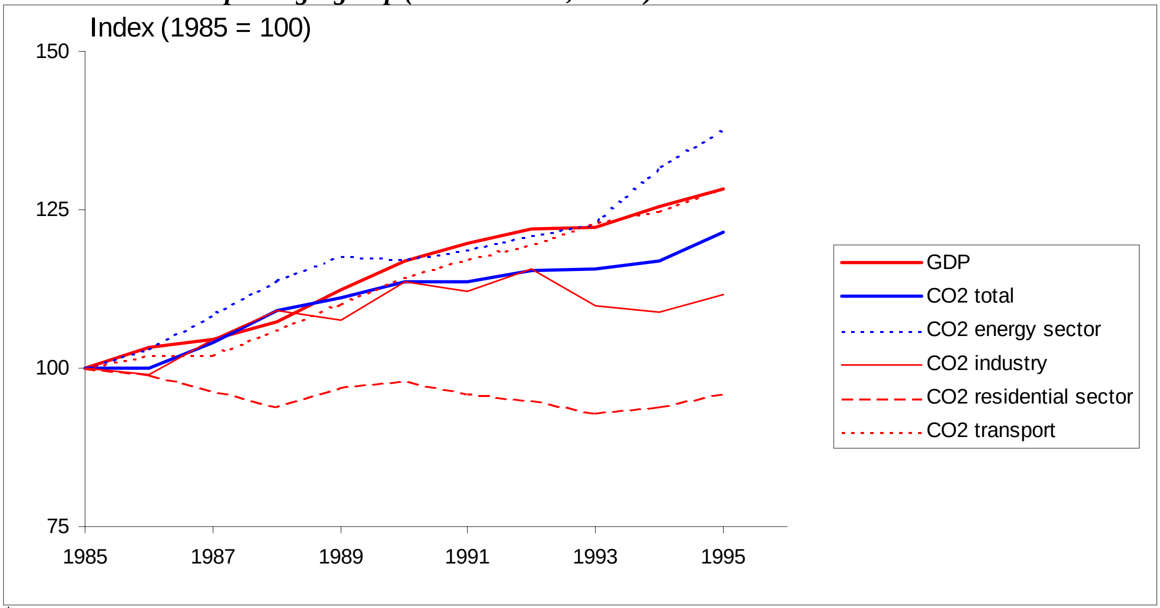
The volume and type of leisure activities only partly explain the increase in the pressure on the environment. For example, in the period 1980-1995 the total amount of time spent on leisure activities barely increased. However, the number of movements by car during leisure hours did as did the number of holidays per inhabitant.

Between 1980 and 1995 the number of vehicle-km in the Netherlands increased by 47% to almost 90,000 mln vehicle-km. In the past years various public authorities have been actively involved in drawing up plans and information campaigns to curb the use of passenger cars.

2.7 Indicators for mitigation performance

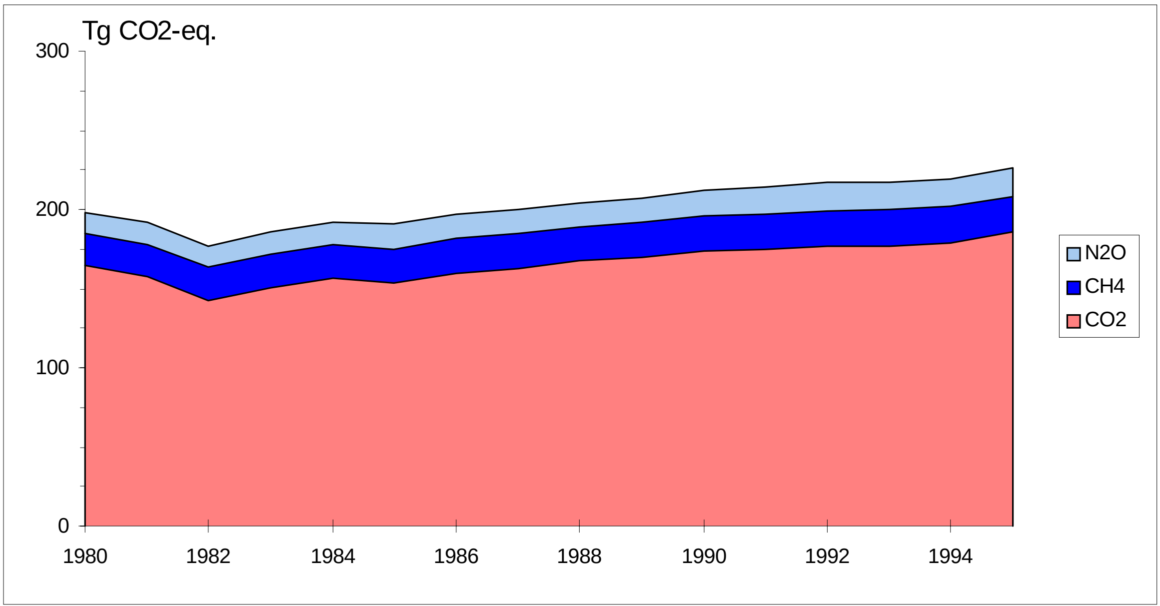
In the period 1990-1995 total temperature-corrected CO_2-equivalent emissions of CO_2, CH_4, N_2O and of HFCs, PFCs and SF_6 increased by 7.6% (uncorrected 9.6%): 4% in industry, 15% in the energy sector, 14% in the transportation sector and decreased by 9% in the residential sector (see *Fig. 2.9)*. Due to the growth in energy consumption, mainly for power generation and in the transportation sector, CO_2 emissions increased in the period from 1990 to 1995 by 6.8% (uncorrected 9.4%). Since 1990, methane emissions first increased by 3% in 1991 and in subsequent years decreased to a level, in 1995, just below the 1990 level. Primarily responsible for this trend was a decrease in agricultural emissions, having a share of 46% in the total 1995 emissions. Waste management and the energy sector contribute 35% and 16% to 1995 emissions of methane. The N_2O emissions increased by 13% in the same period, mainly due to increasing emissions from agriculture and the transportation sector. In the period 1990-1995 CO_2-equivalent emissions of CO_2, CH_4 and N_2O have increased by 6.2% (uncorrected 8.3%), mainly due to a growth in CO_2 emissions (*Fig.2.10*). In the Netherlands, CO_2 contributes about 78% to total CO_2-equivalent emissions, with CH_4 and N_2O contributing 10% and 8%, respectively, using 100-year *Global Warming Potentials* (GWP). Although total energy use includes a relatively high share of natural gas and a low share of coal, the energy-related CO_2 emissions per inhabitant in the Netherlands is similar to that of Germany and Denmark. The average for the 15 EU-countries is about 25% lower; however, the Netherlands' emissions per person are slightly below the OECD average. In the Netherlands the emissions of CO_2 per capita increased in the period 1990-1995 by 3.2% from 11,700 kg/cap in 1990 to 12,100 kg/cap in 1995 (uncorrected increasing by 5.7% from 11,300 kg/cap in 1990 to 11,900 kg/cap in 1995).

Fig. 2.9 Development of GDP and CO_2 emissions (temperature corrected) in the Netherlands in the period 1980-1995: total and per target group (source: RIVM, 1996b).*



* *Fluctuations in uncorrected figures would partially mask trends in emissions.*

Fig. 2.10 Development of the direct greenhouse gas emissions CO_2, CH_4 and N_2O in the Netherlands in the period 1980-1995 for GWP-100 and temperature corrected CO_2 (source: RIVM, 1996b) *



* *Fluctuations in uncorrected figures would partially mask trends in emissions.*

2.8 Governmental procedures in policy-making and legislative processes

The Netherlands is a constitutional monarchy. The legislative powers are vested in the national government, the 12 provinces and the 625 municipalities (in 1996) (responsible, for instance, for granting licences and permits). The Netherlands Parliament or 'States General' consist of a First Chamber (75 members, chosen by the Provinces) and a Second Chamber (150 members, chosen directly by the citizens). The legislative process realised in a combined effort of Government and Parliament. Bills, draft decrees and draft Orders in Council are first submitted to the Council of State. Legislation comes into force when published in The Bulletin of Acts ('Het Staatsblad') or the Government Gazette ('Staatscourant'). Policies can also be formulated in memoranda to Parliament. Commitments in these documents are politically binding and can be elaborated by legislation e.g. a decree or Order in Council or other binding agreements e.g. Long-Term Agreements.

At the moment the Government consists of 14 ministers including the Prime Minister. The Minister for Housing, Spatial Planning and the Environment is primarily responsible for the environmental legislation and policy development. Other ministers are responsible for integrating environmental policy targets and endorsing the *NEPP* within their respective fields. Many actors are involved in the policy-making process, e.g. economic sectors of, consumers, advisory councils, research institutes, environmental protection organisations, and various trade unions and federations.

The formulation of policy, followed by concrete measures, and finally implementation, are developed in conjunction with the relevant 'target groups'. Measures taken can vary, one example being a voluntary agreement between the Government and target groups. Communication between these two is given priority. In the Netherlands, environmental protection organisations also play an important role, for example, by participation in advisory councils.

The *Environmental Protection Act* (EPA) of 1 March 1993 stipulates that the Government is to draw up a *National Environment Policy Plan* (NEPP) every four years, as well as an annual Environment Programme. Before 1993 *NEPPs* were prepared on a voluntary basis. Government presents the *NEPP* to Parliament. If the Parliament passes the Plan, it becomes permanent; not every commitment (e.g. emission targets) in the Plan needs to be legislated.

In 1996 a special *Temporary Commission on Climatic Change* of the Second Chamber held public hearings and other investigations to review the issue of climate change (Second Chamber, 1996b) (see *Appendix C)..*

2.9 Summary of climate-related policies

The Netherlands climate-change policy had been already been established before the FCCC was signed in 1992. In 1989 and 1990 targets and measures were announced by the Government in the *National Environmental Policy Plan* (NEPP) (VROM, 1989), the *National Environmental Policy Plan Plus* (NEPPP) (VROM, 1990a), the *Memorandum on Energy Conservation* (MEC) (EZ, 1990) and the *Second Transport Policy Plan* (VW, 1990). In 1991 a comprehensive overview of the Netherlands' climate change policies was presented in the *Memorandum on Climate Change* (VROM, 1991). These policies were developed further and updated in the *Second National Environmental Policy Plan (NEPP 2)* (VROM, 1993), the *Second Memorandum on Energy Conservation* (SMEC) (EZ, 1993), the *Review of the Second Transport Structure Plan* (VW, 1993) and in the *Forestry Policy Plan* (LNV, 1993a). In 1995 and 1996, these policies were redefined in the *Second Netherlands Memorandum on Climate Change* (VROM, 1996c) as well as in the *Third White Paper on Energy Policy* (EZ, 1995b). In this conjunction three policy letters were sent to Parliament: the so-called *'Repair letter'* of June 1995, the *'CO_2 letter'* of September 1995 and the *CO_2 Reduction Plan* (or *'750 million letter'*) of September 1996. September 1997 a letter will be sent to Parliament to evaluate existing policies and the Netherlands contribution to the Kyoto process (3rd Conference of Parties to the FCCC). Currently, the Government is preparing the *Third National Environmental Policy Plan* (NEPP 3).

3. INVENTORIES OF ANTHROPOGENIC GREENHOUSE GAS EMISSIONS AND REMOVALS

3.1 Introduction

In this chapter we will present a summary of the Netherlands' emission inventory for the period 1990-1995. The following gases, CO_2, CH_4, N_2O, NO_x CO, NMVOC, SO_2, as well as new halocarbons such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), fluoroiodocarbons (FICs) and sulphur hexafluoride (SF_6), are included.

Emissions are reported in the legal territory of the Netherlands, including a 12-mile zone from the coastline and emissions from inland water bodies like the IJsselmeer, the estuaries and the Wadden-sea. Natural emissions are reported, but not included in the national totals, while emissions from off-shore oil and gas production at the Netherlands' part of the continental shelf are. CO_2 emissions from international aviation and sea transport are reported under bunker emissions, and not included in the national totals. Emissions from all the electricity generation in the Netherlands are accounted for, including exported electricity. Carbon embedded in imported (tropical) wood is not reported.

The methodology used for estimating emissions is based on the *IPCC Guidelines for National Greenhouse Gas Emission Inventories* (IPCC, 1995b). Differences with the default IPCC methodology are described in detail in *Appendix A.*

However, we note that recently (February 1997) a refinement of the greenhouse gas emission calculation method for CO_2, CH_4, N_2O and HFCs, PFCs and SF_6 for the Netherlands has now been decided upon. This will result in a better compliance with IPCC guidelines on estimating greenhouse gas emissions. The refined methods are described in detail in Spakman *et al.* (1997). For CO_2, the major differences compared with the presented method (also used in the first *National Communication)* are that actual emissions from feedstock use of energy carriers are lower due to new estimates of carbon storage percentages in products. Detailed emission factors for CO_2 are now used instead of three aggregate factors for coal, oil and gas. Furthermore, CO_2 emissions from energy transformation processes in coke ovens and refineries are estimated lower than with the method used in this report. For methane and nitrous oxide these methodologies are essentially the same as described in Van Amstel (1993) and Kroeze (1994). Estimation procedures for the use and emissions of halocarbons are also described in Spakman *et al.* (1996). However, a recalculation of historical emissions has not yet been carried out and thus updated, and improved emission inventory figures were not available for presentation in this *National Communication.* It is expected that the revised figures will be reported in the next submission of national inventories to the FCCC and the EU by mid-1997 (RIVM, 1997b).

We note that only for CO_2 emissions a temperature correction has been applied for fuel use in space heating, which is described in detail in *Appendix B.* To comply with IPCC guidelines, key figures are also presented without temperature correction. *Appendixes F* and *G* present Detailed Summary Reports and Standard Data Tables, respectively, compiled according to the IPCC guidelines for all gases and sectors described in this chapter. Here, more details can be found on sectors and on the calculation method.

3.2 Carbon dioxide

The most important anthropogenic source of carbon dioxide is the combustion of fossil fuels, contributing to 98% of the Netherlands' total. The largest sources of CO_2 emissions in the Netherlands are the energy transformation sector (60 Mton, including refineries), industrial (48 Mton, of which 14 Mton are from feedstocks), transport (30 Mton) and residential sectors (20 Mton). Other anthropogenic sources of carbon dioxide are industrial processes with the addition of lime (cement, steel, ceramics, glass, flue gas desulphurisation) and waste incineration, which account for less than 2% of the total carbon dioxide emissions.

Trends in emissions

A breakdown of total Netherlands' dioxide emissions and removals per sector is provided for 1990-1995 in *Table 3.1*. Carbon dioxide emissions have constantly increased since the economic crisis in 1982-1983. Between 1990 and 1995 temperature-corrected carbon dioxide emissions increased by 9.4% (corrected 6.8%). The most important sectors responsible for this growth were the energy and transformation sector (+16%), the transport sector (+12%) and the residential and agricultural sectors (+8%). This last figure is partly due to increased capacity in cogeneration of which the emissions here are reported in the sector where the facilities are located.

Table 3.1 Carbon dioxide emissions and removals [in Mton] per IPCC sector 1990-1995

IPCC sector	1990	1991	1992	1993	1994	1995*
1. All energy combustion and fugitive emissions	**164.8**	**171.2**	**169.3**	**173.1**	**172.2**	**180.4**
1A. Fuel combustion total	164.8	171.2	169.3	173.1	172.2	180.4
1A1 Energy and transformation	51.5	52.9	53.2	54.6	57.6	59.7
1A2a Industry: combustion	33.5	32.4	34.4	34.2	31.9	33.5
1A2b Industry: actual from feedstocks	14.8	15.6	14.9	12.7	14.3	14.0
1A3 Transport	26.8	26.9	28.0	28.5	29.0	30.1
1A4a Commercial/Institutional	10.6	12.3	11.5	12.3	10.9	11.3
1A4b Residential	19.2	21.7	19.5	20.6	19.6	20.7
1A4c Agriculture/Forestry	7.5	8.4	8.5	8.7	8.7	9.0
1A5 Statistical differences	1.1	1.0	-0.4	1.6	0.6	2.5
(temperature correction)	(6.4)	(0.4)	(4.5)	(1.2)	(3.8)	(2.5)
2. Industrial processes	**1.9**	**1.8**	**1.8**	**1.9**	**2.0**	**2.1**
A. Iron and steel	0.7	0.7	0.7	0.8	0.8	0.8
B. Non-metallic mineral products	1.0	0.9	1.0	1.0	1.0	1.0
F. Other	0.2	0.2	0.1	0.1	0.2	0.3
5. Land-use change and forestry	**(-1.5)**	**(-1.6)**	**(-1.6)**	**(-1.6)**	**(-1.7)**	**(-1.7)**
A. Temperate forest biomass change	(-1.5	(-1.6)	(-1.6)	(-1.6)	(-1.7)	(-1.7)
6. Waste	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**	**0.9**
C. Waste incineration	0.9	0.9	0.9	0.9	0.9	0.9
Total CO_2 emissions (= 1+2+6)	**167.6**	**174.1**	**172.1**	**175.9**	**175.1**	**183.4**
Total CO_2 emissions (= 1+2+6), temp. corrected	174.0	174.5	176.6	177.1	178.9	185.9
Net CO_2 emissions (= 1+2+5+6), temp.corrected	172.5	173.0	175.1	175.5	177.2	184.2
Total CO_2 removals (= -5)	**1.5**	**1.6**	**1.6**	**1.6**	**1.7**	**1.7**

* Data for 1995 are preliminary. (Source: Spakman *et al*., 1996)

3.2.1 Energy: combustion and transformation [1A]

All carbon dioxide emissions from energy use are top-down and calculated on the basis of the Netherlands' national energy statistics, including all combustion and process emissions from the use of energy carriers as summarised in *Table 3.2*. Aggregated emission factors are used for coal, oil and gas (*Table 3.3)*. The increase of coal consumption in 1994 and 1995 is mainly due to new coal-fired power plants. Oil consumption grew rapidly because of increased road traffic and volume developments in industry and refineries. Natural gas consumption was relatively constant in the industrial sector but increased in the energy sector, mainly due to new CHP plants which are installed as joint ventures with industry, and in greenhouse horticulture. Detailed energy statistics are shown in *Appendix G*.

Table 3.2 Non-feedstock energy consumption by sectors corrected for temperature effects, excluding statistical differences 1990-1995[**]

Energy carrier	Unit	1990	1991	1992	1993	1994	1995*
Coal	[PJ]	356	328	325	327	335	367
Oil	[PJ]	654	656	691	709	721	745
Gas	[PJ]	1322	1362	1396	1384	1374	1385
Other	[PJ]	95	95	106	110	113	116
TOTAL	**[PJ]**	**2427**	**2441**	**2518**	**2530**	**2543**	**2603**

* Data for 1995 are preliminary figures. (Source: CBS).
** Fluctuations in uncorrected figures would partially mask anthropogenic trends in emissions.

Table 3.3 Emission factors for CO_2 from fossil fuel combustion

Energy carrier	Emission factor [kg/GJ]
Coal	94
Oil	73
Natural gas	56

(Source: CBS)

Temperature adjustment

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 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 outlined in *Appendix B* (Spakman *et al*., 1997). In the last five years 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.

Energy use for feedstocks/carbon storage [Industry, 1A2]

Feedstock use of energy carriers, the fourth category of energy use, only partially results in CO_2 emissions. A fraction of the energy carrier is stored in products like plastics or asphalt. These fractions are listed in *Table 3.4.* The non-stored fraction of the carbon in the energy carrier or product is oxidised, resulting in carbon dioxide emissions, either during the use of the energy carrier in the industrial process (e.g. fertiliser production), or during use of the product (e.g. solvents, lubricants), or in both (e.g. monomers). These emissions are categorised as industrial process emissions.

The actual emissions are estimated using this table and the feedstock use of fossil energy carriers according to the national energy statistics. These emissions stem mainly from the fertiliser industry and the organic chemistry sector, a sector extremely sensitive to conjunctural developments. In 1992 and 1993 the production volume dropped, but the sector recovered in 1994 and 1995. In 1994, feedstocks from coal were significantly larger than in other years, leading to about 1.3 Mton of extra feedstock emissions. In 1995, however, coal feedstocks were back to 'normal' levels. This was partly compensated by the increase of feedstock emissions in the organic chemistry sector.

Table 3.4 Emission factors for carbon dioxide from feedstock use of energy carriers

Energy carrier/product	Emission factor CO_2 [kg /GJ]	Fraction stored [%]	Emitted during production [%]	Emitted during use [%]
Coal and coke (steel industry)	*94*	0	0	100
Coal (other)	*94*	100	0	0
Natural gas (fertiliser)	*56*	0	100	0
Natural gas (other)	*56*	55	20	25
Solvents	*73*	0	0	100
Monomers	*73*	55	20	25
Lubricants	*73*	0	0	100
Bitumen	*73*	100	0	0
Petroleum cokes	*73*	0	0	100

(Source: Van Amstel *et al*., 1994)

Table 3.5 Actual carbon dioxide emissions [in Mton] from feedstock use of fossil energy 1990-1995

Energy carrier	1990	1991	1992	1993	1994	1995*
Coal	0.4	0.4	0.4	0.3	1.7	0.4
Oil products	10.0	10.5	9.7	7.7	7.7	8.6
Natural gas	4.4	4.9	4.9	4.7	4.9	5.1
CO_2 from feedstocks	**14.8**	**15.6**	**14.9**	**12.7**	**14.3**	**14.0**

* Data for 1995 are preliminary figures. (Source: CBS; Van Amstel *et al.*, 1994)

Statistical differences [Other, 1A5a]

The total national energy consumption is equal to the bottom-up total of all energy use by sectors (total energy demand) plus the so-called statistical differences, defined as energy consumption not registered within any sector. The fuel used through statistical differences is assumed to be entirely incinerated into carbon dioxide because there is no reason to assume any storage. The statistical difference between supply and demand is usually smaller than 2%. Per energy carrier, however, the difference between supply and demand may vary in both sign and size, as shown in *Table 3.6*.

Table 3.6 Carbon dioxide emissions from statistical differences 1990-1995

Energy carrier	Unit	1990	1991	1992	1993	1994	1995*
Coal	[PJ]	7	0	-4	9	-9	15
Oil	[PJ]	16	25	15	26	26	28
Gas	[PJ]	-13	-14	-20	-20	-8	-17
Total fossil fuel	[PJ]	10	11	-9	15	8	26
CO_2 from stat. differences	**[Mton]**	**1.1**	**1.0**	**-0.4**	**1.6**	**0.6**	**2.5**

* Data for 1995 are preliminary figures. (Source: CBS)

3.2.2 Industrial non-energy process emissions [2]

When using lime in high-temperature industrial processes, the carbonate is thermally destroyed and carbon dioxide including long-cycle carbon is formed. Mineral carbon dioxide emissions from limestone were estimated to be 1.9 Mton in 1990 (Van Amstel *et al*., 1994). This was calculated from a total use of 2.45 mln tonnes of lime and an emission factor of 0.8 tonne CO_2 per tonne pure lime (*Table 3.7*). The CO_2 emissions from cement production in the Netherlands are based on clinker brick production data, since this production process is responsible for the emission of CO_2 and about half of the clinker brick used for cement production in the Netherlands is imported.

Table 3.7 Carbon dioxide emissions [in Mton] from lime use

Process	1990	1991	1992	1993	1994	1995*
2A. Iron and steel production	0.7	0.7	0.7	0.8	0.8	0.8
2E.1 Clinker production (cement)	0.8	0.7	0.7	0.7	0.7	0.7
2E.3 Glass manufacture	0.2	0.2	0.3	0.3	0.3	0.3
2F. Flue gas desulphurization	0.2	0.2	0.1	0.1	0.2	0.3
Total CO_2	**1.9**	**1.8**	**1.8**	**1.9**	**2.0**	**2.1**

***** Data for 1995 are preliminary figures. (Source: Spakman *et al*., 1996)

3.2.3 Waste incineration [6C]

The total amount of carbon dioxide emissions from the incineration of synthetics, i.e. materials containing long-cycle (fossil) carbon, is estimated at 0.9 Mton yearly. This estimate is based on an analysis of waste streams in the Netherlands and the amount of fossil carbon in these waste streams for

1990 (De Jager and Blok, 1993). In this report it was assumed that 4313 kton of waste was incinerated with 888 kton of carbon content, of which 27% (= 240 kton) was of fossil origin, resulting in 880 kton (0.9 Mton) 'fossil' carbon dioxide emissions. The 0.9 Mton can be expected to be relatively stable and will be used until new data become available.

3.2.4 CO_2 removal forestry and other [5A2, 5A5]

In the Netherlands, the carbon sink in biomass mainly refers to the net growth of forests and other trees. The trend in CO_2 removal by sequestration of carbon in biomass in the Netherlands is presented in *Table 3.8*. For 1994 and 1995, the carbon sink was estimated to be equivalent to 1.7 Mton CO_2., based on data provided by the Foundation Forest and Wood (1995) and from the Ministry of Agriculture, Nature Management and Fisheries.

On average, trees in the Netherlands are growing older and heavier. Besides this forest maturation, the total forest area is increasing because of forest expansion. These relatively young plantations show the largest annual volume increment per acre. Because of fellings part of the volume increment of biomass is reduced. Since 1990, a slow reduction in growth rate (because forests are maturing) is slightly overcompensated by planting fast-growing species like poplar and Douglas fir. Fellings have been reduced in recent years.

Table 3.8 Carbon dioxide removal from change in biomass stock 1990-1995

	Unit	1990	1991	1992	1993	1994	1995*
Specific volume increment	[m^3/ha]	8.12	7.97	7.82	7.85	7.88	7.90
Specific fellings	[m^3/ha]	5.12	4.63	4.63	4.52	4.45	4.40
Net volume increment	[10^6 m^3]	1.58	1.76	1.68	1.75	1.81	1.84
CO_2 removal	[Mton]	**1.5**	**1.6**	**1.6**	**1.6**	**1.7**	**1.7**

* Figures for 1995 are preliminary.. (Source: Spakman *et al*., 1996)

3.2.5 Bunkers

Air and marine bunkers also contribute to the emission of anthropogenic carbon dioxide. International emissions from Netherlands' bunkers are relatively large when compared with national total carbon dioxide emissions (e.g. 24% in 1994). This is partly due to the fact that Rotterdam is the world's largest marine bunker location. Schiphol Airport is also Europe's largest air bunker location. As can be seen from *Table 3.9* air bunkers have increased over 50% since 1990, with the following emission factors applied: 77 kg/GJ for marine bunkers and 73 kg/GJ for air bunkers.

Table 3.9 Bunkers and international carbon dioxide emissions 1990-1995

Category	Unit	1990	1991	1992	1993	1994	1995*
Marine bunkers	[PJ]	466	476	478	495	474	487
Air bunkers	[PJ]	61	68	81	89	92	97
Total bunkers	[PJ]	527	544	559	584	566	584
Marine bunkers CO_2	[Mton]	35.9	36.7	36.8	38.1	36.5	37.5
Air bunkers CO_2	[Mton]	4.5	5.0	5.9	6.5	6.7	7.1
Total bunkers CO_2	[Mton]	**40.4**	**41.7**	**42.7**	**44.6**	**43.2**	**44.6**

* Data for 1995 are preliminary. (Source: CBS)

3.2.6 Uncertainties in CO_2 emissions

The uncertainty in emission estimates from fossil 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 estimated to be about 2%. The uncertainty is not well-known for other sources. However, due to the minor share of other sources, the uncertainty in the overall total will not be much larger than a few per cent.

3.3 Methane

The method for estimating methane emissions is, in general, according to IPCC (IPCC, 1995b) and has been based on Van Amstel *et al.* (1993). The largest sources of methane emissions in the Netherlands are waste in landfills (374 Gg), agriculture (ruminants 382 Gg and animal waste 101 Gg), as well as the production and transmission of oil and gas (169 Gg). A minor source is fuel combustion (31 Gg).

A breakdown of total Netherlands' methane emissions per sector is provided for 1990-1995 in *Table 3.2*. Total CH_4 emissions show a slowly decreasing trend of 4% in the last five years, with an exception for 1991 caused by an increase due to a much higher volume of gas distributed domestically than in 1990. The decrease in total emissions is caused mainly by a decrease in agricultural emissions as a result of decreasing livestock numbers, in particular of dairy and beef cattle and of energy-related emissions. More details are provided in the Standard Data Tables in *Appendix G* and in Spakman *et al*. (1996).

The uncertainty in emission estimates of CH_4 emissions from most sectors is estimated at about 25%, with an exception for the uncertainty in emissions from waste, estimated be about 30%. Thus the uncertainty in the overall total will be roughly about 25%.

Table 3.10. Methane emissions [in mln kg] per source category 1990-1995

Sector	1990	1991	1992	1993	1994	1995*
1 A. Energy: fuel combustion total	33.1	33.7	33.1	32.9	30.7	30.7
1A1. Electricity and other transformation	*0.3*	*0.4*	*0.4*	*0.4*	*0.5*	*0.4*
1A2. Industry (only energy)	*2.7*	*2.9*	*2.9*	*2.6*	*2.5*	*2.4*
1A3. Transport	*7.2*	*6.5*	*6.4*	*6.1*	*6.2*	*5.9*
1A4. Residentials, Comm./Instit., Agric.	*19.2*	*20.1*	*19.6*	*20.0*	*17.6*	*18.1*
1A5. Other	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
1A6. Biomass burned for energy	*3.7*	*3.7*	*3.8*	*3.8*	*3.9*	*3.9*
1 B. Energy: fugitive fuel emissions	178.5	186.7	162.9	157.8	169.2	170.1
2. Industrial processes	5.8	6.2	6.1	5.6	5.3	5.0
3. Solvents and other product use	0.0	0.0	0.0	0.0	0.0	0.0
4. Agriculture	505.0	517.0	505.0	497.0	482.3	475.4
5. Land-use change and forestry	0.0	0.0	0.0	0.0	0.0	0.0
6. Waste	379.4	378.0	376.0	375.0	379.1	379.5
7. Other (production of drinking water)	2.0	2.0	2.0	2.0	2.0	2.0
TOTAL	**1103.8**	**1123.6**	**1085.1**	**1070.3**	**1068.6**	**1062.7**

* Data for 1995 are preliminary figures. (Source: Spakman *et al*., 1996)

3.4 Nitrous oxide

Emissions of nitrous oxide are surrounded by large uncertainties. Therefore with increasing knowledge on the sources, revision of emission estimates for specific sectors can be expected. In the Netherlands the largest sources are: agricultural soils (27 Gg), industrial processes (18 Gg), road transport (7 Gg) and polluted surface water (4 Gg). Recent measurements at nitric acid plants show higher emission levels of N_2O (Oonk, 1997; to be published). In addition to the standard reporting categories of IPCC in the Netherlands, two other non-negligible anthropogenic sources of nitrous oxide are identified: wastewater (sewage) treatment plants and polluted surface water (Kroeze, 1994). Emissions from agricultural-waste burning and the combustion of wood and wood waste for energy purposes by industry are currently not accounted for.

A breakdown of total Netherlands' nitrous oxide emissions per sector is provided for 1990-1995 in *Table 3.3.* Total N_2O emissions show an increasing trend of 14% in the last five years. This is mainly due to the increase of 21% in emissions from agriculture and of about 50% in emissions from road transport between 1990 and 1995 as a result of a rapidly increasing penetration of catalytic converters. As mentioned in the previous section on methane emissions, livestock numbers have been decreasing in the last five years, as has the application of chemical fertilisers. However, environmental legislation prescribing direct incorporation of manure in the soil since 1991, leading to 100% direct incorporation as of 1995, resulted in the same period in a sharp increase of agricultural emissions caused by manure spreading. This side-effect of ammonia reduction policies has currently reached its maximum, future trends in agricultural emissions are expected to decrease again as a result of decreasing livestock numbers related to the *Common Agricultural Policies* of the EU. More details are provided in the Standard Data Tables in *Appendix G* and in Spakman *et al*. (1996).

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 quite large: in the order of 50 to 100%. However, some sources are not well-known or may not yet have been identified. The uncertainty in the overall total of sources included in the inventory is estimated to be roughly about 50%.

Table 3.11 Nitrous oxide emissions [in mln kg N_2O] per source category 1990-1995

Sector	1990	1991	1992	1993	1994	1995*
1A. Fuel combustion total	5.8	6.3	7.0	7.5	7.9	8.4
1A1. Electricity and other transformation	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*
1A2. Industry (only energy)	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*	*0.1*
1A3. Transport	*4.9*	*5.4*	*6.1*	*6.6*	*7.2*	*7.7*
1A4. Residentials, Comm./Instit., Agric. a)	*0.0*	*0.0*	*0.0*	*0.0*	*0.1*	*0.1*
1A5. Other	*NA*	*NA*	*NA*	*NA*	*NA*	*NA*
1A6. Biomass burned for energy	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
1B. Fugitive fuel emissions	0.0	0.0	0.0	0.0	0.0	0.0
2. Industrial processes	18.6	19.6	19.1	19.0	18.0	18.1
3. Solvents and other product use d)	0.5	0.5	0.5	0.5	0.5	0.5
4. Agriculture	22.2	22.9	26.1	26.2	26.6	26.9
5. Land use change and forestry	NE	NE	NE	NE	NE	NE
6. Waste c)	0.6	0.6	0.6	0.6	0.6	0.6
7. Other (specified) b)	3.8	3.8	3.8	3.8	3.8	3.8
TOTAL	**51.2**	**53.4**	**56.7**	**57.2**	**57.4**	**58.3**

* Data for 1995 are preliminary figures. (Source: Spakman *et al*., 1996)

Notes:

a) Data for agriculture differ from RIVM (1996a,b) due to a correction for emissions from polluted surface water [7]. In addition, the 1994 figure is 0.2 higher than in RIVM (1996a,b) due to revised manure export data.

b) Polluted surface water. These figures are included under agriculture in RIVM (1996a,b).

c) Data for waste incineration were revised after completion of RIVM (1996a,b) (updated activity levels).

d) Anaesthesia use.

e) Recent measurements indicate higher emission levels.

3.5 HFCs, PFCs, FICs and SF_6

The use in 1995 of hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), carbon tetrachloride (also known as tetrachloroethane or CTC), methyl chloroform (also known as 1,1,1 trichloroethane or MCF) and methyl bromide was reported by Netherlands' companies through a survey compiled by an independent accountant (KPMG, 1996), on commission of the Netherlands Government. In addition, Matthijsen estimated the use and emissions of HFCs, PFCs and SF_6 based on information from several sources (Matthijsen, 1995). *Table 3.12* provides an overview of the halocarbon consumption data for 1986 and for the period 1989-1995, based on the surveys mentioned above. The emission of PFCs by the aluminium industry and of SF_6 was not reported in the surveys of the CFC Commission and KPMG, but have been calculated or estimated separately. At present, it is assumed that, currently, no fluoroiodocarbons (FICs) are used in the Netherlands.

Table 3.12. The use of zero-ODP halocarbons in the Netherlands 1986-1995

Compound	Consumption [ton]								
	1986	1989	1990	1991	1992	1993	1994	1995*	
HFC-23	0	0	0	0	0	0	0	PM	a)
HFC-32	0	0	0	0	0	0	0	PM	a)
HFC-125	0	0	0	0	0	0	0	50	
HFC-134a	0	0	0				274	454	c)
HFC-143a	0	0	0	0	0	0	0	34	
HFC-152a	0	0	0	0	0	0	0	PM	a)
HFC-227ea	0	0	0	0	0	0	0	PM	a)
Total HFCs	**0**	**0**	**0**	**0**	**0**	**0**	**274**	**561**	f)
CF_4 emission from aluminium	346	363	310	305	272	278	300	300	
C_2F_6 emission from aluminium	35	36	31	30	27	28	30	30	
PFC use e)	21	22	22	22	22	23	23	23	b)
Total PFCs	**402**	**421**	**363**	**357**	**321**	**329**	**353**	**353**	
SF_6	**55**	**57**	**58**	**59**	**60**	**60**	**61**	**61**	e)
TOTAL HFCs, PFCs, SF_6	**457**	**478**	**421**	**416**	**381**	**389**	**688**	**975**	f)
TOTAL CO_2-eq (Gg CO_2)	**3885.5**	**4053**	**3686.4**	**3662.63**	**3438.45**	**3504.58**	**4040.1**	**4414.1**	

Source: CFC Commission, 1995; KPMG, 199); for exceptions see notes.
Notes:
* Data for 1995 are preliminary figures.
a) Amount of individual compounds is confidential: total reported use of all compounds (HFC-23, 32, 152a and 227ea) in 1995 was 23.
b) Amount of individual compounds is confidential: total reported use of all PFCs in 1995 was 23 ton. For these so-called pre-Montreal applications, we assume an annual consumption trend following industrial production for previous years (1% per year).
c) Value for 1994 taken from Matthijsen and Kroeze (1996).
d) Thus excluding PFCs emitted during primary aluminium production.
e) Values taken from Matthijsen and Kroeze (1996).
f) Totals for 1995 include the amount of 23 ton HFC mentioned under note a).

3.5.1 Consumption and emission of halocarbons

Matthijsen (1996) and Matthijsen and Kroeze (1996) have estimated the actual emissions of halocarbons in 1990, 1993 and 1994, also for both non-ODP compounds (gases with a zero *Ozone Depleting Potential*). The results of these calculations are presented in *Table 3.13* to include the emissions expressed in CO_2 equivalents using the *Global Warming Potential* (GWP) values for a time horizon of 100 years according to the latest estimates of the IPCC (1996a). We stress that for 1995 no estimate was made for emissions related to the production and handling of HFCs and HCFCs, whereas in the 1993 and 1994 data most estimated emissions of HFCs stem from these activities. In 1994, 60% of the CO_2-eq. emissions from non-ODP halocarbons stemmed from HFC-23 and about 20% from aluminium production, whereas SF_6 emissions contributed about 15%. The emissions from aluminium production, however, are very uncertain.

Table 3.13. Calculated and estimated actual emission of halocarbons in the Netherlands including process emissions 1990-1995 (according to the AFEAS method as adapted by Kroeze)

Compound	GWP g)	Emission [ton]					Emission [mln kg CO_2-eq.]				
	[100 year]	1990	1993	1994	1995*		1990	1993	1994	1995*	
HFC-23	11700	410	423	536	649	e) b)	4797	4949	6271	7593	b)
HFC-32	650	0	0	1	PM	a) b)	0	0	1	0	b)
HFC-125	2800	20	7	20	50	a)	56	20	56	140	
HFC-134a	1300	30	12	31	454	a)	39	16	40	590	
HFC-143a	3800	4	3	6	34	a)	15	11	23	129	
HFC-152a	140	25	29	24	PM	a) b)	4	4	3	0	b)
HFC-227ea	2900	0			PM	a) b)	0	0	0	0	b)
Total HFCs		**489**	**474**	**618**	**1210**	f)	**4911**	**5000**	**6394**	**8453**	f)
CF_4 emission from aluminium	6500	310	278	300	300		2010	1807	1950	1950	
C_2F_6 emission from aluminium	9200	31	28	30	30		290	258	276	276	
PFC use d)	7200 c)	22	23	23	23	a)	157	162	164	166	

Total PFCs		**363**	**329**	**353**	**353**	**2457**	**2227**	**2390**	**2392**
SF_6	23900	**58**	**58**	**61**	**61**	**1380**	**1434**	**1458**	**1458**
TOTAL HFCs, PFCs, SF_6		**921**	**863**	**1032**	**1624** f)	**8803**	**8661**	**10234**	**12302** f)

Source: Matthijsen (1995) for 1993 and 1994; consumption data for 1995 from KPMG (1996); SF_6 from Matthijsen and Kroeze (1996); emissions from aluminium production and emissions of HFC-23 in 1995 from Spakman et al., 1996. Emissions in 1990 were estimated by multiplying the emission in 1993 by the consumption ratio of 1990 over 1993, except for HFCs, which were taken from Matthijsen and Kroeze (1996).

Notes:

* Data for 1995 are preliminary figures.

a) For 1995, we assume that use = emission; use for PFC also for previous years.

b) Amount on individual compounds is confidential: total use of HFC-23, 32, 152a and 227ea amounts to 23 ton (excluding emissions as by-product of HCFC-22 production).

c) Information on individual PFCs is not available; an average GWP value of 7200 has been assumed (KPMG, 1996).

d) Excluding PFCs emitted during primary aluminium production .

e) For 1995 this is one's own estimate based on increase in previous years, which are emissions as by-product of HCFC-22 production.

f) Totals for 1995 include the amount of 23 ton HFC mentioned under note b).

3.5.2 Uncertainties in emissions

The uncertainty in actual emission estimates of HFC, PFC and SF_6 emissions 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. The uncertainty in the overall total of sources included in the inventory is estimated to be order of 50% for HFCs and SF_6 and roughly 100% for PFCs.

3.6 Indirect greenhouse gases and SO_2

In the Netherlands, NO_x and CO are predominant emissions from the transportation sector, whereas sulphur dioxide is mostly emitted by refineries, industry and mobile combustion. Non-methane hydrocarbons (NMVOC) are emitted during transport, both during combustion and by evaporation from the reservoir, e.g. when loading, but also during the diurnal ambient temperature cycle, and by industry. NMVOC is also emitted in fossil fuel production and solvent use. Main sources of SO_2 emissions in the Netherlands include public power generation, industry (including non-combustion processes) and transport. In the *State of the Environment 1995* and *1996* (RIVM, 1995a,b; 1996a,b) emissions are presented for the period 1990-1995 per target group as calculated by the RIVM's Environmental Information Accounting System (RIM^+), with data from the Emission Registration project (VROM, 1995d;1996d).

In *Tables 3.14* to *3.17* the emissions are presented per IPCC sector for the years 1990-1995 as used at RIVM (1996a,b); however, these are converted into the standard IPCC sectors. Furthermore, in transport emission the figures for air traffic include all so-called LTO emissions near airports, both for domestic and international flights (about 2 mln kg NO_x, 5 mln kg CO, 1 mln kg NMVOC and 0.2 mln kg SO_2). No attempt was made to estimate specific emissions of all domestic flights (including cruise emissions).

As a results of current policies, the total emissions of these compounds are clearly shown in the tables to be on the decrease, i.e. 10% (for NO_x) to 25% (for SO_2) in the period 1990-1995.

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 50%. For emission factors for SO_2 from fuel combustion (basically the sulphur content of the fuels) the uncertainty is estimated to be about 25%. Since the uncertainty in the activity data is very small compared to the accuracy of the emission factors, the uncertainty in the overall total of sources included in the inventory is also estimated to be about 50% for CO, NO_x and NMVOC, and about 25% for SO_2.

Table 3.14. Nitrogen oxide emissions [in mln kg] per source category 1990-1995

Sector	1990	1991	1992	1993	1994	1995*
1A. Fuel combustion total	556.6	558.7	548.7	525.3	509.7	505.5
1B. Fugitive fuel emissions	NA	NA	NA	NA	NA	NA
2. Industrial processes	12.7	12.2	11.7	11.2	10.7	10.5
3. Solvents and other product use	IE	IE	IE	IE	IE	IE
4. Agriculture	NA	NA	NA	NA	NA	NA
5. Land-use change and forestry	NE	NE	NE	NE	NE	NE
6. Waste	4.6	4.5	5.2	6.1	3.6	1.9
7. Other (specified)	NA	NA	NA	NA	NA	NA
TOTAL	**573.9**	**575.4**	**565.6**	**542.6**	**524.0**	**517.9**

Source: RIVM (1996a,b) [RIM+].
* Data for 1995 are preliminary figures.

Table 3.15. Carbon monoxide emissions [in mln kg] per source category 1990-1995

Sector	1990	1991	1992	1993	1994	1995*
1A. Fuel combustion total	940.1	877.9	836.7	805.9	787.0	760.1
1B. Fugitive fuel emissions	NA	NA	NA	NA	NA	NA
2. Industrial processes	116.1	112.3	108.6	104.8	101.0	108.0
3. Solvents and other product use a)	2.0	2.0	2.0	2.0	2.0	2.0
4. Agriculture	NA	NA	NA	NA	NA	NA
5. Land use change and forestry	NE	NE	NE	NE	NE	NE
6. Waste	2.2	2.1	2.0	2.1	4.4	3.1
7. Other (specified)	NA	NA	NA	NA	NA	NA
TOTAL	**1060.4**	**994.3**	**949.2**	**914.8**	**894.4**	**873.2**

Source: RIVM (1996a,b) [RIM+].
* Data for 1995 are preliminary figures.
a) Tobacco smoking. Data for 1990-1993 for the residential sector were corrected after completion of RIVM (1996a,b).

Table 3.16. NMVOC emissions [in mln kg] per source category 1990-1995

Sector	1990	1991	1992	1993	1994	1995*
1A. Fuel combustion total	207.5	184.9	178.2	181.3	172.9	157.9
1B. Fugitive fuel emissions	35.1	34.2	33.3	32.4	31.5	33.0
2. Industrial processes	101.5	95.7	89.8	87.0	78.1	78.1
3. Solvents and other product use	100.1	98.6	97.1	95.6	94.1	94.1
4. Agriculture	NA	NA	NA	NA	NA	NA
5. Land-use change and forestry	NE	NE	NE	NE	NE	NE
6. Waste	0.1	0.1	0.1	0.1	1.0	1.0
7. Other (specified)	NA	NA	NA	NA	NA	NA
TOTAL	**444.3**	**413.5**	**398.5**	**396.4**	**377.6**	**364.1**

Source: RIVM (1996a,b) [RIM+] ***(according to 'KWS-2000' definition).***
* Data for 1995 are preliminary figures.

Table 3.17. Sulphur dioxide emissions [in mln kg] per source category 1990-1995

Sector	1990	1991	1992	1993	1994	1995*
1A. Fuel combustion total	174.5	167.1	142.0	139.9	127.4	129.0
1B. Fugitive fuel emissions	NA	NA	NA	NA	NA	NA
2. Industrial processes	25.0	22.8	20.6	18.4	16.2	16.9
3. Solvents and other product use	IE	IE	IE	IE	IE	IE
4. Agriculture	NA	NA	NA	NA	NA	NA
5. Land use change and forestry	NE	NE	NE	NE	NE	NE
6. Waste	3.0	3.0	4.3	2.3	2.3	0.9
7. Other (specified)	NA	NA	NA	NA	NA	NA
TOTAL	**202.5**	**192.9**	**166.9**	**160.6**	**145.9**	**146.8**

Source: RIVM (1996a,b) [RIM+].
* Data for 1995 are preliminary figures.

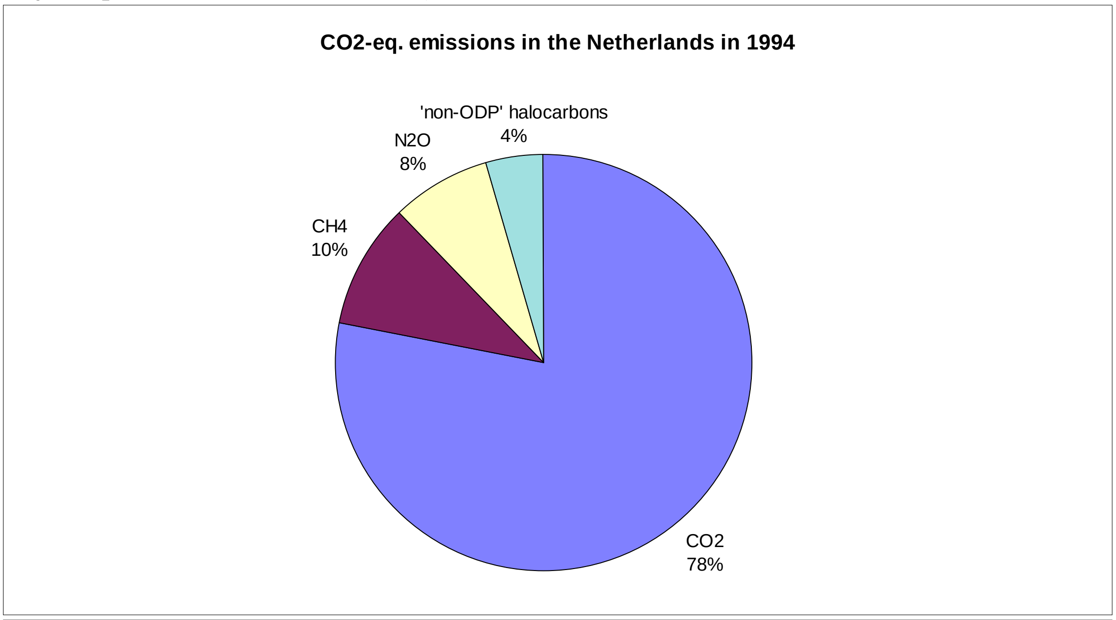
3.7 Greenhouse gas emissions in CO_2-eq.

To indicate the extent to which the emissions of various greenhouse gases contribute to total radiative forcing, we calculated the emission in CO_2 gases from anthropogenic sources in the Netherlands using the *Global Warming Potential* (GWP) values for a time horizon of 100 years taken, where reported, from the most recent IPCC assessment (IPCC, 1996a). However, it is acknowledged that Global Warming Potentials, though very useful for comparing the impact to the enhanced greenhouse effect for different compounds, have limitations. Any GWP value - except for CO_2 of course - has a limited precision, typical uncertainties found in the order of 35%. No GWPs exist for NO_x, CO and NMVOC, which contribute indirectly to the enhanced greenhouse effect as precursors of tropospheric ozone (also a greenhouse gas). This also holds for SO_2, which is now recognised to have a local cooling effect. So in the presentation in terms of CO_2-equivalent emissions only CO_2, CH_4, N_2O and HFCs, PFCs and SF_6 are represented on a CO_2 equivalent basis.

In *Table 3.18* the greenhouse gas emissions of the Netherlands from anthropogenic sources are presented in Mton CO_2-equivalent for the period 1990-1995. The contribution per compound to the CO_2-equivalent emissions in 1994 is presented in *Fig.'s 3.1* and *3.2.* Taking into account the uncertain contribution of non-CO_2 gases and the fact that the emissions of halocarbons are partly based on consumption statistics (according to the *Montreal Protocol* definition, which does not take into account import and export of halocarbon-containing equipment), we can derive the following conclusions:

- CO_2-eq. emissions of compounds covered under the UN-FCCC increased from 1990 to 1995 by 7.6%, mainly due to increasing emissions of CO_2 and of HFCs (uncorrected 9.6%);
- CO_2 emissions showed an increasing trend (+6.8% in 1995 relative to 1990; uncorrected 9.4%);
- CH_4 emissions were slowly decreasing (-4% in 1995 relative to 1990);
- N_2O emissions showed an increasing trend (+13% in 1995 relative to 1990);
- non-CO_2 gases contributed about 22% to total CO_2 equivalent emissions in 1995 (temperature-corrected), of which CH_4 contributed about 9%, N_2O about 8% and non-ODP halocarbons HFCs, PFCs and SF_6 about 5%;
- emissions of HFCs, PFCs and SF_6 increased (about +40% in 1995 relative to 1990) due to the replacement of CFCs and halons, notably by HFCs, and due to emissions of HFC-23 as a by-product of HCFC-22 production;
- emissions of the ozone precursors NO_x, CO and NMVOC were all decreasing (-10 to -18% in 1995 relative to 1990);
- SO_2 emissions substantially decreased by 28% since 1990.

Figure 3.1 Greenhouse gas emissions [in CO_2-eq.] in the Netherlands per compound in 1994 (direct effects only, temperature corrected, GWP-100).



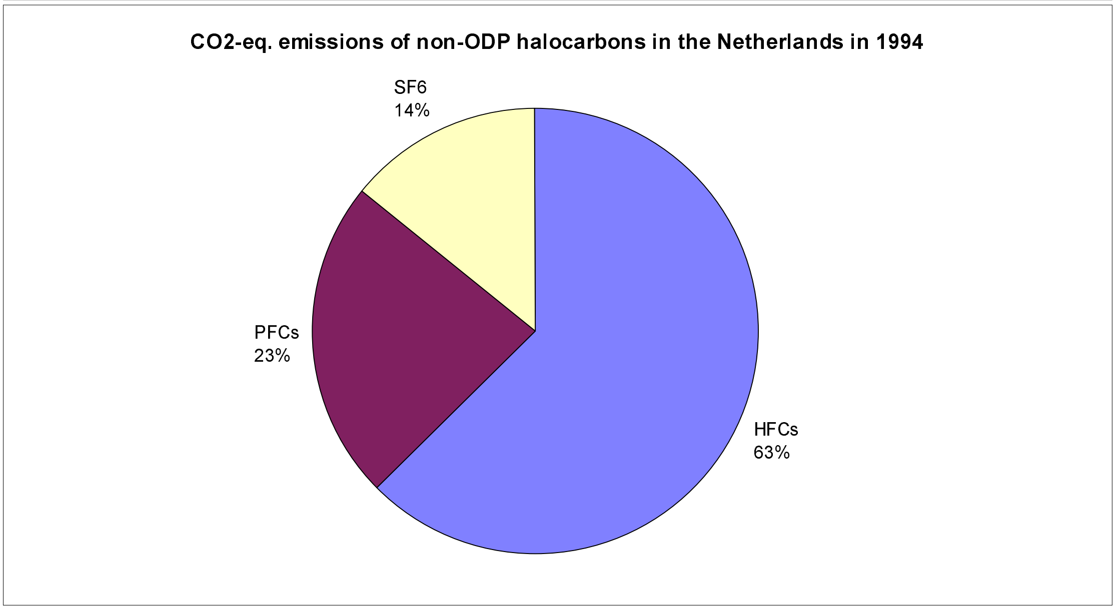


Table 3.18. Contribution of different compounds [in mln kg CO_2-eq.] to anthropogenic greenhouse-gas emissions 1990-1995 (halocarbons according to the Montreal Protocol and direct effects only)***

Compound	GWP [100]	CO_2-eq. emission [Tg CO_2] 1990**	1991	1992	1993	1994	1995*	Index [1990=100] '90	'91	'92	'93	'94	'95*
A. Gases covered under the FCCC													
CO_2***	1	174.0	174.5	176.6	177.1	178.9	185.9	100	100	101	102	103	107
CH_4	21	23.2	23.6	22.8	22.5	22.4	22.3	100	102	98	97	97	96
N_2O	310	15.9	16.6	17.7	17.9	17.8	18.1	100	104	111	112	111	113
TOTAL CO_2-EQ. EMISSIONS		**213.1**	**214.6**	**217.1**	**217.4**	**219.1**	**226.3**	**100**	**101**	**102**	**102**	**103**	**106**
HFCs a)	NA	*4.9*			5.0	6.4	8.5	*100*			102	130	172
PFCs	NA	*2.4*			2.2	2.3	2.4	*100*			91	97	97
FICs	NA	*0.0*			0.0	0.0	0.0	*0*			0	0	0
SF_6	23900	*1.4*			1.4	1.5	1.5	*100*			104	106	106
Total 'non-ODP' halocarbons		***8.7***			**8.6**	**10.2**	**12.3**	***100***			**99**	**117**	**141**
Total CO_2-eq., incl halocarbons		***221.8***			**226.0**	**229.2**	**238.6**	***100***			**102**	**103**	**108**
B. Ozone precursors		**Emission [mln kg]**											
NO_x b)	NA	574.0	575.2	565.5	542.7	524.0	517.9	100	100	99	95	91	90
CO	NA	1060.4	963.6	949.2	914.8	894.4	873.2	100	91	90	86	84	82
NMVOC c)	NA	444.2	413.5	398.5	396.4	377.6	364.1	100	93	90	89	85	82
C. Other gases affecting climate													
SO_2	NA	202.5	192.9	166.8	160.9	145.8	146.8	100	95	82	79	72	72

Notes:

* Data for 1995 are preliminary figures.

** Emissions of halocarbons in 1990 were estimated by multiplying the emission in 1993 by the consumption ratio of 1990 over 1993.

*** Temperature corrected.
Fluctuations in uncorrected figures would partially mask anthropogenic trends in emissions.

a) HFC in 1990 and 1995 include an estimate for HFC-23 as by-product emission based on extrapolation of 1993 and 1994 data. Data for 1995 cannot be compared well with 1993 and 1994 data, as they are estimated differently by different sources.

b) As for NO_2.

c) NMVOC emissions reported here are emissions of NMVOC according to the so-called 'KWS-2000' definition: total NMVOC minus CTC, MCF and CFC-11; and other CFCs, which are only partially (0.346) included.

In *Table 3.19* and *Figure 3.2* the development of the share from IPCC sectors in CO_2-equivalent emissions is presented for the period 1990-1995. This figure shows the large contribution of the Industry sector and of the Energy Production and Transformation sector in all years. In the period 1990-1995 total CO_2-eq. emissions of compounds covered under the UN-FCCC increased by about 8% (also 6% when excluding halocarbons). In this period, Energy Production and Transformation and Transport emissions increased by about 15%, mainly due to increasing CO_2 emissions. However emissions from industry remained at about the same level, although there was a sharp increase of emissions of non-ODP halocarbons, in particular of HFCs. As a result of large initial shares and highest growth rates, the shares from the Energy Production and Transformation and Transport sectors in the national total increased over the last years to 26% and 15% in 1995, respectively, while the shares from the Industry and Agricultural sectors remained almost constant at 29 and 12%, respectively. More information on the causes of these trends and comparisons with emissions and trends in the neighbouring countries can be found in the annual *State of the Environment 1996* (RIVM, 1996a,b).

Table 3.19. CO_2-eq. emissions per sector: trends for 1990-1995 and shares in 1990 and 1995**

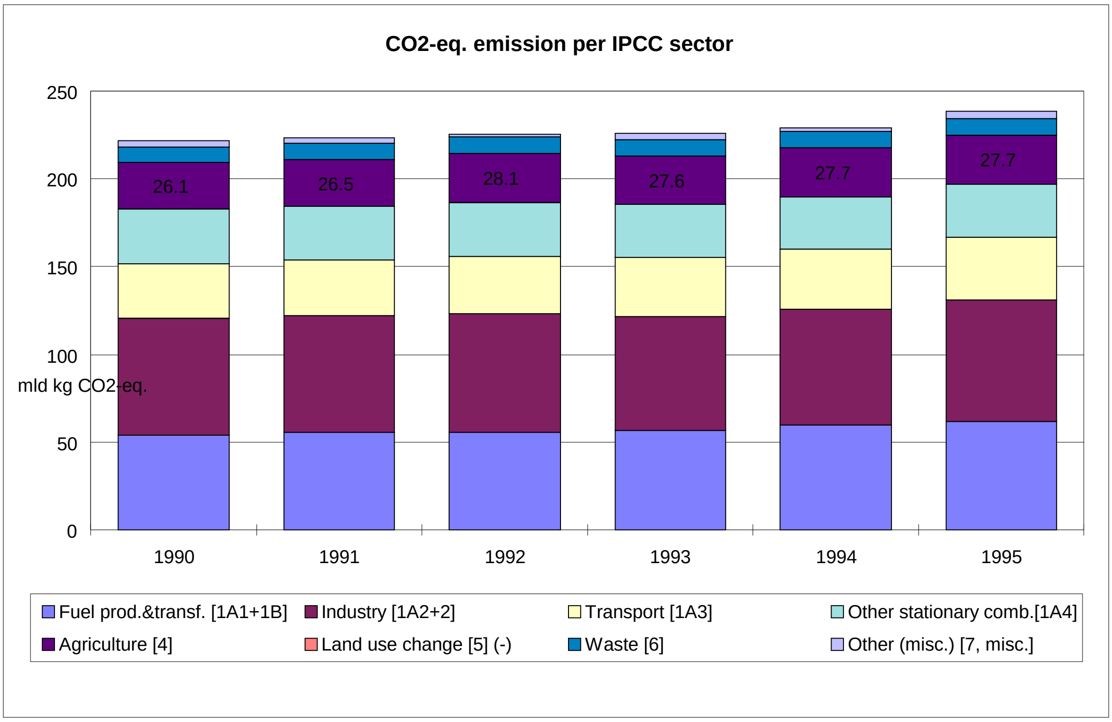
	Index 1990-1995 (1990=100)						**Share in total (%)**	
IPCC sector(s)	**1990**	**1991**	**1992**	**1993**	**1994**	**1995***	***1990***	***1995****
Fuel Production & Transform. [1A1+1B]	100	103	103	105	111	115	*24*	*26*
Industry [1A2+2]	100	99	102	97	99	104	*30*	*29*
Transport [1A3]	100	103	105	109	111	114	*14*	*15*
Other stationary combustion [1A4]	100	98	98	97	95	98	*14*	*13*
Agriculture [4]	100	101	108	106	106	106	*12*	*12*
Land use change [5] (-)	NA	NA	NA	NA	NA	NA	*NA*	*NA*
Waste [6]	100	100	99	99	99	100	*4*	*4*
Other (misc.) [7, misc.]	100	94	48	106	76	135	*1*	*2*
TOTAL	**100**	**101**	**102**	**102**	**103**	**108**	***100***	***100***

Note: Industry includes estimates for non-ODP halocarbons compare to: AFEAS/Kroeze and Montreal Protocol.

* Data for 1995 are preliminary

** Fluctuations in uncorrected figures would partially mask anthropogenic trends in emissions.

Figure 3.2 Greenhouse gas emissions [in Mton CO_2-eq.] per source category 1990-1995 (direct effects only, temperature corrected, GWP-100)*



Notes:

- Industry includes estimates for non-ODP halocarbons compare to: AFEAS/Kroeze and Montreal Protocol. (-):Not Applicable (small and negative);
- 'Other' consists of the sectors construction, drinking water, indirect/other, and waste water treatment.

***** Fluctuations in uncorrected figures would partially mask anthropogenic trends in emissions

4. POLICIES AND MEASURES

4.1 Introduction

This chapter provides an overview of climate-change related policies and measures for the period 1990-2020, with a focus on 1990-2000. In general, a distinction is made between the period 1990-2000, for which policies and measures have been defined in more detail, and the period 2000-2020, for which work is as yet scant. However, no detailed information on policy implementation can be provided yet. First, the overall policy context will be presented in Section 4.2. Next, in Section 4.3, policy and measures on climate change are summarised per greenhouse gas, including targets. Subsequently, the reduction strategies per gas are presented for the period 1990-2020 in Section 4.4, including existing sectoral and cross-sectoral measures and a brief discussion in paragraph 4.1.1.2 of fiscal incentives and the budget available for the implementation of the policies.

4.2 Overall policy context

The Netherlands' climate policy is to a large extent a combination of different policy areas. It coordinates and reinforces policies already in place. Thus climate policy is basically the sum of a large number of policy areas, however, integrated into policy documents overviewing the total impact on climate-change issues (e.g. the *NEPPs* - see below). Climate objectives have also been integrated into the sectoral policies, addressing other environmental objectives as well. The policy areas most relevant to the Netherlands' climate policy include energy, transport, agriculture and waste. Environmental policies, including climate policies, in the Netherlands are constantly being reviewed and assessed by closely monitoring progress towards targets (see *Box 4.1*). Part of the national planning process involves a periodic update of policies and measures on the basis of monitoring and evaluation procedures based on an integral approach (e.g. annual *Environmental Balance* and regular *National Environmental Outlooks*, see *Box 4.2)*.

A summary of recently published and forthcoming documents describing policies that affect climate change or provide background information is presented in *Box 4.2*. Key documents for climate-change policy are the *National Environmental Policy Plan 2* (NEPP 2) of 1993, the '*CO_2 letter'* from the Government to Parliament (1995), the *Third White Paper on Energy Policy* (1995), the *Second Memorandum on Climate Change* (1996), and the CO_2 *Reduction Plan* or '*750 million letter*' from the Government to Parliament (1996).

Box 4.1 Target groups, intermediary organisations, Long-Term Agreements and monitoring

The Netherlands uses a '*target group* approach', i.e. policy instruments and related measures usually address specific sectors in society. *Intermediary organisations* (e.g. relevant sector organisations) play an important role in the execution of supporting programmes such as Long-Term Agreements (LTAs). These organisations often act as intermediaries between the Government and the target groups. Their role often also includes monitoring of the progress made in specific policy areas.

Long-Term Agreements (LTAs) are signed by the sectoral association, individual firms and the Minister of Economic Affairs and include the follow subjects: objective, energy conservation strategy, the Ministry's role, energy-saving plans for individual firms, monitoring energy-efficiency, and duration of the agreement. LTA targets are always defined in terms of energy efficiency.

Monitoring is an integral part of all policy implementation activities. For example, in the LTAs an annual monitoring system on energy is included on the basis of an annual report of individual members of the sector. Aggregated reports are submitted to NOVEM as operating agent and quantified in an energy-efficiency index for the sector. After a few years the parties evaluate the achievements made to date and review the effectiveness of the agreement.

NOVEM, an agency executing *various energy-related programmes* on behalf of the Ministry of Economic Affairs aimed at the development of energy technology and the realisation of energy conservation, is also involved in establishing, implementing and monitoring LTAs.

Box 4.2 Overview of recent policy-related documents

EZ, 1993	Second Memorandum on Energy Conservation (SMEC) *
LNV, 1993	Memorandum on Third-Phase Manure and Ammonia Policy
RIVM, 1993a	National Environmental Outlook 3, 1990-2015 (NEO 3) [MV 3]*
RIVM, 1993b	Environmental Benefits of NEPP 2 [Milieurendement van het NMP-2]
VROM, 1993	National Environmental Policy Plan 2 (NEPP 2) [NMP-2] *
VW, 1993	Review of the Second Transport Structure Plan [SVV-2] (condensed version)
Government, 1994	Netherlands National Communication on Climate Change Policies *
EZ, 1995a	‘Repair letter’ to the Parliament sent by the Government
EZ, 1995b	Third White Paper on Energy Policy [Derde Energienota] *
FIN, 1995	Act on Regulating Energy Taxes [WREB]
LNV, 1995a	Integral Paper on Manure and Ammonia Policy
LNV, 1995b	Regional Scheme for Green Areas [Structuurschema Groene Ruimte, SGR]
RIVM, 1995a,b	Environmental Balance 1995 [Milieubalans 1995] (plus background document)
VROM, 1995a	‘CO_2 letter’ sent from the Government to Parliament *
VROM, 1995b	Plan of Action on Sustainable Construction [PvA Duurzaam Bouwen]
VROM, 1995c	Memorandum on Joint Implementation *
VROM, 1995f	Policy Paper on Air Pollution and Aviation [LULU]*
ECN, 1996	The ECN Contribution to the Third White Paper on Energy Policies: Extended description of the energy sketches for 2020.
EZ, 1996	CO_2 Reduction Plan or ‘750 million letter’ sent from the Government to Parliament, September 1996 *
RIVM, 1996a,b	Environmental Balance 1996 [Milieubalans 1996] (plus background document)
2nd Chamber, 1996a	Report of the Parliamentary Enquiry Commission on Climatic Change
VROM, 1996a	Memorandum with Outline of Second Memorandum on Climate Change
VROM, 1996b	Memorandum on Vehicle Technology and Fuels: Perspectives for the Environment
VROM, 1996c	Second Memorandum on Climate Change *
VW, 1996a	Freight Transport in Balance
VW, 1996b	Working Together on Accessibility
EZ, 1997b	Renewable Energy Action Plan [PvA Duurzame Energie in Opmars]
RIVM, 1997a	National Environmental Outlook 3, 1995-2020 (NEO 3) [MV 4] *(forthcoming)*
VROM, 1997	National Environmental Policy Plan 3 (NEPP 3) [NMP-3] *(forthcoming)*
VW, 1997	Environmental Policy Plan for Shipping 2 *[forthcoming]*

* English version available.

Depending on the developments surrounding the international decision-making process and the growing knowledge on the climate issue, the policy intentions for the period following the year 2000 will be brought into an international context. *NEPP 3* will explore this further.

In 1996 a special *Temporary Commission on Climatic Change* of the Second Chamber of Parliament held public hearings and made other investigations to review the issue of climate change, resulting in a report to the Second Chamber of Parliament (Second Chamber, 1996a). The main findings of this Commission are summarised in *Appendix C.*

4.3 Climate change policy

4.3.1 Policies for 1990-2000

With respect to greenhouse gas emissions, targets have been set for the Netherlands, which are summarised in *Box 4.3*. Originally the CO_2 target was defined as a 3% reduction by the year 2000 with respect to the 1989/1990 level (182 Mton CO_2), or a 5% reduction if the international position and circumstances warranted this (see *NEPP 2*). This level was calculated on the basis of a method that assumed that all fossil fuel consumption, including the use of fossil fuel as raw material (e.g. in the manufacture of plastics) would lead to CO_2 emissions (the 'gross NEPP method').

The CO_2 target was reformulated in September 1995 as a result of the application of a new approach, the internationally accepted IPCC method. The IPCC method gives a better impression of actual CO_2 emission. Here, the carbon content of plastics produced in the Netherlands is not considered, but rather the CO_2 released with the incineration of plastic waste in the Netherlands. In addition, the method also includes other emission sources in addition to fossil fuels. Furthermore, the year of reference chosen was 1990 to concur with the system applied as part of the FCCC and the EU objectives for CO_2. Based on the IPCC method, the CO_2 emission level in 2000 is aimed at 168 Mton.

A package of supplementary measures, based on a publication in spring 1995 by the institutes RIVM, CPB and ECN, was announced in the *'CO_2 letter'* of September 1995 concerning the CO_2 target. The 1995 publication gave the results of calculations which demonstrated a development in CO_2 emissions that does not meet the nationally formulated objectives in *NEPP 2*, i.e. a 3% to 5% reduction in CO_2 in 2000 with respect to 1989/1990. On the basis of two economic scenarios and the effectiveness of current and envisaged policy, as estimated by the Government departments, the Government has determined that the calculated exceedance of the CO_2 emissions in the year 2000 will amount between 2 and 10 Mton. For the other greenhouse gases methane and nitrous oxide a positive balance of 3 Mton CO_2-eq. in 2000 is anticipated. Therefore in the *'CO_2 letter'* the Government has announced that an additional package of measures will be put into operation, with an effect of 2.9 Mton CO_2-eq. (as well as one methane reduction measure). According to the Government, this would keep the 3% reduction target for CO_2 within reach. In view of the efforts required to keep the 3% reduction within reach, the Government has concluded that a decision to intensify the CO_2 reduction target for the year 2000 - from 3% to 5% - would not be realistic. Emission figures for 1995 showed again an increase of CO_2 emissions. In order to curb this trend additional policy was announced in September 1996 (*'CO_2 Reduction Plan'*). At present, the Netherlands is in the proces of preparing a new *National Environmental Outlook* to 2020 and a new NEPP.

Box 4.3 Targets for greenhouse-gas emissions

Gas	Base year	Emission base year	Objective	Objective year	Emission objective	Policy and measures
CO_2 [1])	1990	173 Mton	-3%	2000	168 Mton	[1]
CH_4	1990	1067 kton	-10%	2000	970 kton	[2]
N_2O	1990	59.6 kton	0%	2000	59.6 kton	[3]
HFCs/PFCs	1990	8.5 Mton CO_2-eq.	-	-	-	[4]
NO_x	1988	548 kton	-55%	2000	238-243 kton	[5]
NMVOC	1988	520 kton	-60%	2000	193 kton	[6]
CO	1990	1030 kton	-50%	2000	502 kton	[7]

[1]) Temperature-corrected values (uncorrected values are about 6 Mton lower); rounded net values including removals.

Notes:
[1] CO_2 measures include energy efficiency, renewables, 'fuel switch', mobility, waste policy and use of waste heat.
[2] CH_4 measures include recovery of landfill gas, manure policy, common European agricultural policy, recovery during extraction/exploration of oil and gas.
[3] N_2O measures include emission requirements for acidification/manure measures.
[4] HFC/PFC measures include regulation on leakfree refrigeration equipment, recovery.
[5] NO_x measures include emission requirements for acidification abatement policy, low-NO_x burners and central heating boilers.
[6] NMVOC emission requirements of long-term voluntary agreements, NMVOC programme, cleaner engines.
[7] CO measures include emission requirements for burners and central heating systems.

Source: VROM, 1996c

With respect to the other greenhouse gases methane and nitrous oxide and the hydrofluorocarbons (including HFCs and PFCs), the following activities have been developed:

- the ‘*CO_2 letter*’ included a supplementary measure for the limitation of methane emissions in offshore natural gas production; these measures are being defined in the business environmental plans for this sector;
- for N_2O a study has been performed into the means of still achieving the 2000 target via an Action Plan. It is anticipated that N_2O emissions released with the production of nitric acid could drop with the development of an application of catalytic reduction. Consultation on this matter is in progress with the sector.
- the emission of fluorine compounds (HFCs, PFCs and SF_6) in the Netherlands has been charted (Matthijsen and Kroeze, 1996) describing a variable course of action between 1990 and 2000 (8.5 and 8.9 Mton CO_2-eq., respectively). After 1994, a drop in emissions is anticipated as a result of applying emission control facilities in the production of HCFC-22 in the Netherlands. This is in contrast to the growth in the increasing use of HFCs and PFCs to replace substances that deplete the ozone layer, which are not or will no longer be accepted in the Netherlands. This growth will continue after the year 2000 in such a way that despite reductions in other source categories, the total emissions of fluorine compounds will increase after the year 2000.

4.3.2 Policy for the years beyond 2000

With respect to the Netherlands' targets for the period after 2000 two government documents are of great importance: the *Third White Paper on Energy Policy* (1995) and the *Second Memorandum on Climate Change* (1996). These documents give a clear picture of the Netherlands' post 2000 climate change policies.

The *Third White Paper on Energy Policy* was introduced by the Government in 1995 with a view to increasing the share of renewable energy to 10% in total energy consumption and to improve energy efficiency by one-third in the year 2020 compared to 1990. As a result of these energy generation and consumption adaptations, on average stabilisation of CO_2 emissions corresponding to the year 2000 will occur in 2020. Policy designed prior to the *Third White Paper* would confine CO_2 emissions to an increase of 10% and goals set in the *Third White Paper* will result in stabilisation of CO_2 emissions. The *Third White Paper* shows the best possible commitment within the currently applicable options and preconditions to achieving the goals. The choice balances between advantageous measures, and realistic and feasible objectives. Furthermore, the potential of about half the *Third White Paper* depends to a significant extent on international (specifically EU) developments.

At present the Netherlands is preparing its position on climate-change policies after 2000, described in the *Second Memorandum on Climate Change* of June 1996. The key elements can be summarised as follows:

- the Netherlands advocates a reduction in greenhouse gas emissions of 1-2% per year for all industrialised countries collectively and for the greenhouse gases as group (multi-gas approach) after the year 2000, and is willing to take an equitable share of such a reduction agreement (to be decided in the context of negotiations). Parliament proposed a reduction of 2% per year as a starting point for negotiations;
- for the period after 2000 the Netherlands’ national policy will be to keep its CO_2 emissions at the 2000 level (which is -3% compared to the 1990 level). The feasibility of this post-2000 commitment will depend especially on realisation of adequate EU climate policies. Furthermore, feasibility depends on the extent sectoral developments in the Netherlands are in line with current prognosis on which this Netherlands' post-2000 commitment has been based. Therefore in this respect these assumptions shall be evaluated in 1997;
- with respect to other greenhouse gases the national commitment for the post 2000 period is at least to continue - using a comprehensive approach - to stabilise emissions at the level realised in 2000.

March 1997 the Council of EU Ministers of the Environment agreed ‘that the EU should propose that Annex X Parties, individually or jointly, in accordance with the Berlin Mandate, shall reduce emission levels for CO_2, CH_4 and N_2O together (weighted total, using GWP with a 100 year time horizon) by 15% by 2010 (reference year 1990).' The Council also discussed emission reduction contributions by member states individually on the basis of the outcome of the protocol negotiations. The Council concluded that current commitments for EU member states, already add up to a 10% reduction. This includes a 10% reduction of greenhouse gases by the Netherlands by 2010. This is subject to the acceptance of comparable commitments by other Annex X Parties, agreement on common and coordinated policies and measures in the Protocol under the FCCC (to be signed in Kyoto in December 1997), joint implementation among Annex X Parties and EU policies and measures.

To prepare actively for further emission reductions beyond 2000, the following exploratory activities are underway:

- *Phase 1: preparation for the international negotiations in CoP-3 in December 1997*
  In the first part of 1997, the CPB, RIVM and ECN are working on the project 'Long Term Explorations 1997', which offers mutually consistent concepts on the potential future development of the economy, use of space, energy and mobility. Within this framework, the ECN has already been asked to analyse the consequences of an ambitious, international climate policy with respect to energy. In addition, the Government will ask the cooperating institutes to offer a broader exploration of such a development, more precisely to indicate what the consequences for the Netherlands would be with the implementation of international measures in the fields mentioned to meet CO_2 objectives after 2000. The policy options in an international framework as currently proposed are also included. These also relate to a broad range of policy areas. Through these explorations the Netherlands can prepare itself thoroughly for future international agreements. The scope of these explorations, the supposed rate of reduction of greenhouse gases and the types of policy implications for the Netherlands may be adjusted during 1997, in relation to intermediate decision making in the EU on their negotiation position.
- *Phase 2 [after 1997]: preparation for post-2000 policy*
  On the basis of an evaluation of the international decisions made in 1997 regarding the further reduction in the emissions of greenhouse gases, the Government will formulate an implementation policy, including the commitment required through government instruments and the associated costs. In this phase of the explorations, emphasis will be placed on the way in which reductions can be introduced. These explorations must lead to a clear indication of the joint efforts that could be adopted by Government, industry and consumers in the Netherlands, and at what costs and under what assumptions and preconditions a reduction in emissions is feasible.

Carbon dioxide

The aim of the Netherlands' energy policy as outlined in the *Third White Paper on Energy Policy* is to achieve one-third energy-efficiency improvement in the next 25 years and a 10% share of renewables in total primary energy consumption by 2020. *Box 4.4* provides a summary of the mix of instruments assumed in the *White Paper*. In addition, *Box 4.5* shows examples of measures included in the ECN scenario sketches, prepared for the *Third White Paper*. Broadly speaking, this policy will result roughly in stabilisation at the year 2000 level. An ambitious European policy is thereby an essential precondition for this aim. Further reductions will only be possible as part of an international agreement.

Box 4.4 Instrument mix in the Third White Paper on Energy Policy

What mix of instruments is assumed in the Third White Paper on Energy Policy?

I. International policy: rules for minimum efficiency standards for apparatus/transport, technology development for renewable energy, European energy tax ($10/barrel), research programmes, recycling, material substitution, financial incentives.

II. National policy: Long-Term Agreements (LTAs), also after 2000; Action Plan for Light Industry, further development of Combined Heat and Power (CHP), recycling and reduced material consumption, multiannual programme for intersectoral new technologies (MINT), integrated life cycle management, accelerated depreciation of environmental investments (VAMIL), energy investment deductions, Environmental Action Plans (MAPs), breakthrough technologies and Energy Performance Standards (EPS). Renewables: 'green' electricity, 'green' investment, adequate payment for feedback of electricity, application of Environmental Action Plan funds, Economy/Ecology/Technology programme (EET).

Source: VROM, 1996c

Box 4.5 Examples of measures in the ECN scenario sketches for the Third White Paper on Energy Policy

- a marked increase in recycling;
- new drying processes alone will improve energy efficiency in the paper-making industry by 50%;
- offices, hospitals and schools may derive 40% of their heating needs from heat pumps (currently 0);
  while the number of households has increased by one-third, the total energy consumption in this sector has dropped by one-third (also by reducing the gas consumption of existing homes from 1800 m^3 to 1100 m^3 and new homes down to 500 m^3);
- triple glazing or high-efficiency glass (currently virtually non-existent) in one-third of all living rooms in 2020;
- energy-saving lamps at an average of ten per household (currently two applies);
- 10% of the vehicles for passenger transport will comprise the '3 litre car' (i.e. 3 litre fuel consumption per 100 km);
- 400,000 solar-powered water heaters will be used in 2010 (compared to 5000 at present);
- 300,000 ha land will be used for growing energy crops (now 0 ha), some of which will be grown in the Netherlands.

Source: VROM, 1996c

In the field of energy conservation, new initiatives will be presented and existing programmes intensified. Energy conservation policy will be formulated for different user groups: manufacturing industry and the residential, service, agriculture, and transport sectors. In the manufacturing industry, the LTAs on energy efficiency will remain the cornerstone of policy. In the case of residential sector, the principle of sustainable building will play an important role. New emphasis will be placed on energy-efficient design, appliances and infrastructure. Traffic and transport policy will rely strongly on an European approach and improved vehicle technology. In all areas, the principle of energy conservation must be integrated within the general decision-making process, such as major capital investment decisions (in manufacturing industry and housing construction), and other government policy (such as traffic and transport).

Broadly speaking, the costs of reducing energy-related CO_2 emissions by energy conservation - as outlined in the *Third White Paper* and the *Renewable Energy Action Plan* - are negative to zero, i.e. returns are larger than costs or in equilibrium. Policy is designed to induce those forms of energy-saving which are economical in themselves but will not (fully) occur if the market is left to itself. However, the limits of no-regret policies, where marginal costs are equal to marginal benefits, are close. This is not the case for the 10% renewables target. It is estimated that about half the 10% target has to be achieved by options for which costs in 2020 surpass returns. The net costs of these options are about NLG 28 per ton of CO_2.

The scope in the potential for reducing greenhouse-gas emissions is to a great extent determined by the price one is prepared to pay. The costs of emission reductions are generally expressed in terms of costs per ton of CO_2-eq. prevented and can be calculated using various methods. Two cost calculation methods offer minimum and maximum estimates of reduction costs, respectively: (1) the Method for Environmental Costing and (2) the so-called end-user approach. The first method is defined by the responsible ministries in *NEPP 2* (1993) and is used by the Netherlands' *Central Bureau for Statistics* (CBS), the *National Institute of Public Health and the Environment* (RIVM), and the *Central Planning Bureau* (CPB) to calculate the cost of environmental measures for industry in a standardised manner. These two methods are described in *Box 4.6*.

Box 4.6 Different calculation methods for the costs of emission reductions and selected results

The costs of emission reductions in terms of costs per ton of CO_2-eq. avoided can be calculated using various calculation methods that yield widely divergent results due to variations in perception depending on the principles applied: environmental, commercial, national- or micro-economic. The two methods offer minimum and a maximum estimates of reduction costs, respectively:

1) *Method for Environmental Costing.* The potential benefits to a company, e.g. through energy conservation, are based in the market prices for energy. Other assumptions include a real discount rate of 5% per year and a depreciation period of 10 years, except for constructional parts where it is 25 years.
2) *So-called End-User Approach.* This method is only applicable if the investment not only incurs costs but also offers benefits, e.g. in the case of energy conservation and renewable energy, and is based on the concept that an investor or decision-maker will spontaneously invest only if it is commercially feasible to do so.

Source: VROM, 1996c

Other greenhouse gases

With respect to other greenhouse gases the national commitment for the post 2000 period is at least to continue - using a comprehensive approach - to stabilise emissions at the level realised in 2000 (which is expected to be below 1990 levels).The Government has chosen a combined stabilisation objective for the emission of other non-CO_2 greenhouse gases at the level of emissions in the year 2000. A distinction is made between four categories of greenhouse gases:

1) gases to which the *NEPP 2* has already applied an objective for the year 2000, i.e. methane and nitrous oxide. Their contribution to the stabilisation ceiling is based on the target emissions in 2000;
2) gases whose GWP is known but for which no objective has been agreed to date, although a reasonable prognosis is given for their emissions in 2000. Their contribution to the emission stabilisation ceiling is based on the current estimates of emissions in the year 2000. This category presently includes the HFCs, PFCs and SF_6, as well as the fluorine iodine hydrocarbons, substances with a low GWP (<5) and hardly expected to be used in the Netherlands;
3) tropospheric ozone;
4) gases whose contribution to the perturbation of the radiative balance is not (yet) known.

The stabilisation objective for non-CO_2 greenhouse gases is within reach provided voluntary agreements can be made with industry on N_2O and fluorocarbons, and provided international agreements can be made concerning the restricted emission of these substances within the framework of the FCCC. If the developments do not follow these expectations, the feasibility of realising the stabilisation objective for non-CO_2 greenhouse gases will be reviewed again. If necessary, the *NEPP 3* can formulate supplementary policy to maintain the stabilisation objective. Whenever possible, this will be based on the principle of cost-effectiveness. If it appears that the HFC developments in particular can cause the overall emission ceiling to be exceeded, then international development will also be included in the consideration in this regard. Since CO_2 is subject to a separate objective, no compensation will be sought through additional CO_2 measures.

4.4 Reduction strategies

Often the impact of the measures in terms of CO_2 reduction cannot be determined on an individual basis due to interaction between different measures. An example of this effect is presented in *Box 4.7.* In this section the information available on existing measures will be presented as clearly as possible. Where possible, the objectives and progress indicators of individual measures will be presented in a tabular format.

Box 4.7 Example of interaction between policy measures and the effectiveness of instruments

Below the effectiveness of instruments in the residential sector is compared depending on the order of application (effects in PJ):

Instrument	If only this one is applied	If all are applied and this one is considered to be the last addition
- subsidy	-23	-1
- levies (WREB)	-40	-17
- technology	-59	-15
- standards (best)	-125	-100
- interest rate (0 instead of 8%)	-80	-29

This example illustrates that when different instruments interact with each other, their individual contribution to achieving a target cannot be determined without additional assumptions, e.g. regarding the order of application.

Source: ECN

4.4.1 Strategy for carbon dioxide

In 1990, the largest sources of CO_2 in the Netherlands were energy transformation (30%) and industry (29%). Transport and residential sectors contributed 16% and 13%, respectively. Since 1990, various policy measures have been implemented aiming at the target for 2000, as discussed above. Nevertheless, overall CO_2 emissions increased by 2.8% from 1990 to 1994 and preliminary figures for 1995 suggest a significant increase of 3.9% in 1995 (temperature-corrected figures). Final emission figures for 1995 and preliminary emission figures for 1996 will be published mid-1997 (RIVM, 1997c). In order to curb this trend additional policy was announced in September 1996, which is now included in the existing policies. An overview of the most important measures under current policies is presented in *Table D.1* in *Appendix D*, in which a selection of CO_2 measures (grouped per sector) is described in terms of objectives, status and progress in achieving the targets. We recall that at present 1997 the Netherlands is in the process of preparing a new *National Environmental Outlook* to 2020 (RIVM, 1997a) and a new *NEPP 3* (VROM, 1997). These documents will include the most recent insights into trends in society and the effect of current policies related to the new scenarios. As a result, there might be an update in climate policies in the near future.

4.4.1.1 Cross-sectoral strategies

Several sectors are addressed in a number of policies. These policies include increasing energy efficiency and the use of renewable energy (see also *Table D.1.a*) and are advanced on the basis of the mix of instruments used. Many of these instruments have already been described in the first *National Communication*. The main ones still include:

- standards and regulations;
- financial and fiscal incentives;
- long term (negotiated) agreements between Government and industrial and non-industrial sectors;
- the *Environmental Action Plan* [MAP] of the energy distribution companies, partly financed by a surcharge on gas and electricity prices;
- public awareness;
- research and development.

If progress with these instruments is to be made, an ambitious international, especially European, policy becomes increasingly important. The Long-Term Agreements as well as the regulatory measures will be further highlighted under the sectoral section (paragraph 4.4.1.3), while major new and intensified cross-sectoral developments are outlined in this section.

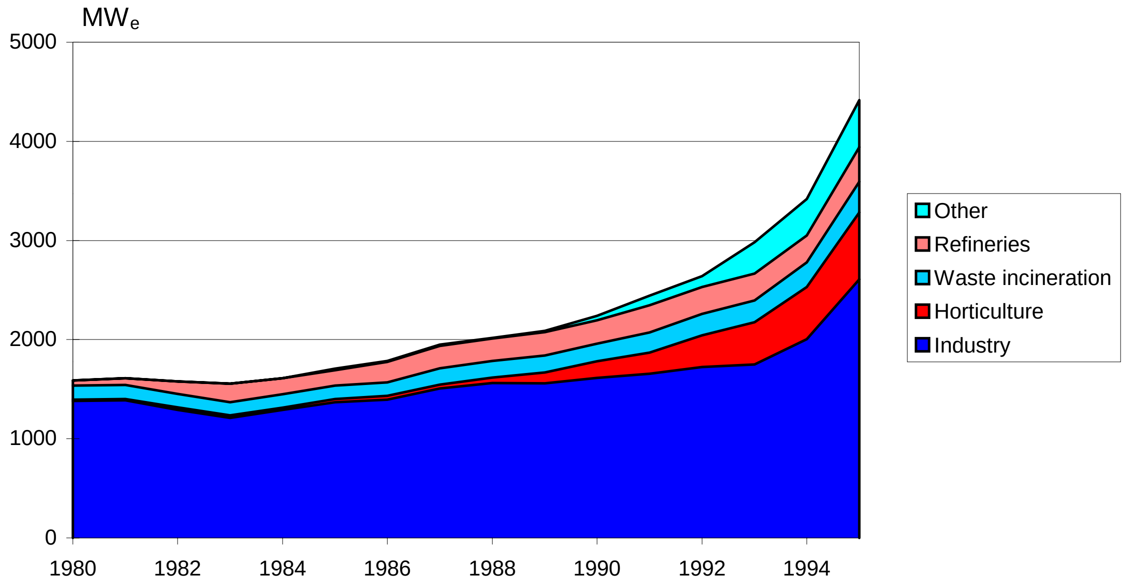


Fig. 4.1 Development of cogeneration in the period 1980-1995 (source: RIVM, 1996b).

Cogeneration

Cogeneration makes an important contribution to the energy efficiency improvement target for the year 2000. By then cogeneration will be about 8000 MW_e (40% of total capacity), which is the target for 2000 (*Fig. 4.1*). After the year 2000, cogeneration will be capable of further growth. Depending on developments in the electricity and heating market, a total cogeneration capacity of 14,000 MW_e in 2020 seems feasible. The largest autonomous growth will be in industrial cogeneration. The ambition is to construct new gas-fired electricity generating capacity, predominantly in the form of cogeneration.

Renewable energy

As long as renewable energy remains relatively expensive, stimulatory measures will be required to promote the accelerated introduction of this energy source. A number of these have already been applied (1% in 1995), but are not sufficient to achieve the 10% target in 2020. The *Renewable Energy Action Programme*, issued in March 1997 (EZ, 1997b) and consisting of the following major elements, addresses this:

- broadening the range of fiscal instruments (see fiscal incentives below), a low 6% VAT tariff on renewable-based electricity and a refund of the regulatory energy tax for renewable energy users (NLG 30 million);
- providing extra R&D budgets (raised to NLG 95 million) and participation in European research programmes;
- demonstration and market introduction projects;
- agreeing to support in the context of the *Environmental Action Plan* [MAP] of the distribution sector;
- setting up the Renewable Energy Project Bureau in 1997;
- providing adequate payments for delivery of electricity generated from renewable resources by private operators to the public sector;
- resolving bottle necks in spatial planning with local authorities.
- a mandated minimum portion of renewable energy in total electricity supply to captive consumers from 2001 onwards, on the basis of the new Electricity Law, if the above-mentioned measures do not achieve the required results.

Currently, so-called *Green Electricity* is available in the Netherlands. *Green electricity* is an initiative of the energy distribution companies designed to promote the application of renewable energy and also citizens' involvement in its further introduction. At the moment, figures for prices of *Green Electricity* and volumes produced are not available. These figures are being investigated and will be published mid 1997.

Regulatory Energy Tax

The bill introducing a regulatory energy tax was passed by Parliament in 1995. The tax applies to natural gas consumption of between 800 and 170,000 m^3 per year and electricity consumption of between 800 and 50,000 kWh per year. The tax is additional to the environmental tax on all fossil fuels. This is paid by all consumers except the greenhouse horticulture sector, which is exempted from the tax on natural gas. The tax, which took effect on 1 January 1996, will raise energy prices for small-scale consumption by 15% to 20%; it is now being implemented in three stages (see *Table 4.1*). Since the tax is intended to induce energy conservation, revenues are being recycled back into the economy through relief in other taxes. Use of renewable energy is exempted from the tax.

Table 4.1 Rates [cents/unit] of the Regulatory Energy Tax

Energy carrier	Unit	1996	1997	1998
Natural gas	m^3	3.20	6.40	9.53
Electricity	kWh	2.95	2.95	2.95
Light fuel oil	litre	2.82	5.64	8.46
Heating oil	litre	2.84	5.68	8.53
LPG	kg	3.36	6.72	10.09

Source: VROM

Note: The rates presented here exclude 17.5% VAT, which is charged on all of these products and on the levies paid on them.

CO_2 Reduction Plan

In 1996 the Government decided to allocate NLG 750 million to a *CO_2 Reduction Plan* (EZ, 1996) for three categories of projects which contribute to a structural reduction in CO_2 emissions:

1) projects intended to improve the energy infrastructure in built-up areas, regions devoted to greenhouse horticulture and large industrial sites;
2) projects aimed at development of clean energy sources; and
3) involving so-called break-through technologies.

*Box 4.*8 summarises the selection procedure for funding of new projects.

Box 4.8 Procedure and criteria for projects funded by the NLG 750 million budget provided in *the 'CO2 Reduction Plan'* (or '750 million letter') of September 1996

In September 1996 the Netherlands' Government allocated 750 million Dutch guilders to investment in the improvement of the energy structure and in a more sustainable energy supply: the *CO_2 Reduction Plan*. Through development and application of new knowledge and technology a spin-off to an improvement in the economic structure is expected. Three categories of projects have been identified:

1) Projects aiming at an improvement in the energy infrastructure in the built-up environment. in market-garden areas and on major industrial sites. Projects are clustered into: waste-heat use from industry, other collective heat systems (e.g. from generation plants), energy infrastructure in cities and generation techniques (e.g. CHP, heat pumps).
2) Projects aiming at clean and sustainable energy, biofuels and agrification, hydrogen/CO_2 technology and other kinds of (large-scale) renewable energy;
3) Projects aiming at technological breakthroughs: technological development in industry and in transportation.

Criteria for selection of projects:

- commitments of potential partners
- improvements to economic structure
- amount of CO_2 reduction and opportunities for spin-off
- cost-effectiveness
- synergy with other Government goals with respect to strengthening the economic structure.

An interministerial Steering Committee preselects the project proposals and presents its advice to the Cabinet of Ministers that takes the final decision. The projects will also be sent to the European Commission for approval. The projects will be approved in portions. In spring 1997 the first portion of proposals approved by the Cabinet covering about one-third of the total budget will be published. The two other portions of approved projects will be published later in 1997.

Fiscal incentives

Investments in both energy conservation and renewable energy are encouraged through a number of provisions in the corporate income tax. An energy investment tax credit was introduced in 1996 and free depreciation of certain kinds of energy and environment-related investments has been possible since 1991. The 'VAMIL scheme' allows the discretionary depreciation of environmentally-friendly investments included in the 'VAMIL list'. 'Green investment' is a tax concession which allows private individuals to invest in projects which foster environmental protection, including nature and woodland conservation. This scheme came into force on 1 January 1995. The following budgets are related to these instruments:

- VAMIL (energy-related part): in 1995 a budget of NLG 22 million, increasing to NLG 35 million by 2000;
- Green investments (energy-related part): in 1996 a budget of NLG 12.5 million, increasing to NLG 15 million by 2000;
- EIA (energy investment deduction): starting in 1997 with a budget of NLG 125 million.

4.4.1.2 Budgets and fiscal incentives for policy implementation

Budgets for energy conservation and renewable energy from Government and the energy distribution sector are presented in *Table 4.2*. The budget for energy conservation and renewables (NLG 330 million) applies mainly to R,D&D (see *Table 4.3*) and consists *inter alia* of 20 programme agreements with NOVEM.These programmes, budgeted up to NLG 200 million, deal with technology transfer, research, development, demonstration and market introduction, and the preparation, support and assessment of the LTAs. About NLG 30 million is used for R&D by the *Netherlands' Energy Research Foundation* (ECN). The Ministry of VROM budgets contain insulation subsidy schemes for housing. The temporary incentive, *Subsidy Scheme for Sustainable Construction,* has budgeted NGL 125 million for the period 1996-1998. About 70% of this budget (estimated to amount to about NGL 85 million) is expected to be spent on energy-saving measures. The *Subsidy Scheme* is applicable to existing dwellings. Other subsidy schemes for housing do exist, but no funds allocated to energy-saving measures are specified in these subsidies. Also other budgets are allocated to R&D programmes and investment schemes, e.g. on transportation. However, it is not possible to single out budgets related to specific greenhouse gas reduction options.

The procedure and criteria for new projects funded by the NLG 750 million budget, as announced in the *CO_2 Reduction Plan* or '*750 million letter'* of September 1996, are summarised in *Box 4.8*. Finally, to be complete, we recall that budgets for fiscal incentives are discussed in the previous section (4.4.1.1).

Table 4.2 Budgets and fiscal incentives [in mln NLG] for energy conservation and renewables

Department/sector	1996	1997
Energy conservation and renewables:		
- Ministry of Economic Affairs (EZ)	232	330
- Ministry of Environment	30	30
Fiscal incentives		
- VAMIL	30	30
- GB	12.5	15
- EIA	-	125
- REB/refund	30	30
CO_2 Reduction Plan '750 mln'	0	≅200
(to be spent within 4 years)		
Energy distribution sector [MAP]	370	270*

Source: VROM, EZ * Preliminary figure.

Table 4.3 Specification of EZ budget [in mln NLG] for energy conservation and renewables in 1997 (excluding budget for ECN)

Subprogramme	1997
Energy conservation:	
Long-term research on conservation technology	25.9
Industrial programmes	70.2
Tender(s) for energy conservation	20.0
Incentives for Energy and Environmental advice	2.0
Tenders for NEWS	8.0
Housing and services programmes	63.0
Traffic and transport programmes	8.5
Agricultural programmes	7.0
	204.5
Renewable energy:	
Solar-thermal	8.6
Solar-photovoltaic	33.1
Wind energy	16.6
Biomass and waste	15.5
Incentives for solar boilers	8.3
Heatpumps	6.0
Project Bureau on Renewable Energy	5.0
	93.1

Source: EZ.

4.4.1.3 Sectoral reduction strategies

Electric power generation [1A1]

For electricity generation the objective is an increase in the average generation efficiency from 40 to 43% in the period 1990-2000 by installing more efficient new plants and by expanding central heat distribution co-generated in electric power plants. The *Electricity Generating Board* (SEP), which is responsible for public large-scale electricity generation, takes part in the executing of so-called *Thermal Plans* aiming at large-scale utilisation of residual heat. In addition, the Government decided in 1995 that a fuel switch to 10% wood be made in two coal-fired power plants by 2000. The terms of reference for investment in coal capacity as presented in the *Second Electricity Supply Master Plan* (SEP, 1993) have not been changed. They offer scope for coal to have a one-third share in total installed capacity in the public generation sector, subject to a maximum of 6000 MW_e. Construction of new nuclear capacity is not on the short-term agenda. A 'no regret' research effort will be maintained to enable the Netherlands to 'board the train' in the 21^{st} century i.e. if they so wish.

Industry [1A2]

The current three-track approach to energy conservation in the manufacturing industry consists of:

- Long-Term Agreements (LTAs);
- a Light Manufacturing Industry Strategy for small firms where the LTA approach cannot be applied, e.g. energy standards in environmental licences;
- consolidation of the technological base, which by and large will be continued after 2000.

The Long-Term Agreements between the sector and the Government, aiming at covering 90% of the industrial energy consumption, strive for improvement in the energy efficiency of 20%. In *Box 4.9* a summary is giving of the current status of the coverage of and achievements by the LTAs in the industrial sector. In addition, the Gasunie, which is responsible for the domestic supply of natural gas, is executing an *Environmental Plan for Industry* [MPI] aiming at improved energy conservation in industry.

Energy conservation and accelerated introduction of new technologies will be further encouraged by intensified R&D and application of tax instruments. The energy savings potential of integrated (product) life-cycle management will be explored further and - where possible - exploited. Besides the desirability of national R&D encouragement, a primary need is a dynamic international strategy, e.g. at European level, designed to support these developments.

Box 4.9 Performance of Long-Term Agreements in industry, including refineries and fuel production

LTA sector	Energy use 1989 (PJ)	Target efficiency improvement (%)[1)]	Concluded
Iron and steel	61	20%	May 1992
Glass	11	20%	Jul 1992
Cement	7	20% (10% in 1995)	Jul 1992
Textiles	4	20%	Oct 1992
Sandlime brick	1	20% (10% in 1995)	Nov 1992
Paper	30	20%	May 1993
Philips	11	25%	May 1993
Margarine/fats/oils	7	22%	Jun 1993
Sugar	7	20%	Sep 1993
Meat processing	2	20%	Sep 1993
Beer	4	20% (12% in 1996)	Oct 1993
Vegetables and fruit	2	20% (10% in 1995)	Oct 1993
Non-ferrous metals	8	20%	Oct 1993
Construction ceramics	9	20%	Oct 1993
Chemicals	310	20%	Nov 1993
Fine ceramics	3	20%	Apr 1994
Coffee roasting plants	1	20%	May 1994
Industrial laundries	2	20%	Jun 1994
Dairy industry	17	20% (8% in 1996)	Jun 1994
Rubber processing	2	20%	Nov 1994
Plastics processing	7	20%	Dec 1994
Iron foundries	2	16%	Jun 1995
Refineries	153	10%	Sep 1995
Asphalt	3	20%	Nov 1995
Surface-treatment industry	3	20%	Mar 1996
Cold/deep freeze operators	2	22%	Mar 1996
Carpet industry	1	20%	Jun 1996
Oil and gas production	39	20%	Jun 1996
Potato processors	5	20%	Jun 1996
Soft-drinks industry	1	21%	Jul 1996

[1)] For 2000 relative to 1989 (between brackets target for 1995 or 1996).

Coverage: 90% of industrial energy use, involving about 1000 companies and dozens of intermediary organisations. Up to 1995 the following results were achieved:

Performance per LTA group	Number of LTAs	Energy-efficiency improvement '89-'95
Food and tobacco	6	9%
Construction materials (non-metallic)	5	10%
Ferro and non-ferro	2	10%
Chemicals	1	9%
Other industry	6	14%

Source: EZ, 1997a

Transportation sector [1A3]

The Netherlands' policy on transportation and environment is a three-track one:

1) measures addressing the sources (technical measures e.g. improving fuel-efficiency of cars)
2) policy on mobility

3) measures addressing driving behaviour.

In 1996 three policy documents *Freight Transport in Balance* (VW, 1996a*), Working Together on Accessibility* (VW, 1996b), and *Memorandum on Vehicle Technology and Fuels* (VROM, 1996b) were released. The CO_2 target for road traffic is a reduction of 10% by the year 2010 compared to 1986 levels.

Regarding policies aimed at technical measures, the Netherlands Government has only limited scope to speed up the development and introduction of more energy-efficient vehicles in the traffic and transport sectors. This is because structural technological developments are dependent on the international automobile industry, whilst the margins for national regulations are usually defined by European policy. In R&D on vehicle technology, priorities will be set in line with the robustness of the Netherlands' manufacturing industry.

With respect to mobility, one can distinguish between addressing 'demand' (influencing people/car drivers) and 'supply' (improving public transport). Various measures and programmes are carried out with the aim of reducing the number of vehicle-km travelled, with special attention being paid to car-pooling and the improvement of public transport, for instance, through measures for major improvements in the rail and bus infrastructure. In order to improve efficiency in freight transport, a joint venture has been set up with sectoral organisations with a view to reaching agreements. As for the tax instrument, proposals will be introduced for stimulating the purchase of energy-efficient passenger cars. A legislative framework agreed at the European level is required for applying regulatory measures governing CO_2 emissions. For a more detailed list of measures implemented under current policies see *Table D.1.d* in *Appendix D*.

Policies on driving behaviour include increase in fuel prices, a stricter control of speed limits, stimulation of more energy-efficient driving and purchase behaviour, and stimulation of other transport modes as alternatives for long-distance road transport (see *Table D.1.d* for a more complete list). Speed limit enforcement has achieved a 1.5% CO_2 emission reduction of total road transport. Possible measures on the optimal fuel mix (petrol, diesel, LPG) and others, including the introduction of econometers, are under review. Excise duties on motor fuels will be increased per 1 July 1997, while the fixed tax for car owners will be decreased, in particular for small - thus more energy-efficient - cars. Electrical cars are excluded from this tax on motor vehicles. Furthermore, a number of demonstration projects are being carried out, e.g. to promote cleaner, less noisy and more energy-efficient transport in urban areas.

National policy, expressed in the *Policy Paper on Air Pollution and Aviation* (LULU) (VROM, 1995f) and the *Environmental Policy Plan for Shipping 2* (VW, 1997; scheduled for July 1997), forms the basis for the Netherlands' policy on these subjects. The Netherlands is striving for the international control of aircraft emissions as a whole, and seeks an international agreement in this area between the Parties to FCCC and the Chicago Convention (ICAO). Such an agreement should at least provide for the reduction in the growth of aircraft emissions on the basis of concrete international objectives for air traffic, and provide for a methodology for calculating and allocating international aircraft emissions. In concrete terms, the Netherlands will continue to emphasise the importance of a global levy on kerosene and the discontinuance of exemptions on value-added tax for international flights. Furthermore, the Netherlands will intensify its efforts within the ICAO in order to achieve a substantial tightening of the existing NO_x standards for aero-engines and CO_2 standards for aircraft, or development of another system which will serve to reduce the growth in aircraft CO_2 emissions. In the context of cooperation between the Parties to the *Framework Convention on Climate Change* and the *International Maritime Organisation* (IMO) the Netherlands will also request attention for the reduction of greenhouse gas emissions from international shipping via performance according to convention obligations (VROM, 1996c).

Residential and service sector [1A4]

It is intended to further promote energy conservation in new homes and buildings by, for example, improving insulation standards, intensifying the Energy Performance Standard (setting limits to the allowable energy use for heating and hot water in homes and other buildings, currently 1450 m^3 per dwelling) in 1998 and 2000, demonstration projects and fiscal incentives for very energy-efficient construction. Attention will not be paid only to the individual buildings, but also to the relationship with energy infrastructure. Construction of energy-efficient residential areas in so-called VINEX locations - areas where the demand for new dwellings is to met in the short term - will be accelerated by adaptation of the *Plan of Action for Sustainable Construction* and by adapting policy regarding VINEX locations. Quality improvement in new construction invariably leads to market trends to upgrade existing buildings, including their energy efficiency. Already existing incentives will support this process. Energy conservation in existing dwellings and office buildings will be stimulated through LTAs with rental agencies in the social housing sector and with relevant organisations for renting and maintaining office buildings (see *Box 4.10*, for a few examples).

Energy-efficient heating systems and appliances, levies, public education and labelling will continue to be a means of inducing energy-conscious (purchasing) behaviour (see *Box 4.11* for results of the *Environmental Action Plans* [MAPs] of the energy distribution sector). According to the *Energy Saving Appliances Act*, labelling has been introduced for refrigerators, freezers, washing machines and tumble dryers; minimum efficiency standards have been introduced for refrigerators, freezers, and central heating boilers. Minimum efficiency standards are to be introduced for a wide range of applications, if possible through voluntary agreements with the manufacturing industry, however, if necessary through regulatory measures. The Netherlands Government has requested the European Commission to come with agreements, for example for washing machines, tumble dryers, dish washers, electromotors and lighting. Improvement of the energy-efficiency has also been addressed in Long-Term Agreements with the greenhouse horticulture sector operating within the agricultural sector (see *Box 4.10*). Some of these efficiency improvements will be realised by increasing the already installed capacity for cogeneration. For a more detailed list of measures implemented under current policies see *Table D.1.e* in *Appendix D*.

Box 4.10 Performance of Long-Term Agreements in the service sector and in agriculture

Sector	Energy use 1989 (PJ)	Target efficiency improvement (%)[1]	Concluded
Greenhouse horticulture	157	30%	Jan 1993
Institutional health care	27	30%	Jun 1994
Royal Dutch Airlines (KLM)	1	28%	Oct 1994
Schiphol Airport	1	28%	Nov 1994
Secondary vocational education	4	30%	Dec 1994
Higher vocational education	2	30% [1]	Feb 1996
Banks	8	25% [1]	Dec 1996

[1] For 2000 relative to 1989, except higher education and banks, which is for 2005 relative to 1995.

Coverage: 80% of agricultural energy use and 30% of energy use in the service sector. In addition to these sectors letters of intent have been received from the following sectors: supermarkets, mushroom cultivators, flower-bulb storage and preparation sector, intermediary organisations for road transport .

Source: EZ, 1997a.

Box 4.11 Performance (in kton CO_2) of MAP I and II of the energy distribution sector

Energy distribution companies (of gas and electricity) are organised as EnergieNed, which is executing the *Environmental Action Plans* [MAPs I and II] addressing energy-use of small-scale end-users in particular, with specific targets defined in terms of CO_2 reduction. Up to 1995 the following results were achieved:

Sector	Reduction target 2000	Actual in 1995 only	Progress '91-'95	Progress in %
Residential sector	3,200	1,365	1,354	42%
Office buildings	1,800	151	543	30%
Industry	1,300	51	67	5%
Heat market	7,600	776	3,957	52%
Renewable energy	1,100	27	184	17%
Other new technologies	500	81	88	18%

Landfill gas	1,700	202	965	57%
Total	**17,000**	**1,653**	**7,158**	**42%**

Source: EnergieNed, 1996.

Waste treatment [6]
The Netherlands waste policy includes a 'programme for climate and waste', which comprises a package of measures aiming at reducing CO_2 emissions by reducing waste production and other means of waste treatment. The programme aims at using 5.1 million ton of waste for energy purposes by 2000. Also part of this programme is increased recycling of plastics, aluminium, paper and cardboard (see *Table D.1.f* in *Appendix D*). Additional combustion of wood waste in coal-fired power plants, which is also part of the programme, is dealt with under 'Electric power generation [1A1]' at the beginning of this section.

4.4.1.4 Afforestation

Current policy for the *Regional Scheme for Green Areas* (SGR) (LNV, 1995b) provides for expansion of forest in the Netherlands of 75,000 ha by the year 2020 (20% to 25% more than at present). This policy will ensure that the number of trees planted yearly exceeds the felling rate, hence increasing the annual quantity of biomass sequestered (the 'carbon sink'). On average, trees in the Netherlands are growing older and heavier. The relatively young plantations show the largest annual volume increment per acre. Since 1990, a slow reduction in growth rate (due to forests maturing) has been slightly overcompensated by planting fast-growing species like poplar and Douglasfir. For 1990, the net carbon sink was estimated to be 1.5 Mton CO_2, whereas for 1994 and 1995 the carbon sink in forests was estimated equivalent to 1.7 Mton CO_2.

4.4.1.5 Measures leading to higher levels of CO_2 emissions

In the context of reduction measures for CO_2 we should also mention three other specific environmental policy measures which will lead to an increase of CO_2 emissions:
- the flue-gas desulphurisation measures taken by coal-fired public power plants and by refineries with the objective of reducing SO_2 emissions;
- the application of low-NO_x burners;
- the standards for fuel composition of transport fuels produced by refineries - e.g. replacement of lead in gasoline by MTBE, a anti-knock material - has led to a higher energy consumption of refineries;

and in general all applications of end-of-pipe add-on emission abatement technology. These measures, however, will lead directly or indirectly to an increase of energy use and thus of CO_2 emissions.

4.4.2 Strategy for methane

Methane emissions in the Netherlands originate predominantly from agriculture (50%) and landfills (40%), whereas fuel production and transmission contributes to about 15%. Since 'current' policies in 1991 with respect to agriculture, waste management and energy transmission were expected to result in a 10% decrease of methane emissions in 2000 relative to 1990 in the first *Memorandum on Climate Change* of 1991 (VROM, 1991), this 10% was set as a reduction target. However, at present the Netherlands Government expects that CH_4 emissions in the year 2000 will be reduced by about 25% (RIVM, 1993a,b), largely exceeding the *NEPP-2* target of -10%. These policies include measures such as recovery of methane from landfills, the manure policy, the European agricultural policy, reduced leakage from gas distribution networks and reduced emissions from offshore gas venting. For an overview of measures see *Table D.2* in *Appendix D*.

Fugitive fossil fuel emissions [1B]

The production and transmission of natural gas is the largest source of fugitive fuel emissions of methane in the Netherlands. The emissions from leakage of the distribution network will decrease due to the regular replacement of old cast-iron pipelines and as a result of improved maintenance. In addition, an agreement was made between the Government and NOGEPA, representing the mining sector, for which a total emission reduction of methane from on and off shore oil and gas production is expected of 30% by the year 2000 compared to 1990.

Agriculture [4]
Manure policy measures aimed at reducing the manure surplus and ammonia deposition are expected to result in a decrease of cattle numbers and thus of mineral (manure) production. Additional reduction of methane emissions from agriculture through a decrease in the number of dairy cattle (as a result of the *Common Agricultural Policies* by the EU) will be partly compensated by an increase of methane per animal. This is due to an increase in roughage and production per animal. Consequently, methane emissions from agriculture will, in the course of time, be reduced.

Waste management [6]
The CH_4 emissions from landfills are affected by two types of measures:

- a decrease in landfilling from 1990 due to prevention, recycling and increasing incineration as a result of the *Decree on Waste Disposal at Landfills* of 1993;
- regulations related to the *Soil Protection Act* and the *Netherlands Emission Regulations* (i.e. *Specific Regulation for Processing Gases of Landfills* of 1994) include provisions that newly-designed landfills need to have equipment to utilise recovered methane or to flare the methane.

In 1995 the recovery of methane from landfills amounted 65 Gg, which is 39 Gg more than in 1990, thus already exceeding the target of 37 Gg additional recovery in 2000 compared to the 1990 level.

4.4.3 Strategy for nitrous oxide

Emissions of nitrous oxide in the Netherlands stem predominantly from agriculture (37%), with industrial processes (28%) and transportation (9%) the second and third largest sources. Since it was expected that emissions of N_2O would remain at the same level as 1990 (VROM, 1991) as a result of opposite and compensating effects in agriculture and transport, at that time a specific policy for this greenhouse gas was not considered necessary.

Industry [3]
The production of nitric acid, caprolactam and other nitrificating processes results in process emissions of N_2O (19 kton in 1990 and for 2000 while nitric acid production is circa 24 kton). Options for reducing N_2O emissions from nitric acid production are now being investigated. The investigation aims at the development of a catalyst capable of reducing N_2O emissions. A feasibility study has been started this year (1997) in a special programme ('BMT-regeling' in Dutch) to subsidise companies, universities, etc. developing new environmentally sound technologies for reducing industrial emissions. This programme is subsidised by the Ministry of Environment.

Agriculture [4]
Policy measures regarding nutrients (nitrate) and ammonia emissions are expected to result in a decrease of cattle numbers and/or a decrease of nitrogen excretion per animal, and thus of mineral (manure) production. The use of chemical fertilisers will also decrease further. These policies, which are part of the *Common Agricultural Policies* of the EU, are expected to result in a substantial reduction of N_2O emissions from agricultural soils. In the last five years, however, this effect has been compensated by an increase in N_2O emissions due to legislation which prescribes direct incorporation of manure into the soil. Now that this measure is fully imple-

mented (see Section 3.3), a further reduction of N_2O emission due to decreasing cattle or mineral production figures may be expected.

Measures leading to higher levels of N_2O emissions
In the context of measures reducing greenhouse gas emissions, we should also mention two environmental policy measures which lead to an increase of N_2O emissions:

- the penetration of catalytic converters in road transport with the aim of reducing emissions of NO_x, CO and NMVOC;
- the development of new manure practices by direct injection into the soil, which substantially reduces NH_3 emissions from manure.

In the period 1990-1995 these measures led to increasing sectoral emissions by 60 and 20%, respectively, resulting in increased national total nitrous oxide emissions by 14% in the same period.

4.4.4 *Strategy for other gases*

HFCs, PFCs and SF_6
The *Technical Requirements for Refrigeration Equipment* to guarantee minimum leakage rates will result in minimised emissions of HFCs. The basis of the policy behind these requirements is that from January 1992 refrigerant (CFCs, HCFCs and HFCs) leakage from refrigerating systems should not exceed 1 to 5% of the system charge per year. Since January 1994, the policy objective is that refrigerant losses should amount to no more than 0.1 to 1% of the total refrigerant charge per year. These percentages are used as guidelines for refrigerating systems of 500 Watt or more.

Part of the production capacity of primary aluminium, a source of CF_4 and C_2F_6, is anticipated to close down after the year 2005. For HFCs, a drop in emissions of HFC-23 after 1994 is anticipated as a result of the applying emission control facilities in the production of HCFC-22 in the Netherlands. This will allow the emissions of HFC-23 to be reduced by at least 50% with respect to the 1995 level.

This is contrasted by a growth in the increasing use of HFCs and PFCs to replace substances that deplete the ozone layer, which are not or will no longer be accepted in the Netherlands. This growth will continue after the year 2000, such that despite reductions in other source categories, the total emissions of fluorine compounds will increase after the year 2000. For a table of measures see *Table D.4* in *Appendix D*.

Ozone precursors and SO_2
Reduction of NO_x and NMVOC emissions is subject to protocols to the UN-ECE *Convention on Long-Range Transboundary Air Pollution,* for NO_x completed with a voluntary declaration, announcing a 30% reduction of emissions in 1998 compared with a year between 1980 and 1986, whereas for NMVOC 30% reduction in 1999 compared with 1988 was agreed upon. However, the national target for NO_x is a reduction of 55% by 2000 and 80 to 90% by 2010 relative to the 1980 level. For NMVOC the national target is a reduction of 70% by 2000 and 80% by 2010 compared to 1981.

Most of these reduction measures aim at the transportation and industrial sectors (for NMVOC covered by LTAs and through a special policy programme to control emissions from solvent application). For reducing NO_x, the power generation sector is also aimed at (e.g. low-NO_x burners) covered by legislation for combustion plants and by voluntary agreements. For CO, 40% reduction by 2000 is expected as a result of measures to control NO_x and NMVOC from road transport and through measures in the steel industry for recycling of CO emissions from the production process. More information on these policies and measures can be found in the first *National Communication* (Government, 1994) and in the *National Environmental Outlook 1990-2015* (RIVM, 1993a).

ECN, 1996 The ECN Contribution to the Third White Paper on Energy Policies: Extended description of the energy sketches for 2020.

EnergieNed, 1996.

EZ, 1993 Second Memorandum on Energy Conservation (SMEC)
EZ, 1995a 'Repair letter' to the Parliament sent by the Government in June 1995
EZ, 1995b Third White Paper on Energy Policy [Derde Energienota]
EZ, 1996a CO_2 Reduction Plan or '750 million letter' sent from the Government to Parliament, September 1996
EZ, 1997a LTAs
EZ, 1997b Renewable Energy Action Plan [PvA Duurzame Energie in Opmars]

FIN, 1995 Act on Regulating Energy Taxes [WREB]

Govt., 1994 Netherlands National Communication on Climate Change Policies *

LNV, 1993 Memorandum on Third-Phase Manure and Ammonia Policy
LNV, 1995a Integral Paper on Manure and Ammonia Policy
LNV, 1995b Regional Scheme for Green Areas [Structuurschema Groene Ruimte, SGR]

Matthijsen and Kroeze, 1996

RIVM, 1993a National Environmental Outlook 3, 1990-2015 (NEO 3) [MV 3]*
RIVM, 1993b Environmental Benefits of NEPP 2 [Milieurendement van het NMP-2]
RIVM, 1995a,b Environmental Balance 1995 [Milieubalans 1995] (plus background document)
RIVM, 1996a,b Environmental Balance 1996 [Milieubalans 1996] (plus background document)
RIVM, 1997 National Environmental Outlook 3, 1995-2020 (NEO 3) [MV 4]

VW, 1993 Review of the Second Transport Structure Plan [SVV-2] (condensed version)

Second Chamber, 1996 Report of the Temporary Commission on Climatic Change (**??**)

SEP, 19xx *Second Electricity Supply Master Plan*

VROM, 1991
VROM, 1993 National Environmental Policy Plan 2 (NEPP 2) [NMP-2]
VROM, 1995a 'CO_2 letter' sent from the Government to Parliament, September 1995
VROM, 1995b Plan of Action on Sustainable Construction [PvA Duurzaam Bouwen]
VROM, 1995c Memorandum on Joint Implementation *
VROM, 1996a Memorandum with Outline of Second Memorandum on Climate Change
VROM, 1996b Memorandum on Vehicle Technology and Fuels: Perspectives for the Environment
VROM, 1996c Second Memorandum on Climate Change *
VROM, 1997 National Environmental Policy Plan 3 (NEPP 3) [NMP-3] *(forthcoming)*

VW, 1993 Review of the Second Transport Structure Plan [SVV-2] (condensed version)
VW, 1996a Freight Transport in Balance
VW, 1996b Working Together on Accessibility

Ref. prices energy heffing PM
Ref. budgets energy saving EZ, VROM, .. ?? PM

5. PROJECTIONS AND EFFECTS OF POLICIES AND MEASURES

5.1 Introduction

A periodic exploration of possible future trends is an integral part of the process of making, reviewing and updating policies. The Netherlands' *Central Planning Bureau* (CPB) has constructed a number of scenarios for the development of the world economy, in general, and the Netherlands' open economy, in particular, for the period 1990-2015. Each of these scenarios represents a specific view on the future, taking into account the driving forces behind economic development.

For estimating future trends in CO_2 emissions, in 1995 the Ministries of Economic Affairs and of the Environment have developed a new scenario based on the so-called sketch scenarios called *'Favourable-High'*, '*Favourable-Low'* and '*Trend'* for energy use compiled by ECN as interpreted by the Netherlands Government. This is also the reason that different growth assumptions are used for the CO_2 scenarios and the scenarios for the other gases. These scenarios take into account some of the latest insights into recent economic development, energy prices, and energy supply and demand. The *'Favourable CO_2 Scenario'* is defined on the average of the *High* and *Low* variants of the *Favourable Scenarios*, while using the *Trend scenario* as a baseline for the development without considering the latest additional measures announced in the *Third White Paper on Energy Policy* and in the *CO_2 Reduction Plan.*

One of the CPB scenarios called '*European Renaissance'* was selected as economic scenario for projecting non-CO_2 emissions for the coming decades. This scenario was also presented in the first *National Communication*, with the exception of HFCs and related compounds, for which no scenarios were made at that time. The projections for non-CO_2 gases are based on existing *NEPP 2* and *Second Memorandum on Energy Conservation* (SMEC) policies (VROM, 1993; EZ, 1993). Since emissions of non-CO_2 gases are less dependent on energy prices and economic growth than CO_2 emissions, adjustments as made for CO_2 are less relevant for these gases. Since the original scenarios have been defined until 2010 or 2015, straightforward extrapolations have been used to extend these emission scenarios to 2020. Since we use in this chapter emission scenarios developed some years ago, emission values mentioned for 1990 and 1995 may differ from more recent estimates reported in Chapter 3.

5.2 Key assumptions used in the scenarios

Some key assumptions of the scenarios used for CO_2 and non-CO_2 gases are described in *Boxes 5.1* and *5.2,* respectively. The existing policies and measures already implemented or committed to, as described in Chapter 4, are taken into account in the projection of the greenhouse gases and in the ECN sketches. As a rule, it is assumed that all policies and measures either are or will be adequately implemented. If monitoring programmes show deficiencies in the effectiveness of current policies, the Government may review and adjust its implementation measures.

At present (1997), a new *National Environmental Outlook 1995-2020* (NEO 4) is in preparation (RIVM, 1997a) which will include several new economic scenarios with the most recent insights in trends and an independent assessment of the effect of the Netherlands' environmental policies in the context of the new scenarios. Current developments as discussed in Chapter 3 indicate a rising level of emissions.

In September 1997 the Government will inform the Parliament on the impact of existing policies, including the effect of the *CO_2 Reduction* Plan and other initiatives taken after 1995. This information will also contain the result of an exploration of further reduction policies (see Section 4.3.2). Furthermore, the Government is preparing a new *National Environmental Policy Plan 3* (NEPP 3) (VROM, 1997), which will present an integrated update of current policies, as will be elaborated in sectoral policy documents.

Box 5.1 Key assumptions in the CO_2 scenarios for energy supply and demand defined by ECN

Trend scenario:
- economic growth 1990-2020: 2.3% per year;
- population growth 1990-2020: 0.5% per year;
- a very moderate rise in energy prices on the world market (to somewhat below $20/bbl in 2020 for oil);
- growth of industrial production: 3.3% per year (note that strong structural shifts in industrial production are assumed, having an effect of -1% per year on industrial energy consumption (e.g. compared with GDP growth);
- growth of number of dwellings: 1.0% per year;
- growth of number of cars: 0.7% per year (i.e. 24% higher in 2020 than in 1990).

Additional assumptions in the *Favourable scenarios:*
- a moderate rise in energy prices on the world market (to $25/bbl for oil in 2020).
- *favourably low*: relatively low growth of energy-intensive manufacturing industry and net imports of electricity; *favourably high*: relatively high growth of energy-intensive manufacturing industry and net exports of electricity;
- from 2000 onwards a European energy/CO_2 tax of $10/bbl (also for large consumers);
- European efficiency standards for electric appliances;
- a European policy with incentives for recycling and use of less energy-intensive materials;
- favourable European conditions for the introduction of energy-efficient cars;
- (national and European) financial incentives and R&D programmes.

5.3 CO_2 emissions

First, a projection 'without measures' has been defined, providing a *Business-as-Usual* (BaU) development. Its construction can be summarised as follows:

a) Actual emissions were used for the period 1990-1995. In 1995 temperature-corrected CO_2 emissions were 186 Mton (RIVM, 1996a,b; Spakman *et al.*, 1996).

b) The effect of existing policies and measures for CO_2 from 1995 on is calculated by assuming that without existing policies and measures CO_2 emissions would grow by 1.2% annually. This is the composite of:
- an annual GDP growth of 2.3%;
- a reduction in energy intensity of GDP of 1.1% per year;
- an assumption of no shift in carbon intensity of the fuel mix.

We note that in the new scenarios for the *NEO 4* higher annual GDP growth rates are assumed (RIVM, 1997a). The figures for the period after 2000 are based on the following set of scenarios developed by the Netherlands Energy Research Foundation (ECN) to form the basis of the *Third White Paper on Energy Policy* (Van Hilten *et al*., 1996a):

1) The '*Trend' scenario* can be considered as an existing-policy scenario. It includes policies already in place in 1995 to reach the target for the year 2000 and can be used as reference scenario. This scenario does not include effects of latest addition to existing-policy announced in the *Third White Paper on Energy Policy* of December 1995 and the *CO_2 Reduction Plan* of September 1996.
2) The *'Favourable' scenarios* have as key characteristic an assumption of a 33% improvement in energy efficiency in the period 1995-2020, and a contribution of renewable energy (including heat pumps and waste combustion for energy purposes) of 10% to the energy supply in 2020, while assuming a favourable basis for climate change policies in the EU (on the basis of the *Third White Paper* policies). ECN distinguishes two scenario variants:
   a) *Favourable-Low* in which the energy-intensive sector in the Netherlands is relatively small in size the Netherlands is also assumed to be a net importer of electricity;
   b) *Favourable-High* in which the energy-intensive sector in the Netherlands is relatively large in size and the Netherlands is also assumed to be on its way to becoming a net exporter of electricity.

The qualifications *Low,* and *High,* therefore, refer to the resulting energy demand, not to energy price levels.

The CO_2 figures given here for the *Favourable scenario* are the average results of these two variants. The 2000 target of -3% reduction compared to 1990 (i.e. 168 Mton) is assumed to be met in addition to existing policies, with a budget for the coming years of NLG 750 million, provided by the *CO_2 Reduction Plan* for investments in clean energy supply and energy efficiency.

This is more-or-less consistent with the present policy goal that aims for at least a stabilisation after the year 2000 at -3% of the 1990 level (-3% of the 1990 base-year figure of 173 Mton gives 168 Mton as the target in absolute temperature corrected figures). Both the target (168 Mton) and the result of the scenario projection (172 Mton) are presented here. If -3% CO_2 emission is not reached, this will have an increasing effect on the emissions after the year 2000. As described in more detail in Chapter 4, the exact choice of policy instruments to reach stabilisation has not yet been made, although, in general, the *Third White Paper on Energy Policy* has set out orientations, whereby part of the policies and measures depend on EU policy-making. Further emission reductions will only be introduced if international agreements on this point are reached (VROM, 1996c). It was assumed that 50% of the additional measures depend on EU policy. These include a $10/bbl energy tax, the introduction of energy-efficient cars, standards for electrical appliances, recycling, introduction of less energy-intensive materials and, finally, a EU R&D programme.

Furthermore, the ECN scenarios only provide figures for 2020; to derive figures for the intermediate years 2005, 2010 and 2015, linear interpolation has been applied for the years 2000 to 2020, assuming an emission of 173.5 Mton (the average of 170 and 177 Mton) in 2000. In addition, since the ECN scenarios are not representative of the additional policies being defined e.g. through the projects funded by the NGL 750 million, no reliable estimate of sectoral emissions can be provided.

Table 5.1 provides a summary of the CO_2 projection according to the *Favourable (average) scenario* and in comparison with the *Trend* and *BaU scenarios*. This projection is shown in *Fig. 5.1*, including a source split for illustration purposes only. The sectoral subdivision for future years is based on an average energy balance for 2020 (average of the energy balance for the *High* and the *Low* variants of the *Favourable* scenario).

To gain some insight into the uncertainty of the results due to specific assumptions in the *Favourable CO_2 Scenario*, we should note that the difference in results between the *Favourable High* and *Low* variants for 2020 is 22 Mton, which is about 13% of the average value of energy-related emissions. This uncertainty is higher than the uncertainty estimate for the emissions, which is a few per cent (see Chapter 3, Section 3.2).

Table 5.1 Summary of projections of anthropogenic emissions and removals of CO_2 1990-2020 (Tg)

	1990*	1995*	2000	2005***	2010***	2015***	2020
Emissions							
Actual/target emissions	173	186	168	168	168	168	168
Without measures (BaU)	173		197	210	222	236.5	251
Trend scenario	173		173.5 (170-177)	181	188	195	202
Favourable scenario	173		168	170 (168-172)	170	170	170 (168-172)
Removals							
Afforestation **	-1.5	-1.7	-1.7	-1.7	-1.7	-1.7	-1.7

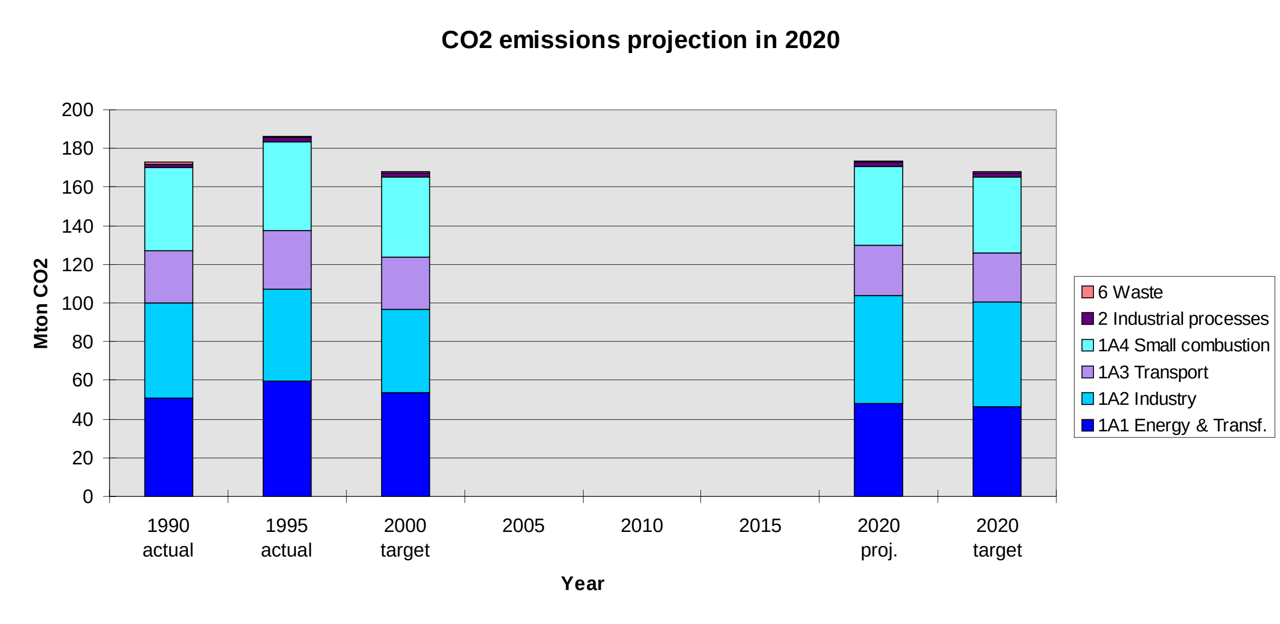
Notes:

* Actual emissions, not projected; temperature corrected (uncorrected figures are about 6 Mton lower for 1990 and 2.5 Mton for 1995).

** No projection known; assumed to be constant.

*** Interpolated values.

Fig. 5.1 Projections of CO_2 emissions in the Netherlands 1990-2020 according to Favourable scenarios and targets (sectoral shares for future years are only indicative) (temperature corrected*).



***** Fluctuations in uncorrected figures would partially mask anthropogenic trends in emissions.

5.4 CH_4 emissions

The projection of methane emissions is based on *NEPP 2* and *SMEC* policies (VROM, 1993; EZ, 1993) where
the *European Renaissance scenario* with high prices '*ER-High'* is the basic scenario. More details on assumptions for specific sectors can be found in Van Amstel *et al.* (1994). *Table 5.3* provides a sectoral breakdown of methane emissions for the period 1990-2020, on the basis of extrapolated projections for 1990-2010. In the projected emission reductions in the table the effect in CH_4 reduction of measures in agriculture and waste management (see *Table 5.2*) are included. Estimated emission reductions from the replacement of the gas distribution network system through improved maintenance as well as the environmental agreement with oil and gas production companies (NOGEPA) may further reduce CH_4 emissions. As can be derived from this table, the overall reduction is caused predominantly by a decrease in emissions from landfills, agriculture (in particular from enteric fermentation and to lesser extent animal waste) and oil and gas production (-80%, -30%, and -40%, respectively in 2010-2020 compared to 1990). The trend in emissions for 1990-1995 is well in line with this projection.

Box 5.2 Key assumptions in the scenarios for CH_4, N_2O and other gases

- the European Renaissance scenario with high prices (*ER-High*), which include an annual economic growth rate of 2.7% between 1990 an 2000 and an increase of end-user energy prices of 23% in 2000 compared to 1990;
- constant natural gas production, export and import;
- increased use of associated gas on offshore production platforms, which would otherwise be vented;
- for agriculture, the impact of the MacSharry plan as well as the Integral Paper on Manure and Ammonia Policy
- (LNV, 1995), resulting in a substantial decrease in livestock numbers;
- specific policies on waste prevention and recycling, leading to an increase in waste incineration and to a decrease in the amounts of waste landfilled, as well as in the fraction of degradable organic carbon of this waste;
- ignoring the effects of the operation of de-NO_x facilities in stationary sources on N_2O emissions;
- ignoring decreased N_2O emissions from soils as a result of decreased deposition of $NO_{x.}$

Table 5.2 Summary of projections of anthropogenic emissions of CH_4 (Gg)

IPCC Category	1990	1995**	2000	2005*	2010	2015***	2020***
1 All energy	**177**	***167***	**151**	***151***	**147**	**145**	**144**
1A Fuel combustion	28	*27*	26	*25*	24	23	22
1B Fugitive emissions	**149**	***140***	**130**	***126***	**122**	**122**	**122**
1B2a1 Oil production	19	*16*	12	*12*	11	11	11
1B2a2 Gas production	52	*46*	40	*37*	33	33	33
1B2b Gas transport	6	*6*	6	*6*	6	6	6
1B2c Gas distribution	72	*72*	72	*72*	72	72	72
2 Industrial processes	**0**	***0***	**0**	***0***	**0**	0	**0**
3 Solvent use	**0**	***0***	**0**	***0***	**0**	0	**0**
4 Agriculture	**508**	***476***	**404**	***380***	**355**	**355**	**355**
4A Enteric fermentation	402	*377*	327	*309*	290	290	290
4B Animal wastes	106	*99*	77	*71*	65	65	65
5 Land use change	**0**	***0***	**0**	***0***	**0**	0	**0**
6 Waste	**382**	***382***	**228**	***169***	**110**	100	**95**
6A Landfills	377	*377*	223	*164*	105	95	*90*
6B Wastewater treatment	5	*5*	5	*5*	5	5	5
7 Other	**0**	*0*	**0**	*0*	**0**	0	**0**
TOTAL	**1067**	***928***	**788**	***700***	**611**	**600**	**594**

Source: Van Amstel *et al.*, 1994; additional information from NOGEPA (see Table D.2).
Notes:
* Interpolated values.
** Decrease reflecting historical trends described in Chapter 3.
*** Simple extrapolation.

5.5 N_2O emissions

The projection of nitrous oxide emissions is also based on NEPP 2 and SMEC policies (VROM, 1993; EZ, 1993) under the assumption that these policies remain unchanged after 2000, with *the European Renaissance scenario* with high prices ('*ER-High*') as basic scenario. More details on assumptions for specific sectors can be found in Van Amstel *et al.* (1994).

We should note that the increasing effects of de-NO_x facilities in stationary sources are ignored in the projection. Decreased emissions of N_2O from soils as a result of decreased deposition of NO_x are also not taken into account in this projection. More important, the effects of incorporating manure into the soil as a highly effective means to reduce ammonia emissions means are not included in the projection for agricultural emissions. As discussed in Chapter 3, this effect is now estimated to amount to an increase of about 3.5 Gg, which occurred in the period 1990-1995. In addition, there is an uncertainty in the development of livestock figures and in the methods of manure storage which will affect N_2O emissions.

Table 5.3 provides a sectoral breakdown of N_2O emissions for the period 1990-2020 on the basis of extrapolated projections for 1990-2010. Projections show that emissions from transport and wastewater treatment plants are expected to increase substantially (+150% and +100%, respectively, in 2010-2020 compared with 1990), whereas emissions from polluted surface waters are expected to decrease by about 50% in 2010-2020 relative to 1990. However, recent developments in manure practices in the agricultural sector described in Chapters 3 and 4 are expected to result in higher N_2O emissions in 2000 than the target of stabilisation at 1990 levels by the year 2000. Compared with the figures shown in *Table 5.3* for 2000 onwards, this effect will mean an addition of about 3.5 Gg. Currently, the Government is carrying out exploratory studies for reduction of N_2O emissions in particular in nitric acid manufacture.

Table 5.3 Summary of projections of anthropogenic emissions of N_2O (Gg)

IPCC Category	1990	1995**	2000	2005*	2010	2015	2020***
1 All energy	**6.1**	***8***	**11.6**	***12***	**13.3**	**14.1**	***15.1***
1A Fuel combustion	6.1	*8*	11.6	*12*	13.3	14.1	*15.1*
1A1 Energy & Transformation	0.5	*0*	0.4	*0*	0.5	0.5	*0.5*
1A2 Industry	0.1	*0*	0.1	*0*	0.1	0.2	*0.2*
1A3 Transport	5.4	*8*	11	*12*	12.6	13.3	*14.3*
1A4 Small combustion	0.1	*0*	0.1	*0*	0.1	0.1	*0.1*
1A6 Traditional biomass	0	*0*	0	*0*	0	0	*0*
1B Fugitive emissions from fuels	0	*0*	0	*0*	0	0	*0*
2 Industrial processes b)	**16.4**	***16***	**19.1**	***20***	**21.6**	**22.6**	***22.6***
3 Solvent use	**0**	*0*	**0**	*0*	**0**	**0**	***0***
4 Agriculture	**25.1**	***27***	**20.7**	***20***	**19.7**	**19.5**	***19.3***
4D Agricultural soils a)	25.1		20.7	*20*	19.7	19.5	*19.3*
5 Land use change	**0**	***0***	**0**	***0***	**0**	**0**	***0***
6 Waste	**4.1**	***6***	**6.9**	***7***	**7.6**	**7.9**	***8.2***
6A Landfills	0	*0*	0	*0*	0	0	*0*
6B Wastewater treatment	4	*4*	6.8	*7*	7.4	7.7	*8*
6C Waste incineration	0.1	*0*	0.1	*0*	0.2	0.2	*0.2*
7 Other	**10.9**	***9***	**6.9**	***6***	**5.9**	**5.3**	***4.9***
TOTAL	**62.6**	***64***	**65.2**	***67***	**68.1**	**69.4**	**70.1**

Source: Kroeze, 1994.
Notes:
a) Including 3.0 from enhanced background emissions from anthropogenic origin.
b) Recent measurements indicate higher 1990-1995 emission levels.
* Interpolated values.
** Increase reflecting historical trends described in Chapter 3.
*** Simple extrapolation.

5.6 Emissions of HFCs, PFCs and SF_6

The projection of emissions of HFCs, PFCs and SF_6 is based on the *European Renaissance scenario* with high prices ('*ER-High'*), which has been translated in terms of development of production, handling and consumption of these substances. By and large, the emission calculation is in line with annually applied methods in AFEAS reports (e.g. AFEAS, 1996) and with the *Revised IPCC Guidelines* (IPCC, 1996b) for estimating emissions of these substances. More details on assumptions for specific sectors and the emission calculation methodology can be found in Matthijsen and Kroeze (1996). A *Reference Scenario* has been defined, assuming that the Montreal Protocol and its subsequent amendments will be fully implemented without additional measures (see *Box 5.3*). *Table 5.4* provides a breakdown of emissions per substance for the *Reference scenario* for the period 1990-2020 in terms of CO_2-eq. Figures on a sectoral basis cannot be provided as it was not considered feasible to make a realistic estimate in which sector emissions will actually occur. Monitoring studies show that, currently, the emissions of these compounds predominantly occur in industry and to some extent in the commercial service sector (Matthijsen, 1996).

Box 5.3 Key assumptions in the Reference Scenario

- Pre-Montreal Protocol demand increases as envisaged in the European Renaissance scenario (with high prices)
- Implementation: of the 1990 version of the Montreal Protocol: use of CFCs, halons and carbon tetrachloride (CTC) in the Netherlands is halted in 1995. Use of HCFCs in 2015 is zero.

- Implementation of existing regulations in the Netherlands for leakage control in stationary refrigeration (VROM, 1995**a**).
- Replacement in 2000, of about 9% CFCs, halons and methyl chloroform (MCF) is met by HFCs, PFCs, FICs and SF_6. By 2020 this percentage is about 25%. The substitution rates take into account the currently observed trend to use less refrigerant per unit of cooling. Substitution starts from 1995 and 2.5% of the refrigerating agents are used for household appliances.
- Emissions during packaging of HFCs are assumed to increase in line with increasing use of the compounds considered.
- Emissions of HFC-23 as a result of HCFC-22 production are assumed to be reduced by 50% as a result of emission control. Emissions of PFCs during aluminium production are assumed to be in line with an envisaged decrease in aluminium production.
- Actual emissions are calculated as described in Matthijsen and Kroeze (1996). New markets for halocarbons are ignored.

It should be noted that estimating future emissions from fluorocarbons is highly uncertain, partly due to unpredictable developments in the mix of substitutes for CFCs and halons, and partly due to inherent uncertainty in variables used to estimate emissions from the use of these substances (e.g. mix of applications, lag times). From *Table 5.4* it can be concluded that due to an increasing use of HFCs and PFCs to replace substances that deplete the ozone layer, related emissions will also increase. In terms of CO_2-eq. in the *Reference Scenario*, the largest emissions stem from HFC-236fa, HFC-23, PFCs, HFC-134a and SF_6. Most emissions in 2020 of HFC-23, SF_6 and (partly) PFCs, originate from industrial process or feedstock emissions. It is expected that part of the production capacity of primary aluminium will be closed down after 2005, which has a mitigating effect on PFC emissions in 2020. For HFCs, a drop in emissions of HFC-23 of at least 50% after 1994 is anticipated as a result of applying emission control facilities to the production of HCFC-22.

Table 5.4 Summary of projections of anthropogenic emissions of HFCs, PFCs and SF_6 in the Reference scenario (Gg and Gg CO_2-eq.)

Compound	1990**	1995**	2000	2005*	2010*	2015*	2020
HFC-23	410	540	279	*289*	*299*	*308*	318
HFC-32	0	0	6	*16*	*26*	*35*	45
HFC-125	20	20	29	*50*	*71*	*91*	112
HFC-134a	30	164	688	*1073*	*1458*	*1842*	2227
HFC-143a	5	5	29	*147*	*265*	*383*	501
HFC-152a	25	25	148	*233*	*318*	*403*	488
HFC-227ea	0	0	24	*36*	*47*	*59*	70
HFC-236fa	0	0	34	*232*	*429*	*627*	824
HFC-245ca	0	0	34	*232*	*429*	*627*	824
HFC-356	0	0	34	*232*	*429*	*627*	824
HFC-4310	0	0	34	*77*	*120*	*162*	205
PFC	330	330	371	*390*	*410*	*429*	448
FIC	0	0	2	*2*	*3*	*3*	3
SF_6	58	61	68	*75*	*82*	*88*	95
Total (Gg)	**878**	**1145**	**1780**	***3081***	***4382***	***5683***	**6984**
Total (Gg CO_2-eq.)	**8500**	**10300**	**8900**	***10200***	***13700***	***17562***	**21423**

Source: Matthijsen and Kroeze, 1996.
* Interpolated values.
** Figures for 1990 and 1995 are different from values presented in *Table 3.13*, since the latter were revised after completion of the scenarios presented here.

5.7 Emissions of other greenhouse gases and SO_2

The projection of the other emissions is based on *NEPP 2* and *SMEC* policies (VROM, 1993; EZ, 1993) with the *European Renaissance scenario* with high prices ('*ER-High*') as basic scenario. More details on assumptions for specific sectors can be found in Van Amstel *et al.* (1994). *Table 5.5* provides a summary of emissions per gas for the period 1990-2020, on the basis of extrapolated projections for 1990-2010. As clearly visible in *Fig. 5.2*, a substantial reduction is expected for most gases between 1990 and 2020. For NOx, NMVOC and SO_2 reductions in 2020 are expected to be between 45% and 55% compared with 1990 levels. NMVOC and SO_2 emissions are expected to remain rather constant from 2000 onwards. For CO, a reduction of about 40% is expected in 2000-2005 compared to 1990, slowly decreasing to 30% in 2020.

Table 5.5 Summary of projections of anthropogenic emissions of the ozone precursors CO, NO_x and NMVOC, and of SO_2 (Gg) 1990-2020 (source: RIVM, 1993a)

Compound	1990	1995*	2000	2005*	2010	2015*	2020**
CO	1030	*830*	630	*650*	670	*687*	704
NO_x	575	*477*	*379*	*355*	*330*	*312*	293
NMVOC	459	*357*	255	*253*	250	*250*	250
SO_2	207	*150*	92	*94*	95	95	95

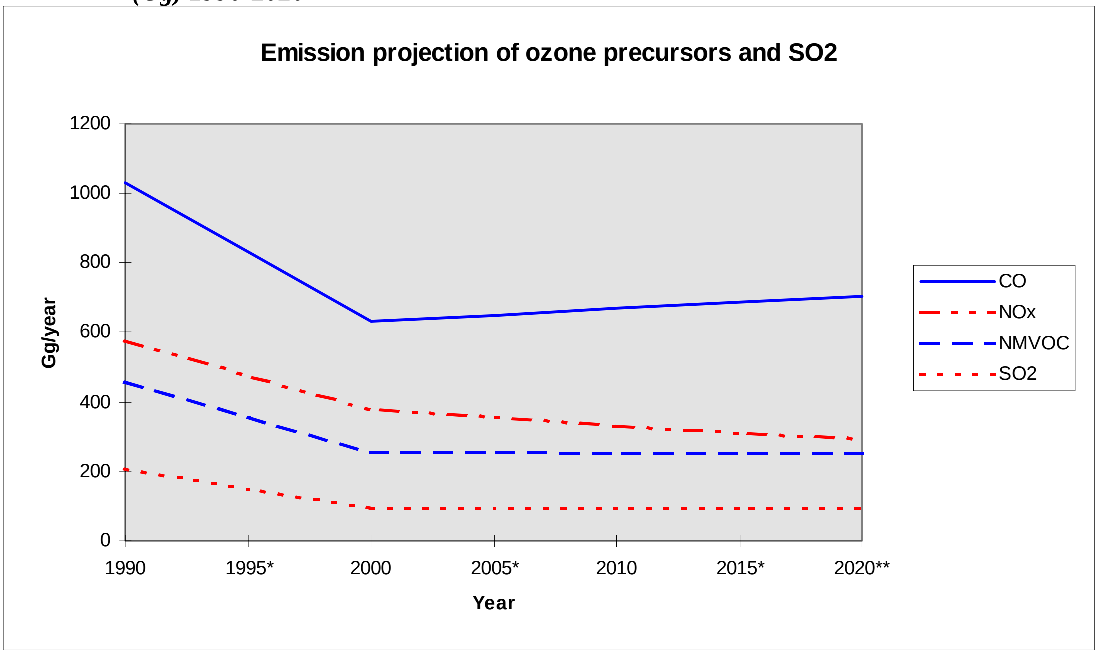
Sources RIVM (1993a) [NEO 3 (1993-2015), 2000 and 2010 of ER scenario], except figures printed in italic, which are from RIVM (1993b) [Environmental Benefits of NEPP2]. Figures for 1990-2015 are also presented in Van Amstel (1995). Van Brummelen *et al.* (1996) for 2020 figures.

* Interpolated values.

** Simple extrapolation.

N.B. underlined values: extrapolation.

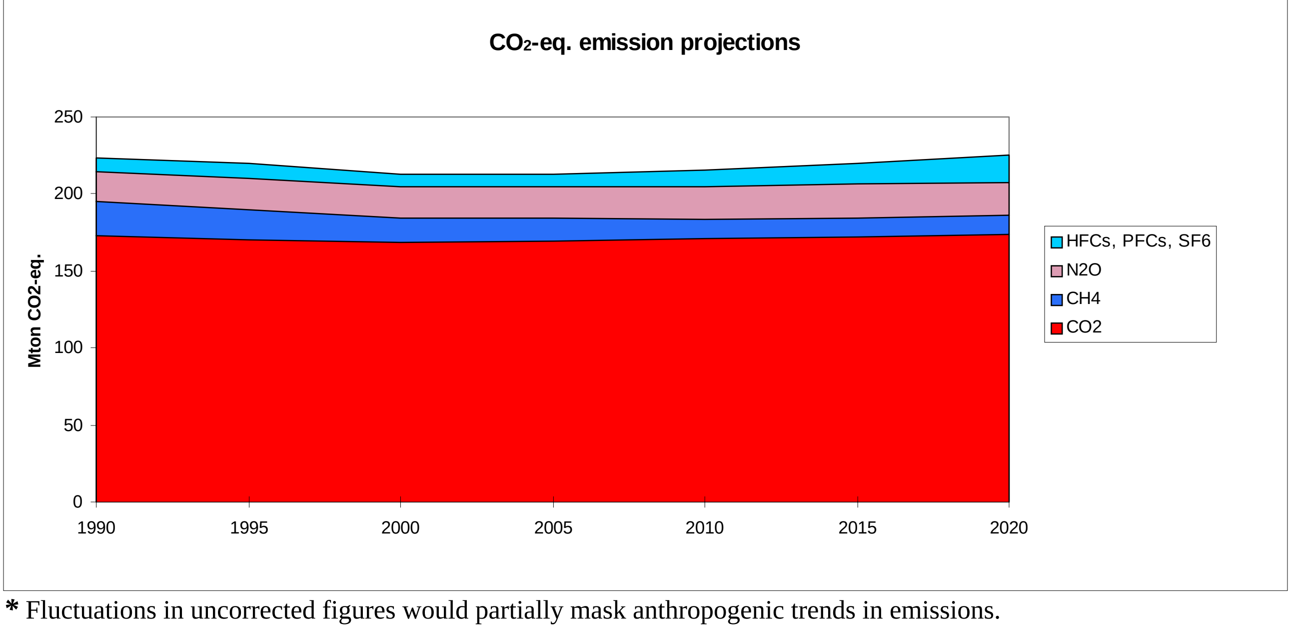
Fig. 5.2 Emission projection of anthropogenic emissions of the ozone precursors CO, NO_x, and NMVOC, and SO_2 (Gg) 1990-2020



5.8 CO_2 equivalent emissions

Fig. 5.3 presents the aggregated emission projection of CO_2, CH_4, N_2O and HFCs, PFCs and SF_6 for the period 1990-2020 using GWP values for a 100-year time horizon. These figures indicate that aggregated total emissions may be at the same level in 2020 as in 1990, under the assumptions of the various scenarios used for estimating the future development of the individual gases presented earlier in this chapter.

Fig. 5.3 Summary of projections of anthropogenic emissions of direct greenhouse gases (Pg CO_2-eq.) 1990-2020 (CO_2 emissions 1990-1995 are actual, temperature-corrected figures*)



***** Fluctuations in uncorrected figures would partially mask anthropogenic trends in emissions.

[*] Fluctuations in uncorrected figures would partially mask anthropogenic trends in emissions.

6. EXPECTED IMPACTS OF CLIMATE CHANGE AND VULNERABILITY ASSESSMENT

6.1 Introduction

Given its geographical situation, the Netherlands is highly susceptible to changes in sea-level rise and related changes caused by extreme weather and hydrological conditions. The densely populated and industrialised delta of the rivers Rhine, Meuse and Scheldt is protected by a combination of natural dunes and solid constructions such as dams, barriers and dikes to prevent extremely high water levels expected to occur only once in 1250 (along the rivers) to once in 10,000 years (in the heart of Holland). Sea-level rise and varying extreme conditions can adversely affect natural beach and dune systems and threaten the solid structures. Maintaining and restoring the resilience of the natural systems and the regular adjustment of the solid structures provide the only guarantee for a sustainable protection of the country.

6.*2* Vulnerability assessment

An evaluation of the present policy of 'dynamic preservation' of the Netherlands coastline was made in 1995 (RWS, 1995). This policy aimed at combating the structural erosion of the dunes was implemented in 1990. The total outer coastline of the Netherlands has a length of 350 km, of which 300 km consists of dunes and beach flats. This natural coast is eroding due to the present sea-level rise of approximately 20 cm per century and due to human interferences in the coastal system. The expected additional increase in sea level rise will lead to an increased erosion of the coastline. The 1995 evaluation showed that the present structural erosion has been stopped effectively due to beach nourishment programmes. Increased erosion of the fore-shore (minus 7-12 m) has, however, been observed. This may, in the long run, lead to instability of the coastal system. Accelerated sea-level rise and change in storm intensity will exacerbate this process. At present, however, there is no evidence for a changing frequency of storms (Bijl *et al*., 1997). The coupled General Circulation Models show that increases in storm surges of 10% to 30% are possible. The accuracy of these calculations, however, is of a similar order (RWS, l997).

The Wadden Sea, formed by a series of tidal basins with channels, shallow tidal flats and salt marshes, already shows a strong natural tendency to sedimentation. This dynamic system is constantly responding to changes like the present sea-level rise and the effects of human interference. A detailed study (RWS, 1994) has revealed the processes involved and made estimates of the increased toll sediments take due to a expected increases in sea-level rise. The present accumulation of sediments is 14-24 million m^3 per year, of which 5 million can be attributed to the sea-level rise of 20 cm. With a sea level rise of 60 cm per century, the extra demand will be approximately 7 mln m^3 per year. This demand can increase with the consequences of extracting gas, sand or shells. The Wadden Sea will wash away the sediments from the barrier islands on its fringes, thereby increasing their vulnerability to flooding.

In the winters of 1994 and 1995, the rivers Rhine and Meuse experienced very high floods. These created dangerous situations along the river embankments. Due to the nature of incidents, it is not possible to attribute such floods to a changing climate. If it turns out that changes in climate initiate changes in the frequency of river floods in the Netherlands, this may change in the future. The floods under consideration occurred seemingly due to a combination of an extreme meteorological condition, belonging to the present climate and the impacts of human interferences in the catchment area, like increased building, cutting of forests, canalising the river courses and gradually occupying the flood plains. Estimates show that due to a changing climate, decisive flood discharges will increase 10% for the Rhine and even 20% for the Meuse in the next century. These expectations, combined with the human interferences, will strongly increase the vulnerability to flooding of the low lying lands in the Netherlands.

Reduced summer discharges expected with a changing climate will lead to negative impacts. Dry summers with high temperatures will lead to higher water demand. Low river flows combined with an increased sea-level rise will result in reduced possibilities for water supply in the delta area. Inland shipping, an important means to distribute goods from Rotterdam harbour to Germany, will also encounter severe problems, leading to high extra costs.

In 1993 a study has been carried out on the potential effects of climate change in the Netherlands, including a first-order estimate of effects on nature and drinking water supply (Delft Hydraulics, 1993). It was estimated that a temperature increase of 3 ^{o}C combined with a precipitation and evaporation increase of 10% each will eventually lead to a decrease in the area of highly valuable nature reserves by about 90%. Warmer and dryer summers may lead to an increase in the demand for drinking water of 1-2%, which combined with decreased availability may lead to extra costs for drinking water supply of tens of millions Dutch guilders per year. Also in 1993 the effects of climate change on agricultural production has been estimated by linkage of climate change and agricultural production models (Wolf *et al*., 1993). Main findings were that the impact of climate change would be positive on agricultural production as a whole, however, limited if compared with the effects of agricultural policies, in particular of the EU. After 1993, several studies on the vulnerability of agricultural and other terrestrial ecosystems as well as on bird communities in estuarine ecosystems have been carried out in the framework of the *National Research Programme on Global Air Pollution and Climate Change* (see Chapter 10).

6.*3* International activities

lntergovernmental Panel on Climate Change (IPCC)

Since the establishment of the IPCC, the Netherlands has taken an active role as member of the IPCC Bureau, serving as vice-chair of Working Group II, and providing the leading author for Chapter 9 of this report on Coastal Zones and Small Islands of the Second Assessment Report (IPCC, 1996b). This chapter describes the aspects of climate change, biogeophysical effects and the socio-economic impacts, including their assessment. National vulnerability assessment case studies and results were presented from 23 nations. A Global Vulnerability Assessment carried out by the Netherlands (Hoozemans *et al.*, 1993) provides a worldwide estimate of the socio-economic and ecological implications of accelerated sea-level rise. Possible adaptation measures are discussed in which the establishment of *Coastal Zone Management Programmes* follows the vulnerability studies as a seemingly logical step.

Global Climate Observing System (GOOS)

The Netherlands attach great importance to the development of a Global Climate Observing System (GOOS) and has therefore taken the initiative to organise the first EuroGOOS conference in 1996 in The Hague, where the EuroGOOS programme had its kick-off (Woods *et al.*, 1996).

Netherlands Climate Change Studies Assistance Programme

A programme to assist developing countries in the preparation of a national policy on climate change and doing so implements Articles 4.1, 4.4, 4.5 and 12.1 of the FCCC. This programme also provides assistance by compiling national inventories of net greenhouse gas emissions, preparing vulnerability assessments of potential climate-change impacts on natural and socio-economic systems and assessing technical and policy options (and associated costs) to prevent, mitigate and/or adapt to climate change making full use of the relevant IPCC guidelines. Vulnerability assessments have been completed in Bangladesh, Egypt, Poland and Vietnam as a part of this programme. These projects are now being followed up with assistance in developing integrated planning for coastal zone management, taking into account potential long-term effects of climate change. At present, assistance is given to vulnerability country studies in Costa Rica, Ecuador, Ghana, Nicaragua, Senegal and Surinam.

7. ADAPTATION MEASURES

7.1 Introduction

This chapter outlines in a nutshell, the recent Netherlands' policies on coastal zones and water management, water quality aspects excepted. Although these aspects form an integral part of these policies, they are only slightly influenced by climate change. Several international activities in coastal zone management will also be mentioned.

7.2 Adaptation measures

Coastal Zone Management

The 1995 evaluation of the implemented policy for 'dynamic preservation' of the 1990 coastline led to the conclusion that the 1990 coastline has been maintained at almost all locations and that the chosen strategy of beach nourishment has been successful. An analysis showed that the threats to the coast will greatly increase in the coming decades. Accelerated sea-level rise, land reclamation plans, extraction of gas and sand, and further urbanisation in the coastal area will have major consequences for the defence-against-flooding function of the coastal system. These developments call for an integrated approach, in which the different functions of the coastal area are in balance. This is an important task for the Provincial Advisory Boards, where national government, coastal provinces, water boards. coastal municipalities and shareholders cooperate.

Restoring and maintaining this function is a prerequisite for a sustainable development of the coastal areas, in other words, the natural processes in the coastal zone should not be disturbed and there must be enough space for the coastal system to adapt to new circumstances like sea-level rise. Only then will a coastal system develop which can be maintained at an acceptable cost, also in the future. The *Technical Advisory Committee on Water Defence* has recommended reserving space in the dune area to guarantee safety for the next 200 years, with a worst-case scenario of 85 cm sea-level rise and a 10% per century increase in storms (TAW, 1995).

It was decided in 1996 that structural erosion loss is to be supplemented also for the long-term, as much as possible by sand nourishment (RWS, 1996). Research will be carried out to determine the best way to supplement the loss of sediment from the foreshore (7-12 m deep) from the year 2000 onwards. The policy will be evaluated every five years and the expectations for the future, including climate change aspects, will be used to design the appropriate measures.

The design of (unavoidable) new engineering works with a long lifetime, like storm surge barriers and dams, will incorporate an expected sea-level rise of 50 cm. The first structure of this kind will be the storm surge barrier near Rotterdam, which is expected to open in 1997.

Water Management

The *Flooding Defence Act* came into force in 1996. This act mentions, the safety standards for all water defences varying from one in 10,000 to one in 1250 years. Every five years the Minister has to determine the decisive water levels matching to these frequencies. Since these decisive levels will determine the height of the embankments, the most recent knowledge on climate change can be incorporated every 5 years into the design of the flood defence.

Protection against high floods is not only a matter for the Netherlands but demands measures for the entire international catchment area. International agreements have been made for both the Rhine and the Meuse to reduce and prevent damage due to high floods. The type of measures are: land-use changes to slow down the discharge; increase in upstream storage, improvement of the protection system (like dikes) and increase in the discharge and storage capacity of the river bed. Especially the last two measures are applicable to the Netherlands. Parallel to the policy on our coastal defence, in which the capacity of the natural coast to maintain its resilience is going to be restored and maintained, is the one for the river system. This can be achieved through widening and deepening the riverbed, enlarging the flood-prone areas, developing natural areas in the winter bed of the river, regulating the settlement pattern in the flood plain and reserving space for future flooding in consideration of the influence climate change will have on the flood levels. An integrated approach, whereby the different functions of the river system here are in balance, is also essential.

Agriculture

Given the existing doubt with respect to the effects of climate change on the agricultural sector, no adaptation measures have yet been developed. It is expected that national agricultural policies, and especially the European Common Agricultural Policy, will have a greater effect on the agricultural sector than possible climate changes. Furthermore, since the agricultural sector is largely dominated by technology, potential adverse effects due to climate change are expected to be limited e.g. by improvements in plant varieties and improved water management.

Nature conservation

In order to improve the ecological situation in the Netherlands, a national ecological network of protected areas has been developed (LNV, 1990). This structure consists of a number of (partially developed) interconnected nature conservation areas in the Netherlands. The overlapping of these different areas provides natural species with the opportunity to migrate, which may also facilitate this opportunity and thus the adaptation of ecosystems to a change in climate. Forest management in the Netherlands focuses on stimulating the stability and options for forest adaptation. Stability is pursued through measures to stimulate mixed-forest planting, and to make conscious choices with respect to different kinds of trees, disease prevention and protection of genetic diversity. These measures also contribute to adaptation to climate change.

Lowering of groundwater levels and desiccation due to withdrawal of groundwater pose a threat to ecosystems and biodiversity. The Netherlands has policies to protect groundwater and surface water as a natural resource, thereby also preventing soil desiccation. This policy is described in the *Drinking and Industrial Water Policy Plan; Part 3* (VROM, 1995e). In addition, the *Third Policy Document on Water Management* (VW, 1990b) deals with safeguarding both the quantity of freshwater in the Netherlands and the chemical quality of the water itself.

7.*3* International activities

The Netherlands with its considerable experience in coastal zone management has strived to share this experience with other countries, in particular the developing countries most vulnerable to the effects of climate change. Support in this respect involves dissemination of information, e.g. via internet, or via instruments, concepts and tools, other knowledge with respect to coastal zone management, and finally, through the training of experts. The governmental *Coastal Zone Management Centre* now provides this kind of assistance to 15 developing countries and countries in transition. The cooperation gives valuable new approaches and insights for the developing country parties as well as for the Netherlands.

8. ACTIVITIES IMPLEMENTED JOINTLY

8.1 Introduction

At the first Conference of Parties in Berlin in March 1995 a pilot phase up to the year 2000 was adopted. During this period experience can be gained through *Activities Implemented Jointly (AIJ),* in which Annex I countries cooperate amongst others with themselves and with non-Annex I countries on a voluntary basis. The pilot phase is meant to explore the pros and cons of *Activities Implemented Jointly*, so that in the process, negotiations on the AJI can take place. This is to realise a cost-effective and equitable environmental instrument to jointly address climate change. No credits shall accrue to any Party during the pilot phase, so activities cannot be used to achieve national stabilisation of greenhouse gas emissions by the year 2000, a commitment of the Annex I countries under the FCCC. The Netherlands participates actively in discussions of the *Subsidiary Body for Scientific and Technical Advice* (SBSTA) on reporting and methodological issues in AIJ projects and will continue to do so. A uniform framework for reporting will make an intercomparison of projects easier. If necessary this framework can be revised during the pilot phase. AJI should lead to so-called 'win-win' situations in which both the host country and the investor must benefit. The Netherlands is therefore an active participant in the pilot phase and reports on it to the FCCC.

8.2 Netherlands initiatives in *Activities Implemented Jointly*

8.*2.1 The Netherlands AIJ Pilot Phase Programme*

The Netherlands Government decision on *Activities Implemented Jointly* was adopted by Parliament in September 1995. Key elements follow:

- AIJ will not be used for its present commitments under the FCCC. The Netherlands will, however, actively advocate the use of joint implementation for the realisation of future obligations under the Climate Convention.
- To be able to present a clear picture of Netherlands AIJ efforts, a system called 'dual accounts' will be set up. In this way emission reduction efforts at home can clearly be separated from AIJ efforts abroad.
- a Pilot Phase Programme will be set up to last until the end of this century. Annual progress reports of this programme will be sent to the Netherlands Parliament and to the Conference of Parties to the FCCC.

This *Pilot Phase Programme* (PPP) aims to carry out a broad range of projects. All greenhouse gases, not only CO_2, will be addressed. Different sources, but also sinks and economic sectors will be considered. Furthermore, the programme aims at projects both in developing countries, and in Central and Eastern Europe. In this way adequate experiences can be gathered on issues like additionality of effects compared to baseline trends, cost-effectiveness of different types of projects, legal framework and monitoring requirements, technology transfer, transaction costs and the issue of equity (simulation of 'credit-sharing'). This in fact means that matters concerning the baseline and emission reductions in the context of the 'pilot phase' will be further discussed and established by the governments of the relevant Parties on the basis of equity and mutual benefits. When agreed upon, these matters shall be tried out so as to gain initial experience on the complex issue of AIJ during the 'pilot phase'. After the pilot phase the private sector is expected to initiate AJI projects as well. To encourage private-sector participation some incentives have been included in the PPP.

The first is the formal registration of projects and certification of the emission reduction or sequestration efforts. Important criteria for project registration and annual certification are of course, first of all, the criteria agreed on by the first Conference of Parties. Dutch companies may use certified emission reduction or sequestration efforts as part of future agreements with the Netherlands Government. For example certificates could play a role in future Long Term Voluntary Agreements on energy in the Netherlands for the period after 2000.

A second important incentive for encouraging the Netherlands AIJ projects in the pilot phase is a special budget allocated for support for both AIJ projects in developing countries and Central and Eastern Europe. For the period 1996-1999, NLG 48 million (about US$ 29 million) in grants is available for supporting AIJ projects in developing countries.

This funding is part of the 0.1% to be spent on environmental projects and programmes (see Chapter 9). For projects in Central and Eastern European countries NLG 36 million (about US$ 22 million) will be available for funding and leveraging AIJ projects in these countries. Besides these incentives, support can be given to AIJ projects - on a case by case basis - by use of the existing fiscal provision of free depreciation of environmentally sound capital goods. Furthermore, a report in preparation will indicate whether or not the 'Green Stock Fund' investment schemes will be a suitable instrument to promote AIJ projects. Dividends from Green Stock Funds are exempted from income taxation. Finally, the efforts to increase support for the AIJ instrument will be continued, both at national and at international levels, with the Netherlands Government prepared to contribute actively to meetings which focus on dissemination of information on AIJ, so as to provide useful input for the FCCC process.

Criteria for eligibility of projects under the Netherlands' pilot phase are conform to the criteria set in the CoP-1 (Decision 5/CP.1). Besides forming positive climate impacts, projects should also have clearly beneficial local environmental and social impacts and be in line with host-country development priorities. Furthermore, projects should include a training component (capacity-building) for authorities and/or institutions (companies, NGOs) in the host country. Involvement of local partners is strongly encouraged.

8.*2.2 Implementation of the AIJ Pilot Phase Programme*

Agreement is first reached on a AIJ working document at interministerial level, which is actually the elaboration in practical terms of the aforementioned Government decision. Since the implementation of the Netherlands *AIJ Pilot Phase Programme* is to be a combined effort of several ministries, close interdepartmental coordination is agreed to be needed. The Ministry of the Environment has developed a system for registering projects and certifying results, and is also responsible for compiling annual progress reports of the Pilot Phase Programme. The Ministry will certify the results of the projects for the participants annually. These can be companies, governmental organisations or NGOs. Finally, this Ministry, in cooperation with the Ministry of Foreign Affairs and Economic Affairs, is responsible for initiating further research projects and communication. Some of the tasks are actually mandated to an external agency, the so-called *Joint Implementation Registration Centre* (JIRC), which has set up the necessary logistical support for the ministries involved covering the pilot phase period till 2000. The tasks of the centre are:

- to set up a registration and certification scheme, shortly to be published in the Government Gazette;
- to register projects;
- to certify projects;
- to verify and register emission reductions;
- to be responsible for supporting research and communication.

The Ministry of Environment will register and certify the (national) creditation of projects. The Ministry of Foreign Affairs will identify, select, finance and implement projects in developing countries, while the Ministry of Economic Affairs will do likewise for projects in Central and Eastern European countries. All the tasks executed by different ministries will ultimately be the common responsibility of an interministerial steering committee. The actual management of the *Pilot Phase Programme* is delegated to the Ministries of the Environment, Foreign Affairs and Economic Affairs (the so-called 'Management Group').

8.*2.3 Joint Implementation Network*

The *Foundation for the Joint Implementation Network* (JIN) was established in 1994. The Foundation is recognised by the secretariat of the FCCC as an official NGO and is financially supported by the Government of the Netherlands. JIN undertakes three types of activities:

1) *Documentation system*. The documentation system set up by JIN is intended to collect and exchange as much information as possible about all the important aspects of joint implementation worldwide.
2) *JI Quarterly and Bulletin Board*. The online Internet Bulletin Board is designed by JIN to be a supporting information system. *JI Quarterly* is a quarterly newsletter which reviews developments in the AIJ. It is currently a publication that meets the need for information about AIJ projects.
3) *Conferences*. The co-organisation on an *ad hoc* basis of conferences in Central and Eastern Europe and developing to expand the dissemina-

tion of experiences with AIJ. Emphasis in these conferences will be on the exchange of information on practical experiences.

8.2.4 Concrete AIJ Projects

Present Netherlands' AIJ projects are:

- Ecuador : Afforestation
- Uganda : Afforestation
- Czech Republic : Reforestation
- Russian Federation : Landfill gas recovery
- Russian Federation : Energy-saving horticulture
- Hungary : Fuel switch in transport
- Hungary : Demand-side management
- Bhutan : Micro-hydro-electric plant
- Romania : Energy saving at power stations.

The afforestation and reforestation projects are carried out as part of the initiative called *FACE* of the *Netherlands Electricity Generating Board* (SEP) (see *Box 8.1*).

Box 8.1 Carbon sequestration by the FACE Foundation

FACE, a foundation to promote *Forests Absorbing Carbondioxide Emission*, was set up by the Netherlands Electricity Generating Board (SEP) in October 1990 to encourage the planting of new forests to sequester CO_2 from the atmosphere. Forests planted with financial assistance from FACE are ecologically adapted to local conditions and coordinated with the project development for the region. FACE only provides assistance where there is a Memorandum of Understanding signed by the Government and when the land-owner has a real interest in the new forest. In this way FACE also contributes to solving economic or ecological problems in the project region. FACE's goal is to establish and maintain 170,000 ha of forests over a period of 25 years. At the end of 1995 about 30,000 ha - out of a total of 135,000 ha aimed at - were contracted in five countries; 11,500 ha has been planted. Including 35,000 ha in preparation for new projects, total CO_2 sequestration will ultimately amount to 115 Mton. Current projects are located in the Netherlands, the Czech Republic, Ecuador and Uganda.

Source: FACE (1996).

In addition, the following projects have been identified as potential AIJ projects, possibly starting up in 1997:

- Morocco : Solar energy as a source of rural electricity
- Bolivia : Fuel switch from oil
- China : Cogeneration in the sugar industry
- Peru : Street lighting
- Honduras : Energy-efficient lighting
- India : Biogas.

In addition, in Poland, Hungary, Ukraine and Russia new projects will be developed. As a result of increasing awareness in developing countries of the Netherlands *Pilot Phase Programme* on AJI, other proposals are expected to be submitted by developing countries. The geographical distribution of projects is fairly balanced, which fits in with the aim of addressing a broad geographical range of projects. Furthermore, three projects focus on sequestration via afforestation and reforestation, while the other's deal with emission reductions, both carbon dioxide and methane. All projects are based on a mutual written agreement (a fundamental principle of every AIJ project) between the host government and the Netherlands Government as required by the Berlin decision on the pilot phase. All the host governments involved have explicitly agreed on reporting to the FCCC.

The size of the projects differs. For example, the four forestry projects aim at afforestation or reforestation of about 150,000 hectares in the coming 25 years. This ambitious goal is supported by a substantial budget. On the other hand, the two projects in the Russian Federation and Hungary are fairly small-scale, primarily set up as demonstration projects and part of the bilateral Netherlands support programmes with the Russian Federation and Hungary. The project in Bhutan concerns a 100 kW micro-hydropower plant in a remote area. The project aims at decreasing the use of unsustainably produced fuelwood and demonstrating in what way climate-change policies can fit in within national development priorities (see *Box 8.2).*

Box 8. 2 Micro-hydropower in Bhutan

Bhutan is a country of some 600.000 inhabitants on the south side of the Himalayas, between China and India. Nature is very important to the Bhutanese people. Economic progress is not a goal in itself, but considered tolerable if the negative impacts on nature are not durable. Bhutan is endowed by natural surroundings with a vast hydro-electric potential because of its geographical location in the mountains with streams and rivers.

These elements were of great importance in the decision of the Netherlands' Ministry of the Environment to start an AIJ pilot project with Bhutan. The Netherlands Government welcomed the chance offered by Bhutan to test the AIJ concept by constructing a micro-hydro-electric plant in Lhuntsi Dzongkhag, a remote district in Bhutan with no access to electricity. Hydropower can reduce the need for kerosene and fuelwood consumption and fits well within the national electrification priorities of Bhutan. The micro-hydro-electric project's strong district development potential lies in the possibilities to increase the district's productive capacity (by making power available to the private sector), and to increase social infrastructure (by improving education, health, and drinking-water facilities) and the quality of life of its population (by providing electricity in homes).

At the end of 1995 the governments of both countries agreed on a project for a 100 kW micro-hydropower plant producing electricity for about 100 households with no CO_2 emission as a substitute to the conventional energy supply from kerosene and fuelwood. The construction of the hydropower plant will be carried out by the Bhutanese government. To assess the AIJ aspects of the project a 4-year monitoring study, to be carried out jointly by Dutch and Bhutanese consultants, has been set up to investigate the CO_2 effect and the cost-effectiveness of AJI in hydro projects.

The detailed survey and investigation of the site conditions has now been completed and the preparation for constructing the plant was started at the beginning of 1997. This project is expected to demonstrate that the global goal of reducing greenhouse-gas emissions may fit in well with socio-economic development priorities of host parties. In addition, experience will be gained in the methodology of monitoring. Institutional capacity will also be built and awareness raised for making decisions in Bhutan on the opportunities and constraints of AIJ in general and specifically for micro-hydro-electric projects. The results of the monitoring study can lay the foundation for further AJI cooperation between the Netherlands and Bhutan. Dissemination of the results to third parties is considered to be of essential value for further decision-making on AJI in the international climate negotiations

9. FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

9.1 Introduction

The Netherlands recognises the need to assist developing countries and countries with economies in transition, not only to comply with their obligations under the Framework Convention on Climate Change but also to enable them to develop effective strategies for mitigation of climate change and adaptation to the potential impacts of climate change. This chapter gives an overview of the Netherlands assistance in this field.

9.2 Financial resources

In 1995-1996 the Netherlands restructured its foreign policy to reflect a more integrated approach. The Government of the Netherlands has committed itself to allocating 0.8% of the Gross Domestic Product to *Official Development Assistance* (ODA). For 1997 this amounts to approximately NLG 6,000 million. As part of this, in 1996 the Netherlands has also committed itself to spend 0.1% of GDP in 1997 on environmental projects and programmes in developing countries, including climate change activities. These financial resources are channelled through a combination of multilateral and bilateral channels.

9.3 Multilateral assistance to meet the costs of mitigation and adaptation to climate change

The Netherlands contributes to a variety of multilateral and intergovernmental institutions assisting developing countries. These include institutions with global coverage (e.g. the World Bank, United Nations funds and programmes and the European Union) as well as regionally oriented institutions (e.g. regional development banks) and, where appropriate, non-governmental organisations.

Till the year 2000, the Netherlands' Government has set aside a sum of NLG 120 million from the development cooperation budget as contribution to the *Global Environment Facility* (GEF), the interim operating entity of the *Framework Convention on Climate Change.* At the first Conference of Parties in Berlin 1995, priority was given to the GEF to finance the development of national climate change policies and the incremental cost of projects aiming at mitigation of climate change. A phased approach has been adopted for adaptation measures, which include financing enabling studies, capacity-building and institutional development. The Netherlands also supports the major multilateral institutions and programmes in the field of climate change, e.g. the IPCC, IPCC Trust Fund, IPCC/OECD Greenhouse Gas Inventory Programme, UN-FCCC and the UN-FCCC Voluntary Fund (*Table 9.1*).

In addition, the Netherlands actively contributes to a number of international scientific programmes addressing climate change issues, including the *World Climate Research Programme* (WCRP), the *International Geosphere-Biosphere Programme* (IGBP) and the *International Human Dimensions of Global Environmental Change Programme* (IHDP). To further strengthen international coordination and research programmes, the Netherlands will continue to actively participate in the activities of the *International Group of Funding Agencies for Global Change Research* (IGFA). The Netherlands will function as the chairman and secretariat [through the *Netherlands Organisation for Scientific Research* (NWO)] for the IGFA until 1998. The Netherlands also provides additional funds for fostering coordination of interdisciplinary scientific cooperation within different core projects, e.g. in transects, and provides basic support for the staffing and operation of the *Core Project Office* (CPO) of the IGBP project *Land-Ocean Interaction in the Coastal Zone* (LOICZ), based in the Netherlands. Funding of research activities in the framework of IGBP/SARCS (South-East Asia) is done by the *Foundation for the Advancement of Tropical Research* (NWO/WOTRO). Furthermore, the Netherlands contributes to the central costs of the *European Project for Ice Coring in Antarctica* (EPICA) of the *European Science Foundation* (ESF). The development Cooperation Directorate of the Netherlands supports the *Global Change System for Analysis, Research and Training* (START) initiative of the IGBP, IHDP and WCRP to assist developing countries in national and regional capacity-building for global environmental change. A training workshop to assist small island states in improving management capacities in meteorological and hydrological fields is supported through the WMO. In the Asian region, a programme on *Geoscience for Coastal Zone Management* is supported within the *Committee for Coastal and Off-shore Geoscience Programmes* (CCOP) of ESCAP.

Apart from support of multilateral institutions and programmes mainly aimed at the climate change agenda, the Netherlands development cooperation contributes to various multilateral institutions whose work is directly or indirectly relevant to climate change. In the framework of the sustainable energy cooperation policy, focused on promotion of energy efficiency and renewable energy, the Netherlands contributes to various multilateral institutions and programmes. These include the *Energy Sector Management Assistance Programme* (ESMAP) of the World Bank and UNDP, the *Asian Alternative Energy Unit* (ASTAE) within the World Bank, the *Regional Wood Energy Development Programme* (RWEDP) of the FAO in Bangkok, the Programme for *Financing Energy Services for Small Scale Energy Users* (FINESSE) through UNFSTD, the SADC-TAU energy activities and the SADC sustainable energy training activities at ESAMI in Arusha, Tanzania. Furthermore, the Netherlands supports the *International Energy Initiative* (IEI) and has played an active role in the development of a renewable energy and energy efficiency fund at the IFC. In the framework of assistance for sustainable forest development activities in developing countries, the Netherlands supports the FAO initiative, *Tropical Forestry Action Plans* (TFAP) which includes policy development and the implementation of concrete projects.

9.4 New and additional multilateral assistance to meet the costs of mitigation and adaptation to climate change

Programmes and projects involving mitigation and adaptation to climate change, include ongoing and new activities for Netherlands multilateral assistance. These programmes are being financed out of the 0.1% of the Netherlands' GDP to be spent on international environmental projects and programmes (see Section 9.2) out of the total development assistance budget of 0.8% of the GDP. However, for technical reasons it is not possible to single out such assistance from other development assistance programmes.

9.5 Bilateral assistance to meet the costs of mitigation and adaptation to climate change

As mentioned in Section 6.3, the Netherlands supports, on request, a number of countries in carrying out a vulnerability assessment to climate change, with focus on coastal zones as part of the adaptation measures. The vulnerability assessments form one of the first steps towards an *Integrated Coastal Zone Management Programme*, which aims at sustainable development of the coastal area taking into account long-term aspects like climate change. Vulnerability assessments have been completed in Bangladesh, Egypt, Poland and Vietnam. These projects are presently being followed up with assistance in developing integrated coastal zone management, taking into account potential long-term effects of climate change. This cooperation provides valuable new approaches and insights both for the parties in the developing country and the Netherlands.

Following the general objectives of the UN-FCCC, the Netherlands Development Cooperation Department started the *Climate Study Programme* in 1996 to assist non-Annex I countries in formulating their own national climate policy. Parallel to this assistance, the country receives assistance in preparing its *National Communication*, which focuses on formulating the basic needs for national climate policies, study proposals focusing on mitigation and adaptation topics, including an outline of the draft *National Communication*.

Seven countries, Bolivia, Costa Rica, Ecuador, Ghana, Senegal, Surinam and Yemen participated at the start of the *Climate Studies Programme*. In Bolivia, the focus was on updating the 1990 inventory; an impact and adaptation study to include revision of climate change scenarios, agriculture, forestry and water resources; a mitigation study in the energy and forestry sector, and the preparation of the *National Communication*. In Ecuador the assistance focuses specifically on coastal zone management. Surinam has not yet ratified the FCCC nor has it conducted any climate change studies. To meet its future commitments under the FCCC, Surinam has received assistance in carrying out an emission inventory and studies on coastal zone management as inputs for initial communications to the climate convention. Building on earlier climate change studies, Costa Rica will be assisted by the *Climate Studies Programme* to study impact and adaptation, including agriculture, forestry, coastal zone management and the preparation of the *National Communication*. In Yemen, the *Climate Studies Programme* complements the UNDP/GEF-funded emission inventory and mitigation study by providing assistance for an impact and adaptation study, including agriculture and water resources, and for preparing the *National Communication*. Finally, the programme assists Ghana in impact and adaptation studies on water resources and coastal zone management, including the preparation of its *National Communication*, and Senegal in impact and adaptation options for agriculture and coastal zone management, plus its *National Communication*. The country studies are expected to be finalised by June 1998. Other countries showing interest in participating in the *Climate Studies Programme* are Mongolia, Kazachstan and Bhutan.

9.5.1 Cooperation with developing countries

Environmental issues have an integral role of the terms of reference in the Netherlands bilateral development cooperation with developing countries. This makes it difficult to specifically single-out the programmes and projects with a component relevant to mitigation and adaptation of climate change issues. A limited number of activities directly relevant to this subject can, however, be mentioned.

The development cooperation policy in the *energy* sector recognises that in facing the threat of global warming, all countries, industrialised and developing, have to develop new energy paths to enable a growing world population to achieve sustainable well-being without bringing about unacceptable climate change. To this end, emphasis is placed on energy efficiency, renewable energy (solar, wind, biomass, sustainable micro-hydro), and clean-energy technologies through development of sustainable energy policies, promotion of energy efficiency, planning and dissemination, and institutional and capacity-building. Biomass reserves will be better monitored, while a rational consumption of current reserves will be fostered, most often in the framework of sustainable land-use and forestry projects.

Although the primary focus of *sustainable land-use and (agro-)forestry* projects is on sustainable rural development, without endangering local resources and biodiversity, projects and components can be directly or indirectly relevant to climate change as well. In many developing countries, the main greenhouse gas emissions are caused by land-use changes, combustion of biomass, burning of agricultural lands, deforestation and livestock farming. Furthermore, sustainable land use and forestry are very significant for the vulnerability and adaptation to impacts of climate change. For instance, several forestry projects are supported (including the PIN project, see Section 9.5.2) to help capture and store CO_2. These are, at the same time, important for the implementation of effective coastal zone management strategies such as that for the mangrove forest.

9.5.2 Cooperation with Central and Eastern Europe

The Netherlands will intensify cooperation with Central and Eastern European countries in a broader sense and in the longer term. To this end, it will build on the initiatives already developed:

- continuing and intensifying the section on Energy and Environment of the *Programme of Eastern European Cooperation* (PSO);
- supporting Latvia and Hungary with the drawing-up of climate programmes and the analysis of cost-effective measures;
- setting up a programme for training and small-scale projects aimed at energy conservation (SCORE);
- continuing and intensifying the *Social Transformation Eastern Europe Programme* (MATRA).

The principles of the Netherlands as regards the cooperation with Central and Eastern Europe are both to broaden support for the climate issue in these countries and to stimulate measures to restrict greenhouse gas emissions. To help expand support for energy conservation policy in this region in particular, the SCORE project (SCORE being an acronym for *Supporting the Cooperational Organisation of Rational Energy use*) will be introduced, its initial targets being Latvia, Poland and Hungary. The demand side of energy supply ('demand side management') has priority here. The first step will be an inventory of the conservation options. Subsequently, advice and training of local authorities/municipalities on the 'no regret' options form an important element of the project. Finally, projects within SCORE may be identified for realisation either as a Joint Implementation project or within the framework of the *Programme of Eastern European Cooperation* (see below). The aim is to extend the SCORE project in the years to come to other Central and Eastern European countries.

Apart from the SCORE project, it is necessary to realise support for concrete climate-related projects in this region. Therefore, the PSO Energy Programme should be intensified for 1997 and beyond. The current activities of the Netherlands, carried out in the framework of the PSO programme, are summarised in *Table 9.2.a*. Within the margins defined for intensified international policy, as described in the policy document *'The Foreign Policy of the Netherlands: a Review'* (BUZA, 1996), the Netherlands has pledged intensive cooperation with Central and Eastern European countries on climate issues. This concerns, in particular, the stimulation of expertise at governmental level ('capacity-building') and the implementation of concrete energy projects. The Netherlands will call on other Annex I countries to take similar initiatives. In addition, it will advocate within the EU investments in infrastructure and capacity-building. In this way, agreements made at the Sofia Conference in October 1995 on environmental cooperation in Europe can be made more concrete.

From the study currently in progress in an Annex I context on the potential for energy-efficiency improvement in Central and Eastern Europe and the relevant financing mechanisms available, it can already be concluded that while much potential is available, investments and loans from multilateral development banks lag far behind what is needed to realise this potential. The Netherlands will support the making of agreements - within the framework of the protocol and beyond - as a means to removing these financial barriers. In this context, OECD activities aimed at Central and Eastern Europe can also make a positive contribution.

As part of the *International Nature Policy Project* (PIN), support is given to the development of nature conservation policy in Central and Eastern Europe and in developing countries. This project also supports the absorption of CO_2 by trees and plants, hence assisting in limiting climate change.

In view of the considerable reduction potential and the high cost-effectiveness of energy conservation projects in Central and Eastern Europe, the Netherlands will also be demanding more attention for financing such projects within the framework of international cooperation and investment programmes currently in progress.

9.6 New and additional bilateral assistance to meet the costs of mitigation and adaptation to climate change

Although the bilateral assistance activities in the specific field of climate change are new and additional as mentioned in Section 9.4, it is not really possible to list them separately from other development assistance projects and components.

9.7 Projects and programmes on transfer of or access to 'hard' and 'soft' technologies

The multilateral and bilateral assistance programmes discussed above support developing countries in acquiring climate-friendly technology and know-how. In direct technology transfer, the private sector plays a very important role because the ownership of the climate-friendly technologies generally lies with the private sector rather than with governmental or multilateral institutions. The Government of the Netherlands has taken up the cause of developing a favourable environment to stimulate private-sector participation in the transfer of climate-friendly technologies to developing countries. Finally, transfer of 'soft' technology through capacity-building, training and research is a key element of the Dutch development cooperation and an integral part of assisting the technology transfer process. Where appropriate, the private sector participates in such activities.

Miliev

The *Miliev Programme* is specifically developed to support initiatives of the Dutch private sector to improve the state of the environment in developing countries through technology transfer. Through this programme, support can be given to direct mitigation of environmental degradation, reduction of pollution through end-of-pipe technology or clean production technology, application of renewable energy and material technologies and development of environmental policy plans. Relevant activities for the climate sector, which are supported through Miliev, include wind generator projects, and low NO_x burner dissemination. The *Miliev Programme* has been budgetted at NLG 13 million for 1996 (see *Table 9.3*)

Table 9.1 Financial contributions to the operating entity or entities of the financial mechanism, regional and other multilateral institutions and programmes

	Contribution (millions of US$)*		
	1994	1995	1996**
Global Environment Facility (GEF)	Up to the year 2000: 64		
Multilateral institutions			
• INC Voluntary Fund	0.22		
• IPCC	0.17		
• UNFCCC Voluntary Fund		0.08	0.08
• CCOP		0.07	0.03
Multilateral training programmes			
• KNMI/WMO management of meteorological and hydrological services			0.19
Multilateral scientific programmes			
• IGBP	0.01	0.01	0.01
• IGBP/WCRP/IHDP intercore activ. (OCW/NWO)		0.01	0.05
• IGBP/CPO/LOICZ (OCW/NWO)	0.50	0.50	0.50
• SARCS research SE Asia (NWO/WOTRO)	0.15	0.15	0.15
• ESF/EPICA			1.50
• START			0.24
Other relevant multilateral assistance:			
• sustainable energy institutions and programmes***	9.3	12.0	12.0

* Rate of exchange: US $1 = NLG 1.90.

** At the time of preparing this report, the 1996 financial year had not yet been closed. Values indicated refer to estimated allocations.

*** The multilateral contributions have been included on the basis of calculated average annual contributions to account for the fact that contributions booked in a single year are relevant for a longer period.

Table 9.2.a Bilateral financial contributions related to the implementation of the Convention

	Contribution (millions of US$)* 1994	1995	1996**
Climate Study Programme	Up to 1998: 3.7		
Support to climate-related workshops	0.10	0.06	0.10
Coastal Zone Management (adaptation):			
• Bangladesh	0.16		
• Egypt	0.08	0.08	0.08
• Nicaragua			0.20
• Poland			0.06
• Vietnam	0.05	0.05	0.05
• Seminar Ghana			0.03
• Seminar Uruguay			0.01
Other relevant bilateral assistance:			
• PSO (mitigation)	8.7	13.1	18.3
• Development cooperation sustainable energy projects, including Miliev*** (mitigation)	4.0	5.4	9.1

* Rate of exchange: US $1 = NLG 1.90.

** At the time of preparing this report, the 1996 financial year had not yet been closed. Values indicated refer to estimated allocations.

*** The assistance budgets indicated cover actual disbursements only to projects directly distinguishable as having relevance to mitigation and adaptation. Various other projects and components of projects have direct or indirect relevance.

Table 9.2.b Specification of bilateral financial contributions under the PSO programme (in mln US$)

Recipient country	Mitigation type	1994	1995	1996
PSO total	**Energy & environment**	**8.7**	**13.1**	**18.3**
Czech Republic		0.0	1.1	0.0
Hungary		0.9	1.6	1.6
Latvia		0.0	0.6	0.6
Lithuania		0.0	0.0	1.3
Poland		0.1	1.3	1.3
Romania		0.0	0.0	1.0
Russian Federation		4.6	5.8	7.0
Slovakia		0.6	0.0	1.0
Slovenia		0.0	0.0	0.6
Ukraine		2.5	2.7	4.0

Table 9.3 Projects of programmes that promote, facilitate and/or finance transfer of or access to 'hard' and 'soft' technologies (actual disbursements)

Contribution (millions of US$)*	1994	1995	1996**
Miliev Programme	0.5	1.3	6.8

* Rate of exchange: US $1 = NLG 1.90.

** By the time of preparing this report, the 1996 financial year had not yet been closed. Values indicated refer to estimated allocations.

10. RESEARCH AND SYSTEMATIC OBSERVATION

10.1 Introduction

Research activities, both policy-supporting and applied climate research, are taking place at the *Royal Netherlands Meteorological Institute* (KNMI), the *National Institute of Public Health and the Environment* (RIVM), the *Netherlands Energy Research Foundation* (ECN), the Netherlands' *Organisation for Applied Scientific Research* (TNO), the *NWO Netherlands Institute for Sea Research* (NIOZ*)*, *Netherlands Institute for Ecological Research-Centre for Estuarine and Marine Research* (NIOO-CEMO), and at many universities. Research in the Netherlands contributes significantly to the work of the *Intergovernmental Panel on Climate Change* (IPCC), for example in the field of integrated global models and emission calculation methodology. According to the IPCC, a joint and coordinated international research effort remains essential to effectively supplement gaps in knowledge and to reduce uncertainties. Furthermore, the broad participation of countries (including those in development) in international research and observation programmes is essential according to the IPCC. The Netherlands actively contributes to various international research programmes, including the *World Climate Research Programme* (WCRP), the *International Geosphere-Biosphere Programme* (IGBP) and the *International Human Dimensions of Global Environmental Change Programme* (IHDP) (see Section 9.3). These programmes relate to both scientific, and socio-economic and cultural, aspects of the climate issue, forming the basis of IPCC's work.

10.2 National research programmes

National research programmes supporting climate change research are:

- *National Research Programme for Global Air Pollution and Climate Change* (NOP-MLK);
- *Netherlands Organisation for Scientific Research* (NWO) global change programme;
- *National Remote Sensing Programme* (NRSP);
- *Earth Observation User Support Programme*.

Other contributions to the Netherlands' climate change research infrastructure are through committees of the *Royal Netherlands' Academy of Arts and Sciences* (KNAW) (see Section 10.2). Besides these KNAW committees the Netherlands also has a number of topic centres on climate change (see Section 10.3). Apart from directly climate-related research, the Netherlands carries out a number of programmes on energy conversion, energy conservation and renewable energy (see Section 10.9 and Chapter 4).

10.2.1 National Research Programme on Global Air Pollution and Climate Change

National research activities are supported and to a significant degree guided by the *National Research Programme for Global Air pollution and Climate Change* (NOP-MLK), in which the ministries responsible for the *NEPP's* and NWO participate. The first phase of this programme (1990-1995) has now been completed and the second will run from 1995-2001. The NOP-MLK programme is broad in scope, considering both the fundamental questions of the global climate issue and policy-specific strategies for solutions. An overview of the research carried out during the first phase of the NRP can be found in the proceedings of the international conference, organised to conclude NRP-I in 1994 (Zwerver *et al.*, 1995). As an illustration of the wide scope of climate-related research in the Netherlands *Box 10.1* presents an overview of studies currently carried out within the NRP. The NRP-II is categorised into four themes (percentages indicate budget allocation):

I. Dynamics of the climate system and its components [33%]
II. Vulnerability of natural and societal systems to climate change [22%]
III. Societal causes and solutions [29%]
IV. Integration and assessment [16%].

The NRP-II budget amounts to NLG 47 million. NRP-II is commissioned in three segments, during which a shift from a science-driven (bottom-up) programming of the research to a more policy-driven (top-down) approach is realised. The policy priorities play a major role. The first segment has been contracted completely bottom-up, while programming of the second and third section is based on policy priorities. Projects in the first and second segment started between 1995 and 1997; projects in the third segment will start at the end of 1997 or beginning of 1998. About 80, mostly large, projects are expected to be contracted in NRP-II.

In the coming years, a matter of serious concern for NRP will be to meet the demand for policy-relevant information for the development of national and international climate policies. Besides the regular research budget, a budget specially dedicated to support short-term policy-relevant projects is available. With respect to supporting policy, extra focus will be put on the integrated assessment function of the programme and the communication on the results of research projects.

The second phase of NOP-MLK is to be completed in 2001. But even after that, the Netherlands will still require a substantial research effort in climate. After all, the climate issue is a long-term problem. The Ministry of Environment will take the initiative in ensuring that the research effort can continue at a level to be determined. Further agreements will reached through *NEPP 3* on the resources available, the organisation and the programme-based approach to climate research after 2000.

Box 10.1 National Research Programme for Global Air Pollution and Climate Change (NRP)

A total of 250 projects were carried out in Phase I of NOP-MLK (NRP-I). Research projects now performed in the second phase of this programme are grouped according to the following four themes:

I. Dynamics of the climate system

Research is focused on material flows, greenhouse gases and aerosols, physical climate processes and climate variability, predictability and scenarios. Projects deal with, for example, methane emissions from rice paddies, the influence from clouds and aerosols on the radiative balance, methane emissions in north-west Europe, greenhouse gas emissions from grasslands and the ice sheet in Greenland.

II. Natural and societal impacts

A distinction can be made between vulnerable systems in the Netherlands and the region (Europe), and vulnerable systems in the global perspective. The first segment of NRP-II saw the launch of projects focusing in particular on the vulnerability of ecosystems in the Netherlands: the Wadden Sea, riverine systems, the Rhine, and forests both in the Netherlands and Europe. One project, however, is directed to the influence of climate change on semi-arid areas (West Africa). Initiatives have also been taken to start research into the vulnerability of societal systems, such as studies on public health, water availability and supply, and the economic aspects of climate change impacts.

III. Societal causes and solutions

Here, the focus is on the question of how anthropogenic climate change can be prevented or mitigated. Research activities include land-use, energy and material systems, mobility and transport, lifestyles and consumption patterns, perceptions and attitudes, and institutions and instruments. Research has started into the possibilities of cost-effective CO_2 reductions in the European energy and material systems, tradable permits, sustainable biomass energy systems and change in household consumption patterns.

IV. Integration and assessment

A strong effort is made to collect and combine the available knowledge produced in the other NRP themes and research. Besides integration of these results, it is most important that insights are communicated between science, policy and society. Here, the objective of the research is to develop instruments for integrated assessment and for fostering the dialogue between science and policy. Projects are focused on multiscale land-use modelling, further development and use of the IMAGE-2 model; furthermore, they stimulate the use of the EDGAR emission database and the possibilities of local climate policy. New projects will focus on enhancing the dialogue between science, policy and society so as to explore long-term solutions in formulating climate policies.

10.2.2 NWO global change research programme

In addition to its participation in the NOP-MLK, the *Netherlands Organisation for Scientific Research* (NWO) fosters research in the framework of the *Global Change Priority Programme* (1990-1998). This programme has a broader scope than the climate-focused NOP-MLK, including research on Antarctic systems in the framework of the *Scientific Committee on Antarctic Research* (SCAR) and the *European Science Foundation* (ESF), and the several research programmes on coastal zones in south-east Asia in the framework of the *South-East Asian Regional Committee on START* (SARCS), the *NWO Foundation for the Advancement of Tropical Research* **(**WOTRO) and the IGBP Core Project *Land-Ocean Interaction in the Coastal Zone* (LOICZ). The programmes on coastal zones in Asia aim at capacity-building as well. An overview of Dutch research has been made in the framework of the *IGFA Resource Assessment*. In additon, the *Foundation for Earth Sciences* (GOA) and the *Space Research Organisation Netherlands* (SRON) fund climate research on a regular basis.

10.2.3 KNAW contribution to climate change research

The *Royal Netherlands' Academy of Arts and Sciences* (KNAW) also contributes to the Netherlands' climate change research infrastructure through the activities of a number of committees. These include the *Climate Committee*, advising the Netherlands' Government on subjects relating to climate change (also acting as national WCRP Committee); the *MAB/SCOPE/IGBP Committee*, coordinating national activities within the framework of international programmes on *Man and Biosphere* (MAB), the *Scientific Committee on Problems of the Environment* (SCOPE) and IGBP; and the *HDP Committee*, established in 1994, advising the Netherlands' Government on issues of human dimensions of global change and coordinating Netherlands' input into the *International Human Dimensions of Global Environmental Change Programme* (IHDP) of the *International Social Science Council* (ISSC).

10.3 The CKO, CPO and CZMC topic centres

The *Netherlands Centre for Climate Research* (CKO) was established in 1995, with the support of both the Ministries of Education, Culture and Sciences (OCW); Transport, Public Works and Water Management (VW); Agriculture, Nature Management and Fisheries (LNV) and Housing, Spatial Planning and the Environment (VROM), and Utrecht University. The CKO represents a cooperation between the *Institute for Marine and Atmospheric Research* (IMAU) of Utrecht University, RIVM and KNMI. Cooperation with the German *Max Planck Institutes* in Mainz (atmospheric chemistry) and Hamburg (meteorology) is being sought on the advice of an international committee chaired by professor dr. P.J. Crutzen of MPI Mainz (RUU, 1996). To strengthen this bond, the Ministry of Sciences has reserved a budget of NLG 6 million for the period 1997-2002. Cooperation between the *National Institute for Coastal and Marine Management* (RIKZ) and the German oceanographic institutes in Bremen is being consolidated, while cooperation with other Netherlands' institutes is currently being evaluated. The CKO aims to enhance the quality and impact of climate research in the Netherlands, in general, and research in 'Climate variability and climate change' and 'Atmospheric composition and climate processes', in particular. A second objective of CKO is to strengthen the international position of the Netherlands' climate research.

The *NWO Netherlands Institute for Sea Research* (NIOZ) houses the *Core Project Office* (CPO) of the IGBP core project *Land-Ocean Interaction in the Coastal Zone* (LOICZ) with the support of the Ministries of OCW, VW and LNV. The present commitment expires at the end of 1997. Furthermore, the *International Coastal Zone Management Centre* (CZMC) is housed by RIKZ.

10.4 Research on impacts

Since projections of the future climate are highly uncertain on regional scales, impact studies mainly focus on changes in the vulnerability of, for example, ecosystems under different scenarios of climate change. A major research issue is the impact of climate change on the discharge of water and sediment by the rivers Rhine and Meuse, and the consequences for the highly controlled inland water systems of the Netherlands. Another key issue is the impact of climate change and sea-level rise on the Wadden Sea, the major coastal tidal flats classified as European wetland reserve.

The Netherlands with its considerable experience in coastal zone management has strived to share this experience with other countries, in particular the developing countries most vulnerable to the effects of climate change. Support in this respect involves dissemination of information on coastal zone management and training of experts. The *Governmental Coastal Zone Management Centre* now provides this kind of assistance to 15 developing countries and countries in transition. For more details we refer to Chapter 7.

10.5 Modelling and prediction

Research activities in the Netherlands often aim at modelling. Many models are used to analyse or to project economic activities and/or related emissions; in some cases modelling is the research activity itself. At the national level, a set of models at CPB, ECN and RIVM are used especially to define scenarios for the *National Environmental Outlooks* (see *Box 10.2*). Contributions to the internationally coordinated projects of WCRP and IGBP are manifold and include modelling ocean circulation, ocean-atmosphere interactions (energy, water, CO_2), soil-vegetation-atmosphere fluxes, atmospheric processes, CO_2 flux models (e.g. those based upon high resolution isotopic analysis), compilation of global emission inventories, modelling impacts of climate change and land use on river discharge, icecap balances (Greenland and Antarctica-EPICA), etc. Contributions to *Global Circulation Models* (GCMs) are aimed mainly at improving components of the ECHO coupled GCM (Hamburg) and adding atmospheric chemistry to this model. Another category of models deals with the economic impacts of CO_2 emission reduction policies.

The IMAGE 2 model has a special role, in that it represents an integrated model designed to simulate the dynamics of the global society-biosphere-climate system. The objectives of the model are to investigate linkages and feedbacks in the system, and to evaluate consequences of climate policies (Alcamo *et al.*, 1996). The IMAGE model is extensively used for IPCC assessments, e.g. of emission scenarios. Recently, to support climate negotiations, the IMAGE 2.1 model was used to calculate a number of feasible 'safe landing corridors' for the period 2000-2020, i.e. the allowable range of greenhouse gas emissions, based on normative principles or calculation rules for the period up to 2100 adopted by the Netherlands Government:

- a rise in temperature of less than 2 °C since the pre-industrial era;
- a maximum rise in sea-level of 50 cm;
- in principle, the global temperature should not rise faster than 0.1 °C per decade (a rule which may be exceeded in the model for one decade after 2020);
- a maximum feasible global emission reduction of no more than several per cent (1-4%) per year.

Box 10.2 Models maintained in the Netherlands

MARKAL:	an IEA LP planning model for energy production, technology and end-use markets (ECN)
SELPE:	LP energy supply model (ECN)
SAVE:	energy demand simulation model (ECN)
CENECA:	econometric model relating energy consumption to data of economic and technological development, and energy policy (CPB)
WORLDSCAN:	macro-economic model generating economic growth for world regions (CPB)
RIM+:	emission information and projection model (RIVM)
ECBILT:	coupled ocean-atmosphere model (KNMI)
IMAGE:	Integrated Model to Assess the Greenhouse Effect, a global dynamic simulation model for quantitative policy assessments of global change (RIVM)

10.6 Climate process and climate systems studies

Most of the modelling activities are based on observational or experimental research. A wide variety of research is performed in the framework of WCRP and IGBP. The scope and scale of research projects vary from molecular genetic research on the production of trace gases up to analysis of satellite radar images of wind-wave relations and ocean circulation. Challenging problems are, for example, improving the resolution of techniques applied and combining upscaling and downscaling techniques in relation to experimental results or in situ observations.

10.7 Data collection, monitoring and systematic observations

Apart from climate research, the observation and monitoring of the climate system is of importance to climate research and climate policy. It is necessary to understand climatic processes, validate models and ensure the timely detection of climate changes. Monitoring is also necessary for a timely evaluation of the policy objectives, by determining greenhouse gas emissions, measuring greenhouse gas concentrations and aerosols, radiative forcing and its effect on climate, and determining the effect of climate change on the earth and the effects of policy measures.

10.7.1 Monitoring of emissions

Netherlands emissions are maintained and annually updated in the national *Emission Registration* system (ER), which consists of emissions of large point sources ['ER-I'], supplemented with emissions of other anthropogenic sources. Agreements have been made between the research institutes in the Netherlands to ensure a uniform method of registration in determining the Netherlands' emissions of CO_2 and other greenhouse gases. Resulting emissions inventories are published annually in the *Annual Emissions Report* [EJR] (e.g. VROM, 1996d) and in a report to the EU in the framework of the Monitoring Mechanism on Greenhouse Gas Emissions and to the secretariat of the UN-FCCC (e.g. Spakman *et al.,* 1996). In view of the large uncertainties surrounding the non-CO_2 emissions, continuous efforts are made improve the accuracy of national emission estimates, in particular of methane, nitrous oxide and fluorocarbons. Based on the experience in the Netherlands on the compilation of emission inventories, contributions are being made to improve the *IPCC guidelines* as applied to the *National Communications*.

Estimates of *global* greenhouse gas emissions are compiled and updated regularly in the EDGAR database, which is maintained in close cooperation with the *Global Emissions Inventory Activity* (GEIA), an activity of the *International Global Atmospheric Chemistry* (IGAC) programme of IGBP.

10.7.2 Climate system monitoring

In an international context the Netherlands contributes to maintaining and improving a global observing system. This applies, in particular, to participation in European programmes in Earth observation, such as the satellite programmes of the *European Organisation for the Exploitation of Meteorological Satellites* (EUMETSAT) and the *European Space Agency* (ESA). In addition, the Netherlands is actively involved in the *Global Climate Observing Systems (*GCOS), the *Global Terrestrial Observing Systems* (GTOS), and *Global Ocean Observing Systems* (GOOS). The budget allocated by the Netherlands Government for the European Earth observing programmes and the national user support programmes is currently NLG 50 million per year.

The data obtained through Earth observation can be used for monitoring the concentrations of greenhouse gases and aerosol, the dynamics of the atmosphere, radiative processes and radiative forcing, the oceans and continents, and for further enhancing our knowledge on these topics. In particular, the monitoring of the abundance and distribution of ozone and other greenhouse gases by instruments on satellites for Earth observation, such as GOME on the ERS-2 and SCIAMACHY on ENVISAT, increases the expertise of the Netherlands used world-wide by the scientific and operational community concerned. Furthermore, results of climate models will be validated with Earth observation data. Priorities for investment in Earth observation with respect to climate change are coordinated by the European satellite organisations in relation to world-wide efforts. The Netherlands plays an active role in the evaluation of these priorities.

In the Netherlands, meteorological observations date back to about 1850/1900, depending on the weather variable considered. KNMI stores and manages the climate data collected at monitoring stations in the Netherlands. At present, there are about 400 observation stations in the Netherlands. 370 Weather variables (including radiosonde data from De Bilt) gathered at the observation stations form the basic data of the Netherlands' weather database. Validated basic data have been made accessible online for the last five years. Derived data calculated after validating the basic data (for instance, daily mean temperature, monthly precipitation, etc.) remain available online.

10.7.3 Availability of databases

A number of databases are maintained in the Netherlands for policy making and research activities (see *Box 10.3)*. Data from the *Emission Registration* (ER) and RIM+ systems are available for national policy-making and data from the annual *States of the Environment* (via CD-ROM) and from the *Emission Database for Global Atmospheric Research* (EDGAR) (electronically via anonymous FTP) for policy-making and climate change research. Requests for EDGAR data have been received e.g. for policy-making on the subject of air traffic, for determining default emission factors for *IPCC guidelines*, and gridded data for NRP and other projects. In addition, data compiled for validating the IMAGE 2 model have been assembled by RIVM in the *Hundred Year Database of the Environment* (HYDE), which is now also accessible for external users.

Access to the *climate database* is coordinated in the climatological service division of KNMI. The database enables weather forecasters to make comparisons between future (forecasted) and past weather, and scientists to validate their models against observational data or perform diagnostic studies. Climatological services may use the database for the reconstruction of weather situations and the preparation of data series requested for specific days, months or seasons. Requests also are submitted by insurance companies (to verify the weather at times of traffic accidents or storm damage) and engineering companies in the fields of agriculture, energy supply, natural and water resources, tourism, industry, urban design and transportation. Finally, the database is used to provide television, radio and newspapers with appropriate data for their public information tasks.

Box 10.3 Databases maintained in the Netherlands

ER:	Emission Registration, national data retrieval system for emissions of point and area sources (VROM/RIVM)
RIM+:	emission information and projection model (RIVM)
ICARUS:	information system on energy conservation and application of resources based on a sectoral approach. Database and scenario model contain energy-saving and CO_2-reduction measures (RUU/NWS)
NEEDIS:	database containing sectoral data on national energy consumption, efficiency and intensity (ECN)
Climate database:	data collected at observation stations in the Netherlands (KNMI)
EDGAR:	Emission Database for Global Atmospheric Research contains global sectoral emissions of greenhouse gases and ozone-depleting compounds by country as well as on a 1^ox1^o grid. Because of EDGAR's structure, activity levels, emission factors and emissions can be extracted per sector and aggregated over regions or latitudinal bands (RIVM/TNO)
HYDE:	Hundred Year Database of the Environment containing various historical data required to test the IMAGE 2 model (RIVM).

10.8 Socio-economic analysis

With regard to socio-economics aspects of climate change emphasis is put, on the one hand, on research into options to reduce emissions of CO_2 and other greenhouse gases due to residential activities and industrial production systems as well as by use of biomass, while on the other, on research into a system of tradable permits. To support the stabilisation of emissions and their potential reduction after the year 2000, sectoral studies are carried out into potential measures and costs, possibilities of and restrictions in the range of policy instruments and an exploration of exchange mechanisms.

10.9 Technology research and development

The control or reduction of the principal greenhouse gas, CO_2, is linked mainly to utilisation of renewable energy and an increase in energy efficiency. The Netherlands is making great efforts here as well (see Chapter 4). The relevant R,D&D forms part of the energy policy as described in the *Third White Paper on Energy Policy* (EZ, 1995b). In 1997 about NLG 330 million is spent on R,D&D and technology transfer in about 20 programmes on energy conservation and renewable energy; about one-third of the budget is allocated to renewable energy sources (see *Fig. 10.1*). For more information we refer to Section 4.1.1.

Part of the Netherlands' development cooperation with developing countries involves technology transfer, e.g. of energy-efficient, renewable or clean technologies, also involving the private sector, for example through the *Miliev Programme*. In addition, cooperation programmes with Central and Eastern Europe such as *PSO* and *SCORE* aim at improving energy-efficiency and energy technology in this region. More information on these activities can be found in Chapter 9.

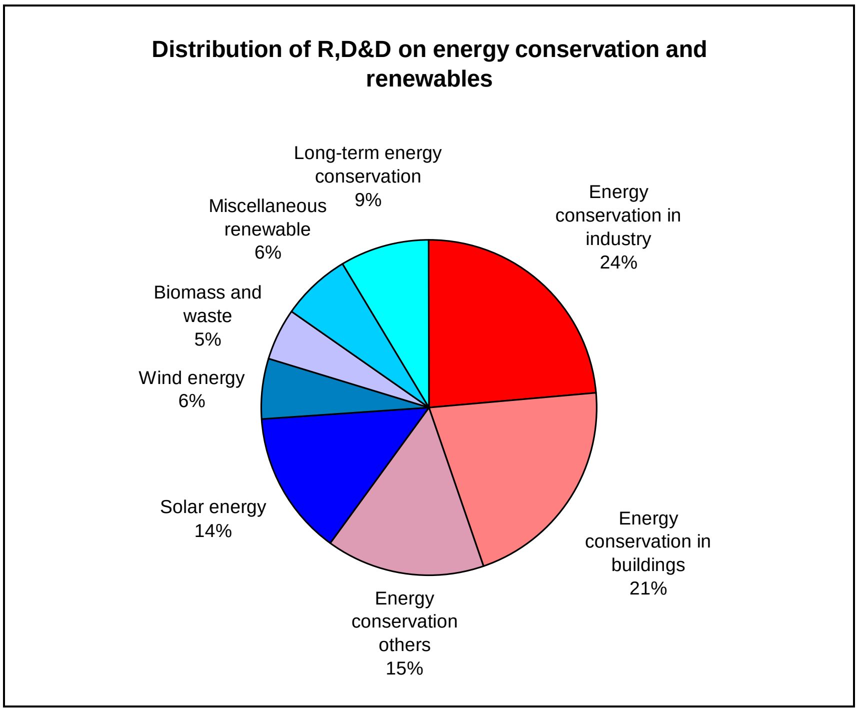


Fig. 10.1 R,D&D priorities for energy conservation and renewable energy (1997 budget of NOVEM programmes).

10.10 Direction of research and monitoring in the future

In the years to come, besides research on the scientific aspects of the climate system, the Dutch contribution to international research will again be aimed at finding global and regional strategies in the long term to satisfy the commitments under the Framework Convention on Climate Change. Here, global integrated models will play an important role. To support the relevant protocols and scenarios studies, an insight into the cost-effectiveness of measures for emission reduction and adaptation, and insight into the effectiveness of administrative instruments, will be required.

To further reinforce international coordination and research programmes, the Netherlands will continue to actively participate in the activities of the *International Group of Funding Agencies for Global Change Research* (IGFA). Until 1998, the Netherlands will function as the chair and secretariat (at NWO) for the IGFA. In addition, the Netherlands supports the 'Climate Agenda' initiative of the WMO's *World Climate Research Programme* to promote more effective cooperation between international climate-related programmes. Attention will also be devoted to European research cooperation, particularly via the *European Framework Programme*. The Netherlands will support the European contribution to global programmes by supporting the establishment of the *Fifth Framework Programme*.

Ref.:

(Climate Change Research: Evaluation and Policy Implications. Proceedings of the International Conference, The Netherlands, 6-9 December 1994. Editors: S. Zwerver, R.S.A.R. van Rompaey, M.T.J. Kok and M.M. Berk. Studies in Environmental Science 65 A and B, 1995, Elsevier).

Third White Paper on Energy Policy (EZ, 1995).

RUU, 1996.

VROM (1996d) *Annual Emissions Report 1996* (in Dutch) [EJR].

Alcamo *et al. (*1996).

Spakman *et al.* (1996)

11. EDUCATION, TRAINING AND PUBLIC AWARENESS

11.1 Introduction

The uncertainty about the reality of climate change and its causes has been substantially reduced in the last five years. Thus the emphasis has shifted from Phase 1 of the 'policy life-cycle' to Phase 2: from 'recognition' to 'policy development'. In this phase the emphasis is on achieving political and social consensus on the seriousness and extent of the consequences of the problem in relation to control measures required and the distribution of the burden. Naturally, developments in the policy-making process also affect the role and the essence of communication and information campaigns. Communication does not aim at recognition of the problem and setting agendas, but instead focuses on maintaining, and whenever possible on enlarging the support for climate policy. In addition, awareness creation has to be strengthened, in particular with respect to the gravity and the urgency of the consequences of climate change.

11.2 Research on information campaigns

Since 1980, research has been conducted every six months into the involvement of citizens in about 45 social issues of various types including, from 1990, the subject of climate change. The involvement of the public in climate change issues appears to be related to public information campaigns and publicity on current events (see *Fig. 11.1).* A peak in public involvement occurred in 1992, coinciding with the 'Earth Summit' on global environmental issues in Rio de Janeiro and with the first large-scale information campaign by the Government on climate change enlisting the mass media (1990-1993). The increase of involvement in 1995 coincides with the publicity on the Second Assessment Report of the *Intergovernmental Panel on Climate Change* (IPCC).

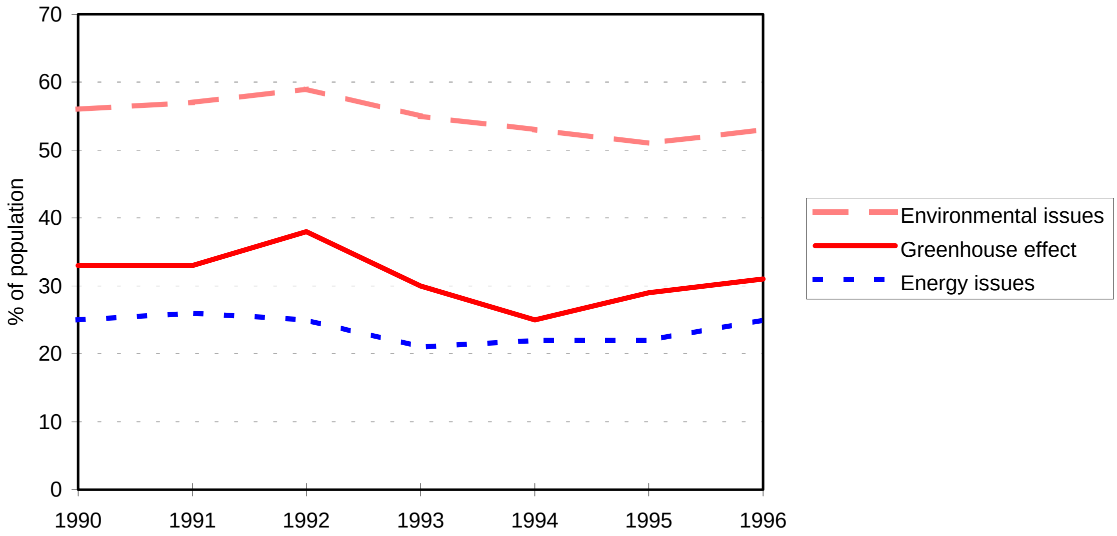


Fig. 11.1 Public involvement between 1990 and 1996 in environmental and energy issues and the greenhouse effect (source: NSS Market Research)

A new information campaign on the greenhouse effect and the subsequent necessity for energy conservation started in January 1997 (see Section 11.4.2). Results of the trial measurement phase in this campaign in 1996 can be compared with the third assessment of the effects of the first campaign on climate change in 1993. The public knowledge on the greenhouse effect (basic problem, causes and consequences) is still almost at the same level as before the campaign. The same holds for the confusion between the issues of climate change and the hole in the ozone layer. About half the public cannot tell them apart. Apart from this, the level of knowledge was considerably higher in 1992 than in 1993, which may be related to the phasing of the first information campaigns. In the first period the emphasis was on setting the climate agenda. Next, the campaign focused on the target group 'Youth' and the subject then shifted to energy conservation. Compared to several years ago, the emotions of the Dutch population related to climate change (such as anxiety, powerlessness, threat) are now not so strong and people are more hopeful. The public is also less emotional about climate change and about the environment in general.

The attitude of the Dutch population on the issue itself has changed substantially in the last years. The issue is considered to be of less importance, less threatening, less disastrous and less close at hand. Public opinion cites the following causes for environmental problems (in decreasing order): industry, air traffic, other countries, road traffic, agriculture and cattle-breeding, other households and, finally, one's own household. The degree in which people hold the industry, traffic and other countries accountable for the problem has hardly changed in recent years. Currently, less responsibility is attributed to households, agriculture and cattle-breeding than in 1993.

In 1995 the Ministry of Environment commissioned a study into the knowledge and attitude of decision-makers in trade and industry on climate change, the results of which have been used in the preparation of the *Second Memorandum on Climate Change* (VROM, 1996c). The main conclusions from this study are summarised in *Box 11.1.* Since then many new developments, both domestic and at the international level, have been taken place that might change these conclusions.

Box 11.1 Knowledge of and attitude on climate change of decision-makers in trade and industry

The following conclusions can be drawn from the study conducted in 1995:

- It appeared that the knowledge on the climate issue appeared to vary between sectors and depended on the size of the company. Knowledge is also very superficial, e.g. the confusion with the issue of depletion of the ozone layer also exists in industry.
- The climate change issue is not denied but there are still doubts about it. One is inclined to hold other sectors more responsible than one's own.
- There is great confidence that solutions will be found in time. Although one expects that initiatives on this issue will be taken, in the first place, by the Government, there is hardly any knowledge about national and international policy processes.
- When thinking of control measures, low-cost measures in particular are considered. For example, energy conservation measures are considered from the perspective of cost reduction.
- Decision-makers are in favour of an international approach to the problem. They agree that the Netherlands operates at the forefront of policy-making, but reject that the Netherlands could supersede other industrialised countries.

11.3 Process communication

Process communication deals with all forms of communication aiming at a good functioning of policy processes. Communication is a means to inform actors in society, to test new ideas and to challenge them to take part in the preparation of new policies. This means participation by target groups results in inputs for the policy process and at the same time contributes to increasing the support in society. *Box 11.2* summarises the activities on process communication in the period 1995-1997.

Box 11.2 Process communication in the period 1995-1997

In 1995 preparatory activities started for the *Second Memorandum on Climate Change*. The various target groups or sectors were informed on this in the autumn of 1995, often as part of regular consultation meetings. Next, the Minister of Environment invited the captains of industry and NGOs concerned with the environment for an informal meeting. At this meeting the current state-of-the-art on climate change was presented and discussions were held on options for choices in climate policy for the post-2000 period. In March 1996 the dialogue on long-term climate policy was continued in the form of a conference for a larger group of about 100 decision-makers representing a large number of different sectors in society.

The Ministry of Environment released a CD-ROM on climate change to illustrate the *Second Memorandum*. It consists of an information section and a policy game. The policy game allows the user to realise a self-selected policy target by composing, per sector, a policy package consisting of a selection of available instruments and measures.

11.4 Information campaigns

11.4.1 Introduction of the regulatory energy tax

To support the introduction of the energy tax per 1 January 1996, an information campaign of the Ministries of the Environment, of Economic Affairs and of Finance, involving several mass media, was carried out in the period between December 1995 and March 1996. Here the target groups were the households and firms, institutions and other organisations. The goal was to provide knowledge, explain the reason for introducing this new tax (to promote energy conservation) and explain the complex regulation which will be introduced step-wise in a period of three years. This campaign covered by television and radio commercials, through free publicity, a leaflet for residentials and a brochure for institutions. This campaign covered three-quarters of the population and resulted in a substantially higher level of knowledge.

11.4.2 The greenhouse effect and energy conservation

In 1996 the Ministry of the Environment started a long-term mass media information campaign on the greenhouse effect and the subsequent necessity for energy conservation. This campaign is coordinated in cooperation with the energy distribution companies through EnergieNed (the branch organisation of energy distribution companies) and the *World Wildlife Fund* (WWF) to enhance the impact of the campaign. The campaign represents a continuation of campaigns in the early 1990's, in which the greenhouse effect was put on the societal agenda. At present the information campaign aims at maintaining and increasing the support for policy measures. A change in behaviour is not a direct objective. This is left to organisations closer to the target groups and better equipped for this task.

11.4.3 Energy conservation and green electricity

In the last years the communication of the energy distribution companies through their *Environmental Action Plans* (MAPs) has focused on promoting energy conservation in the residential sector (*Box 11.3*). During the winter season 1996/1997 central issues were energy-efficient buying and energy-efficient living (with a special focus on energy-efficient appliances such as refrigerators, freezers, washers and dryers). Recently, these appliances have been supplied with so-called energy labels, showing the specific energy consumption in simple terms. Other products which received special attention were energy-saving light bulbs, energy-efficient boilers and insulation materials. These activities are timed to interest the consumer when he/she is considering these investments, e.g. when moving to a new house of when renovating. Energy-efficient buying and living was promoted through a series of television shows and by using the other media facilities. Another eye-catching activity of the energy distribution companies, performed in cooperation with the WWF, is promoting so-called green electricity (see Chapter 4). Besides an increasing number of households the number of companies and local authorities buying green electricity is increasing.

Box 11.3 Information campaign for the residential sector

To maintain the support of the residential sector it is important to clearly relate the progress and the intermediate results of energy conservation (energy-efficiency improvement) of the target group, but also of other sectors. The information campaign started in 1996 addresses the citizens as consumers and in their other roles in society. The following targets have been defined:

- to refresh and supplement the knowledge on the greenhouse effect;
- to provide feedback to the citizens about the results of energy conservation;
- to show that other groups in society and other countries also contribute to this field;
- to emphasise that additional effects are urgently required.

In the campaign use is made of the following media:

- commercials on television and radio;
- advertisements in nation-wide newspapers;
- advertisements in political journals and weekly magazines;
- background information material.

11.4.4 Traffic and transport

In the last years, the Ministry of Transport, Public Works and Water Management has, in cooperation with other organisations, carried out an information campaign aiming at an optimal use of the main road infrastructure. Targets were to influence drivers in choosing a mode of transport and in their driving style. Also, an annual promotion campaign was run for car-pooling.

For many years improving enforcement of speed limits on all types of roads has received special attention in view of the consequences for safety and the environment; many organisations are involved. Often communication activities are combined with infrastructural measures and stricter enforcement. A decrease in actual driving speeds is one of the means to reduce CO_2 emissions from road transport. In 1996 the efforts of the last four years were evaluated. The trend in increasing speeds was brought down to a level which was still too high. In special police surveillance projects on the main roads these activities are carried out in combination with publicity via the mass media. The roads under permanent surveillance are mentioned explicitly, with various signals along the roads themselves. This type of information about enforcement, which increases the 'subjective' chance of being caught, appears to be very effective. From an evaluation it was concluded that besides a reduction in traffic accidents and traffic jams, a reduction in fuel consumption and related emissions also occurred. This type of projects will therefore be extended into the future.

11.5 Education

In 1995 an educational project *'ACT 2: Save energy, save nature'* was launched for secondary schools, in which the relationship between energy, climate and nature is clarified, in particular by energy conservation activities integrated into the lessons and practical activities of the pupils. The target of this project is to have participating schools achieve a structural energy conservation of about 20% in 2000 (see *Box 11.4*). In 1996 some 125 schools had started with the project.

Box 11.4 The ACT 2 project for secondary schools

The project *'ACT 2: Save energy, save nature'* consists of the following parts:

- *Energy management trajectory:* Pupils, teachers and the school board create a School Energy Team, which sets up an assessment for energy use, a measurement registration system, and coordinates energy savings measures. Active pupils provide a substantial contribution. The money saved may be used by the schools to support their own specific school projects or a nature project.
- *Educational trajectory:* Course material (both written and software) has been developed on climate, energy and their influence on nature for different classes and courses.
- *Pupil activities:* Pupils may participate in a nation-wide contest, the 'ACT 2 Challenge', by betting that they are able to practically realise their ideas on energy conservation. This game also received publicity from a television game.

The project is sponsored by five ministries, the World Wildlife Fund (WWF), NOVEM and EnergieNed. For its execution and local support, such as training and energy assessments, schools can call upon local authorities, centres for Nature and Environmental Education, energy distribution companies and the youth organisation 'Codename Future'.

In 1996, 125 schools started with the energy management trajectory. From January 1997, the other parts will be executed. At the end of the school year and the first ACT 2 year, pupils may vote in a referendum on measures to reduce the climate problem and to save energy. The results will be presented to the Government.

11.6 'Perspective'

'Perspective' is an exploratory study into energy-efficient lifestyles for increasing net incomes, aiming at reduction in both direct and indirect energy use. Studies showed that the indirect energy use, which is defined as the total energy of all products and services, contributes to more than half of the total energy use and its share is still increasing. Fifteen households of all income categories participate in this project. For two years these households will try to live as energy-efficient as possible. Every household will try to reduce their 'normal' energy consumption for their income class in the first year by 40%; in the second year they will try to maintain this reduced level of energy use. Since the project has just started results are not yet available The ideas behind the project, including information on the energy content of different goods and services, will be disseminated by means of distributing leaflets, fact sheets and other publications.

11.7 Dialogue between science, policy and organisations in society

The second phase of the *National Research Programme on Global Air Pollution and Climate Change* started (NRP-II) in 1995, and most projects will operate in the period 1995-1998. Phase I has been finished in 1996 with results disseminated widely. A special effort will be made to attract possible users of project results to the execution phase of the project through participation in supervisory committees, workshops, etc. When projects are in their final stage, more attention will be paid to disseminating new insights to policy-makers and relevant organisations.

To strengthen the communication from the NRP on achieved results, the programme office will implement a communication plan in 1997 based on an analysis done in 1996 in which the research projects were related to the information needs of organisations. Besides the usual means of communication, such as an internet site, fact sheets and the publication of an international newsletter *'Change'*, it will be investigated how to disseminate expert knowledge among relevant specialised target groups, e.g. through working conferences, publication in specialised journals.

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APPENDIX A: Differences between emission inventory methodology applied in this report, IPCC guidelines and earlier published inventories

1. Introduction

In September 1995, the Netherlands' Government adopted the internationally agreed IPCC methodology to calculate and report national greenhouse gas emissions for all policy purposes. This methodology was also used in the first *National Communication* (Government, 1994), the *Environmental Balance 1996* (RIVM, 1996a,b) and the *Environmental Programme 1997-2000* (VROM, 1996e). Inventory data reported in this *Second National Communication* are from Spakman *et al.* (1996), which provides a detailed description of the applied methodology and was also used for submission in 1996 to the EU *. For all gases the official Netherlands' inventory data in Spakman *et al.* (1996) comply with data provided by the *Environmental Balance 1996* (RIVM, 1996a,b), except for a few revisions described in this Appendix. We note - as a deviation from the IPCC methodology - that for CO_2 emissions only a temperature correction has been applied to fuel use for space heating; this is described in detail in *Appendix B*.

In general, emissions presented per target group as used for policy purposes in the Netherlands, were converted into IPCC reporting sectors by means of a conversion scheme. Please note that the emissions from coke ovens are included under 'Industry' (except for CO_2) and that off-road emissions are included under 'Transport'. Also aircraft emissions included in 'Transport' have not been corrected according to the IPCC definition of domestic air transport (except for CO_2).

To avoid possible confusion, we want to add that the method for determining CO_2 emissions as used in Spakman *et al.* (1996), and thus in this *Second National Communication*, had not yet been applied when the *Annual Emissions Report 1996* [in Dutch: 'EmissieJaarRapport 1996' (EJR'96)] (VROM, 1996d) was being prepared. Another reason to comply with *Environmental Balance* data instead of using data from the *Annual Emissions Report*, in which a far more detailed bottom-up inventory of actual carbon dioxide emissions was used, is that successive editions of the latter do not include revisions of previous inventories if new sources or new methods are introduced. Therefore this data source does not provide consistent time series required for monitoring national emission trends.

* However, we note now (February 1997) that a refinement of the greenhouse gas emission calculation method for CO_2, CH_4, N_2O and HFCs, PFCs and SF_6 for the Netherlands has recently been decided upon which will result in better compliance with IPCC guidelines on estimating greenhouse gas emissions. The refined methods are described in detail in Spakman *et al.* (1997). For CO_2 the major differences compared with the first *National Communication* are that actual emissions from feedstock use of energy carriers are lower due to new estimates of carbon storage percentages in products. Detailed emission factors for CO_2 will now be used instead of three aggregate factors for coal, oil and gas. Furthermore, estimates for CO_2 emissions from energy transformation processes in coke ovens and refineries are lower than in the first *National Communication*. For methane and nitrous oxide these methodologies are essentially the same as described in Van Amstel (1993) and Kroeze (1994). Estimation procedures for the use and emissions of halocarbons are also described in Spakman *et al.* (1996).

However, a recalculation of historical emissions has not yet been carried out and thus updated and improved emission inventory figures were not available for presentation in this *Second National Communication*. It is expected that the revised figures will be used in the next *Annual Emission Report 1997* (VROM, 1997b) and in the forthcoming *Environmental Balance 1997* (RIVM, 1997b) and reported in the next submission of national inventories to the FCCC and the EU by mid-1997 (RIVM, 1997c).

2. Carbon dioxide

Carbon dioxide emissions were calculated as in Spakman *et al.* (1996), who used the *'first National Communication'* method to calculate CO_2 emissions for 1994 and provisionally for 1995. In addition, that report presents a recalculation of the carbon dioxide emissions for 1993, thereby providing a consistent time-series of CO_2 emissions in the Netherlands for 1990-1995.

Although total carbon dioxide emissions reported here are equal to those reported in the *Environmental Balance 1996,* there are small differences due to the different definitions used for IPCC sectors and Netherlands' target groups. Key differences follow:

- Coke ovens, with 1.4 Mton CO_2 emissions (1994), belong to the energy sector. According to the *Environmental Balance 1996* however, they belong to the 'Industry' target group.
- Refineries belong to the energy sector (1994: 13.2 Mton CO_2) but for the Netherlands' environmental policy they form a target group on their own. The carbon dioxide emissions for the 'Energy sector' target group are in *Environmental Balance 1996* about 14.6 Mton lower than reported in this *Second National Communication* for the energy sector.
- In the *Environmental Balance 1996*, carbon dioxide emissions for traffic were calculated from fuel consumption figures based on estimates of total vehicle-km (passengers) and ton-km (freight). In this *Second Communication* however, carbon dioxide emissions for traffic are calculated - according to the *IPCC Guidelines* - from total fuel for mobile sources sold within the Netherlands. Therefore figures for 1994 reported here are about 40 PJ (3.0 Mton carbon dioxide) lower than in the *Environmental Balance 1996*.
- In the *Environmental Balance 1996* total carbon dioxide emissions were calculated according to the *IPCC Guidelines*. In view of this boundary condition, the choice was made to compensate the fuel consumption in the traffic sector, which was too high in the service sector. Therefore, carbon dioxide emissions reported here are about 3 Mton higher than in the *Environmental Balance 1996* (data for 1994).

4. Methane

Methods for the estimation of methane emissions are described in a background document (Van Amstel *et al.*, 1993) and summarised by Van Amstel *et al.* (1994). Some assumptions are different from earlier estimates and new information on emission factors have been used in some cases:

- Methane emissions from oil and gas production have been completely revised by using separate emission factors for on-shore and off-shore production, which differ substantially due to different flaring and venting practices. These data comply with data used in the RIVM (1996a,b) sectoral analysis; however, the summary table for methane in these reports erroneously shows other figures and revised preliminary production data are used in the 1995 estimate.
- Methane emissions from transport are estimated as a percentage of total VOC per process per fuel type.
- New statistical information on manure production has also become available for the agricultural sector. Previous calculations underestimated manure production by beef cattle. On average, annual agricultural emissions are now 5% higher than earlier estimates. Therefore, a revision was made for all years, including 1990.
- In the residential sector, methane emissions from space heating by biofuel (about 4 kton) from 1994 have been included. The figures for previous years have been revised to include this source so as to maintain a consistent time-series. This has not been done in RIVM (1996a,b).
- For drinking-water production, data for 1994-1995 were corrected after completion of the RIVM reports (1996a,b).

Emission factors for methane from fuel combustion are not estimated separately but derived from the emission factors of total VOC based on the assumed fraction in the compound group profile of total VOC. Emission factors for VOC were determined partly by direct measurements, as in the case of large point sources, and partly based on the literature (Bakkum *et al.*, 1987, for stationary sources and Veldt and Van der Most, 1993, for mobile sources). The VOC profiles used are also based on these references. We note that emissions from the combustion of wood, and wood waste for energy purposes, apply to the residential sector only; industrial emissions from biofuel use are not yet accounted for.

Recently, methane emissions from oil and gas operations have been estimated separately for on-shore and off-shore activities (Oonk and Vosbeek, 1995). For 1994, the emission factor for off-shore oil and gas production is 52 and 115 g/GJ, respectively. At on shore sites less methane is emitted because in most cases flaring is practised. The emission factors for onshore oil and gas production are 34 and 2 g/GJ, respectively. The large difference between onshore and offshore factors can be explained by the fact that in offshore activities gas venting, also applicable to methane, is predominant because flaring is considered to be too dangerous.

Methane emissions from agricultural soils are estimated to be about 50 mln kg; emissions from other soils, including wetlands, are estimated to be about 75 mln kg for 1994. Methane emissions from agricultural soils, other soils and wetlands are not considered to be anthropogenic and are thus not included in the national total.

4. Nitrous oxide

Methods for compiling a national emission inventory for nitrous oxide are described in Kroeze (1994). The most important revisions of sectoral emission estimates follow:

- Emissions from polluted surface water are now reported under 'Other' [7], instead of under 'Nature', since these emissions are indirectly caused by (predominantly) human activities.
- For agriculture, the 1994 figure is 0.2 Gg N_2O higher than reported in RIVM (1996a,b) due to a revision of manure export data after completion of the RIVM reports.
- For waste incineration, the figures for 1990-1995 are different from RIVM (1996a,b) due to corrections of underlying calculations after completion of these reports (updated activity data). Furthermore, an erroneous emission factor was applied in Van Amstel *et al.* (1995), which resulted in N_2O emissions that were too high.
- For electric power generation and refineries, the figures for 1990-1993 are different from RIVM (1996a,b) due to a correction of erroneous emission factors, which resulted in N_2O emissions were too high. These erroneous data were also applied in Van Amstel *et al.* (1995).
- Some earlier estimates, as described by Van Amstel *et al.* (1994), are now down-scaled. The emission from sewage treatment plants is now estimated to amount to about 0.5 million kg/yr instead of 4.0 million kg/yr, as reported earlier for 1990. Further, the estimate of nitrous oxide from polluted inland and coastal waters is now 3.8 million kg/yr instead of earlier estimates for 1990 of 10.9 million kg. These reduced estimates result from measurement information recently published in scientific literature and summarised by Kroeze (1994).
- Information on emissions from the nitric acid producers was used to calculate N_2O emissions in 1993 and 1994. However, recent measurements at nitric acid plants show higher emission levels of N_2O (Oonk, 1997; to be published), which have not yet been included in current inventories.

Air traffic emissions refer to *all* so-called LTO emissions near airports, both for domestic and international flights, and are negligible (about 0.04 mln kg N_2O). Therefore, no attempt has been made to estimate and replace specific emissions of all *domestic* flights.

We note that in RIVM (1996a,b) and VROM (1996d) no N_2O emissions were reported for waste incineration in 1994 and 1995. This was an accident and has been improved in Spakman *et al.* (1996), where 0.4 mln kg N_2O for 1994 and 0.3 mln kg were reported for 1995 from waste incineration. For wastewater treatment, an emission of 2% of the total nitrogen removed from the waste water is assumed. For polluted inland and coastal surface water (an emission source currently not included in the IPCC guidelines), an emission of 1.57% of the N load to surface water has been assumed. This latter source is now reported as 'Other anthropogenic source' instead of under 'Nature'.

5. HFCs, PFCs, FICs and SF_6

The Netherlands' CFC Commission published an annual survey on the use of several halocarbons in the Netherlands (CFC Commission, 1995). The CFC Commission finished its work after January 1995 because the phase-out of production and use of new CFC had been completed by that date. However, the use in 1995 of hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), carbon tetrachloride (also known as tetrachloroethane or CTC), methyl chloroform (also known as 1,1,1 trichloroethane or MCF) and methyl bromide has now been reported by Netherlands' companies through a survey compiled by an independent accountant (KPMG, 1996) commissioned by the Netherlands' Government. In addition, Matthijsen has estimated the use and emissions of HFCs, PFCs and SF_6 based on information from several sources (Matthijsen, 1995). The emission of PFCs by the aluminium industry and emission of SF_6 were not reported in the surveys of the CFC Commission and KPMG but have been calculated or estimated separately. At present, it is assumed that no fluoroiodocarbons (FICs) currently are used in the Netherlands.

We stress that no estimate was made for emissions related to the production and handling of HFCs and HFCs for 1995, whereas in the 1993 and 1994 data most estimated emissions of HFCs stem from these activities. For 1990 there is no monitoring information available on the use and production of HFCs and HCFCs. Therefore, in the construction of a time-series of emissions, care should be taken to avoid combining inconsistent data whenever possible.

Emissions of HFCs and PFCs

Matthijsen (1996) and Matthijsen and Kroeze (1996) have estimated the actual emissions of halocarbons in 1990, 1993 and 1994. The emission calculation conforms, by and large, with the methods applied by AFEAS in their annual emission reports (AFEAS, 1996), but were adapted in some cases by Kroeze (Kroeze, 1995). For 1995, the actual emissions were not calculated in this way, but were estimated on the basis of the ratio of consumption figures in 1994 and 1995, and the calculated emissions for 1994. In 1994, the CO_2-eq. emissions from non-ODP halocarbons stem for about 60% from HFC-23 and about 20% from aluminium production, whereas emissions of SF_6 contributed about 15%. The emissions from aluminium production, however, are very uncertain.

In the Netherlands the aluminium industry uses pre-baked anodes. Since it is assumed that emissions are decreasing because of technological change, we have assumed that the emission factor for CF_4 is equal to the weighted default of 1.2 kg CF_4/ton (globally weighted average of old and new prebaked technology), whereas for 1980 we have assumed a somewhat higher factor of 1.4 kg CF_4/ton. A much better emission estimate can be made when more information becomes available on the definition of the default types 'old' and 'modern' prebaked, as identified by the IPCC (IPCC, 1996c) and of the actual process technology used in the Netherlands. Aluminium production in the Netherlands is reported by the *Netherlands' Bureau of Statistics* (CBS).

SF_6

For other gases with high GWPs, only the use and emission of SF_6 in the Netherlands has been estimated (Matthijsen and Kroeze, 1996). It is assumed that this compound was used in 1987 for the following applications (Annema, 1989):
- as insulation gas or for fire retardation in gear shifts and circuit breakers: 49-54 ton;
- other applications, e.g. etching, as tracer, etc.: 1-5 ton.

For 1986, total use is assumed to amount to 55 ton, with a growth in consumption corresponding to growth in industrial production (about 1% annually). In addition, to estimate emissions we assumed consumption in a quasi-stationary state, i.e. that the annual consumption rate is equal to annual emission rate to the atmosphere.

6. NO_x, CO, NMVOC and SO_2

In the Netherlands, nitrogen oxides and carbon monoxide are predominantly emitted by the transportation sector, whereas sulphur dioxide is mostly emitted by refineries, industry and mobile combustion. Non-methane hydrocarbons are emitted from transport, both during combustion and by evaporation from the reservoir, e.g. when loading but also during the diurnal cycle of the ambient temperature, and by the industry. NMVOC is also emitted in fossil fuel production and solvent use. In the '*Environmental Balance 1995*' and '*1996*' (RIVM, 1995a,b; 1996a,b) emissions are given per target group for the period 1990-1995 as calculated by the RIVM's *Environmental Information and Accounting System* RIM^+, with data from the *Emission Registration* project (VROM, 1995d; 1996d).

The emissions of NMVOC are recorded in the RIM+ system according to the 'KWS-2000' definition only. This definition differs somewhat from the NMVOC definition used in the *Annual Emission Reports* published by the Ministry of Environment (VROM). CTC, methyl chloroform and CFC-11 emissions are not included and emissions of other CFCs are only partially (0.346) included in the 'NMVOC-KWS-2000' definition. The main difference will be found in the target group 'Industry', where the use of CFCs, CTC and MCF is about 2 mln kg according to Matthijsen (1995) (about 2.5% of total NMVOC).

Furthermore, the figures for transport include for air traffic *all* so-called LTO emissions near airports, both for domestic and international flights (about 2 mln kg NO_x, 5 mln kg CO, 1 mln kg NMVOC and 0.2 mln kg SO_2). No attempt was made to estimate specific emissions of all *domestic* flights (including cruise emissions).

APPENDIX B:
Temperature correction of 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.

Calculation method

1.
Nearly all the space heating in the Netherlands is done with natural gas. Thus, gas consumption is corrected only for outside temperature variations.

2.
The temperature correction requires two multiplication factors, one for each economic sector:

- the ***Heating-Degree Day (HDD) correction factor*** $\mathbf{G_T}$
- the sector-specific ***application factor*** $\mathbf{T_S}$.

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.
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 B.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 B.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.
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 (see *Fig. 2.2* in Chapter 2). 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.
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, 1995b) (see *Table B.3*). Other sectors use fixed application factors provided by the Ministry of Economic Affairs (see *Table B.2*) (Wieleman, 1994).

Table B.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 B.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, 1995b

As an example see *Table B.4* for the calculation of the temperature correction of sectoral CO_2 emissions for 1990. In addition, *Table B.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 B.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 con-sumption uncorrected [PJ]	Applicatio n factor	HDD cor-rection fac-tor	Addition factor	Correction of gas con-sumption [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)

Table B.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 B.4* due to revised data used in Spakman *et al.* (1997) for calculating sectoral temperature corrections.

APPENDIX C:
Conclusions of the Parliamentary Enquiry Commission on Climatic Change

The *Temporary Commission on Climatic Change* of the Second Chamber of Parliament has spoken intensively with scientists, including Dutch Nobel prize winner Professor dr. P.J. Crutzen, about the greenhouse effect and the human factors affecting it. Based on these interviews and findings from literature reviews the *Commission* has selected the precautionary principle as starting-point for climate policy. The main conclusions of the *Temporary Commission on Climatic Change* follow below [unauthorised translation of 'Slotakkoord' of Second Chamber (1996a)].

1. The Commission in concluding its findings with a final agreement, which both literally and figuratively is seen to focus on national and international climate policy. With a view to the findings in their entirety the Commission has chosen the *precautionary principle* as policy target. The Commission has familiarised itself with the current opinions of scientists on the climate problem and the associated human factor. Although the Commission does not pretend to pass scientific judgement, it is of the opinion that the factors signalling an increase of the greenhouse gas concentrations in the atmosphere resulting in climate change, and possibly accompanied by drastic and dangerous effects, should be taken seriously. Rapid and adequate action is essential. The existing scientific uncertainties and necessity for further research should not be used as an alibi for a business-as-usual policy; the commission feels that it is better to be safe than sorry.

2. The Commission recalls that in Article 2 of the Climate Convention the greenhouse gases should be stabilised at a level at which danger to human actions can be averted. In general this would be case if the average global temperature were to rise by more than 1 ^oC per 100 years.

If the greenhouse gases enter the atmosphere according to the current trends, their concentrations there will continue to increase for a very long time. Scientists expect that between 1990 and 2100 the global temperature will increase from 1 to 4.5 ^oC and sea level within a margin of 10 to 100 cm.

To stabilise the concentration of carbon dioxide, the most important greenhouse gas, at 1 or 2 times the pre-industrial level, a global emission reduction of 90% to 70%, respectively, will be needed. This illustrates the seriousness of the climate issue, making very large global emission reductions necessary. This will be an enormous assignment, considering that the continuing upward trend will have to be turned into a substantial downward trend.

3. The Commission is of the opinion that this is even more relevant for the *industrialised countries* because some growth in emissions for the developing countries is inevitable in view of the expected population increase and economic growth. Furthermore, the position of the developing countries in the Climate Declaration is acknowledged, just as is the arrangement to have the industrialised countries, with their economic and technological advanced position and relatively high emissions level, take the lead in mitigating climate change.

4. The commission responds positively to the question of whether *quantitative goals* should be set. This is because these direct and inspire the policy and, in particular, establish the level of ambition that Government and the societal actors want or should attain. Quantitative objectives also offer the opportunity to make a division between countries and, nationally, between sectors. Setting quantitative goals for some instruments, like Joint Implementation and negotiable emission rights, is even made a condition, functioning as a standard to which countries and/or companies can credit or negotiate their efforts.

5. Because climate change is a global problem, the consideration of how much, and at what rate, emission reduction must be realised in the Netherlands should, according to the Commission, be set off against the global decor. We are thus concerned here with choosing an input by the Netherlands in such a way as to secure a maximum output in international negotiations.

The Commission has established that the Netherlands' share of per capita greenhouse gas emissions is, compared to other countries, rather high due to energy-intensive production and consumption, but that the total of country emissions comes to less than 1% of the global total. A large emission reduction in our country should then go hand in hand with a similar reduction in especially the other industrialised countries.

Because the Netherlands has a relatively energy-intensive production and consumption pattern, it is in the national interest to anticipate aspects of future energy and climate policy in an early stage to avoid shock-effect policy adjustments.

At the same time the Netherlands industry is seen internationally to be energy-efficient. For this reason shock-like changes and de-investment should be avoided since these could lead to a shifting, instead of a reduction, in emissions.

6. The commission is of the opinion that there is great potential in the Netherlands to realise substantial emission reductions in the medium term through *technological improvements and innovations*. The commission finds a reduction of 30 to 40% in 2020 relative to 1990 feasible. The actual reduction will, of course, depend on the policy options chosen. The commission urges both the Government and the societal actors to exert maximum efforts to use the technological options wherever possible. Partly with a view to the international market position, the Government will have to contribute to eliminating the tension between technical and economic possibilities by introducing effective policy instruments.

7. On the basis of the policy options inventory, the Commission has found energy-saving by industry and households the most promising. Replacing fossil fuels with solar and wind energy, and biomass, also provides a great number of (international) possibilities. Less promising but certainly of importance as an interim solution are the storage systems for carbon dioxide such as forestation and underground storage. There are good long-term expectations for fuel reactors and for hydrogen as energy carrier.

Further to this, technological and societal breakthroughs will be necessary, along with adaptations to consumption and production patterns. The Commission sees the following bottlenecks here:
- the issue of mobility
- the question of under what conditions financial and fiscal instruments are applied and finally,
- energy diversification (in particular whether or not to employ nuclear energy).

Without tackling these bottlenecks (requiring large political investments) solving the climate problem will be nigh impossible.

8. Taking all this into view the Commission urges the Netherlands to execute a credible policy based on the following two-tracks:

* The Netherlands in its international negotiations has established global long-term goals reflecting the seriousness of the climate issue. Consequential to this the industrialised countries, including the Netherlands, will have to commit themselves in the next century to collectively reducing emissions, with special reference to carbon dioxide, by 30-40%. Because the Netherlands is a member of the European Union, it would seem obvious to agree to this obligation within the European context. The first opportunity for action will be during the following round of negotiations on the Climate Convention to be held in Japan at the end of 1997.
* The Netherlands is committed to a national goal for emission reduction conforming to this international goal and will take appropriate concrete policy measures. The Netherlands in this way demonstrates its material efforts in challenging the problems on climate.

APPENDIX D: Overview of policies and measures

Measures listed here are taken from various documents, including Government (1994), EnergieNed (1995b), EZ (1995a,c; 1996; 1997a), Senter (1994), VROM (1995a), VW (1995), and additional information from the Ministries of EZ, VROM and VW.

Table D.1.a Selection of CO_2 measures under current policies: Cross-sectoral [1A1]

Measure	**Instruments (collectively for all three measures)**	**Objective/target of measure**	**Status of implementation of instrument**	**Indicator of progress of measure**
Increasing energy efficiency	a. standards and regulations b. regulating energy tax for small scale energy consumption	33% improvement in 1996-2020	a. on-going b. on-going	
Increasing share of renewable energy	c. CO_2 reduction plan: funding from 750 mln budget d. other financial/fiscal incentives: - VAMIL (free depreciation) - GB (Green Inventments)	3% (84 PJ) of energy use in 2000; 10% in 2020	c. in execution; decision for first portion in 1997 d. on-going	29 PJ in 1995: - 250 MW windenergy capacity in 1995 - 3,4 mln ton waste incineration capacity in 1995
Increasing CHP capacity	- EIA (energy investment tax credit) e. LTAs f. MAP (Environmental Action Plan) g. public awareness campaigns h. R,D&D	8000 MW in 2000	e. in execution f. in execution g. ongoing h. in execution	5500 MW in 1995

Table D.1.b Selection of CO_2 measures under current policies: Electric Power Generation [1A1]

Measure	**Instrument**	**Objective/target**	**Status of implementation**	**Indicator of progress**
Increasing energy efficiency by: - heat distribution plans - new, more efficient plants	investment plans of power generators	increase from 40 to 43% of average efficiency in period 1990-2000	on-going	
Addition of 10% wood in 2 coal-fired plants in 2000	agreement with E-sector	0.4 Mton CO2	announced September 1995	

Table D.1.c Selection of CO_2 measures under current policies: Industry [1A2]

Measure	**Instrument**	**Objective/target**	**Status of implementation**	**Indicator of progress**
Energy saving in industry: CHP, energy management (good housekeeping, monitoring) and new technologies	- Long Term Agreements (LTAs) for 90% of industrial energy use - fiscal incentives - R,D&D	- LTAs aiming at 20% efficiency improvement in 2000	- 29 LTAs by end of 1996 (industry) [covering 90% of energy use] and 9 LTAs in other sectors	- 10% efficiency improvement in 1989-1995 based on 20 LTAs
Energy saving other companies	- energy standards in environmental licences - fiscal incentives - MAP - energy services	contribution to 20% efficiency improvement in industry	information and support by Infomil to regulating agencies regarding inclusion of energy standards in environmental licences	

Table D.1.d Selection of CO_2 measures under current policies: Traffic and Transport [1A3]

Measure	Instrument	Objective/target	Status of implementation	Indicator of progress
1. Road transport: technical measures				
Energy saving in traffic and transport (programme REV)	subsidies for R&D	technology and efficiency improvement	programme in execution	
Programme on More Quiet, Cleaner and Efficient transport in urban areas (SSZ)	subsidies	stimulation projects on energy efficient vehicles	running, a.o. subsidies for low NO_x, low noise buses	
Wide-scale introduction of econometers, board computers and cruise controls	R&D support, pilot projects, fiscal scheme and agreements with industry	wide-spread standard in-car application	R&D projects running; stimuli in preparation	
2. Policy on mobility				
Curbing the growth of car-km:		limitation growth of car-km to 35% in 2010 relative to 1986		growth of 24% in 1995 relative to 1986
	a. creation and execution of company transport plans (commuter traffic)		a. in execution	
	b. stimulating car-pooling (a.o. by fiscal incentives)		b. further development of car-pooling; regional demonstration projects	600,000 car-poolers in 1995
	c. implementation of stringent parking policy		c. in execution	50% of communities > 30,000 inhabitants
	d. location policy near hubs of public transport		d. in execution	
	e. excise duty on gasoline, diesel and LPG; price development of public transport		e. increase of excise duty on gasoline and diesel by 11 and 8 cent, respectively; indexed taxes; introduction of excise duty on LPG started in 1994	
	f. Masterplan Bike (support for local bicycle infrastructure)	more cycling	f. under evaluation	
	g. Call-a-car (Car Plan) (support for local schems)	less car ownership	g. on-going	in 1996 20,000 participants
Improvement of public transport:		increase of p-km in public transport of 8% (city/ region) and 10% (railways) in 2000 compared with 1995	in execution	-
	a. improvement of rail infrastructure (Rail 21) (NLG 20,000 mln)		a. in execution	
	b. more and faster bus connections		b. evaluated in 1995	
	c. introduction of train-taxis		c. in execution	c. per 1995 train-taxis to/from 82 train stations
	d. improvements of public transport in and around cities (infrastructure)		d. in execution	
Curbing growth of long distant road transport to other modes	stimulation by information campaigns of environmentally sound modes of transport	limitation of increase of v-km 1994-2010 to 20% instead of 30%	ongoing	-
Substitution from air to rail (HST South and East)	expansion of HST infrastructure	reducing air-km for short distance trips	being studied; decision on construction of HST in preparation	
Freight transport:				
Curbing the growth of v-km freight ('Transaction')	agreements with companies and stimulating a broad application of technologies.	30% reduction of CO_2 in 2010 relative to 1986	- project Transaction started in 1995 - demonstration projects in preparation	
Reduction of vehicle-km	information campaign 'Loading together, working together'	higher load factors, thereby reducing v-km	pilot programmes in execution	
Reduction of CO_2 emissions	agreement and logistics for enforcement of 80 km/h limit for	0.2 Mton CO_2	implementation in international context	

	trucks			

Table D.1.d Selection of CO_2 measures under current policies: Traffic and Transport [1A3] (continued)

Measure	**Instrument**	**Objective/target**	**Status of implementation**	**Indicator of progress**
3. Driver behaviour:				
Reduction of CO_2 emissions	more effective enforcement of speed limits	0.1-0.3 Mton CO_2	on-going	
More energy-efficient road traffic and purchase behaviour	campaign 'Buy ecowise, drive econice' [KZRZ]	1 Mton CO_2 in the period 1996-2001	in execution	a more positive attitude towards more energy efficient driving
4. Other transport modes:				
Technical measures for emission reduction, including (renewable) fuel	Demonstration project 'Environmentally sound ships'	Promotion of energy-effcient (*short-sea*) shipping	on going until mid 1998	in start-up phase
International regulation on shipping emissions	implementation of a new MARPOL Annex on air pollution	overall emission reduction	te be implemented from approx. 2000	still in preparation
Target of higher emission standards for aircraft	stimulating implemention at international levels	development of CO_2 standards (and strengthening of NO_x standards)	elaboration of measures of 'LuLu'	-

Table D.1.e Selection of CO_2 measures under current policies: Residential, commercial and agricultural sectors [1A4]

Measure	Instrument	Objective/target	Status of implementation	Indicator of progress
Energy saving in new buildings:				
Energy Performance Standard for new residential and non-residential buildings	Energy Performance Standard (from 1992 improved insulation standards)	about 1450 m^3 gas per dwelling, about 15% energy saving in new non-residential buildings	in effect from end of 1995; strengthening is being considered	1450 m^3 gas for new dwellings built after 1995
Acceleration of construction of energy-efficient built-up areas, industry and greenhouse horticulture	- Plan of Action Optimal Energy Infrastructure	acceleration of construction of energy-efficient residential areas	enlarging active involvement of and stimulating cooperation between investers, local authorities, and energy companies	plans for better energy infrastructure in almost every large building site (including industry and greenhouse horticulture) (VINEX) by the end of 1996
Energy saving in existing dwellings:				
a. Energy saving in social renting sector	voluntary agreement with intermediate organisations for renting agencies in the social sector	target of 28-30% efficiency improvement relative to 1989	in effect from 1992; extension per 1995; in 1997 a new Sustainable Construction agreement will be signed for 15% efficiency improvement for 1996-2001	in 1992-1994 substantial acceleration of insulation measures and HE boilers: 150,000 double glazing, 75,000 HE boilers, 75,000 roof and wall insyulation
b. Stimulating insulation and energy-efficient products	subsidies and information campaigns (MAP)	'91-2000:17.2 Mton [212PJ]: - residential: 3.2 [54 PJ] - offices: 1.8 [29 PJ] - industry: 1.3 [21 PJ] - heating market: 7.6 [83 PJ] - other new technologies: 1.6 [21 PJ] - landfills 1.7	3rd phase started	'91-'95: 7.3 Mton [92PJ]: - residential: 1.3 [24 PJ] - offices: 0.5 [9 PJ] - industry: 0.1 [1 PJ] - heating market: 4.0 [52 PJ] - other new technologies: 0.3 [1 PJ] - landfills 1
c. Stimulating energy-efficient appliances and other products	- subsidies and information campaigns (MAP) - subsidies for measures in 55,000 existing dwellings - WET - energy labels - training of sales persons	3.2 Mton CO_2 in 2000 relative to 1991	on-going	7.3 Mton CO_2 (1991-1995)
Energy saving in existing office buildings:		target of 23% efficiency improvement		
a. Voluntary agreements with (intermediary) organisations	voluntary agreements	15% efficiency improvement in social sector (building measures only); 23% in non-residential buildings (buildings and behaviour)	a. letter of intent in the social sector, non-residential buildings	30% coverage of energy consumption
b. Energy saving in government buildings	voluntary agreements	LAT, 20% efficiency improvement (building measures and behaviour)	b. LTAs for most Ministries	-
c. Stimulating more efficient air-conditioners, appliances and good housekeeping	c. subsidies and information campaigns (MAP)	(see *Existing dwellings*, measure b.)	c. 21 mln m^2 of surface insulated; 15000 HE boilers installed	(see *Existing dwellings*, measure b.)
Acceleration of energy saving in office buildings	agreement on shift in expenditure of MAP budget, in line with sector activities	1.0 Mton CO_2	announced September 1995; requires new MAP agreements in 1997	-
Additional support of energy policy at municipal level	necessary strengthening of other measures, in line with socalled VOGM procedure	supporting previous measure	announced September 1995	-
Agriculture				
Energy savings in greenhouse horticulture	voluntary agreement	target of 30% energy improvement in 2000 relative to 1989 (50% relative to 1980), complete coverage of energy use in greenhouse horticulture	complete coverage; intermediate goal for 1995 reached (8% improvement relative to 1992)	40% energy improvement in 1995 relative to 1980

Table D.1.f Selection of CO_2 measures under current policies: Waste [6]

Measure	**Instrument**	**Objective/target**	**Status of implementation**	**Indicator of progress**
Energy production	planning; subsidies; regulation on disposal at landfills	5.1 Mton waste in 2000 use for energetic purposes	almost accomplished by construction of incineration plants and disposal regulation	1995: 2,9 Mton waste
Recycling van plastics	voluntary agreements; ban on disposal at landfills; regulation on packages (draft)	250 kton recycled in 2000	in execution; regulation per 1997	1995: 150 kton plastics
Recycling of aluminium	voluntary agreements	113 Mton aluminium recycled in 2000	in execution	1994: 66 kton aluminium
Recycling of paper and card board	voluntary agreements; regulation on disposal at landfills; regulation on packages (draft)	2.2 Mton paper and cardboard recycled in 2000	in execution	1995: 2,1 Mton paper and card board

Table D.2 Selection of CH_4 measures under current policies: Energy Production and Transmission [1B], Agriculture [4], and Waste Management [6]

Measure	Instrument	Objective/target	Status of implementation	Indicator of progress
1B Energy production and transmission				
Leakage reduction	replacement scheme of gas distribution networks and improved maintenance	reduction of 19 Gg CH_4 in 2000	in execution	8 Gg reduction in 1995
Reduction of on and off shore emissions	environmental agreement with NOGEPA	30% emission reduction expected in oil and gas production (30 Gg CH_4)	elaboration of Sectoral Environmental Plan related to NOGEPA agreement	-
4 Agriculture				
Decreasing number of cattle	European Agricultural Policies	reduction of 70 Gg CH_4 in 2000	in execution	25 Gg reduction in 1995
Manure reduction	European Agricultural Policies	reduction of 35 Gg CH_4 in 2000	in execution	4 Gg reduction in 1995
6 Waste management				
Reduction of amount landfilled	regulation by Soil Protection Act/ Decree on Waste Disposal at Landfills	reduction of 117 Gg CH_4 in 2000	in execution	in 1995 1350 mln kg DOC vs. 2400 mln kg DOC in 1990
Recovery of methane from landfills, followed by incineration and/or use as fuel	regulation by Soil Protection Act	additional reduction of 37 Gg CH_4 in 2000	in execution	39 Gg additional methane recovery in 1995

Table D.3 Selection of N_2O measures under current policies: Industrial processes [3]

Measure	Instrument	Objective/target	Status of implementation	Indicator of progress
Industrial processes [2]				
(Emission reduction in nitric acid production)	(subsidy for R&D)	(application of control technology)	(feasibility study in execution)	-

Table D.4 Selection of HFC/PFC measures under current policies: Industrial processes [3]

Measure	Instrument	Objective/target	Status of implementation	Indicator of progress
Industrial processes [2]				
Emission control in HCFC-22 production	permit	emisssion reduction of HFC-23 of 50% relative to 1995 level	-	-
Emission reduction from leakage	technical requirements for refrigeration equipment	maximum of 0.1 to 1% leakage per year	in execution	-

APPENDIX E:
Overview Table with Estimates, Quality and Documentation for 1990 [IPCC Table 8A]

Table E.1 Overview table of greenhouse gases in the Netherlands in 1990 (Gg/year full molecular weight)
(including termperature correction for CO2) (quality and documentation for 1994 and 1995 is the same as for 1990)[IPCC Table 8A]

Greenhouse gas emissions (Gg a-1)	CO2		CH4		N2O		NOx		CO		NMVOC		SO2		Documentation
Source categories	*Estimate*	Q.	Estimate	Q.	Estimate	Q.	Estimate	Q.	Estimate	Q.	Estimate	Q.	Estimate	Q.	
Total net national emissions	***173950***	**H**	**1103.8**	**M**	**51.2**	**L**	**573.9**	**M**	**1071.8**	**M**	**444.3**	**M**	**202.5**	**H**	**H**
1. All energy (combustion and fugitive)	***171200***	**H**	**211.7**	**M**	**5.5**	**L**	**556.6**	**M**	**951.6**	**M**	**242.6**	**M**	**174.5**	**H**	**H**
1A. Fuel combustion total	*171200*	H	33.2	M	5.5	L	556.6	M	951.6	M	207.5	M	174.5	H	H
1A1. Energy & Transform. Industries **	*51600*	H	0.3	M	0.5	L	99.9	M	17.1	M	IE		118.0	H	H
1'A2. Industry (only energy) **	*34100*	H	2.7	M	0.1	L	63.2	M	131.4	M	IE		25.0	H	H
1A2f. Actual from feedstocks	*14800*	M	NE	M	NE		NE		NE		NE		NE		H
1A3. Transport	*26800*	H	7.2	M	4.9	M	350.9	M	706.4	M	196.9	M	26.5	H	H
1A4. Small combustion	*42800*	H	19.3	M	0.0	L	40.5	M	11.9	M	1.2	M	4.8	H	H
1A5. Other ***	*1100*	H	0.0	M	NA		NA		NA		3.5	M	NA		H
1A6. Biomass burned for energy	*(1600)**	L	3.7	L	0.0	L	2.1	L	84.7	L	5.9	L	0.2	L	H
1B. Fugitive fuel emissions	*NA*		178.5	M	NA		NA		NA		35.1	M	NE		H
1B1. Solid fuels	*NA*		NA		NA		NA		NA		NA		NA		H
1B2. Oil and natural gas	*NE*		178.5	M	NA		NA		NA		35.1	M	NE		H
2. Industrial processes	***1850***	**H**	**5.8**		**18.6**	**L**	**12.7**	**M**	**116.1**		**101.5**	**M**	**25.0**	**H**	**H**
3. Solvents and other product use	***NE***		**NE**		**0.5**		**IE**		**2.0**		**100.1**	**M**	**NA**		**H**
4. Agriculture	***0***		**504.9**	**M**	**22.2**	**L**	**NA**		**NA**		**NA**		**NA**		**H**
4A. Enteric fermentation	*0*		401.9	M	NA		NA		NA		NA		NA		H
4B. Animal wastes	*0*		103.0	L	IE		NA		NA		NA		NA		H
4C. Rice cultivation	*NA*		NA		NA		NO		NO		NO		NO		H
4D. Agricultural soils	*0*		0.0	L	22.2	L	NA		NA		NA		NA		H
4E. Savanna burning	*NA*		NA		NA		NA		NA		NA		NA		H
4F. Agricultural waste burning	*0*		NE		NE		NE		NE		NE		NE		H
5. Land-use change and forestry	***(-1500)****	**M**	**NE**	**M**	**NE**	**L**	**NE**	**M**	**NE**	**M**	**NE**		**NE**		**H**
6. Waste	***900***	**M**	**379.4**	**M**	**0.6**	**L**	**4.6**	**M**	**2.2**	**M**	**0.1**	**M**	**3.0**	**M**	**H**
6A. Landfills (solid waste disposal)	*NE*		376.4	M	NE		NA		NA		0.1	M	NA		H
6B. Wastewater (sewage) treatment	*NE*		3.0	M	0.5	L	IE	M	IE	M	IE		IE	M	H
6C. Waste incineration	*900*	M	0.0	M	0.1	L	4.6	M	2.2	M	0.0	M	3.0	M	H
7. Other sources (specified)	***IE***		**2.0**	**M**	**3.8**	**L**	**NA**		**NA**		**NA**		**NA**		**H**
A. Drinking-water treatment	*IE*		2.0	M	NE		NA		NA		NA		NA		H
B. Polluted surface waters	*NA*		NE		3.8	L	NA		NA		NA		NA		H
International bunkers	**40400**	H													
Nature *	**..**		**125.0**	**L**	**1.5**	**L**	**16.3**	**L**	**26.7**	**L**	**3.7**	**L**	**..**		

Halocarbon emission total (Gg):	**0.912**	L
HFCs	0.489	M
PFCs	0.363	L
FICs	0	M
SF6	0.058	M

Uncertainty:
CO_2: 2%; CH_4: 25%; N_2O: 50%
CO, NO_x, NMVOC: 50%; SO_2: 25%
HFCs: 50%, PFCs:100%, FICs: NA, SF_6: 50%

Notes:
a. NMVOC = Non-Methane Volatile Organic Compounds
b. ISIC = International Standard Industrial Classification
c. CO2 from biomass burning is not included in the energy category total. If net CO2 emissions result from unsustainable bioenergy use, this will appear in the land-use change categories
d. NE = not estimated, small
e. NA = not applicable.
f. IE = included elsewhere, NO = not occuring

Q = Quality of data: H=high confidence in estimate, M=medium, L=low.
Disaggregation : CO2: Subsectoral split; Other gases: sectoral split.

* Not included in national total.
** For CO2, coke oven emissions are included under 'Energy and Transformation Industries'; for non-CO2 gases, the emissions of coke ovens are included under 'Industry'.
*** For CO2, including statisitical differences.

APPENDIX F:

Detailed Summery Reports for 1990, 1994 and 1995 [IPCC Table 7B]

Table F.1 Greenhouse gases in the Netherlands in 1990 [IPCC Table 7B] (Gg/year full molecular weight) (including temperature correction for CO2)

Greenhouse gas emissions (Gg = 10^9 g)	CO2 not corrected	CO2 *temp.corrected*	CH4	N2O	NOx	CO	NMVOC	SO2
Total net national emissions	**167550**	***173950***	**1103.8**	**51.2**	**573.9**	**1071.8**	**444.3**	**202.5**
1. All Energy (combustion and fugitive)	**164800**	***171200***	**211.7**	**5.5**	**556.6**	**951.6**	**242.6**	**174.5**
1A. Fuel combustion total ****	**164800**	***171200***	**33.2**	**5.5**	**556.6**	**951.6**	**207.5**	**174.5**
1A1a. Electricity and heat production	38100	*38300*	**IE**	0.4	81.1	12.2	IE	48.1
1A1c. Other transformation **	13300	*13300*	0.3	0.1	18.8	4.9	IE	69.9
1'A2. Industry (only energy) **	33400	*34100*	2.7	0.1	63.2	131.4	IE	25.0
1A2f. Actual from feedstocks	14800	*14800*	NE	NE	NE	NE	NE	NE
1A3. Transport ***	26800	*26800*	7.2	4.9	350.9	706.4	196.9	26.5
1A4a. Commercial/Institutional	10600	*11800*	7.6	0.0	11.5	3.0	IE	3.4
1A4b. Residential	19200	*22300*	11.6	0.0	18.9	6.0	IE	0.9
1A4c. Agriculture/forestry/fishing	7500	*8700*	0.1	NE	10.1	2.9	1.2	0.5
1A5. Other	0	*0*	NA	NA	NA	NA	3.5	NA
1A5c. Statistical differences	1100	*1100*	NE	NE	NE	NE	NE	NE
1A6. Biomass burned for energy	(1600)*	*(1600)**	3.7	0.0	2.1	84.7	5.9	0.2
1B. Fugitive fuel emissions	**NA**	***NA***	178.5	**NA**	**NA**	**NA**	**35.1**	**NE**
1B1. Coal mining	NA	*NA*	NA	NA	NA	NA	NA	NA
1B2a. Crude oil	NE	*NE*	14.3	NA	NA	NA	14.3	NE
1B2b. Natural gas	NE	*NE*	164.2	NA	NA	NA	20.8	NE
2. Industrial processes (ISIC)	**1850**	***1850***	**5.8**	**18.6**	**12.7**	**116.1**	**101.5**	**25.0**
2.A. Iron and steel	**700**	***700***	IE	NA	IE	IE	IE	IE
2.B. Non-ferrous metals	IE	*IE*	IE	NA	IE	IE	IE	IE
2.C. Chemicals (inorganic)	IE	*IE*	IE	18.6	IE	IE	IE	IE
2.D. Chemicals (organic)	IE	*IE*	IE	IE	IE	IE	IE	IE
2.E. Non-metallic mineral products	1000	*1000*	IE	NE	IE	IE	IE	IE
2.F. Other	150	*150*	5.8	NE	12.7	116.1	101.5	25.0
3. Solvents and other product use *****	**NE**	***NE***	**NE**	**0.5**	**IE**	**2.0**	**100.1**	**NA**
4. Agriculture	**0**	***0***	**504.9**	**22.2**	**NA**	**NA**	**NA**	**NA**
4A. Enteric fermentation	0	*0*	401.9	NA	NA	NA	NA	NA
4B. Manure management	0	*0*	103.0	IE	NA	NA	NA	NA
4C. Rice cultivation	NA	*NA*	NA	NA	NO	NO	NO	NO
4D. Agricultural soils	0	*0*	0.0	22.2	NA	NA	NA	NA
4E. Savanna burning	NA	*NA*	NA	NA	NA	NA	NA	NA
4F. Agricultural waste burning	0	*0*	NE	NE	NE	NE	NE	NE
5. Land use change and forestry	**(-1500)***	***(-1500)****	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
5A. Forest clearing	NE	*NE*	NE	NE	NE	NE	NE	NE
5A2. Plantation establishment	(-15]00)*	*(-1500)**	NE	NE	NE	NE	NE	NE
5B. Conversion of grass to cult. land	NE	*NE*	NE	NE	NE	NE	NE	NE
5C. Abandonment of managed lands	NE	*NE*	NE	NE	NE	NE	NE	NE
5D. Other	NE	*NE*	NE	NE	NE	NE	NE	NE
6. Waste	**900**	***900***	**379.4**	**0.6**	**4.6**	**2.2**	**0.1**	**3.0**
6A. Landfills (solid waste disposal)	NE	*NE*	376.4	NE	NA	NA	0.1	NA
6B. Wastewater treatment (sewage)	NE	*NE*	3.0	0.5	IE	IE	IE	IE
6C. Waste incineration	900	*900*	0.0	0.1	4.6	2.2	0.0	3.0
6D. Other waste	NE	*NE*	NE	NE	NE	NE	NE	NE
7. Other (specified)	**IE**	***IE***	**2.0**	**3.8**	**NA**	**NA**	**NA**	**NA**
7A. Drinking-water treatment	IE	*IE*	2.0	NE	NA	NA	NA	NA
7B. Polluted surface water	NA	*NA*	NE	3.8	NA	NA	NA	NA
NATURE *	**..**	**..**	**125.0**	**1.5**	**16.3**	**26.7**	**3.7**	..

Notes:
a. NMVOC = Non-Methane Volatile Organic Compounds (as defined acc. 'KWS-2000')
b. ISIC = International Standard Industrial Classification
c. CO2 from biomass burning is not included in the energy category total. If net CO2 emissions result from unsustainable bioenergy use, this will appear in the land-use change categories
d. NE = not estimated, small
e. NA = not applicable
f. IE = included elsewhere, NO = not occuring

* Not included in national total. Methane emissions include 50 Gg natural background emissions from agricultural soils.
** For CO2, coke oven emissions are included under 'Other transformation'; for non-CO2 gases, the emissions of coke ovens are included under 'Industry'.
*** NMVOC emissions from combustion in transport include 48 Gg from evaporation (about 24% of total).
**** Emissions from cogeneration (CHP) are included in the sectors in which it is applied.
***** N2O emissions from anaesthesia use and CO emissions from tabacco smoking.

Other greenhouse gas emissions (Gg = 10^9 g)

Halocarbons (I	Consumption	Emission
HFCs	**0.000**	**0.489**
HFC-23	0.000	0.410
HFC-32	0.000	0.000
HFC-125	0.000	0.020
HFC-134a	0.000	0.030
HFC-143a	0.000	0.004
HFC-152a	0.000	0.025
HFC-227ea	0.000	0.000
PFCs	**0.022**	**0.363**
CF4		0.310
C2F6		0.031
Other PFC us	0.022	0.022
FICs	**0.000**	**0.000**
SF6	**0.058**	**0.058**
International bunkers (Gg):		**40400**
CO2 from marine bunkers		35900
CO2 from aviation bunkers		4500

Uncertainty:
CO2: 2%; CH4: 25%; N2O: 50%
CO, NOx, NMVOC: 50%; SO2: 25%
HFCs: 50%, PFCs:100%, FICs: NA, SF6: 50%

Table F.2 Greenhouse gases in the Netherlands in 1994 [IPCC Table 7B](Gg/year full molecular weight) (including temperature correction for CO2)

Greenhouse gas emissions (Gg)	CO2 no temp. corr.	CO2 *temp. corrected*	CH4	N2O	NOx	CO	NMVOC	SO2
Total net national emissions	**175200**	***178900***	**1068.6**	**57.7**	**524.0**	**894.4**	**377.6**	**145.9**
1. All Energy (combustion and fugitive)	**172300**	***176000***	**199.9**	**7.9**	**509.7**	**787.0**	**204.4**	**127.4**
1A. Fuel combustion total ****	**172300**	***176000***	**30.7**	**7.9**	**509.7**	**787.0**	**172.9**	**127.4**
1A1a. Electricity and heat production	42800	*42900*	IE	0.4	59.4	18.9	IE	16.6
1A1c. Other transformation **	14600	*14600*	0.5	0.1	16.7	2.3	IE	58.9
1'A2. Industry (only energy) **	31900	*32200*	2.5	0.1	53.1	114.4	IE	16.2
1A2f. Actual from feedstocks	14300	*14300*	NE	NE	NE	NE	NE	NE
1A3. Transport ***	29000	*29000*	6.2	7.2	341.0	551.1	158.0	31.0
1A4a. Commercial/Institutional	10900	*11700*	1.0	0.0	7.1	3.3	IE	3.4
1A4b. Residential	19600	*21400*	13.1	0.1	20.0	6.3	IE	0.9
1A4c. Agriculture/forestry/fishing	8600	*9300*	3.5	NE	10.2	1.6	2.3	0.4
1A5. Other	0	*0*	NA	NA	NA	NA	6.4	NA
1A5c. Statistical differences	600	*600*	NE	NE	NE	NE	NE	NE
1A6. Biomass burned for energy	(1600)*	*(1600)**	3.9	0.0	2.2	89.1	6.2	0.2
1B. Fugitive fuel emissions	**NA**	***NA***	169.2	**NA**	**NA**	**NA**	**31.5**	**NE**
1B1. Coal mining	NA	*NA*	NA	NA	NA	NA	NA	NA
1B2a. Crude oil	NE	*NE*	6.8	NA	NA	NA	11.4	NE
1B2b. Natural gas	NE	*NE*	162.4	NA	NA	NA	20.1	NE
2. Industrial processes (ISIC)	**2000**	***2000***	**5.3**	**18.0**	**10.7**	**101.0**	**78.1**	**16.2**
2.A. Iron and steel	800	*800*	IE	NA	IE	IE	IE	IE
2.B. Non-ferrous metals	IE	*IE*	IE	NA	IE	IE	IE	IE
2.C. Chemicals (inorganic)	IE	*IE*	IE	18.0	IE	IE	IE	IE
2.D. Chemicals (organic)	IE	*IE*	IE	IE	IE	IE	IE	IE
2.E. Non-metallic mineral products	1000	*1000*	IE	NE	IE	IE	IE	IE
2.F. Other	200	*200*	5.3	NE	10.7	101.0	78.1	16.2
3. Solvents and other product use *****	**NE**	***NE***	**NE**	**0.5**	**IE**	**2.0**	**94.1**	**NA**
4. Agriculture	**0**	***0***	**482.3**	**26.6**	**NA**	**NA**	**NA**	**NA**
4A. Enteric fermentation	0	*0*	381.7	NA	NA	NA	NA	NA
4B. Manure management	0	*0*	100.6	IE	NA	NA	NA	NA
4C. Rice cultivation	NA	*NA*	NA	NA	NO	NO	NO	NO
4D. Agricultural soils	0	*0*	0.0	26.6	NA	NA	NA	NA
4E. Savanna burning	NA	*NA*	NA	NA	NA	NA	NA	NA
4F. Agricultural waste burning	0	*0*	NE	NE	NE	NE	NE	NE
5. Land use change and forestry	**(-1700)***	***(-1700)****	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
5A. Forest clearing	NE	*NE*	NE	NE	NE	NE	NE	NE
5A2. Plantation establishment	(-1700)*	*(-1700)**	NE	NE	NE	NE	NE	NE
5B. Conversion of grass to cult. land	NE	*NE*	NE	NE	NE	NE	NE	NE
5C. Abandonment of managed lands	NE	*NE*	NE	NE	NE	NE	NE	NE
5D. Other	NE	*NE*	NE	NE	NE	NE	NE	NE
6. Waste	**900**	***900***	**379.1**	**0.9**	**3.6**	**4.4**	**1.0**	**2.3**
6A. Landfills (solid waste disposal)	NE	*NE*	374.0	NE	NA	NA	1.0	NA
6B. Wastewater treatment (sewage)	NE	*NE*	5.1	0.5	0.2	0.1	NE	0.7
6C. Waste incineration	900	*900*	0.0	0.4	3.4	4.3	0.0	1.6
6D. Other waste	NE	*NE*	NE	NE	NE	NE	NE	NE
7. Other (specified)	**IE**	***IE***	**2.0**	**3.8**	**NA**	**NA**	**NA**	**NA**
7A. Drinking-water treatment	IE	*IE*	2.0	NE	NA	NA	NA	NA
7B. Polluted surface water	NA	*NA*	NE	3.8	NA	NA	NA	NA
NATURE *	**..**	**..**	**125.0**	**1.5**	**16.3**	**26.7**	**3.7**	..

Notes:
a. NMVOC = Non-Methane Volatile Organic Compounds (as defined acc. 'KWS-2000')
b. ISIC = International Standard Industrial Classification
c. CO2 from biomass burning is not included in the energy category total. If net CO2 emissions result from unsustainable bioenergy use, this will appear in the land-use change categories
d. NE = not estimated, small
e. NA = not applicable
f. IE = included elsewhere, NO = not occuring

* Not included in national total. Methane emissions include 50 Gg natural background emissions from agricultural soils.
** For CO2, coke oven emissions are included under 'Other transformation'; for non-CO2 gases, the emissions of coke ovens are included under 'Industry'.
*** NMVOC emissions from combustion in transport include 45 Gg from evaporation (about 28% of total).
**** Emissions from cogeneration (CHP) are included in the sectors in which it is applied.
***** N2O emissions from anaesthesia use and CO emissions from tabacco smoking.

Other greenhouse gas emissions (Gg = 10^9 g)

Halocarbons (Gg)	Consumption	Emission
HFCs	**0.274**	**0.618**
HFC-23		0.536
HFC-32		0.001
HFC-125		0.020
HFC-134a	0.274	0.031
HFC-143a		0.006
HFC-152a		0.024
HFC-227ea		0.000
PFCs	**0.023**	**0.353**
CF4		0.300
C2F6		0.030
Other PFC use	0.023	0.023
FICs	**0.000**	**0.000**
SF6	**0.061**	**0.061**
International bunkers (Gg):		**43200**
CO2 from marine bunkers		36500
CO2 from aviation bunkers		6700

Uncertainty:
CO2: 2%; CH4: 25%; N2O: 50%
CO, NOx, NMVOC: 50%; SO2: 25%
HFCs: 50%, PFCs:100%, FICs: NA, SF6: 50%

Table F.3 Greenhouse gases in the Netherlands in 1995 [IPCC Table 7B] (Gg/year full molecular weight)
(including temperature correction for CO2) (preliminary data)

Greenhouse gas emissions (Gg)		CO2	CO2	CH4	N2O	NOx	CO	NMVOC	SO2
		no temp. corr.	*temp. corrected*						
Total net national emissions		**183400**	***185900***	**1062.7**	**58.5**	**517.9**	**873.2**	**364.1**	**146.8**
1. All Energy (combustion and fugitive)		**180400**	***182900***	**200.8**	**8.4**	**505.5**	**760.1**	**190.9**	**129.0**
	1A. Fuel combustion total ****	**180400**	***182900***	**30.7**	**8.4**	**505.5**	**760.1**	**157.9**	**129.0**
	1A1a. Electricity and heat production	44800	*44900*	**IE**	0.4	60.6	18.8	IE	17.5
	1A1c. Other transformation **	14700	*14700*	0.4	0.1	16.9	2.3	IE	60.6
	1'A2. Industry (only energy) **	33400	*33600*	2.4	0.1	53.7	119.6	IE	16.3
	1A2f. Actual from feedstocks	14000	*14000*	NE	NE	NE	NE	NE	NE
	1A3. Transport ***	30100	*30100*	5.9	7.7	333.8	518.0	148.1	30.3
	1A4a. Commercial/Institutional	11300	*11900*	1.0	0.0	7.2	3.2	IE	3.0
	1A4b. Residential	20700	*21900*	13.6	0.1	20.6	7.5	IE	0.7
	1A4c. Agriculture/forestry/fishing	8900	*9300*	3.5	NE	10.5	1.6	2.3	0.4
	1A5. Other	0	*0*	NA	NA	NA	NA	1.3	NA
	1A5c. Statistical differences	2500	*2500*	NE	NE	NE	NE	NE	NE
	1A6. Biomass burned for energy	(1600)*	*(1600)**	3.9	0.0	2.2	89.1	6.2	0.2
	1B. Fugitive fuel emissions	**NA**	***NA***	170.1	**NA**	**NA**	**NA**	**33.0**	**NE**
	1B1. Coal mining	NA	*NA*	NA	NA	NA	NA	NA	NA
	1B2a. Crude oil	NE	*NE*	5.1	NA	NA	NA	12.6	NE
	1B2b. Natural gas	NE	*NE*	165.0	NA	NA	NA	20.4	NE
2. Industrial processes (ISIC)		**2100**	***2100***	**5.0**	**18.1**	**10.5**	**108.0**	**78.1**	**16.9**
	2.A. Iron and steel	800	*800*	IE					
	2.B. Non-ferrous metals	**NE**		IE					
	2.C. Chemicals (inorganic)	NE	*NE*	IE	18.1	IE	IE	IE	IE
	2.D. Chemicals (organic)	NE		IE					
	2.E. Non-metallic mineral products	1000	*1000*	IE	NE	IE	IE	IE	IE
	2.F. Other	300	*300*	5.0	NE	10.5	108.0	78.1	16.9
3. Solvents and other product use *****		**NE**	***NE***	**NE**	**0.5**	**IE**	**2.0**	**94.1**	**NA**
4. Agriculture		**0**	***0***	***475.4***	***26.9***	**NA**	**NA**	**NA**	**NA**
	4A. Enteric fermentation	0	*0*	376.7	NA	NA	NA	NA	NA
	4B. Manure management	0	*0*	98.7	IE	NA	NA	NA	NA
	4C. Rice cultivation	NA	*NA*	NA	NA	NO	NO	NO	NO
	4D. Agricultural soils	0	*0*	0.0	26.9	NA	NA	NA	NA
	4E. Savanna burning	NA	*NA*	NA	NA	NA	NA	NA	NA
	4F. Agricultural waste burning	0	*0*	NE	NE	NE	NE	NE	NE
5. Land use change and forestry		**(-1700)***	***(-1700)****	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
	5A. Forest clearing	NE	*NE*	NE	NE	NE	NE	NE	NE
	5A2. Plantation establishment	(-1700)*	*(-1700)**	NE	NE	NE	NE	NE	NE
	5B. Conversion of grass to cult. land	NE	*NE*	NE	NE	NE	NE	NE	NE
	5C. Abandonment of managed lands	NE	*NE*	NE	NE	NE	NE	NE	NE
	5D. Other	NE	*NE*	NE	NE	NE	NE	NE	NE
6. Waste		**900**	***900***	**379.5**	**0.8**	**1.9**	**3.1**	**1.0**	**0.9**
	6A. Landfills (solid waste disposal)	NE	*NE*	374.4	NE	NA	NA	0.8	NA
	6B. Wastewater treatment (sewage)	NE	*NE*	5.1	0.5	0.2	0.1	NE	0.6
	6C. Waste incineration	900	*900*	0.0	0.3	1.7	3.0	0.2	0.3
	6D. Other waste	NE	*NE*	NE	NE	NE	NE	NE	NE
7. Other (specified)		**IE**	***IE***	**2.0**	**3.8**	**NA**	**NA**	**NA**	**NA**
	7A. Drinking-water treatment	IE	*IE*	2.0	NE	NA	NA	NA	NA
	7B. Polluted surface water	NA	*NA*	NE	3.8	NA	NA	NA	NA
NATURE *		**..**	**..**	**125.0**	**1.5**	**16.3**	**26.7**	**3.7**	..

Notes:
a. NMVOC = Non-Methane Volatile Organic Compounds (as defined acc. 'KWS-2000')
b. ISIC = International Standard Industrial Classification
c. CO2 from biomass burning is not included in the energy category total. If net CO2 emissions result from unsustainable bioenergy use, this will appear in the land-use change categories
d. NE = not estimated, small
e. NA = not applicable
f. IE = included elsewhere, NO = not occuring

* Not included in national total. Methane emissions include 50 Gg natural background emissions from agricultural soils.
** For CO2, coke oven emissions are included under 'Other transformation'; for non-CO2 gases, the emissions of coke ovens are included under 'Industry'.
*** NMVOC emissions from combustion in transport include 45 Gg from evaporation (about 30% of total).
**** Emissions from cogeneration (CHP) are included in the sectors in which it is applied.
***** N2O emissions from anaesthesia use and CO emissions from tabacco smoking.

Other greenhouse gas emissions (Gg = 10^9 g)

Halocarbons (Gg)	**Consumption**	**Emission**	
HFCs	**0.274**	**1.210**	
HFC-23		0.649	a)
HFC-32			a)
HFC-125		0.050	
HFC-134a	0.274	0.454	
HFC-143a		0.034	
HFC-152a		0.023	a)
HFC-227ea			a)
PFCs	**0.023**	**0.353**	
CF4		0.300	
C2F6		0.030	
Other PFC use	0.023	0.023	
FICs	**0.000**	**0.000**	
SF6	**0.061**	**0.061**	
International bunkers (Gg):		**44600**	
CO2 from marine bunkers		37500	
CO2 from aviation bunkers		7100	

Uncertainty:
CO2: 2%; CH4: 25%; N2O: 50%
CO, NOx, NMVOC: 50%; SO2: 25%
HFCs: 50%, PFCs:100%, FICs: NA, SF6: 50%

a) Amount is confidential: total use of HFC-23, 32, 152a and 227ea is 23 ton (excluding emissions as by-product from HCFC-22 production).

APPENDIX G:
Detailed Tables for 1990, 1994 and 1995 [IPCC Standard Data Tables 1-7]

Table G.1.a Standard Data Table 1. Energy [1A]: Fuel combustion activities in 1994
(Gg/year full molecular weight)(including temperature correction for CO2)

Source category	Activity data (PJ)	(PJ) temp. corr.	Emission estimate (Gg) CO2	CO2 temp. corr.	CH4	N2O	Aggregate emission factors* (ton/TJ**) CO2	CH4	N2O
1A. FUEL COMBUSTION TOTAL	**2744**	***2811***	**172200**	***176100***	**30.7**	**7.9**		**11200**	**2900**
coal***	**350**	***350***	**32400**	***32400***		**0.4**	**92.6**		
oil***	**992**	***992***	**62100**	***62100***		**7.4**	**62.6**		
gas***	**1402**	***1469***	**77700**	***81500***		**0.1**	**55.4**		
biomass fuel	**NA**	***NA***			***3.9***	***0.0***		**NA**	**NA**
1.A.1 ENERGY	**795**	***797***	**57600**	***57800***	**0.5**	**0.5**		**600**	
1.A.1.a Electricity and heat production									
coal	252	*252*	23688	*23688*	IE	0.4	94		1400
oil	12	*12*	876	*876*	IE	0.0	73		600
gas	330	*332*	18480	*18592*	IE	0.0	56		100
1.A.1.b Refineries									
coal	0	*0*	0	*0*	IE	0.0	94		1400
oil	163	*163*	11899	*11899*	IE	0.1	73		600
gas	23	*23*	1288	*1288*	IE	0.0	56		100
1.A.1.c Cokeovens									
coal	15	*15*	1410	*1410*	0.5	0.0	94		1400
oil	0	*0*	0	*0*	0.0	0.0	73		600
gas	0	*0*	0	*0*	0.0	0.0	56		100
1.A.2 INDUSTRY	**490**	***495***	**46100**	***46400***	**2.5**	**0.1**		**5100**	**200**
coal, non-feedstock	**67**	***67***				0.0			**400**
oil, non-feedstock	**99**	***99***				0.1			**600**
gas, non-feedstock	**324**	***329***				0.0			**100**
1.A.2.a Industry: Iron and steel									
coal	62	*62*	5832	*5832*			94		
oil	0	*0*	0	*0*			73		
gas	13	*13*	728	*728*			56		
1.A.2.b: Industry: Non-ferrous metals									
coal	0	*0*	0	*0*			94		
oil	4	*4*	267	*267*			73		
gas	26	*27*	1436	*1512*			56		
1.A.2.c: Industry: Chemicals									
coal	0	*0*	0	*0*			94		
oil	92	*92*	6713	*6713*			73		
gas	108	*110*	6033	*6160*			56		
1.A.2.d: Industry: Pulp, paper and print									
coal	0	*0*	0	*0*			94		
oil	0	*0*	0	*0*			73		
gas	29	*29*	1624	*1624*			56		
1.A.2.e: Industry: Food, Beverages & Tobacco									
coal	1	*1*	94	*94*			94		
oil	2	*2*	146	*146*			73		
gas	72	*73*	4032	*4088*			56		
1.A.2.f Industry: Other									
coal	5	*5*	466	*466*			94		
oil	2	*2*	115	*115*			73		
gas	76	*77*	4256	*4312*			56		
1.A.2.g Industry: actual from feedstocks									
coal	24	*24*	1650	*1650*			69		
oil	246	*246*	7740	*7740*			31		
gas	103	*103*	4940	*4940*			48		
1.A.3 TRANSPORT	**397**	***397***	**29000**	***29000***	**6.2**	**7.2**		**15600**	
coal	0	*0*	0	*0*		0.0	94		1400
oil	397	*397*	28981	*28981*		7.2	73		**18100**
gas	0	*0*	0	*0*		0.0	56		100
1.A.4 SMALL COMBUSTION	**680**	***740***	**38900**	***42300***	**17.6**	**0.1**		**25900**	
1.A.4.a Commercial/Institutional					1.0				
coal	1	*1*	94	*94*		0.0	94		1400
oil	37	*37*	2701	*2701*		0.0	73		600
gas	143	*157*	8008	*8792*		0.0	56		100
1.A.4.b Residential					13.1				
coal	0	*0*	0	*0*		0.0	94		1400
oil	8	*8*	584	*584*		0.0	73		600
gas	339	*371*	18984	*20776*		0.0	56		100
1.A.4.c Agriculture/ forestry					3.5				
coal	0	*0*	0	*0*		0.0	94		1400
oil	3	*3*	219	*219*		0.0	73		600
gas	149	*163*	8344	*9128*		0.0	56		100
1.A.5. OTHER: Statistical differences			**600**	***600***					
coal	-9	*-9*	-846	*-846*			94		NA
oil	26	*26*	1898	*1898*			73		NA
gas	-8	*-8*	-448	*-448*			56		NA
1.A.6. Biomass burned for energy			**(1600)***	***(1600)****	**3.9**	**0.0**			

* Emission factors printed in bold are calculated (i.e. aggregated) values; others are basic factors used to estimate the emissions.
** ton/TJ = kg/GJ
*** Including feedstock and statistical differences, thereby reducing the aggregated emission factors of CH4 and N2O.
All values larger than 100 are rounded to 100.

Table G.1.b Standard Data Table 1. Energy [1A]: Fuel combustion activities in 1995
(Gg/year full molecular weight)(including termperature correction for CO2)(preliminary data)

Source category	Activity data (PJ)	*(PJ)* *temp. corr.*	Emission estimate (Gg) CO2	*CO2* *temp. corr.*	CH4	N2O	Aggregate emission factors* (ton/TJ**) CO2	CH4	N2O
1A. FUEL COMBUSTION TOTAL	**2866**	***2910***	**180700**	***183100***	**30.7**	**8.5**		**10700**	**3000**
coal* **	**393**	***393***	**37600**	***37600***		**0.4**	**95.7**		
oil* **	**1040**	***1040***	**64000**	***64000***		**7.9**	**61.5**		
gas* **	**1433**	***1477***	**79100**	***81700***		**0.1**	**55.2**		
biomass fuel					***3.9***	***0.0***		**NA**	**NA**
1.A.1 ENERGY	**821**	***822***	**59800**	***59800***	**0.4**	**0.5**		**500**	
1.A.1.a Electricity and heat production									
coal	268	*268*	25192	*25192*	IE	0.4	94		1400
oil	10	*10*	730	*730*	IE	0.0	73		600
gas	339	*340*	18984	*19040*	IE	0.0	56		100
1.A.1.b Refineries									
coal	0	*0*	0	*0*	IE	0.0	94		1400
oil	166	*166*	12118	*12118*	IE	0.1	73		600
gas	22	*22*	1232	*1232*	IE	0.0	56		100
1.A.1.c Cokeovens									
coal	16	*16*	1504	*1504*	0.4	0.0	94		1400
oil	0	*0*	0	*0*	0.0	0.0	73		600
gas	0	*0*	0	*0*	0.0	0.0	56		100
1.A.2 INDUSTRY	**504**	***508***	**47600**	***47800***	**2.4**	**0.1**		**4800**	**300**
coal, non-feedstock	**82**	***82***				**0.0**			**600**
oil, non-feedstock	**111**	***111***				**0.1**			**600**
gas, non-feedstock	**311**	***315***				**0.0**			**100**
1.A.2.a Industry: Iron and steel					NE	NE			
coal	79	*79*	7426	*7426*			94		
oil	0	*0*	0	*0*			73		
gas	13	*13*	728	*728*			56		
1.A.2.b: Industry: Non-ferrous metals					NE	NE			
coal	0	*0*	0	*0*			94		
oil	6	*6*	438	*438*			73		
gas	25	*25*	1400	*1400*			56		
1.A.2.c: Industry: Chemicals					NE	NE			
coal	0	*0*	0	*0*			94		
oil	101	*101*	7373	*7373*			73		
gas	104	*106*	5824	*5936*			56		
1.A.2.d: Industry: Pulp, paper and print					NE	NE			
coal	0	*0*	0	*0*			94		
oil	0	*0*	0	*0*			73		
gas	29	*29*	1624	*1624*			56		
1.A.2.e: Industry: Food, Beverages & Tobacco					NE	NE			
coal	0	*0*	0	*0*			94		
oil	2	*2*	146	*146*			73		
gas	69	*70*	3864	*3920*			56		
1.A.2.f Industry: Other					NE	NE			
coal	3	*3*	282	*282*			94		
oil	2	*2*	146	*146*			73		
gas	71	*73*	3976	*4088*			56		
1.A.2.g Industry: actual from feedstocks					NA	NA			
coal	11	*11*	1650	*1650*			150		
oil	266	*266*	7740	*7740*			29		
gas	109	*109*	4940	*4940*			45		
1.A.3 TRANSPORT	**413**	***413***	**30100**	***30100***	**5.9**	**7.7**		**14300**	
coal	0	*0*	0	*0*		0.0	94		1400
oil	413	*413*	30149	*30149*		7.7	73		**18600**
gas	0	*0*	0	*0*		0.0	56		100
1.A.4 SMALL COMBUSTION	**713**	***753***	**40700**	***42900***	**18.1**	**0.1**		**25400**	
1.A.4.a Commercial/Institutional					1.0				
coal	1	*1*	94	*94*		0.0	94		1400
oil	33	*33*	2409	*2409*		0.0	73		600
gas	156	*164*	8736	*9184*		0.0	56		100
1.A.4.b Residential					13.6				
coal	0	*0*	0	*0*		0.0	94		1400
oil	6	*6*	438	*438*		0.0	73		600
gas	361	*383*	20216	*21448*		0.0	56		100
1.A.4.c Agriculture/ forestry					3.5				
coal	0	*0*	0	*0*		0.0	94		1400
oil	3	*3*	219	*219*		0.0	73		600
gas	153	*163*	8568	*9128*		0.0	56		100
1.A.5. OTHER: Statistical differences			**2500**	***2500***					
coal	15	*15*	1410	*1410*			94		NA
oil	28	*28*	2044	*2044*			73		NA
gas	-17	*-17*	-952	*-952*			56		NA
1.A.6. Biomass burned for energy			**(1600)***	***(1600)****	3.9	0.0			

* Emission factors printed in bold are calculated (i.e. aggregated) values; others are basic factors used to estimate the emissions.
** ton/TJ = kg/GJ
*** Including feedstock and statistical differences, thereby reducing the aggregated emission factors of CH4 and N2O.
All values larger than 100 are rounded to 100.

Table G.1.c Standard Data Table 1. Energy [1B2]: Fugitive emissions from fuels (oil and gas) in 1990, 1994, 19
(Gg/year full molecular weight)(preliminary data for 1995)

Source Category	Activity data		Emissions estimated			Aggregate emission Factors		
year **1990**			CH4	CO2	NMVOC	CH4	CO2	NMVOC
	[unit]	#	[Gg]	[Gg]	[Gg]	[Gg / unit]	[Gg / unit]	[Gg / unit]
1.B TOTAL fugative emission oil and gas			**178.5**	**0.0**	**35.1**			
1B2 a Oil								
i Exploration *			I.E.	N.A.	I.E.			
ii Production of crude oil			I.E.	N.A.	I.E.			
iii Transport of Crude oil			I.E.	N.A.	I.E.			
iv Refining/Storage	Mton crude	51.7	I.E.	N.A.	14.3		N.A.	0.277
v Distribution of Oil Products			I.E.	N.A.	I.E.			
vi Other			N.E.	N.A.	N.E.			
1B2 b Natural Gas								
i Production/Processing			I.E.	N.A.	I.E.			
ii Transmission/Distribution **	PJ	655	78.9	N.A.	7.7	0.120	N.A.	0.012
ii Other leakage			N.E.	N.A.	N.E.			
1B2 c Venting and Flaring ***								
i Oil			I.E.	N.A.	I.E.			
ii Natural Gas			I.E.	N.A.	I.E.			
iii Combined	10^6 m3	190	99.6	I.E	13.1	0.524	I.E	0.069

Source Category	Activity data		Emissions estimated			Aggregate emission Factors		
year **1994**			CH4	CO2	NMVOC	CH4	CO2	NMVOC
	[unit]	#	[Gg]	[Gg]	[Gg]	[Gg / unit]	[Gg / unit]	[Gg / unit]
1.B TOTAL fugative emission oil and gas			**169.2**	**0.0**	**31.5**			
1B2 a Oil								
i Exploration *			I.E.	N.A.	I.E.			
ii Production of crude oil			I.E.	N.A.	I.E.			
iii Transport of Crude oil			I.E.	N.A.	I.E.			
iv Refining/Storage	Mton crude	58.8	I.E.	N.A.	11.4		N.A.	0.194
v Distribution of Oil Products			I.E.	N.A.	I.E.			
vi Other			N.E.	N.A.	N.E.			
1B2 b Natural Gas								
i Production/Processing			I.E.	N.A.	I.E.			
ii Transmission/Distribution **	PJ	717	74.4	N.A.	7.2	0.104	N.A.	0.010
ii Other leakage			N.E.	N.A.	N.E.			
1B2 c Venting and Flaring ***								
i Oil			I.E.	N.A.	I.E.			
ii Natural Gas			I.E.	N.A.	I.E.			
iii Combined	10^6 m3	214	94.8	I.E	12.9	0.443	I.E	0.060

Source Category	Activity data		Emissions estimated			Aggregate emission Factors		
year **1995****			CH4	CO2	NMVOC	CH4	CO2	NMVOC
	[unit]	#	[Gg]	[Gg]	[Gg]	[Gg / unit]	[Gg / unit]	[Gg / unit]
1.B TOTAL fugative emission oil and gas			**170.1**	**0.0**	**33.0**			
1B2 a Oil								
i Exploration *			I.E.	N.A.	I.E.			
ii Production of crude oil			I.E.	N.A.	I.E.			
iii Transport of Crude oil			I.E.	N.A.	I.E.			
iv Refining/Storage	Mton crude	60.3	I.E.	N.A.	12.6		N.A.	0.209
v Distribution of Oil Products			I.E.	N.A.	I.E.			
vi Other			N.E.	N.A.	N.E.			
1B2 b Natural Gas								
i Production/Processing			I.E.	N.A.	I.E.			
ii Transmission/Distribution **	PJ	756	75.2	N.A.	7.1	0.099	N.A.	0.009
ii Other leakage			N.E.	N.A.	N.E.			
1B2 c Venting and Flaring ***								
i Oil			I.E.	N.A.	I.E.			
ii Natural Gas			I.E.	N.A.	I.E.			
iii Combined	10^6 m3	221	94.9	I.E	13.3	0.429	I.E	0.060

* Includes ALL drilling for exploration and exploitation, both for oil and gas
** Calculations are based on detailed information with destinction between transmission and transport. Figures presented here are therefore aggregated data. Activitydata concern distribution of gas
*** Calculation are based on detailed information on amounts of gas vented and flared, with destinction between on-shore and off-shore activities. Figures presented here are therefore aggregated data.
**** Data for 1995 are preliminary.

Table G.2 Standard Data Table 2. Industrial processes [2] in 1990, 1994, 1995 (Gg/year full molecular weight) (preliminary data for 1995)

Year: 1990

Source category	Activity data	Emission estimate (Gg)			Aggregate emission factors (kg/ton product)		
	(kiloton)	CO2	CH4	N2O	CO2	CH4	N2O
2.A. Iron and steel	5180	700	IE	NA	0.139		
2.B. Non-ferrous metals			IE	NA			
2.C. Chemicals (inorganic)			IE				
Nitric acid	618			17.0			27.5
Other *	NE			1.6			NA
2.D. Chemicals (organic)			IE	IE			
Adipic acid	0			0.0			NA
Other							
2.E. Non-metallic mineral products			IE	NE			
2E1. Cement production: clinker pr.	973	800			0.800		
2E2. Glass manufacture	1194	250			0.200		
2E3. Other							
2.F. Other			5.8	NE		NA	
2F1. Flue gas desulphurization **	226.6	150			0.662		
2F2. Other							
Total		**1900**	**5.8**	**18.6**			

Year: 1994

Source category	Activity data	Emission estimate (Gg)			Aggregate emission factors (kg/ton product)		
	(kiloton)	CO2	CH4	N2O	CO2	CH4	N2O
2.A. Iron and steel	5949	800	IE	NA	0.139		
2.B. Non-ferrous metals			IE	NA			
2.C. Chemicals (inorganic)			IE				
Nitric acid	664			16.4			24.7
Other *	NE			1.6			NA
2.D. Chemicals (organic)			IE	IE			
Adipic acid	0			0.0			NA
Other							
2.E. Non-metallic mineral products			IE	NE			
2E1. Cement production: clinker pr.	858	700			0.800		
2E2. Glass manufacture	1404	300			0.200		
2E3. Other							
2.F. Other			5.8	NE		NA	
2F1. Flue gas desulphurization **	286	200			0.662		
2F2. Other							
Total		**2000**	**5.8**	**18.0**			

Year: 1995

Source category	Activity data	Emission estimate (Gg)			Aggregate emission factors (kg/ton product)		
	(kiloton)	CO2	CH4	N2O	CO2	CH4	N2O
2.A. Iron and steel	5949	800	IE	NA	0.139		
2.B. Non-ferrous metals			IE	NA			
2.C. Chemicals (inorganic)			IE				
Nitric acid	668			16.5			24.7
Other *	NE			1.6			NA
2.D. Chemicals (organic)			IE	IE			
Adipic acid	0			0.0			NA
Other							
2.E. Non-metallic mineral products			IE	NE			
2E1. Cement production: clinker pr.	858	700			0.800		
2E2. Glass manufacture	1404	300			0.200		
2E3. Other							
2.F. Other			5.8	NE		NA	
2F1. Flue gas desulphurization **	300	200			0.662		
2F2. Other							
Total		**2000**	**5.8**	**18.1**			

* Caprolactam production
** Gypsum production
NE = not estimated, small or confidential
NA = not applicable
IE = included elsewhere, NO = not occuring

Table G.3 Standard Data Table 3. Solvent and other product use [3] in 1994, 1995
(Gg/year full molecular weight)(preliminary data for 1995)

Year: 1994

Source category	Activity data (kiloton)	Emission estimate (Gg)			Aggregate emission factors (kg/ton product)		
		CO2	CH4	N2O	CO2	CH4	N2O
3. Solvents and other product use							
3.D.Other *	0.5	NA	NE	0.5	NA	NA	1000
	NA	**NA**	**NE**	**0.5**	**NA**	**NA**	**NA**

* N2O emissions from anaesthesia use.

Year: 1995

Source category	Activity data (kiloton)	Emission estimate (Gg)			Aggregate emission factors (kg/ton product)		
		CO2	CH4	N2O	CO2	CH4	N2O
3. Solvents and other product use							
3.D.Other *	0.5	NA	NE	0.5	NA	NA	1000
	NA	**NA**	**NE**	**0.5**	**NA**	**NA**	**NA**

* N2O emissions from anaesthesia use.

Table G.4.a Standard Data Table 4. Agriculture [4A and 4B]: Enteric fermentation and manure management in (Gg/year full molecular weight)(preliminary data for 1995)

Source category	Activity data			Emission estimate (Gg)			Aggregate emission factors
	1990	1994	1995*	1990	1994	1995*	1990-1995
4. Agriculture							
4A. Enteric fermentation				**401.9**	**381.7**	**376.7**	
4B. Animal wastes				**103.0**	**100.6**	**98.7**	
4.A Enteric fermentation	**(1000 heads)**						**(kg CH4/head per year)**
	1990	**1994**	**1995***	**1990**	**1994**	**1995***	**1990-1995**
1.a. Dairy cattle	3606	3277	3298	290.7	263.9	265.5	
- young <1 yr	*806*	*735*	740	*39.7*	*36.2*	*36.4*	*49.25*
- young female >1yr	*879*	*803*	808	*55.2*	*50.4*	*50.7*	*62.80*
- female	*1878*	*1698*	1708	*191.8*	*173.4*	*174.4*	*102.13*
- male >1yr	*43*	*41*	42	*4.0*	*3.8*	*3.9*	*93.22*
1.b. Non-dairy cattle	1319	1439	1356	74.9	79.6	73.8	
- calves	*601*	*690*	669	*10.6*	*12.2*	*11.8*	*17.65*
- steers	*599*	*603*	541	*52.1*	*52.5*	*47.1*	*87.01*
- female >1yr	*119*	*146*	146	*12.2*	*14.9*	*14.9*	*102.13*
3. Sheep	1700	1766	1674	13.6	14.1	13.4	8.00
4. Goats	63	64	76	0.5	0.5	0.6	8.00
6. Horses	72	97	100	1.3	1.8	1.8	18.00
8. Swine	13933	14565	14397	20.9	21.8	21.6	1.50
TOTAL	**20693**	**21208**	**20901**	**401.9**	**381.7**	**376.7**	
4.B Manure management **	**(million m^3)**						**(kg/m3)**
	1990	**1994**	**1995***	**1990**	**1994**	**1995***	**1990-1995**
1.a. Dairy cattle	36.5	33.1	33.3	25.5	23.1	23.3	0.698
1.b. Non-dairy cattle	4.7	4.8	4.4	11.9	12.1	11.2	2.534
1.b.2 Fattening calves	2.1	2.4	2.3	5.3	6.1	5.9	2.534
3/4. Sheep and goats	0.3	0.3	0.3	0.8	0.8	0.7	2.979
8. Swine	16.4	16.4	16.1	49.2	49.3	48.6	3.009
9. Poultry	2.5	2.2	2.2	10.3	9.2	8.9	4.110
TOTAL	**62.4**	**59.2**	**58.7**	**103.0**	**100.6**	**98.7**	

* Data for 1995 are preliminary figures.

** Manure production in stables, thus excluding manure excreted in meadows which is dealt with under Agricultural soils [4D].

Table G.4.b Standard Data Table 4. Agricultural soils in 1990, 1993-1995
(Gg/year full molecular weight)(preliminary data for 1995)

	Source category SOURCE / N flow	Activity data (kiloton) 1990	1993	1994	1995*	Emission estimate (Gg) N2O**** 1990	1993	1994	1995*	Aggregate emission factors (as % of N applied) 1990-1995	(kg N2O/ton N applied) 1990-1995
4D	**Agricultural soils *** **					**22.2**	**26.2**	**26.6**	**26.9**		
4D.1	**ANTHROPOGENIC BACKGROUND agricultural soils ****	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**	**4.7**		
4D.2	**CHEMICAL FERTILIZER USE**										
	total N consumption	412.0	390.0	372.0	372.0						
	NH3-N emission	8.2	7.8	7.4	7.4						
	nett N application	403.8	382.2	364.6	364.6						
	mineral soils 90%	363.4	344.0	328.1	328.1	5.7	5.4	5.2	5.2	1	15.7
	organic soils 10%	40.4	38.2	36.5	36.5	1.3	1.2	1.1	1.1	2	31.4
	subtotal N2O emission					**7.0**	**6.6**	**6.3**	**6.3**		
4D.3	**MANURE**										
	total N excretion	657.0	682.0	648.0	643.0						
	part in meadow (fraction)	0.3	0.3	0.3	0.3						
	excretion in meadow	164.3	170.5	162.0	160.8						
	NH3-N emission grazing	13.1	13.6	13.0	12.9						
	share N in urine	0.6	0.6	0.6	0.6						
	urine-N in meadow	90.7	94.1	89.4	88.7	2.8	3.0	2.8	2.8	2	31.4
	faeces-N in meadow	60.4	62.7	59.6	59.2	0.9	1.0	0.9	0.9	1	15.7
	subtotal N2O emission					**3.8**	**3.9**	**3.7**	**3.7**		
4D.4	**STABLE + STORAGE**										
	excretion in stable	492.8	511.5	486.0	482.3						
	NH3 emission stable	83.7	88.4	85.3	84.3						
	NH3 emission storage	5.2	6.2	5.9	3.9						
	nett N content manure	419.5	433.6	410.9	409.6						
	biologically treated storage	0.0	1.0	2.0	2.0	0.0	0.0	0.1	0.1	2	31.4
	anaerobic storage	419.5	432.6	408.9	407.6	0.7	0.7	0.6	0.6	0.1	1.6
	subtotal N2O emission					**0.7**	**0.7**	**0.7**	**0.7**		
4D.5	**MANURE SPREADING**										
	manure-export abroad	6.4	15.0	18.0	23.0						
	field application	413.1	417.6	390.9	384.6						
	NH3 emission application	104.9	64.5	45.3	32.4						
	check: NH3-N emission	86.4	53.1	37.3	26.7						
	nett N content applied manure	326.8	364.5	353.5	357.9						
	surf.appl.mineral soil 87%	284.3	94.3	13.5	0.0	4.5	1.5	0.2	0.0	1	15.7
	surf.appl.organic soil 13%	42.5	47.4	46.0	0.0	1.3	1.5	1.4	0.0	2	31.4
	share incorporation (fraction)	0.0	0.6	0.8	1.0						
	incorporation all soils	0.0	222.8	294.1	357.9	0.0	7.0	9.2	11.2	2	31.4
	subtotal N2O emission					**5.8**	**10.0**	**10.9**	**11.2**		
4D.6	**LEGUMES**										
	total N-fixation	15.0	14.0	14.0	14.0	0.2	0.2	0.2	0.2	1	15.7
	subtotal N2O emission					**0.2**	**0.2**	**0.2**	**0.2**		

* Data for 1995 are preliminary figures.
** Resulting from past lowering of the groundwater tables and past application of fertilizers and manure (Kroeze, 1994).
*** Including present enhanced background emissions due to historical anthropogenic activities (see note 2).
**** No estimate was made for CO2 and CH4.

Table G.5.a Standard Data Table 5. Landuse change and forestry [5A]: Changes in forest and other woody biomass s (Gg/year ful molecular weight)

Sheet 1: Annual Growth Increment 1990

Source and sink Categories	A Area [ha]	volume increment trunks only	 total tree [m3/ha]	volume increment [1000 m3]	carbon content [kg C /m3]	B Carbon uptake [Gg C]	C aggregate uptake factor [t C/ha]
Temperate Forests:	342,000	8.12	9.74	3,332	250	0.833	2.44
Non-forrest Trees:	98,000	8.12	9.74	955	250	0.239	2.44
Total	**440,000**			**4,287**		**1.072**	**2.44**

Sheet 2: Annual Harvest 1990

Source and Sink categories	A Area [ha]	fellings trunks only	 total tree [m3/ha]	biomass removed total tree [1000 m3]	carbon content [kg C /m3]	B carbon emission [Gg]	C aggregate emission factor [t C/ ha]
Temperate forests	342,000	5.12	6.1	2,101	250	0.525	1.54
Non-forrests trees	98,000	5.12	6.1	602	250	0.151	1.54
Total	**440,000**			**2,703**		**0.676**	**1.54**

Sheet 3: CO2 Emissions/Removals 1990

Source and Sink Categories	Emissions/Uptake Carbon [Gg]	Emissions/Removal CO2 [Gg]
Total annual growth increment	1.072	3.93
Total annual fellings (incl. Harvest)	0.676	2.48
Net emissions (+) or removals (-)	**-0.396**	**-1.45**

Table G.5.b Standard Data Table 5. Landuse change and forestry [5A]: Changes in forest and other woody biomass stocks in 1994 (Gg/year full molecular weight)

Sheet 1: Annual Growth Increment 1994

Source and sink Categories	A Area [ha]	volume increment trunks only [m3/ha]	 total tree	volume increment [1000 m3]	carbon content [kg C /m3]	B Carbon uptake [Gg C]	C aggregate uptake factor [t C/ha]
Temperate Forests:	341,000	7.88	9.46	3,224	250	0.806	2.36
Non-forrest Trees:	98,000	7.88	9.46	927	250	0.232	2.36
Total	**439,000**			**4,151**		**1.038**	**2.36**

Sheet 2: Annual Harvest 1994

Source and Sink categories	A Area [ha]	fellings trunks only [m3/ha]	 total tree	biomass removed total tree [1000 m3]	carbon content [kg C /m3]	B carbon emission [Gg]	C aggregate emission factor [t C/ ha]
Temperate forests	341,000	4.45	5.34	1,821	250	0.455	1.34
Non-forrests trees	98,000	4.45	5.34	523	250	0.131	1.34
Total	**439,000**			**2,344**		**0.586**	**1.34**

Sheet 3: CO2 Emissions/Removals 1994

Source and Sink Categories	Emissions/Uptake Carbon [Gg]	Emissions/Removal CO2 [Gg]
Total annual growth increment	1.038	3.81
Total annual fellings (incl. Harvest)	0.586	2.15
Net emissions (+) or removals (-)	**-0.452**	**-1.66**

Table G.5.c Standard Data Table 5. Landuse change and forestry [5A]: Changes in forest and other woody biomass stocks in 19 (Gg/year full molecular weight)(preliminary data)

Sheet 1: Annual Growth Increment 1995

Source and sink Categories	A Area [ha]	volume increment trunks only [m3/ha]	 total tree	volume increment [1000 m3]	carbon content [kg C /m3]	B Carbon uptake [Gg C]	C aggregate uptake factor [t C/ha]
Temperate Forests:	340000	7.9	9.48	3223.2	250	0.806	2.37
Non-forrest Trees:	98000	7.9	9.48	929.04	250	0.232	2.37
Total	**438000**			**4152.24**		**1.038**	**2.37**

Sheet 2: Annual Harvest 1995

Source and Sink categories	A Area [ha]	fellings trunks only [m3/ha]	 total tree	biomass removed total tree [1000 m3]	carbon content [kg C /m3]	B carbon emission [Gg]	C aggregate emission factor [t C/ ha]
Temperate forests	340000	4.4	5.28	1795.2	250	0.449	1.32
Non-forrests trees	98000	4.4	5.28	517.44	250	0.129	1.32
Total	**438000**			**2312.64**		**0.578**	**1.32**

Sheet 3: CO2 Emissions/Removals 1995

Source and Sink Categories	Emissions/Uptake Carbon [Gg]	Emissions/Removal CO2 [Gg]
Total annual growth increment	1.038	3.81
Total annual fellings (incl. Harvest)	0.578	2.12
Net emissions (+) or removals (-	**-0.460**	**-1.69**

Table G.6.a Standard Data Table 6. Waste [6A, 6C, 6D]: Solid Waste disposal on land, waste incineration and other waste in 1990, 1993-1995 (Gg/year full molecular weight)(preliminary data for 1995)

Year: 1990

Source category/ disposal method	Activity dat (Gg) Landfilled	DOC landfilled	Emission estimate (Gg) CO2	CH4	N2O	Aggregate emission factor (kg/ton) CO2	CH4	N2O	CH4 recovered (Gg)
6. Waste			**900**	**376.4**					
6A1 Landfills (solid waste disposal)	13900	2400	NE	376.4	NE	NA	156.8	NE	43
6A2 Open dumps	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Waste treated	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**	
6C. Waste incineration		3735	900	0.0	0.1	241	0	0.020	NA
6D. Other waste		NE	NE	NE	NE				

Year: 1993

Source category/ disposal method	Activity dat (Gg) Landfilled	DOC landfilled	Emission estimate (Gg) CO2	CH4	N2O	Aggregate emission factor (kg/ton) CO2	CH4	N2O	CH4 recovered (Gg)
6. Waste			**900**	**372.0**					
6A1 Landfills (solid waste disposal)	11300	1770	NE	372	NE	NA	210.2	NE	53
6A2 Open dumps	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Waste treated	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**	
6C. Waste incineration		3880	900	0.0	0.1	232	0	0.020	NA
6D. Other waste		NE	NE	NE	NE				

Year: 1994

Source category/ disposal method	Activity dat (Gg) Landfilled	DOC landfilled	Emission estimate (Gg) CO2	CH4	N2O	Aggregate emission factor (kg/ton) CO2	CH4	N2O	CH4 recovered (Gg)
6. Waste			**900**	**374.0**					
6A1 Landfills (solid waste disposal)	9100	1560	NE	374.0	NE	NA	239.7	NE	65
6A2 Open dumps	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Waste treated	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**	
6C. Waste incineration		4410	900	0.0	0.1	204	0	0.020	NA
6D. Other waste		NE	NE	NE	NE				

Year: 1995*

Source category/ disposal method	Activity dat (Gg) Landfilled	DOC landfilled	Emission estimate (Gg) CO2	CH4	N2O	Aggregate emission factor (kg/ton) CO2	CH4	N2O	CH4 recovered (Gg)
6. Waste			**900**	**374.4**					
6A1 Landfills (solid waste disposal)	8500	1350	NE	374.4	NE	NA	277.3	NE	65
6A2 Open dumps	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Waste treated	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**	
6C. Waste incineration		4370	900	0.0	0.1	206	0	0.020	NA
6D. Other waste		NE	NE	NE	NE				

* Data for 1995 are preliminary figures.

Table G.6.b Standard Data Table 6. Waste [6B]: Waste water treatment in 1994, 1995
(Gg/year full molecular weight)(preliminary data for 1995)

Year: 1994

Source category	Activity data	Emission estimate (Gg)			Aggregate emission factors (kg/ton)		
	(Gg N removed)	CO2	CH4	N2O	CO2	CH4	N2O
6. Waste				**0.5**			
6B. Wastewater treatment (sewage)	25.7	NE	NA	0.5			20

Year: 1995*

Source category	Activity data	Emission estimate (Gg)			Aggregate emission factors (kg/ton)		
	(Gg N removed)	CO2	CH4	N2O	CO2	CH4	N2O
6. Waste				**0.5**			
6B. Wastewater treatment (sewage)	27	NE	NA	0.5			20

* Data for 1995 are preliminary figures.

Table G.7 Standard Data Table '7'. Drinking water treatment and polluted surface water [7A and 7B] in 1994, 1995 (Gg/year full molecular weight)(preliminary data for 1995)

Year: 1994

Source category	Activity data	Emission estimate (Gg)			Aggregate emission factors (kg/ton product)		
	(kiloton)	CO2	CH4	N2O	CO2	CH4	N2O
7. Other (specified)			**2.0**	**3.8**			
7A. Drinking-water treatment	NA	IE	2.0	NE		NA	
7B. Polluted surface water	NA	NA	NE	3.8			NA

Year: 1995*

Source category	Activity data	Emission estimate (Gg)			Aggregate emission factors (kg/ton product)		
	(kiloton)	CO2	CH4	N2O	CO2	CH4	N2O
7. Other (specified)			**2.0**	**3.8**			
7A. Drinking-water treatment	NA	IE	2.0	NE		NA	
7B. Polluted surface water	NA	NA	NE	3.8			NA

* Data for 1995 are preliminary figures.

Errata on Second Netherlands' National Communication on Climate Change Policies (date: 25 July 1997)

Page 32: ***Table 2.2. The pressure on the environment per km^2 and per inhabitant by a number of social developments in the Netherlands compared with neighbouring countries in 1993***
Column 'Passenger cars per capita' must be:

Index (NL = 100)	Population per km²	GDP per capita	Energy consumption per capita	Passenger cars per capita	Vehicle-km per capita	Fertiliser per km²	Cattle per km²	Pigs per km²
Netherlands	100	100	100	100	100	100	100	100
Belgium	78	101	110	108	91	56	77	55
Germany	55	116	91	109	111	36	34	18
United Kingdom	57	79	82	102	117	52	37	8
Denmark	29	126	83	85	116	33	38	63

Page 135: Table E.1 Overview Table with Estimates, Quality and Documentation for 1990 [IPCC Table 8A]
Add under 'Uncertainty':
CO_2: 2%; CH_4: 25%; N_2O: 50%

Page 137: Table F.2 Greenhouse gases in the Netherlands in 1994

International bunkers (Gg):
CO_2 from marine bunkers: 36500 (was 6500)

Page 138: Table F.3 Greenhouse gases in the Netherlands in 1995

1A4c Agricultural/forestry/fishing, CO_2 no temp. corr.:	8900 (was 8700)
2. Industrial processes (ISIC), CO_2 no temp. corr.:	2100 (was 2000)
2. Industrial processes (ISIC), temp. corrected:	2100 (was 2000)
2.F. Other, CO_2 no temp. corr.:	300 (was 200)
2.F. Other, CO_2 temp. corrected:	300 (was 200)

Page 139: Table G.1.a Standard Data Table 1.

1.A.4.a Commercial/Institutional:	Emission Estimate CH_4 1.0 (was Aggregate emission factors 1.0)
1.A.4.b Residential:	Emission Estimate CH_4 13.1 (was Aggregate emission factors 13.1)
1.A.4.c Agricultural/forestry:	Emission Estimate CH_4 3.5 (was Aggregate emission factors 3.5)

Page 140: Table G.1.b Standard Data Table 1. Energy [1A]

Lines must be:
1.A. Fuel combustion total

	Activity data PJ	PJ	Emission estimate CO2	CO2	CH4	N2O	CO2	CH4	N2O
1A									
biomass fuel					3.9	0.0		NA	NA
1.A.2 Industry: iron and steel					NE	NE			
1.A.2.b Industry: Non ferrous metals					NE	NE			
1.A.2.c Industry : Chemicals					NE	NE			
1.A.2.d Industry: Pulp, paper and print					NE	NE			
1.A.2.e Industry: Food, Beverages & Tobacco					NE	NE			
1.A.2.f Industry: Other					NE	NE			
1.A.2.g Industry: actual from feedstocks					NA	NA			

1.A.4.b Residential		13.6	

Page 141: Table G.1.c Standard Data Table 1. Energy [1B2]

Year: 1990 must be:

		Emissions estimated			
		CH4	CO2	NMVOC	
1.B TOTAL fugative emission oil and gas		**178.5**	**0.0**	**35.1**	

Year: all (1990, 1994, 1995) must be:

		Emissions estimated			
		CH4	CO2	NMVOC	
1B2 a Oil					
i Exploration *		I.E.	N.A.	I.E.	
ii Production of crude oil		I.E.	N.A.	I.E.	
iii Transport of Crude oil		I.E.	N.A.	I.E.	
v Distribution of Oil Products		I.E.	N.A.	I.E.	
vi Other		N.E.	N.A.	N.E.	
1B2 b Natural Gas					
i Production/Processing		I.E.	N.A.	I.E.	
iii Other leakage		N.E.	N.A.	N.E.	
1B2 c Venting and Flaring ***					
i Oil		I.E.	N.A.	I.E.	
ii Natural Gas		I.E.	N.A.	I.E.	

Page 142: Table G.2 Standard Data Table 2. Industrial processes [2] in 1990, 1994, 1995

Year: all (1990, 1994, 1995) must be:

	Activity data	**Emission estimate**			**Aggregate emission factors**		
	(kiloton)	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**
2.B. Non-ferrous metals			IE	NA			
2.C. Chemicals (inorganic)			IE				
2.D. Chemicals (organic)			IE	IE			
2.E. Non-metallic mineral products			IE	NE			
2.F. Other			5.8	NE		NA	

Page 145-146: Table G.5.a-b-c Standard Data Table 5. Landuse change and forestry [5A]: Changes in forest and other woody biomass stock

Sheet 1 and 2: all figures in column 'Area [ha]' should have a comma (,) instead of a point (.)
Sheet 1 and 2: all figures in column 'volume increment [1000 m^3]' should have a comma (,) instead of a point (.)

Page 147: Table G.6.a standard Data Table 6. Waste [6A, 6C, 6D]

Year: 1990

	Waste treated	**CO2**	**CH4**	**N2O**	**CO2**	**CH4**	**N2O**	Recov.
6C. Waste incineration	3735	900	0.0	0.1	241	0	0.020	NA
6D. Other waste	NE	NE	NE	NE				

Page 148: Table G.6. Standard Data Table 6. Waste [6B]

Year: 1994

	Activity data	Emission estimate			Aggregate emission factors		
	(Gg N removed)	CO2	CH4	N2O	CO2	CH4	N2O
6B. Wastewater treatment (sewage)	25.7		NA	0.5			20

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