THIRD NETHERLANDS' NATIONAL COMMUNICATION ON CLIMATE CHANGE POLICIES

Prepared for the Conference of the Parties under the Framework Convention on Climate Change

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TABLE OF CONTENTS

TABLE CAPTIONS

FIGURE CAPTIONS

BOX CAPTIONS

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
GJ	Giga Joule (10^9 Joule)
TJ	Tera Joule (10^{12} Joule)
PJ	Peta Joule (10^{15} Joule)
kW	kilo Watt (10^3 Watt)
MWe	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)
bbl	Oil barrel US (= 0.159 m3)
Nm^3	Normal cubic metre (volume of gas at 10^5 Pa and 20^oC)
ha	hectare
NLG	Netherlands Guilder
US$	US Dollar
€	Euro

CONVERSION FACTORS FOR EMISSION FACTORS

From element basis to full molecular mass:

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

From full molecular mass to element basis:

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

ABBREVIATIONS

ACSEX	Agulhas Current Source Experiment
ASAP	Automated Shipboard Aero logical Programme
AIJ	Activities Implemented Jointly
CAMP	Clivarnet Atlantic Monitoring Programme
CBS	Central Bureau for Statistics
CCB	Centre for Climate Change and Biosphere Research
CCDM	Coordinating Committee for Monitoring of Target Group
CESAR	Cabauw Experimental Site for Atmospheric Research
CER	Certified Emission Reductions Unit
CERUPT	Certified Emission Reduction Unit Procurement Tender
CCDM	Coordination Committee for Monitoring of Target Groups
CCOP	Committee for Coastal and Off-shore Geoscience Programmes
CDM	Clean Development Mechanism
CHP	Combined Heat and Power (Cogeneration)
CKO	Centrum voor Klimaat Onderzoek *(trans. Netherlands Centre for Climate Research)*
CLIMAT	Climate messages encoded for the WMO network
CONCAWE	Oil companies' European Organisation for Environment, Health and Safety
CoP	Conference of the Parties (to the Climate Convention)
CPB	Central Planning Bureau
CPO	Core Project Office
CZMC	Coastal Zone Management Centre
DDR	Deutsche Democratische Republik *(trans. East Germany)*
DOC	Degradable Organic Carbon
DIVERSITAS	Biodiversity Programme of the Rio Conference 1992
EC-LNV	Expert Centrum van het Ministerie voor Landbouw Natuurbeheer en Visserij *(transl. National Reference Centre for Agriculture (formerly IKC-L)*
ECN	Energie Centrum Nederland *(transl. Netherlands Energy Research Centre)*
EDGAR	Emission Database for Global Atmospheric Research
EAJR	Emissie en Afval JaarRapport *(trans. Annual Emissions Report)*
ECA	European Climate Programme
EIA	Energie Investerings Aftrek *(transl. Energy Investment tax Deduction)*
EINP	Subsidieregeling Energievoorzieningen In de Non-Profitsector en bijzondere sectoren *(transl. Energy Investment Program for non-Profit sectors)*
EPA	Environmental Protection Act
EPICA	European Project for Ice Coring in Antarctica
EPS	Energy Performance Standard
ER	Emission Registration
ER	European Renaissance scenario
ERU	Emission Reduction Unit
ESA	European Space Agency
ESF	European Science Foundation
EU	European Union
EUMETNET	European Organisation for the Exploitation of Meteorological Network
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
EZ	Ministerie van Economische Zaken *(trans. Ministry of Economic Affairs)*
FAO	Food and Agriculture Organisation of the United Nations
FCCC	Framework Convention on Climate Change
FINESSE	Financing Energy Services for Small Scale Energy Users
F-gases	Fluorinated greenhouse gases (HFC's, PFC's, SF_6)
FLUXNET	Global Terrestrial Network - Carbon
FTP	File Transfer Protocol
GAVE	Subsidieregeling milieugerichte technologie GAsvormige en Vloeibare Energiedragers *(transl. Subsidy program environmental technology Gaseous and Liquid Energy Carriers)*
GAW	Global Atmosphere Watch of WMO
GC	Global Competition
GCOS	Global Climate Observing System
GDP	Gross Domestic Product

GEF	Global Environmental Facility
GEIA	Global Emissions Inventory Activity
GHSN	Global Historical Station Network
GNP	Gross National Product
GOOS	Global Ocean Observing System
GPCC	Global Precipitation Climatology Centre
GCOS	Global Climate Observing System
GOME	Global Ozone Monitoring Experiment
GOA	Geografische Onderzoek Associatie *(transl. Foundation for Earth Sciences)*
GPS	Global Positioning System
GSN	GCOS Surface Network
GTN-G	Global Terrestrial Network - Glaciers
GTN-P	Global Terrestrial Network - Permafrost
GTOS	Global Terrestrial Observing System
GUAN	GCOS Upper Air Network
GWP	Global Warming Potential
HDD	Heat Degree Day
HYDE	Hundred Year Database of the Environment
IEA	International Energy Agency
IFC	International Finance Corporation
IGBP	International Geosphere-Biosphere Programme
IGOS	Integrated Global Observing Strategy
IHDP	International Human Dimensions Programme (of Global Environmental Change)
IMAGE	Integrated Model to Assess the Greenhouse Effect
IMAU	Institute for Marine and Atmospheric Research
IPCC	Intergovernmental Panel on Climate Change
JI	Joint Implementation
JIN	Foundation for the Joint Implementation Network
KNAW	Royal Netherlands' Academy of Arts and Sciences
KNMI	Koninklijk Nederlands Meteorologisch Instituut *(trans. Royal Netherlands Meteorological Institute)*
LDV	Light Duty Vehicle
LNV	Landbouw, Natuurbeheer en Visserij ministerie *(transl. Ministry of Agriculture, Nature Management and Fisheries)*
LML	Landelijke Monitoring Luchtkwaliteit *(transl. National Air Quality Monitoring Network)*
LOICZ	Land-Ocean Interaction in the Coastal Zone
LPG	Liquefied Petroleum Gas
LTA	Long-Term Agreement
LUCF	Land-Use Change and Forestry
MARE	Mixing of Agulhas Rings Experiment
MATRA	Social Transformation Eastern Europe Programme
MIA	Milieu Investerings Aftrek *(trans. Environment Investment Tax Reduction)*
MPI	Milieu Plan voor de Industrie *(transl. Environmental Plan for Industry)*
MSG	Meteosat Second Generation
NCCSAP	Netherlands Climate Change Studies Assistance Program
NCPIP	National Climate Policy Implementation Plan
NDSC	Network of Detection of Stratospheric Change
NDVI	Normalised Difference Vegetation Index
NC	National Communication
NEO	National Environmental Outlook
NEPP	National Environmental Policy Plan
NGO	Non-Governmental Organisation
NIOZ	Netherlands Institute for Sea Research
NIOO-CEMO	Ned. Instituut voor Oceanografisch Onderzoek – Centrum voor Estuarium en Maritiem Onderzoek *(transl. Netherlands Institute for Oceanographic Research - Centre for Estuarine and Marine Research)*
NIR	National Inventory Report
NMVOC	Non-Methane Volatile Organic Compounds
NOVEM	Nederlandse Organisatie voor Energie en Milieu *(transl.Netherlands Organisation for Energy and the Environment)*
NRP	National Research Programme

NRP-MLK	National Research Programme on Global Air Pollution and Climate Change
NWO	Nederlandse Organisatie voor Wetenschappelijk Onderzoek *(transl. Netherlands Organisation for Scientific Research)*
NWP	Numerical Weather Prediction
NWP	Netherlands Water Partnership
OCW	Ministry of Education, Arts and Science
ODA	Official Development Assistance
OECD	Organisation for Economic Co-operation and Development
OMI	Ozone Monitoring Instrument
PER	Pollutant Emission Register
PIN	International Nature Policy Project
PSO	Programme of Eastern European cooperation
PSOM	Programme for Stimulation of Upcoming Markets
PV	Photovoltaic
QA	Quality Assurance
QC	Quality Control
QUELRC	Quantified Emission Limitation and Reduction Commitment
RIVM	Rijksinstituut voor Volksgezondheid en Milieu *(trans. National Institute of Public Health and the Environment)*
ROB	Reductieprogramma Overige Broeikasgassen *(trans. Reduction Programme for non-CO_2 greenhouse gases)*
R&D	Research & Development
R,D&D	Research, Development & Demonstration
RUU	State University of Utrecht
RWS	Directorate General of Public Works and Water Management
SARCS	Southeast Asia Research Committee on START
SAF	Satellite Application Facilities
SCAR	Scientific Committee on Antarctic Research
SCIAMACHY	Scanning Imaging Absorption Spectrometer for Atmospheric Cartography
SCORE	Supporting the Cooperational Organisation of Rational Energy use
SFC	Surface Drifters
SMEC	Second Memorandum on Energy Conservation
SOOP	Ship of Opportunity Programme
SRON	Space Research Organisation Netherlands
SST	Sea-Surface Temperature
START	Global Change System for Analysis, Research and Training
STEG	Steam Turbine and Gas Turbine combination
TEWI	Total Equivalent Warming Impact
TNO	Netherlands Organisation for Applied Scientific Research
UN	United Nations
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
UNFFFC	United Nations Framework Convention on Climate Change
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNFSTD	United Nations Fund for Science and Technology Development
USDOE	United States Department of Energy
VAMIL	Accelerated Depreciation of Environmental Investment Scheme
VOS	Volunteer Observing Ship
VROM	Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer *(trans. Ministry of Housing, Spatial Planning and the Environment)*
WEB	Werkgroep Emissie monitoring Broeikasgassen *(transl. Working group Emission monitoring Greenhouse gases)*
WCRP	World Climate Research Programme
WMO	World Meteorological Organisation
WOTRO	NWO Foundation for the Advancement of Tropical Research
WOUDC	World Ozone and UV Data Centre
WUR	Wageningen University and Research centre
WWF	World Wildlife Fund

EXECUTIVE SUMMARY

1. Introduction

In 1997, the Conference of the Parties under the UNFCCC approved the Kyoto Protocol. Shortly thereafter the Netherlands' government issued its *Third National Environmental Policy Plan* (NEPP3) containing a first draft of the post-Kyoto climate policy. After the general elections in May 1998, the new government began developing a *National Climate Policy Implementation Plan* (NCPIP). The first part of this plan was published in 1999 and describes the additional measures to be taken in the Netherlands. The second part of the NCPIP was published in 2000, describing measures to be implemented in cooperation with foreign countries. The government decided that 50% of the Kyoto commitment by the Netherlands would have to be achieved via the Kyoto mechanisms.
There are several reasons why the government decided to take early action towards fulfilling its commitments under the Kyoto Protocol, e.g. because economic developments in the Netherlands lead to an increasing trend in emissions of greenhouse gases. Another reason is that development and implementation of previous policies and measures took far longer than expected.

This *Third National Communication* (NC3) describes developments in the Netherlands' climate change policy starting with the NEPP3. It also includes a summary of policies and measures announced in the *NCPIP part 1*. An overview of the Netherlands' initiatives to apply the Kyoto mechanisms as well as *Activities Implemented Jointly* under the UNFCCC is provided in Annex B of this report.

The NCPIP will be evaluated early in 2002. Furthermore the business-as-usual scenario that was used for the NCPIP is currently under revision. New insights into economic and social developments will be taken into account, as well as improved insights into emission factors. The results of studies performed for this purpose may have a considerable effect on the figures presented in the NC3, but unfortunately they will not be available until after publication of this report.

2. National Circumstances

Population profile
In the period 1980-2000, the population in the Netherlands increased by 12%, from 14.1 million to 15.8 million inhabitants. It is estimated that the Netherlands will have approximately 16.6 million inhabitants in 2010 and 17.1 million in 2020. Compared to other EU countries, the population in the Netherlands is increasing rapidly.

Geographic profile
The Netherlands is situated in the delta of the rivers Rhine, IJssel and Meuse, with approximately 24% of the land below sea level. The surface area of both the land and coastal waters amount to 41,526 km². The land surface covers 34,000 km² and consists of 59% agricultural land, 9% forest, 5% natural land and 27% for urban use, infrastructure and other uses.

Climate profile
The Netherlands is located in the so-called temperate zone, but due to strong maritime influences its climate is much milder than average conditions at the same latitude. The annual average temperature in the centre of the country is 9-10°C.

Economic profile
The Gross Domestic Product (GDP) increased 32% between 1990 and 2000: from € 300,100 million to € 400,600 million. The Netherlands performs well on the world market and ranks relatively high among agricultural exporters. Principal export products are machinery and transport equipment (36% in 2000), chemicals (16%), and food and other livestock products (13%). The current export quote is 58%. Large domestic reserves of natural gas contribute to a relatively large chemical industry (using natural gas as chemical feedstock). Rotterdam is important for its oil refineries and ports, which are among the largest in the world.

Energy profile
In the period 1990-1999 the annual increase in energy consumption was approximately 0.7%, except for 1995

when it was 3.4% partly due to the revival of the organic chemistry. In the period 1990-1999 energy consumption increased around 3% in the residential and service sectors, 8% in agriculture, 4% in industry, 14% in the transportation sector and 10% in the energy sector (mainly public power generation). Although the overall energy intensity decreased steadily by 17% in the period 1980-1999, electricity use increased by 30% in this period, thus exceeding the growth in GDP, which amounted to 27%. An important cause is the penetration of electrical appliances. The share of electricity in the total energy demand was about 12% in 1999, which is one of the lowest in the European Union (EU).
In industry, electricity use increased faster than GDP (on average 4% annually). This is in contrast to the service and residential sector, where electricity use increased by around 8% annually during the period 1985-1990, dropping to near 0% in the period 1990-2000.

Oil and gas production
Since 1980 natural gas production in the Netherlands has been approximately 80,000 million Nm^3 annually. The domestic market uses half of this. Around half of the initial reserves have now been used, causing gas pressure to drop in the fields. The number of wells, pumps and compressors is steadily increasing to maintain the production level. Energy use for fuel production has increased to over 1% of the total production.

Electricity production
Total electricity use in the Netherlands increased by 33% in the period 1990-1999. This increased demand was mainly supplied by cogeneration, and - from 1999 onwards - by importing electricity from Germany, France (around 12% of the domestic demand) and other countries. Since 1990, the average conversion efficiency of conventional gas-fired power plants has increased from 40% to 46%, while new 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%, mainly due to CHP installed when expanding existing capacity. Since 1990 the production of renewable energy has increased by a factor of 2.5, resulting in a 1.3% share in the energy supply in 1998. More than half of the renewable energy stems from waste combustion. The installed capacity of wind power amounted to around 440 MW_e by the end of 2000.

Transportation
The number of car-km per inhabitant increased by less than that of other EU countries. This may be explained by the fuel prices for end-users, which increased significantly in the Netherlands compared to other countries, mainly due to government levies.

Industry
The Netherlands' industry operates in a relatively energy-intensive way, compared to other EU countries. This is mainly caused by the chemical industry, which has an energy intensity that is three times higher than in Germany, the UK and Denmark.

Building stock and urban structure
In 2000, the number of residential dwellings was 6.6 million, of which 2.0 million are apartment buildings. Since 1990 approximately 80,000 to 90,000 new homes have been built per year. The total built-up area in the Netherlands has increased from 9% to 10% in the last 10 years.

Waste
In 1999, residential and office waste accounted for approximately 21% of the national total of 57 million tons. Industrial waste (including refineries) accounted for around 38% and the demolition waste from buildings and roads amounted to around 31%. However, 75% of the total waste is reused: 45% of residential and office waste, 80% of industrial waste and 90% of demolition waste. Waste from agriculture and coal-fired power plants is fully recycled.

Agriculture
Agriculture in the Netherlands focuses on cattle breeding, crop production and greenhouse horticulture. The amount of horticulture is increasing over time. Between 1990 and 1999 the number of dairy and non-dairy cattle fell by 18% and 7% respectively.
The number of sheep and pigs also dropped by 18% and 3%, whereas the number of poultry increased by 13% in the same period. Stricter standards for phosphate fertilisation of fodder maize have caused an increase in nitrogen levels on grassland since 1990, due to increased application of animal manure on grassland. A ban on surface spreading of manure and encouraging manure injection into the soil resulted in a larger percentage of

the nitrogen being absorbed by grassland.

Forestry

In 1998, 11% or 3,233 km² of the Netherlands was forest. The estimated volume amounts to around 40 million m³ of round wood, with an annual growth of approximately 1.7 million m³. The annual amount of harvested wood is around 1.2 million m³. Over the past 15 years, the Netherlands' forests have become more mature, better structured and more mixed forests (30% Scotch pine, 15% oak trees). The objective is to expand the forested area by 75,000 ha during the period 1994-2020, notwithstanding the 70% arrears in the actual planning of forestation.

3. Greenhouse Gas Inventory

The 2001 update of the national Pollutant Emission Register (PER) shows that in 1999 the net total CO_2 equivalent emissions of the 'Kyoto gases' increased by around 6% compared to 1990 (1995 for F-gases). The largest increase occurred in the transport sector. Please note that CO_2 emission data for 1999 are not completely consistent with the CO_2 data for previous years due to the fact that statistical differences for CO_2 were eliminated in 1999.

CO_2 emissions

Compared to 1990, CO_2 emissions have increased by around 8%. The transport sector contributed the most to this increase (approximately 19%). An overview of emissions per IPCC sector is provided in Table ES.1. The overall uncertainty in annual emissions of CO_2 is estimated at ±3%. A significant part of the energy consumption in the Netherlands is used for space heating. During cold winters energy consumption is substantially higher than in mild winters, leading to a disturbance in the CO_2 trend of up to 5%. In order to enable an accurate monitoring of the trend in CO_2 emissions and the effectiveness of policy instruments, the Netherlands' CO_2 emissions are corrected for temperature variations. Based on temperature-corrected values, CO_2 emissions in 1999 were 7% higher than those in 1990.

CH_4 emissions

In 1999 total methane emissions had fallen by 20% compared to the 1990 level, with the waste, agriculture and energy sectors contributing the most to this decrease. The main reasons include: less land-filled waste, higher methane recovery rates from landfills, decreasing numbers of livestock and lower fugitive fuel emissions. In the period 1990-1999 the fugitive CH_4 emissions from oil and gas fell by 20% mainly due to measures to prevent venting of natural gas during production. The overall uncertainty in annual emissions of CH_4 is estimated at ±25%.

Table ES.1 CO_2 emissions and sinks per IPCC sector in the period 1990 – 1999 (no T-correction).

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

Table ES.2 Total greenhouse gas emissions in CO_2-equivalent and indexed (no T-correction) in the period 1990 – 1999.

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

N_2O emissions

In 1999 total N_2O emissions increased by around 15% compared to 1990 levels, mainly due to the agricultural sector (16%) and the industrial sector (15%). Injecting manure into the soil is the main reason for the emission increase in the agricultural sector. Growth of production is the main reason for the increase in industrial emission. The overall uncertainty in annual emissions of N_2O is estimated at ±50%.

Emissions of fluorinated halocarbons

HFC emissions have increased by 30% in 1999 compared to 1995 levels. This is mainly caused by an increase in HFC consumption (as a substitute for CFC use, particularly to HFC-134a) and a limited increase of process emissions of HFC-23 from the manufacture of HCFC-22. The latter was limited by control measures implemented to reduce HFC-23 emissions from the facility. PFC emissions from aluminium production increased by about 35% during this period, due to an increase in aluminium production. The relatively very low SF_6 emissions tend to vary each year. The uncertainty in the overall estimates is in the order of 50% for HFCs and PFCs and -10% to +100% for SF_6 (each with an order of magnitude-factor of 1.5).

Trends in total greenhouse gas emissions

The trend in total CO_2-eq. emissions of greenhouse gases and the contribution of the various gases are calculated using the *IPCC Global Warming Potentials* (GWP) for a 100-year period. Table ES2 shows the relative contribution of each gas to annual total emissions. For fluorinated greenhouse gases, the year 1995 is used as reference year.

4. Policies and Measures

In Kyoto the EU committed itself to an emissions reduction of 8% in the first commitment period, compared to the emissions in the base year. After the Burden Sharing process within the EU, the emissions reduction commitment for the Netherlands was fixed at -6%. Shortly following the Kyoto agreement, in May 1998 the Third National Environmental Policy Plan (NEPP3) was published, containing a first draft of the post-Kyoto climate policy. Several additional measures were announced, to be elaborated by the new government after the elections that took place in 1998. In the NEPP3 the government

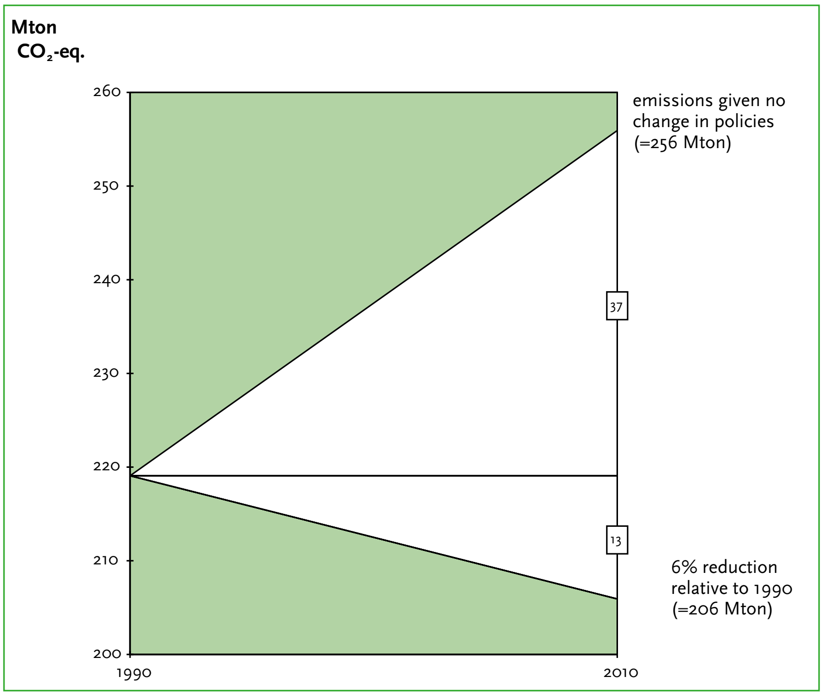


Fig. ES.1 The policy shortfall in 2010.

concluded that the objectives for the Netherlands' climate change policy for 2000 would not be met, with the exception of CH_4. The national target for CO_2 in 2000 might be exceeded by 10%.
The following reasons can be given for the national objectives not being met:

- since 1996 the economic growth has been over 3.5% annually and higher than foreseen;
- energy prices did not provide sufficient incentives for energy conservation;
- development and implementation of policies and measures took far longer than expected.

The Netherlands government therefore decided to start developing a comprehensive package of policies and measures at an early stage, in order to be able to comply with the Kyoto commitments. The Cabinet issued the NCPIP in June 1999, in which necessary efforts for meeting the Kyoto commitments by 2010 were assessed, relative to the *Business as Usual Global Competition* scenario. This reduction, the 'policy shortfall' was estimated at 50 Mton CO_2-equivalent per year.

One of the conditions for climate change policy, defined by the new government in 1998, was that international agreements should allow sufficient latitude (around 50%) for using the Kyoto mechanisms to meet commitments. It was therefore decided that half of the necessary efforts (25 Mton per year) would have to be achieved by national policies and measures. The basic *NCPIP part 1* package contains the measures that the target groups are taking in the period leading up to 2008-2012 in order to reduce domestic emissions to 231 Mton per year. The domestic target of 231 Mton per year is the sum of the Kyoto commitment of 206 Mton per year (-6%) and 25 Mton per year, which will be reduced abroad via the Kyoto mechanisms as indicated above. Using Kyoto mechanisms to secure the remaining half of the reductions needed was set out in Part 2 of the plan (issued in March of 2000 and approved in October).
The *NCPIP part 1* also contains a reserve package, describing a package of measures to be held in reserve in order to be able to respond quickly to unfavourable future developments. Furthermore it lays the foundations for further intensification of policies for the period after 2012.

The basic package consists of the following measures:

Cross-sectional measures

Three tax incentives have been implemented or adapted to stimulate further growth in combined heat and power (CHP). Firstly, the existing corporate income tax deduction for energy investments (including investments in

CHP) was raised to 55% of the investment costs. Secondly, the fuel tax on inputs for electricity production was converted into a tax on kWh-outputs and integrated into the regulatory energy tax. Electricity from CHP for own-use was exempted from this operation, giving it a price advantage. Finally, a payment discount (of € 0.03 per kWh) was introduced into the regulatory energy tax for electricity generated in CHP installations that produce heat utilised in the Netherlands.

Transport sector

Energy labels were introduced in January 2001, indicating fuel consumption and CO_2 emissions of new passenger cars. These labels report both absolute fuel consumption and the relative consumption compared to other similar sized cars. The labels are similar to those already in use to indicate the energy efficiency of refrigerators and washing machines.
The government has also committed € 12 million to a multi-year programme to promote fuel-efficient purchasing and driving behaviour. The programme is implemented in close cooperation with market parties, and includes activities such as driver training.

Industrial sector

In July 1999 a *Benchmarking Covenant* was signed between national and provincial governments and representatives of industry. In this voluntary agreement, energy-intensive companies, with annual energy consumption of at least 0.5 PJ, agreed to achieve (and/or hold) a position among the most energy-efficient industries in their type of business in the world by no later than 2012. An international standard of comparison (a benchmark) is being developed for each industrial process covered by the agreement. In return, the government will not impose any additional specific energy conservation or CO_2-reduction measures on the participating companies. Currently 224 installations participate in the agreement, representing 80% of the eligible companies and 93% of the eligible energy consumption. A Verification Bureau Benchmarking facilitates the process. The government is currently negotiating with less energy-intensive industries about a second round of Long-Term Agreements on energy efficiency. The first round of such agreements was successful and an energy efficiency improvement of over 20% was achieved over the period 1990-2000.
The group of participating industries also included industries that are now participating in the Benchmark agreement. The government supports both the Long-Term Agreements and the Benchmarking Covenant with the 'carrot' of fiscal incentives and the 'stick' of environmental permits.

Energy sector

An agreement (in principle) was reached (mid 2000) between the government and the owners of existing coal-fired electric power plants. Owners have committed themselves to replacing coal with biomass for 475 MW of installed coal capacity. They will also participate in the Benchmarking Covenant for both gas-fired and coal-fired plants. As part of this agreement, the government has changed the tax on fuel inputs in electricity production into a tax on kWh-output as part of the regulatory energy tax, with effect from January 1, 2001.

Under certain conditions, interest and dividend on green funds are exempted from income tax, which implies that these funds may offer lower interest rates in loans to private persons or companies. One of the conditions is that a 'declaration of approval' is issued indicating that the funds are sufficiently invested in appropriate green projects. Many renewable energy projects are eligible as a green investment. An independent organisation assesses whether the investment projects meet the declaration criteria.

Household sector

A voluntary *Energy Performance Advice* (EPA) for existing housing was introduced in 1999. This EPA classifies the energy-related quality of a house, provides advice on the most appropriate energy-saving measures that can be taken and gives information on energy savings and costs of required measures.
An *Energy Premium* for energy-efficient appliances and insulation came into effect on January 1, 2000. The Premium targets existing housing and implies a partial rebate for consumers purchasing the most efficient type of insulation, double glazing, etc. This programme has a structural budget of approximately € 90 million per year.

Forestry sector

A payment discount has been introduced into the regulatory energy tax to accelerate afforestation. Under this scheme the *National Green Fund* makes agreements with various parties to plant new forests and maintain them in a sustainable manner for a period of at least 50 years. The fund issues certificates for the number of hectares for which CO_2 sequestration rights have been acquired. An energy company wanting to acquire the right for CO_2 sequestration can deduct € 4,500 from its energy tax bill, providing this amount is paid to the *National Green Fund*.

Technological innovation

The government has made € 18 million available for a 10-year programme to speed up the introduction of new, climate-neutral gaseous and liquid energy carriers (GAVE Programme). The term 'climate neutral' indicates the goal of replacing petrol, diesel fuel and natural gas with fossil-based and renewable-based energy carriers that are compatible with far-reaching CO_2 reductions in the period after 2010. The government also has plans to introduce a payment discount for climate-neutral energy carriers into the regulatory energy tax, comparable to that for renewable energy. An amount of € 4.5 million per year has been reserved for this purpose.

A cross sectional programme: reductions of non-CO_2 greenhouse gases

A reduction of 8 Mton CO_2-equivalents of non-CO_2 greenhouse gases is included in the basic package, which will be realised through the *Reduction Programme for non-CO_2 Greenhouse Gases* (ROB). The programme consists of a number of generic projects (e.g. developing a format to calculate the Total Equivalent Warming Impact of projects and technologies) plus some 15 sector-oriented projects. A limited number of these projects (mainly related to F-gases) have been assigned a (tentative) reduction target and are included in the basic package (PFC emissions from aluminium production, HFC process emissions from HCFC production, HFCs/PFCs used as alternatives for (H)CFCs, and nitrous oxide emissions for catalysts in petrol-driven cars). In addition, the basic package encompasses a number of research-oriented projects dealing with sectors to which reduction targets could not be assigned in 1999. If and when these research-oriented projects yield promising reduction possibilities, these will be taken into account when the basic package is evaluated or in a second commitment period.

The ROB programme studies emissions and reduction options, and policies are proposed and implemented. Budget is also available for research, development and demonstration of technologies where necessary, and for investment support, if and when necessary.

Innovation in policy instruments

In August 2000, the government appointed a commission of experts to study the feasibility of introducing ceilings for CO_2 emissions in respect to households and sheltered sectors of the Netherlands' economy. The commissions' work focuses on a national cap and trade system, which must be shaped in such a way that it can be linked to or integrated into other possible national or supranational systems which may be introduced. The commissions' report is expected in late 2001.

Cooperation with foreign countries (NCPIP, part 2)

Part 2 of the NCPIP (described in Annex B of this report) explains the policies that will be implemented in order to achieve half the reduction commitment via the Kyoto mechanisms. Because many rules for applying the Kyoto mechanisms have yet to be defined, there are many uncertainties to the conditions under which those mechanisms may be used. With these uncertainties in mind, the government has decided to develop initiatives, where possible and sensible, in order to reduce emissions in cooperation with other countries.

The overall aim of these initiatives is to stimulate project development in time to achieve the considerable reductions required in 2008-2012. The government considers it important to gain experience in using the Kyoto mechanisms in order to be able to contribute to the elaboration of the rules. The same is true for the countries with which the Netherlands cooperates. The activities staged by the Netherlands will be evaluated periodically, with the first evaluation planned for 2002.

5. Projections

The NCPIP uses the *Global Competition (GC)- scenario* as the Reference Scenario (so called *With Measures Scenario*). This scenario, which was also used to update the NC2, assumes a strong rate of economic growth, relatively high global oil prices, a high rate of technological development and penetration of new technologies

Table ES.3 Total emissions in mln kg CO_2 equivalents in the period 1990-2020.

Compound	Historical emissions			Reference Scenario (with measures)					Additional Policy[2]		
	1990 actual	1990 scenario	1995 scenario	2000	2005[1]	2010[1]	2015[1]	2020	2000	2005	2010[1]
CO_2	161	161 [3]	177 [3]	189	198	207	220	233	183	187	190
CH_4	27	27	25	20	17	14	12	10	20	17	14
N_2O	20	20	22	23	22	21	21	21	23	21	20
Subtotal	**208**	**208**	**224**	**232**	**237**	**242**	**253**	**264**	**226**	**225**	**224**
HFCs	5	5	7	5	6	9	13	16	2	3	3
PFCs	2	3	2	3	3	3	3	3	3	2	1
SF_6	0	1	1	2	2	2	2	2	2	2	2
Subtotal	**8**	**9**	**10**	**9**	**10**	**14**	**18**	**21**	**6**	**6**	**6**
Total [CO_2 eq.]	**216**	**217**	**234**	**241**	**247**	**256**	**271**	**285**	**232**	**231**	**230**

1 Data for 2005, 2010 (for F-gases) and 2015 are interpolated.

2 The policy effects for 2015 and 2020 have not been estimated in the Climate Policy Implementation Plan.

3 Not corrected for the temperature .

and the continuation of policies in place in the Netherlands up to NEPP3 (1998). The measures were described in the NC2. This means that the reference scenario referred to in this NC3 is the With Measures Scenario for the UNFCCC.
The Additional Policy Scenario in this NC3 includes the measures from the NEPP3 and all measures from the basic package of the *NCPIP part 1.*

Table ES.3 indicates that the CO_2 equivalent emissions in the Additional Policy scenario in 2010 will be around 5% higher than the emissions in the base year (1990; 1995 for F-gases). An additional emissions reduction of around 11% is necessary to meet the emissions reduction commitment of -6% in the first commitment period. These reductions will be realised by applying the Kyoto mechanisms (25 Mton CO_2 equivalents).
The *Additional Policy* scenario has only been assessed for the first commitment period of the Kyoto Protocol and does not include an assessment for 2015 and 2020.

6. Vulnerability Assessment

The possible risks of climate change for the Netherlands have been identified in the *Third Climate Report* published by *KNMI*. The most urgent risks of climate change for the Netherlands are rising sea levels and increased concentration in water flux through the rivers Rhine, Meuse and Schelde.
As a result of the business-as-usual coastal defence policy the loss of material in the coastal zone (between minus 7 m and plus 3 m) is retrieved on the beaches and eventually in the shallow water zone. The total coastal system (area between minus 20 m to plus 3 m) is also losing material. The total loss is estimated to be double the amount of material lost in the shallow zone. This loss will also be retrieved. As a result of a possible sea-level rise of 60 cm by the end of this century, the amount of sand needed would increase by 30%.

In 2000 the *Technical Advisory Committee on Water Defence* advised the government to better anticipate future developments in climate, bottom subsidence, population and economic values. A good mix of spatial and technical measures should be applied, with a preference for spatial measures such as widening river forelands and deploying water storage and retention areas. New investments in water management of national and regional water systems are planned.

7. Financial assistance and technology transfer

The Netherlands government has decided to set its Official Development Assistance (ODA) budget at 0.8% of GNP. The budget also covers expenditures for environmental assistance based on the principles of Agenda 21. A sum amounting to 0.1% of GNP has been earmarked for such expenditures since 1997. The 0.1% target was met in 1998, 1999 and 2000, thus carrying out the Rio commitment to make available new and additional means on top of regular development assistance budgets.
The quantifiable targets, which determine the course of development cooperation policy, also include the 0.2% allocation for assistance to the least developed countries

Table ES.4 Breakdown of environment-related expenditures within Official Development Assistance in € million.

Expenditures (€ million)	1997	1998	1999	2000
Multilateral institutions				
GEF/ Montreal fund	7.3	7.3	8.5	9.7
UNEP	0.9	0.9	1.2	2.1
UNFCCC		0.2	0.2	0.2
Desertification Treaty			0.1	0.1
IFAD (10%)[1]	0.3	0.6	0.7	0.6
World Bank partnership (30%)		2.5	20.4	8.9
UNDP (20%)	15.4	15.0	14.1	15.0
European Development Fund (5%)	3.4	6.5	4.0	5.4
International Development Association (10%)	16.5	20.3	23.1	15.9
Regional development banks and funds (5%)	2.0	2.7	2.7	2.0
Environmental programmes				
Country programmes	120.9	128.9	126.9	169.3
Miliev programme	13.9	32.2	39.6	36.3
Education	0.9	0.9	0.9	0.9
Other (5-15%)	115.5	121.7	118.5	140.1
Environment total	296.8	339.7	360.8	406.4
ODA total	2,760.0	2,919.4	3,126.3	3,465.8
GNP (x 1000)	323.5	344.3	372.5	407.5
Environment as % of GNP	0.09%	0.10%	0.10%	0.10%

1) The percentages in brackets indicate the proportion of environment-related expenditures within the total contributions

and a minimum of € 46 million per annum for assistance in sustainable management of tropical rainforests. The Netherlands also lives up to the target, as agreed in the Rio Declaration, to make available 0.7% of its GNP as ODA. Table ES.4 gives an overview of all environmental expenditures within the ODA. These financial resources are made available through a combination of multilateral, bilateral and non-governmental channels.

The Netherlands has longer term development cooperation programmes with Bangladesh, Burkina Faso, Bolivia, Egypt, Eritrea, Ethiopia, Ghana, India, Indonesia, Macedonia, Mali, Mozambique, Nicaragua, Palestinian Authority, Sri Lanka, South Africa, Surinam, Tanzania, Uganda, Vietnam, Yemen and Zambia. From these countries, Mozambique, Ghana, India, Sri Lanka, Macedonia, Surinam and Vietnam have decided, in consultation with the Netherlands, to have a special focus on the environment in the bilateral cooperation programme. For the other countries the cooperation on environmental issues results from cooperation in relation to sectors such as water management, rural development, agriculture and health.
In addition to these longer term development cooperation programme with the afore mentioned countries, the Netherlands cooperates with a number of countries on environmental issues: Brazil, Cape Verde, China, Colombia, Ecuador, Guatemala, Mongolia, Nepal, Pakistan, Peru, the Philippines and Senegal. Cooperation also exists with Benin, Bhutan and Costa Rica on the basis of Sustainable Development Treaties.

In view of the need for a structural approach to the climate issue, the Netherlands Development cooperation has set up a structural climate programme, anchored into the Convention on Climate Change and its Kyoto Protocol, which is compatible with existing Netherlands development cooperation policy. The programme aims to support countries planning to formulate and implement their own climate change policy. In consultation with, and at the request of, the aforementioned developing countries, they will receive support for:

- building the capacity and developing the institutions required to formulate and implement climate policy, including in some cases, participation in CDM;
- contributions towards limiting greenhouse gas emissions;
- adapting to the adverse effects of climate change.

8. Research and Systematic Observation

Research on climate change in the Netherlands has two important characteristics:

- *active participation in and coordination with international programmes*. The Netherlands provides a significant contribution to 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).
- *improved coordination of activities, through clustering in so-called topic centres*. These enhance coordination and exchange of experiences. Examples are the Centre for Climate Research (CKO), the Centre for Climate Change and Biosphere (CCB), the Core Project Office (CPO) of the IGBP core project Land-Ocean Interaction in the Coastal Zone (LOICZ) and the Coastal Zone Management Centre (CZMC). Extensive support is given to the work of the Intergovernmental Panel on Climate Change (IPCC).

The second stage of an extensive research programme, the *National Research Programme on Global Air Pollution and Climate Change* (NRP), which was started in 1995, will be finalised in 2001. A follow-up programme will be set up; the scope and structure will be discussed after the NRP has been evaluated.

9. Education, Training and Public Awareness

Surveys show that over the past decade the attitude of the general public in the Netherlands initially showed an increasing interest in this issue, but this was followed by a slight decline. However, the public maintains a relatively high interest in the subject. Policies have recently aimed at keeping up and revitalising public interest. The focus in communication has shifted from national or international policies to practical and easy-to-implement solutions for specific target groups, e.g. households and other involved parties. The central message is that everyone should be concerned about climate change. The public is also kept informed about the activities in the different sectors of society. The Conference of the Parties in The Hague also raised a great deal of media attention and contributed to the general public's awareness of climate change issues.
In addition to these general campaigns, other activities are also being undertaken in this field, often to support the introduction of specific policies and measures. Examples include:

- *energy-efficient lifestyle and Eco-teams*: provide households with practical steps and options;
- *green electricity*: a supportive campaign for green electricity;
- *new way to drive*: provides advise and training materials for more comfortable, safe and energy-efficient styles of driving;
- *green labelling of cars*: a communication campaign was launched to inform the general public about energy labels on new cars; trade and consumer organisations inform the public and the automobile industry.

Innovative methods for structural change in behaviour are stimulated as well, e.g. through a subsidy (Enter Facility) for innovative pilot projects.

Public and non-governmental organisations are closely involved in many of the campaigns and actions. Apart from the aforementioned campaigns, NGOs promoted several other activities, e.g. the Solaris project, which was implemented by *Greenpeace* together with local authorities and energy distribution companies.

1 INTRODUCTION

In 1997, the Conference of the Parties under the UNFCCC approved the Kyoto Protocol. Shortly thereafter the Netherlands' government issued its *Third National Environmental Policy Plan* (NEPP3) containing a first draft of the post-Kyoto climate policy. After the general elections in May 1998, the new government started developing a *National Climate Policy Implementation Plan* (NCPIP). The first part of this plan was published in 1999 and describes the additional measures to be taken in the Netherlands. The second part of the NCPIP was published in 2000, describing measures to be implemented in cooperation with foreign countries. The government decided that 50% of the efforts necessary to comply with the Kyoto commitment of the Netherlands would have to be achieved by policies and measures in the Netherlands, the other 50% by applying the Kyoto mechanisms.

There are several reasons why the government decided to take early action to achieve its commitments under the Kyoto Protocol, e.g. because the economic developments in the Netherlands lead to an increasing trend in emissions of greenhouse gases. Another reason is that development and implementation of previous policies and measures took far longer than expected.

This *Third National Communication* describes developments in the Netherlands' climate change policy starting with NEPP3. It also includes a summary of policies and measures announced in the *NCPIP, part 1*. An overview of the Netherlands' initiatives to apply the Kyoto mechanisms as well as Activities Implemented Jointly under the UNFCCC is provided in Annex B of this report. Although the UNFCCC reporting guidelines for National Communications do not require reporting on initiatives for applying the Kyoto mechanisms, the Netherlands provides this information because they play an important role in the Netherlands' climate change policy.

The development of climate change policy is continuing, internationally as well as nationally. In Bonn (July 2001) the Parties under the UNFCCC agreed on the modalities of the Kyoto Protocol, although many (technical) issues have yet to be resolved. The NCPIP will be evaluated early in 2002, when the remaining issues hopefully will have been resolved at CoP7 in Marrakech. The results from Bonn and Marrakech will play a role in this evaluation. Furthermore, new insights into the social and economic developments in the Netherlands will be taken into account, as well as improved insights into emission factors. The *Business as Usual* scenario used for the NCPIP is under revision to include these internal developments. Based on the results from Bonn, Marrakech and the evaluation of the NCPIP, the government will probably decide to ratify the Kyoto Protocol in 2002.

Due to the time schedule of this *Third National Communication*, the results of the revision of the *Business as Usual* scenario and the NCPIP evaluation cannot be presented in this report. It should be noted that the results of studies performed for these purposes may affect climate change policy in the Netherlands as presented in this report.

2 NATIONAL CIRCUMSTANCES RELEVANT TO GREENHOUSE GAS EMISSIONS AND REMOVAL

2.1 Government structure

The Netherlands is a constitutional monarchy. The legislative powers are vested in the national government, the 12 provinces and the 625 municipalities (responsible, for example, for granting licences and permits). The Netherlands Parliament consists of a First Chamber (75 members, chosen by the provinces) and a Second Chamber (150 members, chosen directly by the citizens). The legislative process is 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 such as Long-Term Agreements.

The *Environmental Protection Act* (EPA) of March 1, 1993 stipulates that the government must draw up a *National Environment Policy Plan* (NEPP) every four years, as well as an annual Environment Programme. The government presents the NEPP to Parliament. If Parliament approves the Plan, it becomes permanent. Not every commitment (e.g. emission targets) in the Plan needs to be legislated.

The Minister for Housing, Spatial Planning and the Environment is initially 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, consumers, advisory councils, research institutes, environmental protection organisations, and various trade unions and federations. The formulation and implementation of policy is usually carried out in collaboration or consultation with relevant 'target groups'. Good communication between government and market parties is given high priority. Environmental protection organisations also play an important role in the Netherlands, e.g. through participation in advisory councils.

2.2 Population profile

The period 1980-2000 saw a population increase in the Netherlands of 12%, from 14.1 million to 15.8 million people (Figure 2.1). Annual growth fell from 0.8% in 1980 to around 0.5% in 1995. However, since 1998, annual growth increased once again. The population density increased from 415 to 465 persons per km^2 (CBS, 2000). Recent analyses anticipate that the Netherlands will consist of around 16.6 million inhabitants in 2010 and 17.1 million in 2020 (CBS, 2000). In comparison with most other EU countries, this population increase can be considered relatively high. Another important demographic factor influencing the pressure on the environment is a decrease in the num-

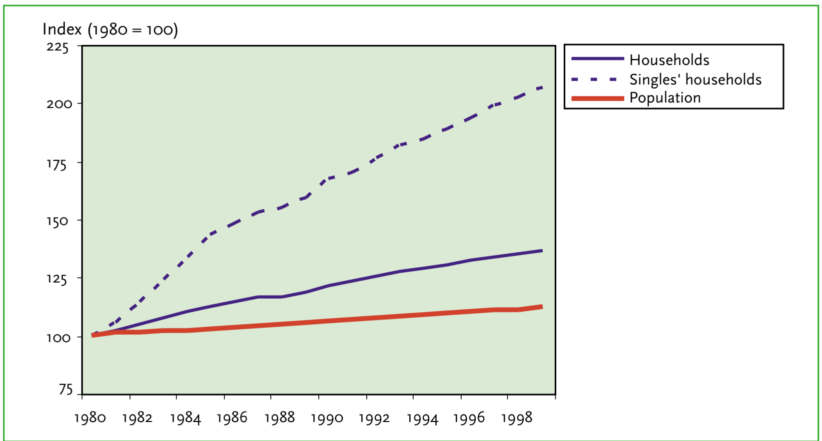


Fig. 2.1 Development of the total population, number of households and the number of singles households in the Netherlands in the period 1980-2000.
Source: RIVM/CBS, 2000

ber of persons per household (from 2.8 in 1980 to 2.5 in 1990 and 2.3 in 2000). The number of households increased from 5 million in 1980 to almost 6.9 million in 2000, while the percentage of singles' households increased from 22% to around 33% (RIVM/CBS, 2000).

2.3 Geographic profile

The Netherlands is a low-lying country situated in the delta of the rivers Rhine, IJssel and Meuse, with around 24% of the land 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. The eastern part of the Netherlands includes Pleistocene ice-pushed ridges covered with wind-borne sand deposits. The south consists mainly of Meuse terraces with loess deposits or wind-borne sand deposits. The highest point is 321 m above sea level, at the border with Belgium and Germany, and the lowest point is 7 m below sea level. The surface area of the land plus inland and coastal waters amounts to 41,526 km². The land surface covers 34,000 km² and consists of 59% agricultural

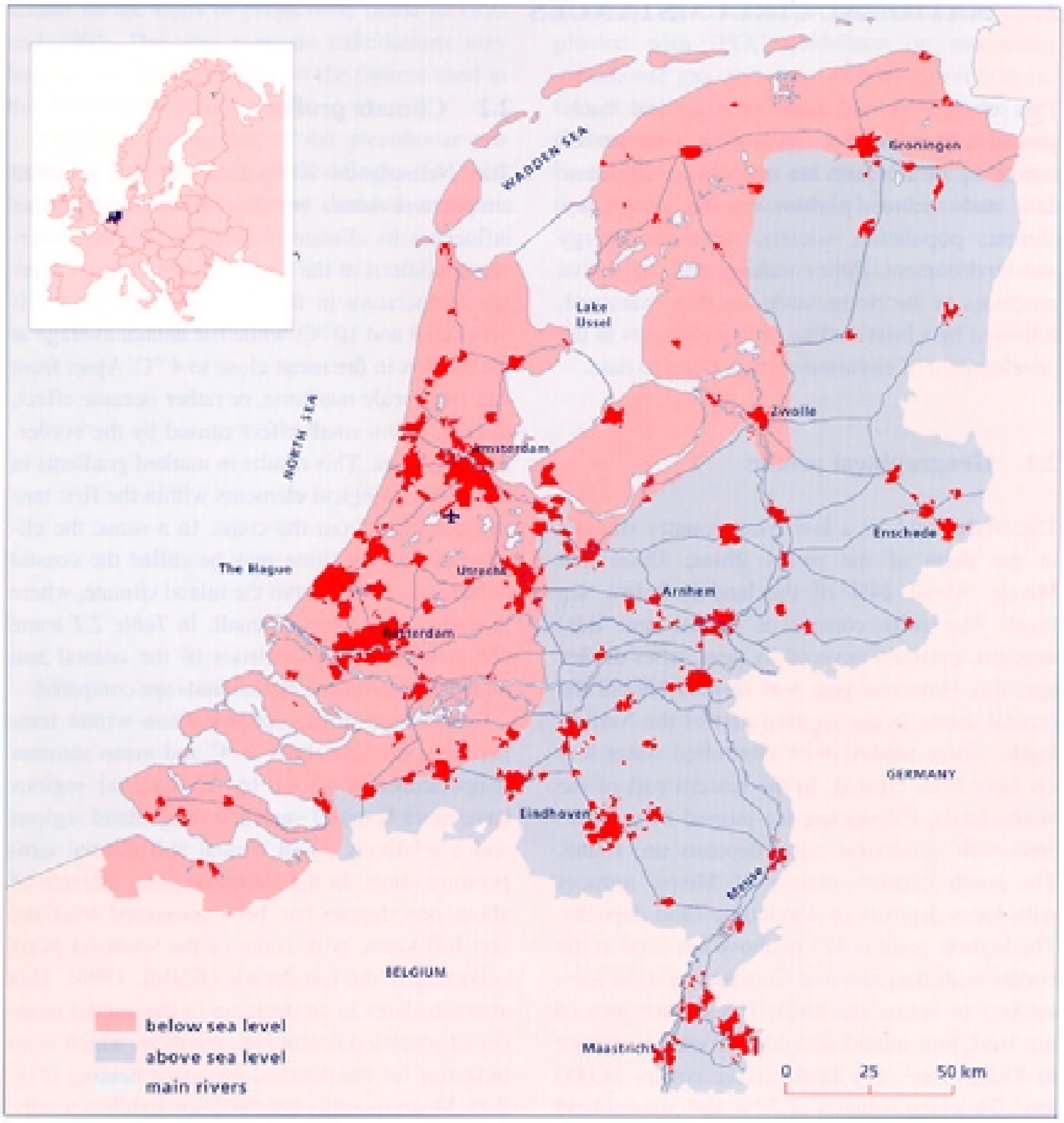


Fig. 2.2 Key elements of the Netherlands' geographic profile.

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

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

Source: KNMI

land, 9% forest, 5% natural land and 27% for urban uses, infrastructure and other uses. The population density is highest in the '*Randstad*' (a cluster of cities in the western part 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 among the largest in the world. Schiphol Airport near Amsterdam is important as an air transit point for the rest of Europe. Several geographic features are shown in Figure 2.2.

2.4 Climate profile

The Netherlands is located in the so-called 'temperate zone'. Due to strong maritime influences the climate is much milder than average conditions at the same latitude. The annual average temperature in the centre of the country is 9 - 10°C, while the mean annual average at 52°N is close to 4°C. Apart from this larger 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 climatologic elements within the first tens of kilometres from the coast. Inland gradients are generally small. Table 2.1 compares some climatologic characteristics of the coastal and inland climate of the Netherlands.

Throughout the country mean winter temperatures are just above 0°C and mean summer temperatures at around 16°C. Coastal regions have more hours of sunshine than inland regions and a relatively small annual and diurnal temperature range. An increase of around one degree has been measured in the Netherlands over the last 100 years, with some of the warmest years occurring in the last decade (KNMI, 1996). This also translates in a drop in the annual number of so-called 'heating degree-days', which is an indicator of the demand for space heating (Figure 2.3).

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 national mean of 775 mm (Colenbrander et al., 1989).

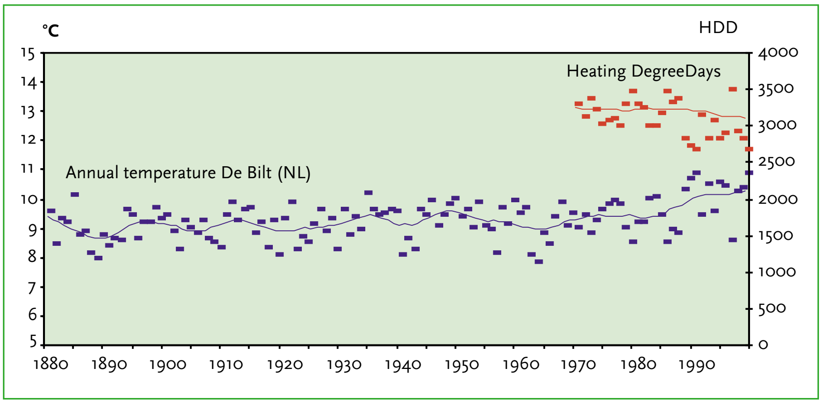


Fig. 2.3 Development of the average surface temperature and the number of heat degree-days (HDD) in the Netherlands in the periods 1880-2000 and 1975-2000, respectively.

Sources: KNMI, 2000; EnergieNed

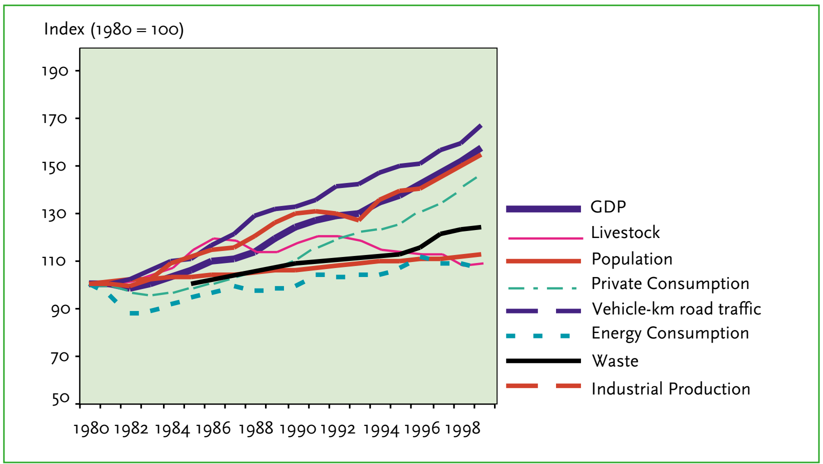


Fig. 2.4 Trends in volume development in the Netherlands in the period 1980-1999.
Sources: RIVM/CBS, 2001; RIVM, 2001

2.5 Economic profile

The Gross Domestic Product (GDP) of the Netherlands was € 300,100 million in 1990 and € 400,600 million (using 2000 prices) in 2000, an increase of 32% (CBS, 2001). In the period 1980-1999 real GDP increased annually, apart from 1981 and 1982 (see Figure 2.4), with annual growth figures between 1% and 4%. The growth of GDP per capita was around 1% to 1.5% annually at the beginning of the 1990's, except for 1993 (0.1%). During the years 1996-2000 this increase was approximately 3% annually. Economic growth in the Netherlands is somewhat higher than the average for the European Union countries.

The Netherlands performs well on the world market and ranks relatively high among agricultural exporters. The principal exports are machinery and transport equipment (36% in 2000), chemicals (16%) and food and other livestock products (13%). The current export quote is 58%. Exports increased by around 80% between 1990 and 2000 (in constant prices). This growing export trend is inextricably linked to developments in the freight transport sector. Principal imports to the Netherlands in 2000 included machinery and transport equipment (40%), and manufacturing goods (26%). The transportation sector has traditionally been one of the main economic activities (8% in 1999) because of the country's favourable location for transporting goods from a harbour to the EU inland destinations. The geographic 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.

During the last few decades the volume of many important variables, such as GDP, mobility, livestock, energy consumption and waste production, which strongly

Table 2.2 The pressure on the environment, per km² and per inhabitant, by a number of social developments in the Netherlands, compared to neighbouring countries in 1993.

Index (NL = 100)	Population	GDP	Energy consumption	Passenger cars	Vehicle-km	Fertiliser	Cattle	Pigs
	per km²	per capita	per capita	per capita	per capita	per km²	per km²	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

Sources: RIVM, 1996; IEA

influence the development of emissions, has increased in the Netherlands, as illustrated in Figure 2.4. Only the development of livestock numbers deviates from this trend. The greatest 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 1980-1999 the growth in energy consumption was lower than the growth in GDP. Apart from transportation, the indicators presented in Table 2.2 show that the environmental pressure in the Netherlands, compared to neighbouring countries, ranks among the highest.

Private consumption increased by 28% in the period 1990-1999 (Figure 2.4). A comparison of consumption trends with neighbouring countries shows the same picture as for production: growth of private consumption in the Netherlands and Germany (excluding the former DDR) is somewhat higher than the average for European Union countries. In recent years, households in the Netherlands have purchased a relatively high number of electrical appliances, e.g. the percentage of households owning a PC increased from 26% in 1990 to 62% in 1998 (RIVM/CBS, 2000), while the penetration of washing machines, colour TVs, microwave ovens etc. is high. Combined with the increasing number of households this has led to a significant growth in residential electricity consumption.

2.6 Energy profile

After a drop in domestic energy consumption during the economic recession at the beginning of the 1980s, energy consumption in the Netherlands in the period 1985-1990 increased by 2.2% annually. From 1990-1999 the annual increase was around 0.7%, except for 1995 when it was 3.4%, which was partly due to the revival of the organic chemistry. At that time energy consumption increased in all sectors (see Table 2.3): approximately 3% in the residential and service sectors, 8% in agriculture, 4% in industry, 14% in the transportation sector and 10% in the energy sector (mainly public power generation). Since 1990 energy consumption trends in industry and agriculture have been influenced by a major increase in cogeneration in these sectors, resulting in reduced fuel consumption in the public power generation sector.

Although the overall energy intensity decreased in the period 1980-1999, electricity use in this period increased by 30%, thus exceeding the growth in GDP, which was 27%. An important cause was the penetration of electrical appliances. In the residential sector electricity use was almost constant between 1980 and 1988, increasing by 3% annually from 1990 onwards. Industrial electricity consumption grew faster than GDP, on average by 4% annually. In contrast, the growth of electricity use in the service sector was around 8% annually during the period 1985-1990, but this has fallen to around 0% over the past 10 years. The share of electricity in the total energy demand in the Netherlands, has increased from 10% to 12% over the past decade, though this is still one of the lowest shares in the European Union (EU).

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, particularly the share of the basic materials processing industry. The fuel mix in the Netherlands also differs substantially from that in other countries (Figure 2.5). The share of natural gas in the total end use for energy was approximately 50% in 1990, which is extremely high.

Table 2.3 Energy use per sector in PJ (after temperature correction) in the period 1980-1999.

Target group	**1980**	**1985**	**1990**	**1995**	**1999**
Residential	516	461	458	468	463
Transport	349	350	400	444	457
Agriculture and horticulture	131	102	161	175	174
Industry	985	887	1010	1056	1055
Other	233	289	304	311	321
Energy sector	348	325	350	381	379
Refineries	151	111	151	174	171
Others	8	-27	14	20	0
Total domestic consumption	**2721**	**2498**	**2848**	**3029**	**3020**

Source: CBS

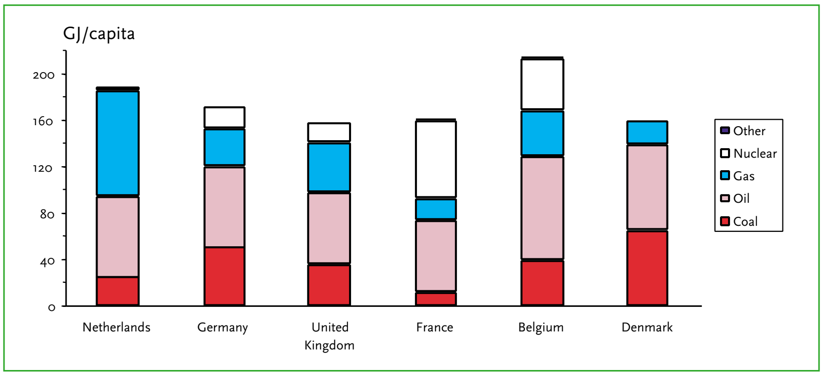


Fig. 2.5 Energy use per inhabitant by fuel type in the Netherlands compared with other countries.
Sources: IEA/OECD; World Bank

However, energy intensity dropped in the 1980s: GDP growth was 1.8% annually, and energy consumption fell on average by 0.8% annually (RIVM, 1999). In the 1990s GDP growth rose to 2.9% annually, while growth of energy consumption amounted to 1.1%. Since a maximum of 0.5% of this figure may be attributed to negative structural effects, the remaining 1.3-1.5% can be attributed to energy conservation by the economy as a whole (RIVM, 2001).

Oil and gas production

Since 1980 natural gas production in the Netherlands has totalled approximately 80,000 million Nm^3 per year. Half this amount is used by the domestic market. The policy of mitigating the depletion of the large Slochteren field to extend its use has increased the (mainly offshore) exploration and exploitation of other relatively small fields. Around half the initial reserves have now been used up, causing gas pressure to drop 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 over 1% of the total amount produced.

Electricity production

Total electricity use in the Netherlands increased by 33% in the period 1990-1999. This increase was mainly ‘countered’ by increased cogeneration and, from 1999 onwards, by increased electricity imports. Boosted by a doubling of the installed capacity, the amount of combi-

Table 2.4 Electricity imports and exports in the Netherlands in the period 1990-1999.

Electricity (in PJ)	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total final electricity	275.0	282.8	291.2	301.4	311.3	318.5	332.1	299.6	357.4	365.4	376.8
Imports of which:	**34.8**	**35.2**	**32.1**	**38.1**	**43.1**	**43.1**	**40.6**	**47.2**	**44.0**	**80.7**	*
. France	16.3	16.6	14.6	15.4	15.5	19.2	12.3	12.2	11.7	*	*
. Germany	18.1	16.8	16.2	18.2	20	20.8	26.3	32.8	29.0	*	*
. Belgium/Luxembourg	0.4	1.8	1.3	4.5	7.6	3.1	2.1	2.1	2.5	*	*
. Switzerland	-	-	-	-	-	-	-	0.1	0.2	*	*
. UK - -	-	-	-	-	-	-	-	*	*		
. Sweden	-	-	-	-	-	-	-	-	-	*	*
Exports of which:	**1.7**	**2.2**	**2.2**	**0.8**	**1.0**	**2.1**	**2.5**	**1.7**	**1.5**	**14.3**	*
. France	0.6	-	-	-	-	0.1	0.0	-	0.0	-	
. Germany	0.9	1.2	0.1	0.8	0.8	0.7	0.8	0.8	1.0	*	*
. Belgium/Luxembourg	0.0	1.0	0.6	0.2	0.3	1.3	1.7	0.9	0.5	*	*
. Switzerland	0.1	0.1	0.1	-	-	-	-	-	-	*	*
Net import	**33.1**	**33.0**	**29.8**	**37.2**	**42.2**	**41.0**	**38.1**	**45.5**	**42.5**	**66.4**	**68.0**
Net import as % of total	12%	12%	10%	12%	14%	13%	11%	15%	12%	18%	18%

* No complete information available. Due to changes in the registration system only the net import is published.
\- = 0 (nil).
Sources: CBS, EnergieNed

ned heat and power generation increased substantially from 1990, resulting in less fuel consumption for total power generation. Until 1999, imported electricity, mainly from Germany and France, contributed around 10-12% to domestic demand (Table 2.4). However, since 1999 the liberalisation of the European electricity market has resulted in the net import of electricity increasing to 18%.

New coal-fired power plants came into operation in 1993 and 1994. One of these was a 250 MW_e coal gasification demonstration plant. Over the past 10 years the conversion efficiency of conventional gas-fired power plants has increased from 40% to 46% and the newest gas-fired STEG power plants have an efficiency of 55%. Over the same period the efficiency of coal-fired plants increased from 38% to 41%. In the last decade the production of renewable energy has increased by a factor of 2.5, which resulted in a 1.3% share in the energy supply in 1998. More than half of this stems from waste combustion. The installed capacity of wind power amounted to approximately 440 MW_e by the end of 2000.

Refineries

The Netherlands has six large and two smaller refineries, with four of the large refineries located in Rotterdam. These refineries represent 10% of the production in Western Europe, whereas the Netherlands' share in the consumption of oil products in Western Europe is 5% (CONCAWE, 1994). This high production level is related to the high efficiency rate compared to foreign refineries, the proximity of many petrochemical industries and the influence of the German demand. This makes Rotterdam the world's largest supplier of fuel oil bunker and makes Schiphol Airport, Western Europe's largest supplier of jet fuel 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 this figure 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 regarding the composition of the fuel (e.g. sulphur and lead content). Since 1985 the use of refinery gas by the refineries has increased substantially.

Energy prices

Since the mid 1980s the price of crude oil has been relatively low compared to prices shortly after the oil crises. Crude oil prices, corrected for inflation, were around 30% less in 1995 than in 1990 (Figure 2.6). However, prices for end-users did not follow this trend, as they are also influenced by other costs (e.g. refineries, power generation, distribution, taxes and other levies). In the early 1990s real end-user prices remained at the same level. In comparison with other EU countries, fuel prices for large consumers varied little (RIVM, 2001). Energy prices for small consumers were substantially lower in the Netherlands than in other EU countries, with exception of the UK. Regional differences in gas prices for households are less than 10% (ECN, 2000). In 1996 a regulatory energy tax was introduced on natural gas, electricity, light fuel oil, heating oil and LPG. The effect of its introduction and annual increase is illustrated in Figure 2.6.

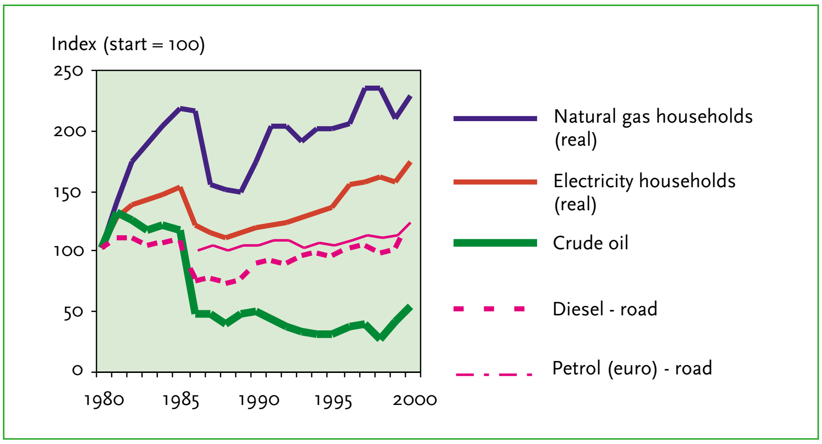


Fig. 2.6 Development of energy prices in the Netherlands in the period 1980-1999.
Source: RIVM, 2001; ECN, 2000

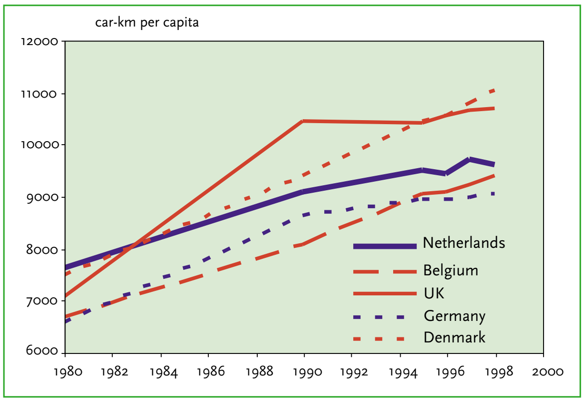


Fig. 2.7 Development of vehicle-km of passenger cars in the Netherlands, Belgium, former Western Germany, UK and Denmark in the period 1980-1999.
Sources: CBS; Eurostat; OECD

2.7 Transportation

The volume of transportation is influenced by demographic, economic, spatial and infrastructure factors. Air and international shipping are highly concentrated: Schiphol Airport handles 95% of all air passengers and air freight, with the port of Rotterdam handling 80% of the total freight in tonnage.

Between 1990 and 1999 the number of vehicle-km of passenger cars increased by 20%, which was higher than the increase in GDP. The trend in heavy-duty vehicle-km in this period was similar to the trend in GDP (Figure 2.4) but the volume of light-duty vehicles (LDV) or vans increased rapidly by over 100%. Since 1993, however, annual increases appear lower. Passenger transport in the Netherlands appears to have increased less in the period 1986-1993 than in other EU countries (Figure 2.7), whereas freight transport increased substantially more than in the other EU countries, mainly due to a major increase in LDV. The number of car-km per inhabitant also increased less in the Netherlands than in 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.

Table 2.5 Development of GDP (at 1990 prices) and the share of economic sectors in the period 1980-1999.

		1980	1985	1990	1995[1]	1999
Real GDP (in 1000 million €; price level of 2000):		**250**	**258**	**300**	**333**	**385**
Share in total gross value added (factor costs) of commercial enterprises[2] (in %):						
AgricultureAgriculture		2.5%	2.9%	3.2%	3.3%	3.1%
Industry		**34%**	**32%**	**31%**	**29%**	**27%**
of which:	Mineral production	4.1%	3.6%	2.6%	2.7%	2.2%
	Food and tobacco industry	3.8%	3.8%	3.7%	4.0%	3.6%
	Chemical, rubber and synthetics industry	2.3%	3.2%	3.2%	3.3%	3.1%
	Metals industry	7.2%	7.2%	6.9%	6.5%	6.4%
	Other industry	6.8%	6.1%	6.1%	5.5%	5.2%
	Construction industry and installation firm	10.0%	8.0%	8.1%	6.8%	6.5%
Energy sector		**3%**	**3%**	**3%**	**3%**	**2%**
of which:	Public utilities	2.6%	2.3%	2.2%	2.2%	1.9%
	Refineries	0.5%	0.6%	0.8%	0.8%	0.5%
Commercials				**64%**	**65 %**	**68%**
of which:	Trade, hotels, catering and repair shops			14.2%	13.9%	14.6%
	Transport, storage and communication			6.8%	7.5%	8.3%
	Real estate			9.1%	9.5%	8.9%
	Banks and insurance			7.6%	6.8%	7.0%
	Public health services			9.3%	9.2%	8.3%
	Other commercial services			16.8%	18.5%	20.4%

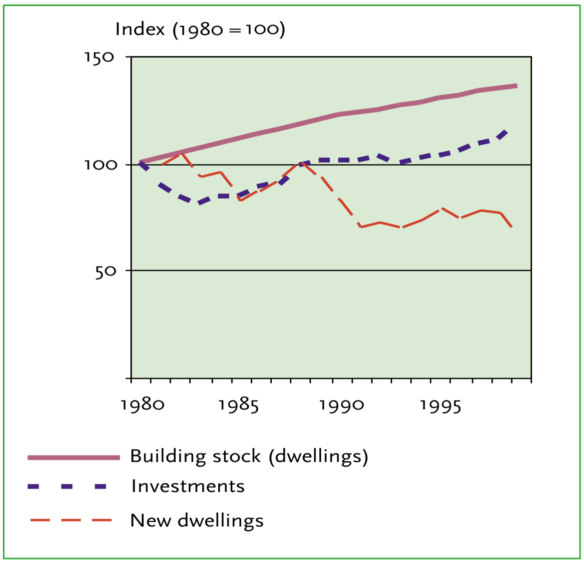
1 Time series contain a trend breach in 1994.
2 Except for public health, public services are excluded in the sectoral shares.
Source: CPB

2.8 Industry

The structure of the economy and its development over the last decade are shown in Table 2.5. In 1990, commercial services accounted for around two-thirds and industry for almost one-third. Agriculture and energy sectors both contributed 3%. In the last 10 years the total industrial production has increased annually by 1.5%, with the chemical, food processing and metals industries showing the highest growth figures. However, the share of the industrial sector as a whole fell from 31% to 27% with a relatively large reduction in the construction industry and in 'other industry'. These trends follow those already observed in the 1980s.
Compared to other EU countries the industrial structure of the Netherlands is relatively energy-intensive in terms of energy use per € production value. This is *inter alia* caused by the chemical industry, which is three times more energy intensive than the chemical industry in Germany, UK or Denmark.

2.9 Building stock and urban structure

The number of residential dwellings in 2000 was 6.6 million, of which 2.0 million were apartment buildings. Since 1990 approximately 80,000 - 90,000 new houses are built annually (Figure 2.8). The total built-up area in the Netherlands increased from 9% to 10% over the last 10 years (this excludes 4% area used for roads). Around 89% of the population live in urban areas (UN, 1999).



From 1989 to 1996, the area used for residential buildings, industry and trade and other buildings increased by 7%, 19% and 5%, respectively. The last figure may be an indication of the trend in offices and shops in the commercial and public service sector, where employment increased in the same period by around 20% (RIVM/CBS, 2000).

2.10 Waste

Figure 2.9 shows the main sources of waste in the Netherlands in 1999. Some 75% of the total amount of waste is reused. This includes 45% of residential and office waste, 80% of industrial waste and 90% of demolition waste. Waste from agriculture and coal-fired power plants is fully recycled.

However, some 14 million tons are not reused or recycled, of which residential waste has the largest share (35%), followed by industrial waste (28%) and office waste (14%). Of these residual waste categories, around 20%, 40% and 60% respectively were disposed of in landfills in 1999. Of the remaining demolition waste around 80% is disposed of in landfills. The residual waste that is not reused or landfilled is incinerated (7 million tons, around half of which comes from the residential sector) or discharged into water (1 million ton, mainly consisting of phosphoric acid gypsum) (RIVM/CBS, 2000).

Fig. 2.8 Trends in total number of dwellings and annual production of new houses in the period 1980-1999.
Source: RIVM/CBS, 2000

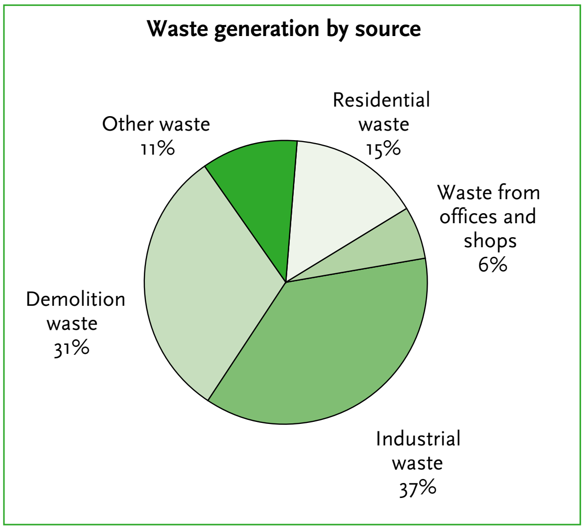


Fig. 2.9 Waste generation in 1999 by source category: gross generation excluding polluted soil, dredging sludge and animal manure.
Source: RIVM/CBS, 2000

The amounts that are landfilled have been substantially reduced as a result of the policy on waste management. This focuses firstly on prevention, secondly on reuse and thirdly on waste incineration with energy recovery. Separation of waste streams at the source for recycling purposes is a key factor, in particular for paper, glass and garden and food wastes (compost). However, the target of 4 million tons maximum landfilled waste in 2000 will probably not be met as a result of the present limited capacity of central waste incineration plants and the limited use of waste as fuel in other combustion facilities.

Despite an increase of 13% in total waste generation over 1990-1999, the net amount of waste generated dropped by 30%. This is due to a 40% increase in reuse (Figure 2.10) and an 80% increase in waste incineration. Landfilled waste fell by 60%.

2.11 Agriculture

Agriculture in the Netherlands focuses on cattle breeding, crop production and greenhouse horticulture. The share of horticulture in total agricultural production is increasing over time (Figure 2.11). The amount of fuel consumed by this sector is comparable to fuel consumption in the commercial and public service sector (taking cogeneration into account).
Due to the quota system for milk production and the increasing milk production per dairy cow, the number of dairy cattle is steadily decreasing. Between 1990 and 1999, the number of dairy and non-dairy cattle has fallen by 18% and 7% respectively. The number of sheep also fell by 18% in this period, while the number of pigs dropped recently by 3% compared to 1990, due to an outbreak of classic swine fever and subsequent restructuring of the pig breeding sector. In contrast, poultry numbers increased by 13% in the 1990-1999 period (Olivier et al., 2001).

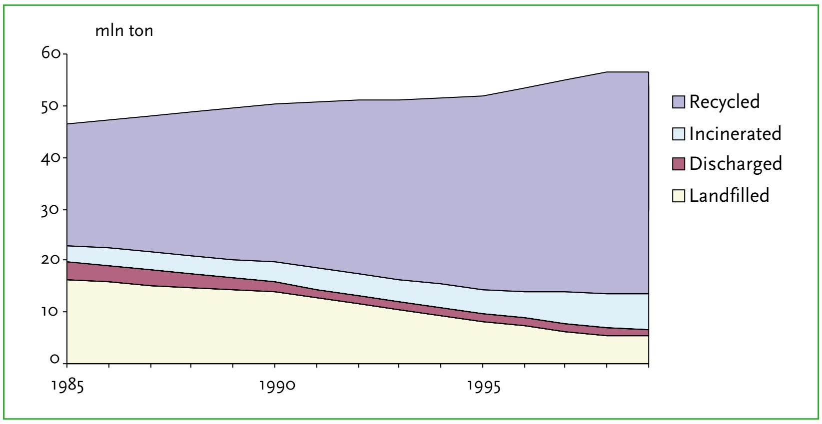


Fig. 2.10 Waste generation and disposal methods in the period 1985-1999.
Source: RIVM/CBS, 2000

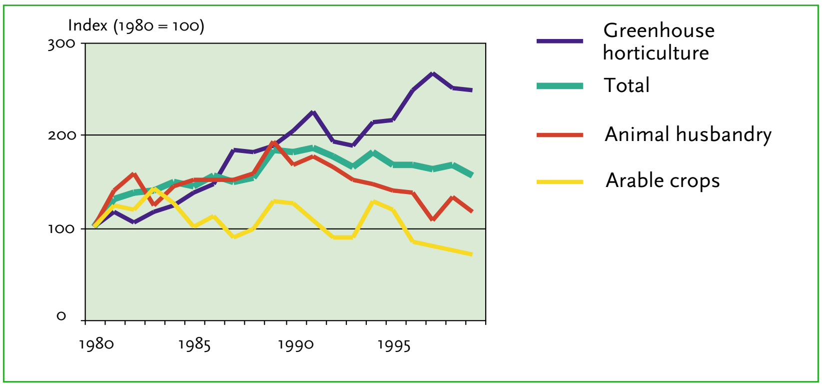


Fig. 2.11 Trends in agricultural production by subsector in the period 1980-1999.
Source: RIVM/CBS, 2000

The most important agricultural crops are cereals, maize for fodder, potatoes and sugar beets. Legislation concerning manure resulted in a more even distribution of manure over agricultural areas. Excess manure is increasingly used on arable cropland. Legislation concerning ammonia banned the surface spreading of manure and required manure injection and incorporation into the soil. This has resulted in more nitrogen being absorbed by grassland and cropland. A small fraction of the manure is exported; some 80% of this originates from poultry farms (RIVM/CBS, 2000).

2.12 Forests

In 1990, 2,905 km² or 8% of total land use was forested area. By 1998 this had increased by 11% to 3,233 km². The existing stock is estimated at around 40 million m³ of roundwood, with an annual growth of approximately 1.7 million m³. The annual amount of harvested wood is around 1.2 million m³ with a net harvest of 1 million m³. Approximately 70% comes from thinning and 30% from logging (RIVM/CBS, 2000). The development of forests in the Netherlands is monitored from around 2,500 permanent measuring stations, one-fifth of which are visited annually. In the last 15 years the forests have become more mature, better-structured and mixed forests. Around 45% of all forests are unmixed (see Table 2.6). Tree types that dominate in the Netherlands are Scotch pine (30%) and oak trees (15%). Living stock showed a strong increase, both total and density, per hectare. The harvested amount has also increased, as well as the amount of dead material per hectare.

The Netherlands aimed to expand the forested area by 75,000 ha (750 km²) for the period 1994-2020. An extra 63,800 ha is planned through governmental agencies, mainly in rural areas (54,000 ha, of which 30,000 ha on agricultural grounds and 15,000 ha in existing and new nature areas included in the 'Ecological Main Structure' policy) and urban areas (8,800 ha). The present rate of afforestation is lagging around 70% behind the planned expansion rate, due to the high demand for space for various purposes (particularly urban development), resulting in high land prices and great difficulty for the government in acquiring areas for nature development (RIVM, 2000). The Netherlands therefore recently revised its quantitative forest policy into the more general objective of expanding the total forested area (LNV, 2000).

Table 2.6 Composition of forests in the Netherlands.

Type of forest	Share '93-'97
unmixed coniferous	38%
mixed coniferous	3%
mixed coniferous/broadleaf	17%
unmixed broadleaf	18%
mixed broadleaf	13%
open, new forest	10%
cutting area	1%
Total	**100%**

Source: Bosdata, HOSP 97

3 GREENHOUSE GAS INVENTORY INFORMATION

3.1 Summary tables: trends in emissions

3.1.1 *Introduction*

This chapter summarises the Netherlands' greenhouse gas emissions for the period 1990-1999 as reported in the 2001 *National Inventory Report* (NIR). This report explains the trends in greenhouse gas emissions for the period 1990-1999 and provides a first assessment of so-called 'key sources' and their uncertainty following the Tier 1 and Tier 2 approach of the IPCC Good Practice Guidance. It also provides information on methods, data sources and emission factors applied, plus quality assurance and quality control activities. The inventory includes CO_2, CH_4, N_2O, as well as the hydrogenated fluorocarbons (HFCs), perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6). The ozone precursors NO_x, CO, and NMVOC (indirect greenhouse gases) are also included along with SO_2.

Please note that all data for 1999 are preliminary. For CO_2 emissions a temperature correction has been applied for fuel use (i.e. of natural gas) in space heating. However, to comply with the UNFCC guidelines the key figures are also presented without temperature correction. Emissions have been reported for all territory belonging to the Netherlands, including a 12-mile zone from the coastline and emissions from inland waterways such as the IJsselmeer, the estuaries and the Wadden Sea. It excludes emissions from Aruba and the Netherlands Antilles, which are self-governing dependencies of the Royal Kingdom of the Netherlands. Emissions from offshore oil and gas production on the Netherlands part of the continental shelf are included in the national totals. The emission through all electricity generation in the Netherlands is totalled, including the emission related to exported electricity. The methodology and data sources used for estimating the emissions are described in more detail in a separate report on methods for greenhouse gas emissions.

3.1.2 *Inventory information*

Annex A to this report provides the Trend Table 10 per compound for 1990-1999 and the Completeness Table 9. However, after finalising the *National Inventory Report 2001* a further update of the national greenhouse gas inventory showed new information. The main changes are:

(a) an update of the CO_2 emissions for 1990 and 1995-1998 primarily due to a revision of the statistical differences in the energy balances of the Netherlands;
(b) recalculation of N_2O emissions from road transport and from industrial production;
(c) some minor changes in the emissions of F-gases, due to new measurement data that have become available.

This information will be reported in detail in the 2002 submission of the NIR.

3.1.3 *Differences in baseline data due to changes in methodology or data*

The emissions reported in this National Communication differ from those in the previous report. This is mainly due to new data and studies that became available. This has led to:

- changes in energy consumption data of chemical waste gas used for cogeneration by auto-producers (so not used by utility producers);
- changes in energy consumption by off-road vehicles and inland shipping;
- more detailed emission factors for CO_2 from bunker fuels;
- a revision of the biofuel consumption data;
- changes in CH_4 emissions from oil and gas production;
- changes in CH_4 and N_2O emissions from road transport;
- a revision of F-gas emission data, in particular for PFCs and SF_6 (completely recalculated), but also for HFC-23.

Emissions of SF_6 were recalculated in 2000. These new emissions are 10 times lower than previously reported, as previous estimates were based on an old potential emission estimate. For 1995 actual emissions of SF_6 are now estimated at 0.17 Tg CO_2-eq. Actual emissions of

HFC-134a from 1995 onwards have been recalculated using new information on the contributions of various applications. PFC emissions from aluminium production have also been updated based on recent measurements. As a result, total CO_2-eq. emissions in 1995 from F-gases fell by around 1.5 Gg CO_2-eq. to 8.7 Tg CO_2-eq.

Compared to the data presented in the update of the Second National Communication, the total 1990 emissions of CO_2 have changed by -0.2 Mton CO_2-eq., while emissions of PFCs, HFCs and SF_6 in 1995 have changed by +0.2, -0.5 and -1.3 Mton CO_2-eq., respectively. The 1990 emissions of CH_4 and N_2O have not changed significantly.

3.2 Descriptive summary

This section summarises and gives a brief description of the main emission trends.

3.2.1 CO_2 emissions and sinks

Trends in emissions per sector are summarised in Table 3.1. In 1999 the net total CO_2 emissions increased by around 8% compared to 1990 (7% for temperature-corrected emissions). Please note that emissions in 1999 are not completely consistent with the previous years due to the exclusion of the CO_2 from statistical differences reported under category 1A5 ('Other') of the NIR. In 1999 total CO_2 emissions decreased by 7 Mton compared to 1998. The main causes were:

1) a discontinuity in the time series for CO_2 due to the elimination of the statistical differences in 1999 (2-4 Mton);
2) a 55% net increase in imported electricity, accounting for 17% of gross domestic electricity consumption (2-3 Mton);
3) a shift in the fuel mix for electricity generation (1 Mton).

The relatively warm winter of 1999 also caused uncorrected CO_2 emissions to decrease by another 1.5 Mton compared to 1998. In 1999, temperature-corrected CO_2 emissions were 5.2 Mton (or 3%) higher than uncorrected CO_2 emissions. The largest increase in emissions occurred in the transport sector.

The uncertainty in annual emission estimates from fossil fuel combustion is related to uncertainty in activity data (energy statistics) and emission factors for CO_2 (the carbon content of the fuels). This uncertainty is currently estimated to be around 3% (with an order of magnitude-factor of 1.5). For other sources, the uncertainty is not well known, particularly not for feedstock use of oil products. However, due to the minor share of these other sources the uncertainty in the overall annual total is estimated to be around 3%. The Tier 1 trend uncertainty in total CO_2 emissions has been calculated at ±3% points.

Table 3.1 CO_2 emissions and sinks per IPCC sector in the period 1990-1999 in 1000 Gg (no T-correction).

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

Source: Olivier et al., 2001

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

CO_2 from feedstock use of fuels

The Netherlands has a relatively large petrochemical industry, as can be seen from actual CO_2 emissions associated with non-energy use of oil products and natural gas. For information purposes Tables 3.2 and 3.3 show the CO_2 emitted and stored in feedstock products as included in the Reference Calculation for CO_2. According to this calculation, feedstock emissions can vary substantially from year to year, but overall they remain at the same level. In the 1990-1999 period between 14 and 18 Tg CO_2 is annually stored in products.

Temperature correction for CO_2

The annual variation of heating degree-days can be considerable in the Netherlands, particularly in the category *1A.4 Other sectors*, where most of the fuel is used for space heating.

Table 3.2 Trend in CO_2 emitted by feedstock use of energy carriers in Gg according to the CO_2 Reference Approach in the period 1990-1999.

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

* Using country-specific carbon storage factors

** Due to change in definition of feedstock and energetic use of coke and coal in iron and steel production, no data are available for 1999 according to the old definition.

Source: Olivier et al., 2001

Table 3.3 Trend in CO_2 storage in feedstock in Gg according to the default CO_2 Reference Approach in the period 1990-1999.

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

* Using country-specific carbon storage factors

Source: Olivier et al., 2001

Table 3.4 Temperature-correction values for energy and CO_2 emissions per IPCC sector in the period 1990-1999.

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Heating Degree Days (HDD-t) [HDD]		2677	3163	2829	3076	2835	2917	3504	2929	2821	2676
30-year moving average (HDD-av.)		3211	3198	3203	3177	3156	3140	3124	3135	3133	3118
T correction factor (=HDD-av/HDD-t)		**1.20**	**1.01**	**1.13**	**1.03**	**1.11**	**1.08**	**0.89**	**1.07**	**1.11**	**1.17**
Space heating natural gas [PJ]											
1A1a	Electricity and heat production	2.9	0.2	2.0	0.5	2.0	1.4	-2.2	1.2	2.0	3.7
1A2a-e	Industry	13.8	0.9	8.0	2.1	7.1	5.0	-5.4	2.9	7.2	10.5
1A4a	Commercial / institutional	22.5	1.4	16.1	4.3	14.3	9.6	-16.6	9.1	15.7	18.2
1A4b	Households	51.8	3.2	36.1	9.1	29.8	20.0	-36.1	20.0	29.1	41.9
1A4c	Agriculture / forestry / fishing	21.0	1.3	15.0	3.9	13.6	9.1	-15.8	8.8	12.0	19.0
TOTAL correction gas consumption		**111.9**	**7.0**	**77.1**	**19.9**	**66.8**	**45.1**	**-76.1**	**41.9**	**66.0**	**93.3**
Emissions CO_2 [Gg]											
1A1a	Electricity and heat production	160	10	110	30	110	80	-120	60	110	210
1A2a-e	Industry	770	50	450	120	400	280	-300	160	400	590
1A4a	Commercial / institutional	1260	80	900	240	800	540	-930	510	880	1020
1A4b	Households	2900	180	2020	510	1670	1120	-2020	1120	1630	2340
1A4c	Agriculture / forestry / fishing	1180	70	840	220	760	510	-880	490	670	1060
TOTAL correction CO_2 emissions		**6270**	**390**	**4320**	**1120**	**3740**	**2530**	**-4250**	**2340**	**3690**	**5220**

Source: Olivier et al., 2001

Table 3.5 CO_2 emissions from statistical differences in the period 1990-1999 [I].

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999[I]
A. Energy (PJ)										
Coal	7	0	-4	9	-9	15	27	30	24	0
Oil	16	25	15	26	24	28	28	62	36	0
Natural gas	-13	-14	-20	-20	-8	-17	-23	-18	-24	0
B. Co_2 emmissions (Tg)										
Coal	0.7	0.0	-0.4	0.8	-0.8	1.4	2.6	2.8	2.3	0.0
Oil	1.2	1.8	1.1	1.9	1.8	2.0	2.1	4.5	2.6	0.0
Natural gas	-0.7	-0.8	-1.1	-1.1	-0.4	-1.0	-1.3	-1.0	-1.3	0.0
TOTAL	**1.1**	**1.0**	**-0.4**	**1.6**	**0.5**	**2.5**	**3.4**	**6.4**	**3.6**	**0.0**

1 Since 1999, the method for calculating the statistical differences has changed. The differences have been removed methodologically by new assumptions regarding coal exports, distribution losses of natural gas and consumption of oil products.

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

For policy purposes, trends in CO_2 emissions are therefore corrected for climate variation of fuel consumption for space heating. Table 3.4 presents the temperature correction used by RIVM in the trend analysis. This only applies to natural gas consumption since the amount of other fuels used for space heating is negligible. Positive figures in the table indicate an addition of natural gas consumption and CO_2 emissions due to a relatively warm winter in that calendar year. The correction factor varies between -11% in 1996 to +20% in 1990.

CO_2 emissions relating to statistical differences

The fuel use relating to statistical differences is included in the Netherlands' inventory as a source of CO_2, since it has been assumed that the associated fuel use is real but not accounted for in individual end-use sectors. The statistical difference between supply and demand is usually less than 2%. However, per energy carrier, this may vary both in sign and size, as is shown in Table 3.5. In recent years the statistical differences for coal and oil products have increased substantially, probably due to fewer administrative burdens for importing and exporting goods between EU countries.

However, this approach had to be abandoned in 1999, because in the 1999 national energy balance the statistical difference was effectively eliminated through incorporation in either export or domestic consumption/loss figures. Since the energy balances for previous years have not been revised, it is currently not possible to provide a consistent time series for this category for the entire period 1990-1999. The statistical differences in the energy statistics for the years 1990 and 1995-1998 will be revised for the next update of the national energy balance.

Table 3.6 International bunkers: energy consumption and related CO_2 emissions in the period 1990-1999.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Energy consumption [PJ]										
Marine bunkers *	**466**	**476**	**478**	**495**	**474**	**479**	**488**	**518**	**517**	**559**
- heavy fuel oil	386	396	398	411	386	377	393	429	429	473
- gasoil	80	80	80	84	88	102	95	89	88	86
Aviation Bunkers	**61**	**68**	**81**	**89**	**92**	**105**	**113**	**123**	**131**	**138**
- jetfuel (kerosine)	61	68	81	89	92	105	113	123	131	138
- aircraft gasoline	0	0	0	0	0	0	0	0	0	0
TOTAL Bunkers	**527**	**544**	**559**	**585**	**566**	**584**	**601**	**641**	**648**	**697**
Emissions [Gg]										
Marine bunkers *	**35 560**	**36 330**	**36 490**	**37 780**	**36 140**	**36 480**	**37 200**	**39 530**	**39798**	**40757**
- heavy fuel oil	29 720	30 490	30 65	31 650	29 720	29 030	30 260	33 030	33015	34494
- gasoil	5 840	5 840	5 840	6 130	6 420	7 450	6 940	6 500	6392	6263
Aviation Bunkers	**4 450**	**4 960**	**5 910**	**6 500**	**6 720**	**7 670**	**8 250**	**8 980**	**9521**	**10066**
- jetfuel (kerosine)	4 450	4 960	5 910	6 500	6 720	7 670	8 250	8 980	9521	10066
TOTAL Bunkers	**40 010**	**41 290**	**42 400**	**44 280**	**42 860**	**44 150**	**45 450**	**48 510**	**49319**	**50823**

* The CRF also reports an amount of lubricant consumption in marine bunkers of 5.3 PJ, which is equivalent to 0.4 Tg CO_2.

Source: CBS, 1990-1998 (NEH/Energy Monitor)

CO_2 emissions from international bunkers

Table 3.6 shows both energy consumption and CO_2 emissions from international air transport and international shipping per fuel type. In 1999 the bunker emissions of CO_2 increased by around 11.2 Tg (or 28%) compared to 1990. International aviation showed a particularly high growth of around 125%, whereas international shipping increased by only 16%. Because the majority of bunker emissions stem from marine bunkers, international shipping and aviation both contributed half of this increase. The share of international air traffic in international bunkers emissions has doubled from about 10% in 1990 to about 20% in 1999.

3.2.2 CH_4 emissions

Total methane emissions fell by 20% in 1999 compared to the 1990 level (Table 3.7). The waste, agriculture and energy sectors contributed most to the decrease. The main reasons were less landfilled waste, higher methane recovery rates from landfills, decreasing numbers of livestock and lower fugitive fuel emissions. In the period 1990-1999 the fugitive CH_4 emissions from oil and gas fell by 20%, mainly as a result of measures to prevent the venting of natural gas during production. Since 1990 the number of dairy and non-dairy cattle in the Netherlands has dropped by 18% and 7%, respectively. This is the main cause of the reduction in CH_4 emissions from animals. A shift in numbers of various types of cattle also contributed to this reduction. The decrease in emissions of landfills is due to the threefold increase in the amount of CH_4 recovered and the reduced amounts of landfilled waste and its carbon content.

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

3.2.3 N_2O emissions

In 1999 total N_2O emissions increased by approximately 15% compared to 1990 (Table 3.8). This is mainly due to an increase in the industrial sector of around 15% (mainly from nitric acid production) and in the agricultural sector of about 16%. The latter is almost entirely due to increased emissions relating to using animal manure on agricultural soils. As a result of the policy to reduce ammonia emissions, over the past 10 years this practice

Table 3.7 CH_4 emissions per IPCC sector in Gg in the period 1990-1999.

IPCC Sector	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Total net national emissions	**1292.7**	**1308.7**	**1256.2**	**1224.7**	**1203.1**	**1172.4**	**1163.1**	**1102.8**	**1061.8**	**1033.5**
1. All Energy (combustion and fugative)	**214.1**	**223.8**	**199.1**	**192.4**	**202.3**	**209.3**	**214.4**	**186.6**	**176.8**	**174.1**
A Fuel combustion total	35.0	35.7	36.0	34.4	33.8	35.3	36.9	30.1	30.7	29.9
1 Energy	1.3	3.2	3.8	3.4	3.7	4.9	5.7	3.1	4.4	4.1
2 Industry	5.8	3.5	4.9	3.2	2.6	2.8	1.5	1.6	1.8	1.6
3 Transport	7.9	6.9	6.8	6.4	6.3	6.3	5.7	5.3	4.9	4.6
4a Commercial / Institutional	1.0	1.1	1.0	0.9	1.4	0.6	1.4	0.6	1.1	1.1
4b Residential	16.7	18.3	16.8	17.7	17.0	17.9	19.9	17.2	16.1	16.1
4c Agriculture / Forestry / Fishing	2.3	2.7	2.7	2.8	2.8	2.8	2.8	2.4	2.4	2.5
B Fugitive fuel emissions	179.1	188.1	163.1	158.0	168.5	174.0	177.5	156.5	146.1	144.2
2 Crude oil and natural gas: process emissions	179.1	188.1	163.1	158.0	168.5	174.0	177.5	156.5	146.1	144.2
2. Industrial processes (ISIC)	**3.4**	**3.5**	**3.7**	**4.9**	**5.3**	**4.9**	**5.7**	**2.7**	**2.4**	**2.5**
3. Solvent and other product use	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
4. Agriculture	**504.9**	**517.0**	**505.0**	**497.0**	**483.0**	**475.7**	**463.4**	**446.2**	**432.4**	**422.9**
A Enteric fermentation	401.9	412.0	401.0	393.0	382.0	376.7	365.3	352.6	339.4	331.8
B Manure management	103.0	105.0	104.0	104.0	101.0	99.0	98.1	93.6	93.0	91.0
5. Land use change and forestry	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
6. Waste	**568.4**	**562.4**	**546.4**	**528.4**	**510.2**	**480.5**	**477.6**	**465.3**	**448.3**	**432.1**
7. Other	**2.0**	**2.0**	**2.0**	**2.0**	**2.3**	**2.0**	**2.0**	**2.0**	**1.9**	**1.9**

Source: Olivier et al., 2001

Table 3.8 N_2O emissions per IPCC sector in Gg in the period 1990-1999.

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

Source: Olivier et al., 2001

has changed to incorporation of manure into the soil (injection and ploughing in) leading to a substantial increase in N_2O emissions per amount of manure applied. In 1998 these emissions were lower than in 1997 due to the rainy weather in the second half of 1998, which meant that part of the manure could not be spread in 1998 and was postponed to 1999. In road transport, increasing emissions resulting from further penetration of cars equipped with catalyst converters were compensated by decreasing N_2O emissions from diesel vehicles, resulting in overall decreasing emissions since 1998.

Compared to CO_2 and CH_4, the uncertainty in emission factors for N_2O in the identified sources is often fairly large (in the order of 50 -100%), even more for indirect N_2O emissions from agriculture. Some sources are also not well known or may not have been identified yet. The uncertainty in the overall annual total of sources included in the inventory is estimated to be around 50% (with an order of magnitude-factor of 1.5). The Tier 1 trend uncertainty in total N_2O emissions has been calculated at ±12% points.

3.2.4 Emissions of fluorinated halocarbons

Trends in actual emissions (this year also for SF_6) are presented in Table 3.9, which shows that HFC emissions increased in 1999 by 30% compared to 1995. This is largely caused by an increase in HFC consumption as

Table 3.9 Actual emissions per compound of HFCs, PFCs and SF_6 in Gg CO_2-eq. in the period 1990-1999.

Compound	IPCC	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
HFC-134a	2F	12	12	23	7	96	340	620	900	934	1003
HFC-143a	2F	10	10	10	10	24	35	69	107	190	228
HFC-125	2F	20	20	20	20	55	67	100	132	145	169
HFC-23	2E	5101	4820	4540	5066	6271	6271	6709	6709	7387	7387
HFC-152a	2E	1	1	1	4	3	3	6	4	0	0
Other HFCs	2F	0	0	0	0	0	6	20	32	39	49
HFC-Total		**5144**	**4863**	**4594**	**5107**	**6449**	**6724**	**7524**	**7884**	**8695**	**8836**
CF_4 (PFC-14)	2C	1957	1957	1677	1690	1482	1450	1606	1697	1924	2002
C_2F_6 (PFC-116)	2C	442	442	377	377	350	350	359	368	442	469
PFC use	2F	34	39	44	51	59	68	78	89	103	118
PFC-Total		**2432**	**2437**	**2098**	**2118**	**1891**	**1867**	**2042**	**2154**	**2469**	**2589**
SF_6 use	**2F**	**145**	**100**	**106**	**110**	**148**	**174**	**160**	**182**	**132**	**137**
Total HFC/PFC/SF_6		**7720**	**7400**	**6799**	**7335**	**8488**	**8765**	**9727**	**10219**	**11296**	**11562**

* Mainly by-product from HCFC-22 production.

** From aluminium production.

Source: Olivier et al., 2001

a substitute for CFC use (particularly HFC-134a) and a limited increase of by-product emissions of HFC-23 from the manufacturing of HCFC-22. The latter was limited by control measures implemented in recent years. PFC emissions from aluminium production increased by approximately 35% during this period due to increased aluminium production. The relatively very low SF_6 emissions tend to vary from year to year. Compared to the 1995 level, total emissions of all F-gases increased by around 30% (50% compared to 1990).

HFC, PFC and SF_6 activity data are often rather precise, but larger uncertainties are found in the other data. Since recent research has shown that some SF_6 sources may still be missing, the uncertainty estimate for SF_6 is assumed to be asymmetrical. The uncertainty in the overall *annual* totals is estimated to be in the order of 50% for HFCs and PFCs and -10% to +100% for SF_6 (each with an order of magnitude-factor of 1.5). The Tier 1 *trend* uncertainty in total F-gas emissions has been calculated at ±20% points.

3.2.5 Trends in total greenhouse gas emissions

The trend in total CO_2-eq. greenhouse gas emissions has been calculated using the IPCC *Global Warming Potential* (GWP) for a time horizon of 100 years. Table 3.10 shows trends in total (net) emissions for 1990-1999. Figure 3.1 shows the various greenhouse gases in the total emissions and the relative contribution of each gas to annual total emissions.

Total CO_2-equivalent emissions of the six greenhouse gases together increased in 1999 by approximately 6% relative to 1990 (1995 for fluorinated gases). The uncertainty in this trend is about ±3% points, based on the IPCC *Tier 1 trend uncertainty assessment*. Table 3.10 and Figure 3.1 show that, at present the CO_2-eq. emissions of N_2O are slightly higher than CH_4 emissions. However, it should be kept in mind that the uncertainty in annual emissions of N_2O and CH_4 is estimated at ±50% and ±25% respectively.

Table 3.10 Total greenhouse gas emissions in CO_2-eq. and indexed (no T-corr.) in the period 1990-1999.

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

Source: Olivier et al., 2001

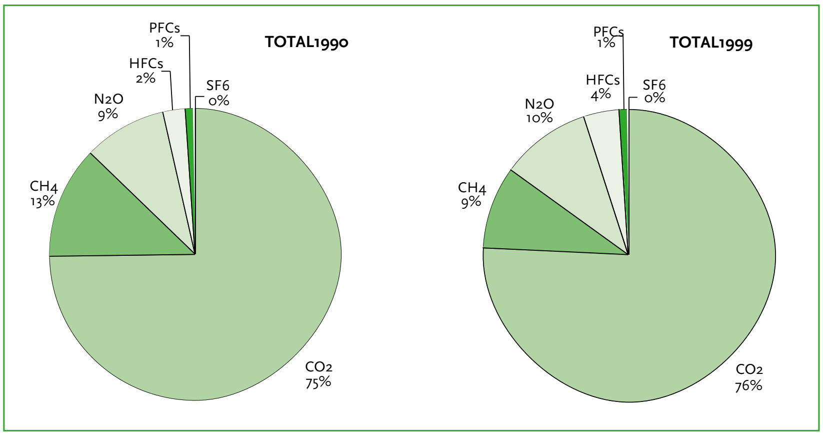


Fig. 3.1 Percentages of greenhouse gases in total emissions in 1990 (1995 for F-gases) and in 1999.
Source: Olivier et al., 2001

Figure 3.2 illustrates the trend in total CO_2-eq. emissions (i.e. for all six gases jointly) per IPCC source category. The sector showing the largest growth in CO_2-eq. emissions over the past 10 years is the transport sector (around 19%), whereas most other sectors showed a growth of approximately 10%. Clear exceptions are the waste sector and agriculture, which showed a decrease in CO_2-eq. emissions of over 20% and 4%, respectively. Emissions from the residential and service sectors increased by 3%, but these are substantially influenced by climatic effects. With inclusion of the temperature correction these emissions decreased by about 10%.

3.2.6 Trends in emissions of precursor gases

Trends in total emissions of CO, NO_x, NMVOC, and SO_2 are summarised in Table 3.12. It clearly shows that CO and NMVOC emissions in 1999 are around 40% lower than in 1990, with SO_2 even 50% lower. For NO_x the 1999 emissions are around 30% lower than the 1990 level. In contrast with the direct greenhouse gases, emissions of precursors from road transport have not been corrected for fuel sales (according to the national energy statistics) but are directly related to transport statistics (on vehicle-km), which differ to some extent from the IPCC approach.

The uncertainty in the overall total estimates of sources included in the inventory is estimated to be in the order of 25% for CO, NO_x and SO_2 and approximately 50% for NMVOC (with an order of magnitude-factor of 1.5). However, results of recent research indicate that the uncertainty in SO_2 emissions may be considerably lower (in the order of ±10%).

Table 3.11 Total greenhouse gas emissions with temperature correction in CO_2-eq. and indexed in the period 1990-1999.

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

Source: Olivier et al., 2001

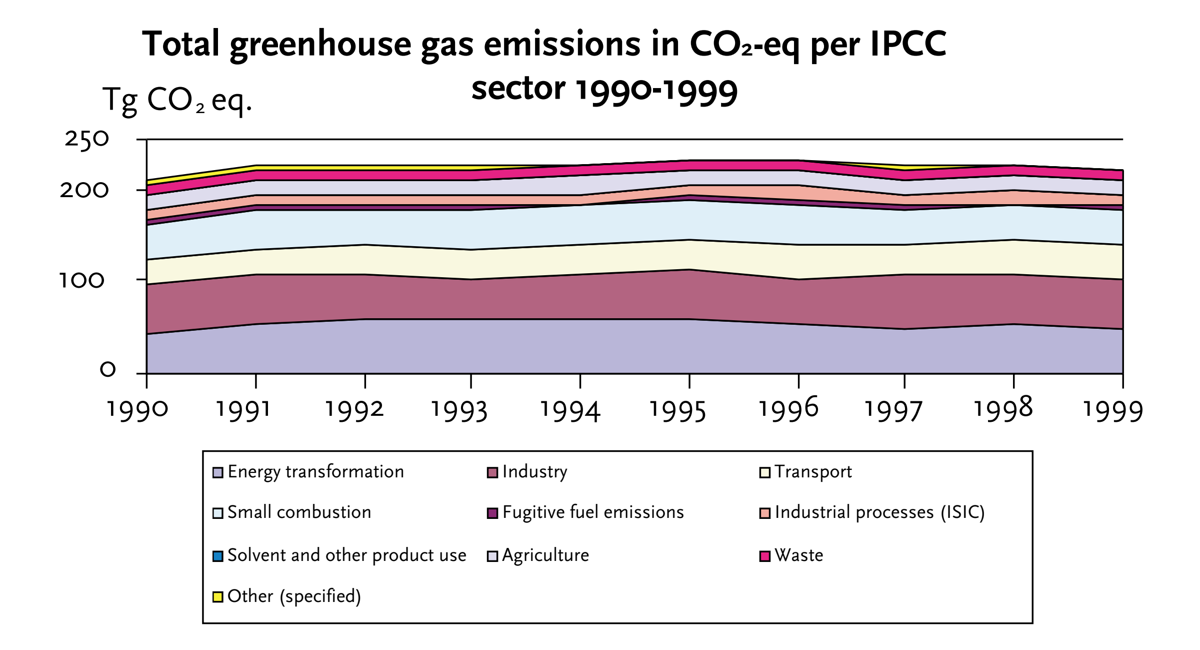


Fig. 3.2 Trend in CO_2-eq. emissions per sector in the period 1990-1999 (no T-correction).
Source: Olivier et al., 2001

3.2.7 Uncertainties and key sources

Introduction

To obtain a more detailed first order estimate of uncertainties in trend and annual emissions, the IPCC Tier 1 methodology has recently been applied to the more detailed IPCC list of possible key sources (IPCC, 2000). These uncertainties can also be used for a first Tier 2 analysis to identify 'key sources' as defined in the *IPCC Good Practice Guidance* report (IPCC, 2000). This section describes the results, although the information presented here should only be considered as a first step in this process; key source identification can be achieved by using many more criteria and will be important in meeting the National System requirements.

The IPCC Tier 1 methodology for calculating uncertainties is - strictly speaking - only valid when uncertainties have a standard-normal probability distribution and are not too large. There should also be no correlation between sources. In practice however, a number of sources are correlated. Moreover, it is often unavoidable to base uncertainty estimates on expert judgements with regard to how representative they are for national circumstances. We believe that this data set provides a reasonable first assessment of the order of magnitude of individual uncertainties for key source categories in the Netherlands. All figures mentioned should be interpreted as corresponding with a confidence interval of two standard deviations (2σ) or 95%.

Table 3.12 Trends in emissions of precursors in the Netherlands in the period 1990-1999.

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

Source: Olivier et al., 2001

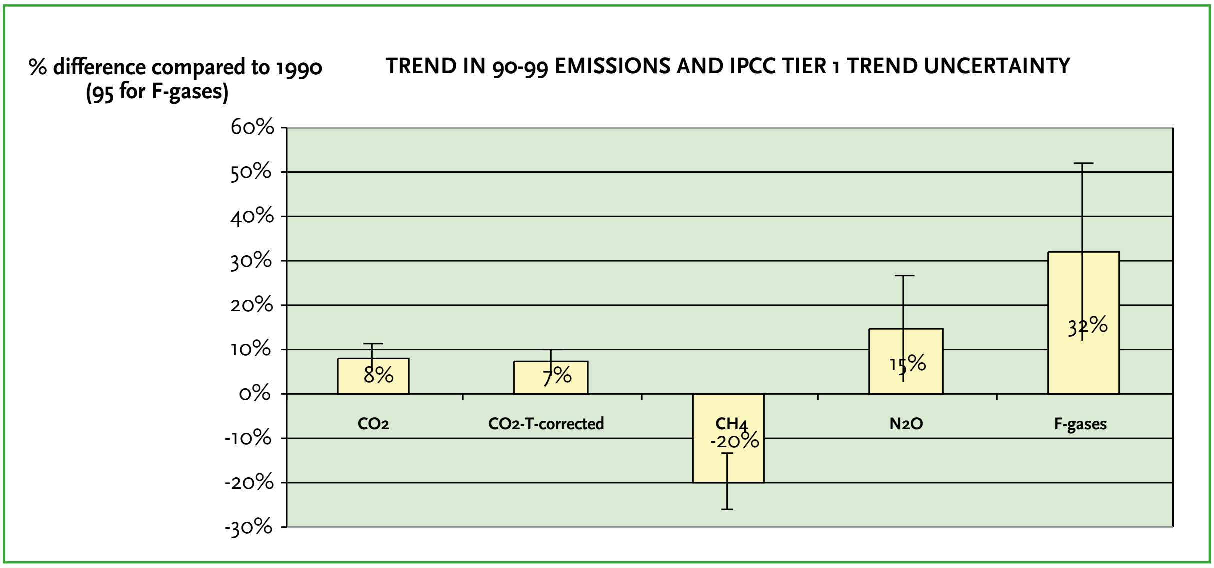


Fig. 3.3 Trends in greenhouse gas emissions per gas in the period 1990-1999 (1995-1999 for new gases) and their uncertainty according to the IPCC Tier 1 trend uncertainty analysis (also showing CO_2 with temperature correction).

Uncertainty

The calculation of annual uncertainties in CO_2-eq. emissions according to the IPCC Tier 1 uncertainty approach indicated uncertainties of 2%, 15%, 35% and 22% for CO_2, CH_4, N_2O and F-gases respectively and an overall uncertainty of 4%. However, these figures do not include the correlation that exists between source categories, nor do they include corrections for unreported sources (notably for SF_6). Actual uncertainties will be somewhat higher. The previous sections indicate these actual uncertainties as estimated by RIVM. Figure 3.3 shows the relative size of these uncertainties.

The resulting uncertainty in national annual total CO_2-eq. emissions is estimated to be around ±5%. The result of the estimate of the trend uncertainty calculated according to the IPCC Tier 1 approach (IPCC, 2000) shows an uncertainty in total CO_2-eq. emissions for 1990-1999 (1995 for F-gases) of ±3% points. This implies that the increase in total CO_2-eq. emissions between 1990 and 1999, calculated at 6%, will be between 3% and 9%.

The sources contributing most to both total annual uncertainty in 1990 (1995 for F-gases) and 1990-1999 trend uncertainty are detailed in the table below.

Key source identification

In the preliminary identification of key sources according to the IPCC Good Practice approach (IPCC, 2000), national emissions were, where possible, allocated to the IPCC's potential key source list. Given the high share of feedstock use of fuels, a non-combustion category of CO_2 has been added to this list. The IPCC Tier 1 method consists of ranking this list of source category gas combinations according to their contribution to the national total annual emissions and to the national total trend. The IPCC Tier 2 method also requires uncertainties to be incorporated into each of these sources before ranking. This has been achieved using the uncertainty estimates described above.

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

Table 3.13 Trend in CO_2 emissions in Gg according to the Reference Approach and the National Approach in the period 1990-1999.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Liquids	50554	52156	51866	50499	51492	56304	56557	58838	58228	56338
Solids	35415	32119	31346	32794	33156	37156	36766	36215	36353	30401
Gaseous	71693	80204	77740	80092	77964	79621	87597	82459	81538	80592
Total	**157662**	**164478**	**160952**	**163386**	**162612**	**173082**	**180920**	**177512**	**176119**	**167331**
National Approach	**158536**	**164860**	**163430**	**165890**	**166750**	**174224**	**182021**	**178266**	**177395**	**170619**
Difference	0.6%	0.2%	1.5%	1.5%	2.5%	0.7%	0.6%	0.4%	0.7%	2.0%

* Preliminary calculation, using provisional carbon factors for crude oil and natural gas liquids (NGL). As indicated earlier (for 1990-1998) CO_2 emissions associated with statistical differences in coal, oil and gas consumption are included in the national approach, whereas for 1999 the statistical difference has been effectively eliminated from the national energy balance.

Source: Olivier et al., 2001

The result is a list of around 21 key sources. A comprehensive analysis has yet to be made, since a higher or lower number of source categories can be selected, depending on which criteria are used to determine the key sources (level, trend, qualitative criteria such as expected high growth or decrease, combinations of these, etc.).

CO_2 Reference Approach

The CRF files include a provisional calculation of the *IPCC Reference Approach* (RA) for CO_2 from energy use. Due to lack of information on the carbon content of crude oil, natural gas liquids and other refinery inputs, estimated figures are used for the carbon content. Table 3.13 presents the results of the Reference Approach calculation for 1990-1999 compared to official national totals. The differences vary between -0.4% and +2.5% with an average of 1.0%. A study is currently being carried out to establish country-specific carbon content factors for crude oil and natural gas liquids used by refineries in the Netherlands. This study is part of the Netherlands' Greenhouse Gas Inventory Improvement Programme.

3.2.8 Quality Assurance and Quality Control

Emission Pollutant Register

The Netherlands has a national Pollutant Emission Register (PER), also known as the Emission Inventory System[1]. This encompasses registration, analysis, localisation and presentation of emission data in the Netherlands. The coordination Committee for Monitoring of Target Groups (CCDM) is responsible for achieving agreement among all groups involved in the inventory work with regard to definitions, methods, emission factors and emissions. CCDM coordinates the work of seven expert groups, which formulate a protocol for the monitoring process for each specific target group (data collection, data validation, data storage, data management, and data dissemination).

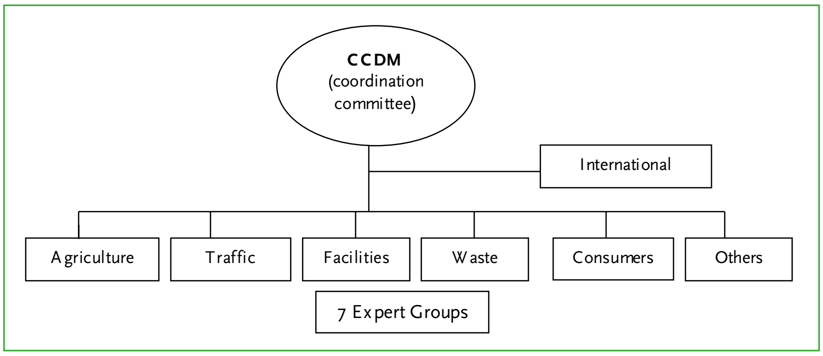


Fig. 3.4 Protocol expert groups for target group monitoring.

1 Several organisations cooperate in the inventory maintenance project e.g.: Ministry of Housing, Spatial Planning and the Environment (VROM/-HIMH), Statistics Netherlands (CBS), National Institute of Public Health and Environment (RIVM), Ministry of Agriculture, Nature Conservation and Fishery (LNV) represented by the National Reference Centre for Agriculture (EC-LNV, formerly IKC-L), Ministry of Transport, Public Works and Water Management (V&W) represented by the National Institute of Water Management and Waste Treatment (RWS/RIZA) and the Netherlands Organisation for Applied Scientific Research (TNO).

Emissions from large industrial point-sources are registered individually using detailed information on each individual plant; however, this process has been changing over the past few years. Emissions from small and medium-sized enterprises, as well as non-industrial sources, are calculated based on statistical activity data and emission factors. *Task Groups*, consisting of representatives from CBS, RIVM, EC-LNV, RIZA and TNO collect the data required and perform the emission calculations.

Quality Control

The Inspectorate for Environmental Protection of the Ministry (VROM) commissions the annual drafting of a detailed plan for compiling the emissions inventory for the next year. This project plan includes the responsibilities and tasks of the parties involved, the selection of substances, a list of source categories and the time schedule. At the end of the project, also the necessary improvements identified for next year's emissions inventory update are reported additionally.

The Quality Control (QC) activities of the Netherlands Emission Inventory in 2000 can be divided into several steps:

- QC by PER Task Groups before data delivery to TNO;
- QC by TNO;
- QC by PER Task Groups before the trend verification workshop;
- QC by PER Task Groups and Target Group coordinators at RIVM during the workshop;
- QC for the IPCC summary tables included in the annual 'EAJR report'.

Data delivery and feedback to the Task Groups is performed in accordance with the quality assurance system of the Netherlands Emission Inventory System. TNO performs QC activities such as checks on completeness, consistency and formats. The relevant emissions in the draft data file are returned to the Task Groups in order to check the data handling by TNO. Detected errors and information about how the quality control is performed by the Task Groups are reported to TNO.

Inventory improvement programme

The preparation of greenhouse gas emissions inventories is part of the larger national annual emission inventory containing over 100 different pollutants from point sources, area sources and diffuse sources with emissions to air, water, soil and including waste handling data. This process is organised as a project with an annual cycle. Prior to the next data collection, changes in coverage of sources and pollutants and priorities for improvement are discussed each year and documented in a project plan.

For the greenhouse gas inventory it was decided to start a separate process to further improve data quality, methodologies, documentation and data compilation procedures. In 1999 two workshops were held with experts from the institutes involved to discuss uncertainties and identify areas for improvement. The *Working Group 'Greenhouse Gas Emission Monitoring'* (WEB) was subsequently established to set priorities in projects for quality improvement and direct further actions herein. The result of these actions will be integrated into the emission monitoring and reporting system directed by the CCDM.

4 POLICIES AND MEASURES

4.1 Introduction

This chapter provides an overview of climate change related policies and measures in the Netherlands, focusing on the emission reduction efforts necessary to comply with the commitments under the Kyoto Protocol. Section 4.2 describes the overall policy context. The main climate policy elements are outlined in Section 4.3, while Section 4.4 goes into more detail on the individual policies and measures. Sections 4.5 and 4.6 describe the process of accounting and evaluation of climate policy in the Netherlands.

The *Second National Communication* and its update describe policies and measures up to early 1998, when the third environmental policy plan (NEPP3) (VROM, 1998) was published, which included a first draft of the post-Kyoto climate policy. However, the cabinet approved some additional measures and additional funding. The *Energy Conservation Memorandum* (EZ, 1998) was also issued at that time. In May 1998, elections were held in the Netherlands and the new cabinet supported the modalities of the measures announced in NEPP3. This forms the starting point for the policies and measures described in this report.

One of the decisions of the new cabinet was that a *National Climate Policy Implementation Plan* (NCPIP) should be developed, incorporating a policy plan to follow up the reduction commitments as laid down in the Kyoto Protocol (and the EU burden sharing agreement). The cabinet also decided that 50% of the Kyoto commitments should be achieved by applying the Kyoto mechanisms. A detailed description can be found in the *NCPIP part 1* (Measures in the Netherlands (VROM, 1999)) and part 2 (Cooperation with Foreign Countries (VROM, 2000)).

This chapter summarises the measures announced (and adopted by Parliament) in the *NCPIP part 1*. It should be noted that although policies and measures in this chapter are described according to their status at January 1, 2001, in some cases a qualitative description of relevant developments (at a later stage) has been added. The chapter also describes the objectives of part 2 of the policy note. Annex B contains a more extensive description of the cooperation between the Netherlands and other countries.

4.2 Overall policy context and objectives

As described in the *Second National Communication* of the Netherlands (VROM, 1997), the pre-Kyoto emission reduction objectives of the Netherlands were formulated in the *Second Memorandum on Climate Change* (VROM, 1996). Table 4.1 compares actual emissions in 1999, in relation to the base year for the objectives.

The objectives for greenhouse gas emissions in 2000, will be met for CH_4 only. Important reasons for not achieving these objectives are:

- a higher than projected economic growth (average 3.5% annually over the past five years). As a result, energy use also increased, although this increase was relatively small (1-2% per year);
- relatively low energy prices and a subsequent lower

Table 4.1 Emission reduction objectives of the Netherlands compared to actual emissions (expressed as % relative to the base year).

	Pre-Kyoto			Post-Kyoto	
Gas	Base year	Objective (2000)	Actual emissions 1999 vs. base year	Base year	QUELRC[1] (2008 – 2012)
CO_2	1990	-3 %	+8%	1990	
CH_4	1990	-10 %	- 20%	1990	
N_2O	1990	0 %	+15%	1990	
F-gases	-	-	+32%	1995	
Total of 6 Kyoto gases			+ 6%		-6%

[1]) Quantified Emission Limitation and Reduction Commitment.

Source: VROM, 1996

than expected incentive for energy conservation;
- a number of policies and measures (at EU level) were overestimated and had only a limited effect on greenhouse gas emissions in the Netherlands;
- the development and implementation of policies and measures in the Netherlands took longer than expected.

As a result, it was decided to start developing policies and measures necessary to meet the Kyoto commitments at an early stage. It was also decided to use a high economic growth scenario, as a robust estimate for the necessary efforts to meet the commitments.

The cabinet issued the NCPIP in June 1999. Until then, the Netherlands' climate policy followed a no-regret strategy. Policies and measures considered were largely derived from strategies in other policy areas, energy conservation being the most important of these. However, the NCPIP changed this situation. Compared to other areas, climate change policy is now, more than ever, a sustaining part of government policy. Nevertheless, climate policy remains intertwined with other policy areas, the most important of which being energy, transport, agriculture and waste.

4.3 Climate Change Policy: main developments

4.3.1 Developments in the Climate Change Policy up to 1999

NEPP3 and the *Energy Conservation Memorandum* were both published early in 1998. NEPP3 made an additional amount of € 77 million available for climate change policies. The *Energy Conservation Memorandum* provided a more detailed survey of possibilities for stepping up energy conservation policy, aiming at improving energy efficiency by 2% per year in the period 1998-2010. Based on these policy notes, a number of policies and measures were already implemented prior to the NCPIP being published, e.g. tax revision measures aimed at reducing CO_2 . These are described in more detail in Section 4.4.

4.3.2 Preparation of a new climate policy implementation plan

A new coalition government was formed following the general elections in May 1998. The coalition agreement underscored the importance of the Kyoto agreement and the EU decision on burden sharing, which yielded a 6% reduction for the Netherlands. The coalition attached a number of conditions to this reduction and announced that specific and recognisable steps towards realising the target would be taken during the government's term of office. It was also noted that part of the reduction would be realised after the end of the government's term in 2002, when more would be known about common European policies and the modalities for applying the Kyoto mechanisms (JI, CDM and emissions trading).

Preparations for the Climate Policy Implementation Plan began before the Netherlands' share in the EU target was known. It started with the preparation of a technical *Options Document* by ECN/RIVM (1998), which bundled a wealth of technical information on 61 domestic emissions reduction options in six areas: traffic measures, energy savings, renewable energy, power plants, non-CO_2 greenhouse gases and CO_2 storage in forests and underground. Each option was described according to a format that included emission reduction potential, costs, policy instruments for realising the measure, timeframe for achieving the reductions, societal support and sensitivity for future developments. The document thus provided a menu of possible measures from which to choose.

The emission reduction potential of the various options was calculated relative to emissions in 2010 as projected by the Business as Usual variant of the *Global Competition Scenario* (see Chapter 5). This *GC-scenario* was chosen because it provides a robust background against which to assess the effects of policy measures and instruments. It assumes a healthy rate of economic growth, relatively high world oil prices, a high rate of technological development and penetration of new technologies, and the continuation of policies in place in the Netherlands before the Kyoto Protocol was signed. These policies include the regulatory energy tax introduced in 1996, the long-term negotiated agreements with industry on improving energy efficiency, energy efficiency standards for new buildings and subsidies for CO_2

reduction projects such as residual heat utilisation. It also includes policies to increase the market share of renewables (with a goal of achieving a 10% market share by 2020). These policies and measures are set out in the *Second National Communication* (VROM, 1997 en 1998).

For calculating the costs associated with the various emission reduction options, two methods were used to reflect differences in the way costs are perceived by different stakeholders (see Box 4.1). The *Options Document* ranked these emissions reduction options according to cost-effectiveness based on both cost calculation methods. Cost-effectiveness calculated using the Financial Costs Method ranged from minus € 386 to plus € 681 per ton CO_2-equivalent. The lowest cost options were in the traffic sector and involved increasing excise duties, while installing solar cells on buildings was the most costly, followed by afforestation projects. There were 19 million tons of reduction potential with negative costs, indicating that the value of the energy saved would actually outweigh the costs of taking the measures for the target groups involved.

Box 4.1 Methods for calculating costs.

Methods for calculating costs

The Financial Costs Method (also called the Final Users Approach) expresses costs as they are perceived by market parties such as businesses and households. Five sectors are distinguished: households, small businesses, agriculture, energy companies and industry. Costs calculated according to this method indicate the extent to which financial factors might move market parties to take certain measures on their own initiative. It may also indicate the extent to which policy instruments such as regulations or financial incentives might be needed in order to get the measures implemented. The Financial Costs Method works with the differing energy prices paid by end-users of energy in the various sectors, including distribution margins, taxes and excise duties, and VAT (where relevant).

End-users energy prices assumed in the Options Document

Sector	Electricity, NLG/kWh	Natural gas, NLG/Nm3
Households	0.31	0.80
Small businesses	0.23	0.60
Agriculture	0.26	0.33
Industry	0.13	0.23
National shadow price	0.09	0.22

Annual capital costs are calculated with the (estimated) interest rates that are paid on average by the various sectors of the economy (8% for households and agriculture, 15% for small businesses, energy companies and industry). Cost-effectiveness may be presented either including or excluding the effect of tax schemes and other government policies (tax credits, depreciation allowances, subsidies etc.) which affect capital outlays differently in individual sectors.

The National Costs Method, on the other hand, presents the costs and benefits of options for the Netherlands as a whole. This method is used to provide a consistent basis for comparing the cost-effectiveness of measures regardless of who must ultimately take or pay for them. Costs for one sector are often benefits for another. While this information is certainly relevant for the sectors involved the costs and benefits cancel each other out at the national level. This method uses national shadow prices for energy. Finally, a social discount rate is used in calculating capital costs, based on the real interest rate. The Options Document assumed a social discount rate of 5%, in line with the real interest rate in the business-as-usual scenario.

Finally, the Options Document made a distinction between the costs of a measure (defined as an action to be taken by a target group, leading to a reduction in emissions of greenhouse gases) and the costs of a policy instrument used by the government to induce the target group to take the measure. Some policy instruments, such as taxes and excise duties, change not only the costs of the measure in question, but also the costs to be borne by other target groups and the government. The extra burden due to possible raises in taxes was not included in the presentation of costs.

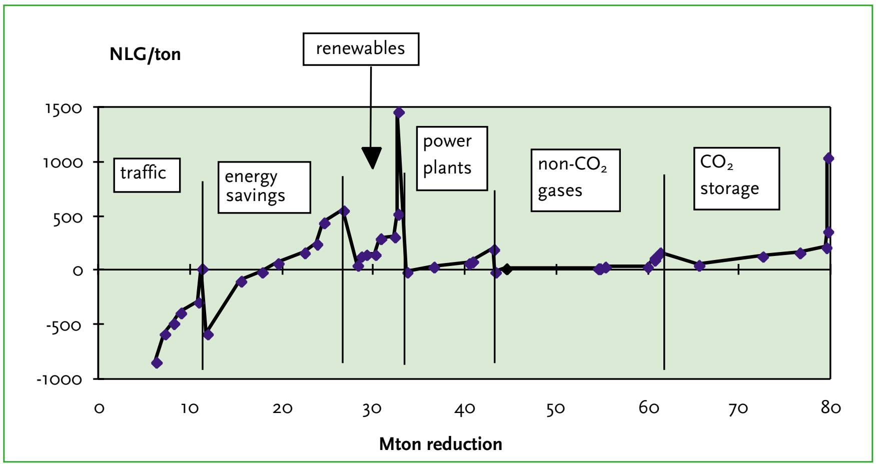


Fig. 4.1 Marginal costs according to the Financial Cost Method in six different emission reduction categories.
Source: VROM, 1999

4.3.3 National Climate Policy Implementation Plan

4.3.3.1 Introduction

The NCPIP assessed the emission reduction that would be needed in 2010 relative to the *Business as Usual Global Competition (GC) scenario*. This reduction, the 'policy shortfall' was estimated at 50 Mton CO_2-equivalent per year. One of the conditions that the 1998 coalition agreement attached to the 6% emission reduction target was that international agreements should allow sufficient latitude (around 50%) for using the Kyoto mechanisms in meeting the commitments. The NCPIP consists of two parts.

Part 1 of the NCPIP was approved by Parliament in November 1999 and described the additional measures that would be taken in the Netherlands to meet half of the estimated policy shortfall of 50 Mton per year in the commitment period.
Part 2 sets out the use of the Kyoto mechanisms to secure the remaining half of the reductions needed (VROM, 2000) and was approved in October 2000. The Netherlands started efforts to gain experience with joint activities to mitigate or sequestrate greenhouse gas emissions under the UNFCCC pilot phase for Activities Implemented Jointly. These activities and the application of the Kyoto mechanisms (JI, CDM) are described in Annex B of this report.

The NCPIP (part 1) distinguishes between three packages of measures. In addition to a basic package of policies and measures, a reserve package is described with measures that will be considered in the event of unfavourable developments. Thirdly, an innovation package lays the foundations for further intensifying policies to

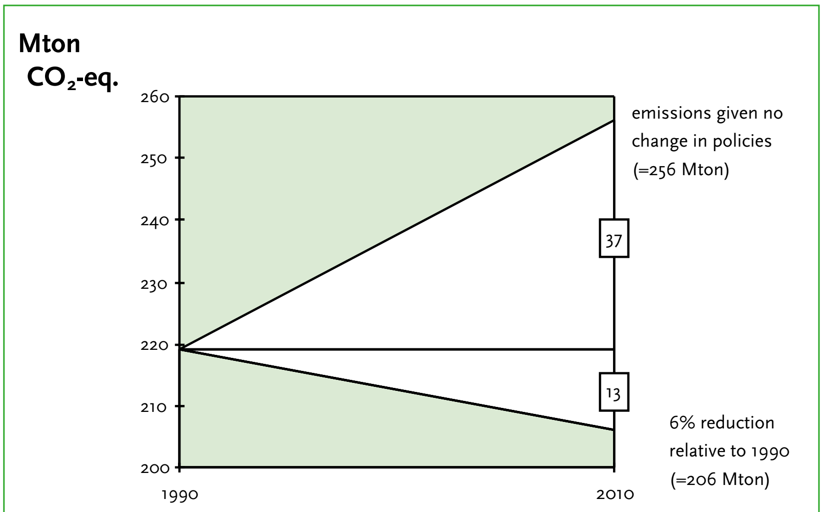


Fig. 4.2 The policy shortfall in 2010.
Source: VROM, 1999

Table 4.2 Sector emission reductions in 2010.

Sector	**Emissions in 2010** in Mton CO_2-eq.	**Reduction in 2010** in %
Industry (including refineries)	89	11.2
Energy and waste companies[1]	61	13.1
Agriculture	28	7.0
Traffic[2]	40	7.4
Households	23	10.0
Trade, services, government	12	8.3
Other	6	--

1 Total reduction due to renewable energy has been attributed to energy companies, although in practice part of this will be realised by other target groups. Waste disposal is also included under energy companies.

2 Given the margin in estimates of the reductions due to a number of traffic measures, the traffic sector will reduce emissions by between 6.25% and 8.5%. The table presents the mid-point of the range.

enable the Netherlands to achieve more far-reaching emission reductions in the period following 2012. These three packages are briefly described below.

4.3.3.2 The basic package

The basic package contains the measures that the target groups are taking in the period leading up to 2008-2012, in order to reduce domestic emissions to 231 Mton. This target represents the difference between the Kyoto target of 206 Mton (-6%) and the 25 Mton that will be reduced abroad via the Kyoto instruments. The basic package consists of measures to:

- *reduce CO_2 emissions* e.g. through energy conservation in all major sectors, greater reliance on renewable energy and measures at coal-fired power plants. Policy instruments include e.g. agreements with target groups, aided by regulation and support in the form of subsidies and positive tax incentives;
- *increase CO_2 storage* through accelerated afforestation in the Netherlands;
- *reduce emissions of non-CO_2 greenhouse gases*. Over 75% of the reductions in emissions of non-CO_2 greenhouse gases involve HFCs, PFCs and SF_6 and will be achieved via regulations, covenants and possibly investment support.

The *NCPIP part 1* describes the policy instruments and resources that the government will use to ensure that the target groups actually implement these measures. The package was put together with the aim of achieving the domestic target in a cost-effective way. Around 70% of the emissions reduced by the basic package are CO_2 and around 30% are non-CO_2 greenhouse gases, closely reflecting the current split in total emissions of approximately 78% CO_2 en 22% other gases.

In order to reach the Kyoto goal for the Netherlands, total emissions must be reduced by around 20% of the level they would reach in 2010 in the *Business as Usual Global Competition scenario*. The basic package accounts for half of this reduction, which means that the target

Table 4.3 Costs of the measures in the basic package, in € million in 2010.

	National costs	**Financial costs**
Energy savings in traffic and transport sector	-215	**
Energy savings in other sectors	300	115
Renewable energy + measures at coal-fired power plants	300	415
Non-CO_2 greenhouse gases	140 (65)	220 (100)
Total	**450**	**630**

* *Non-financial factors (i.e. immaterial costs in the broad sense of welfare economics) have not been included. Savings due to assumed changes in behaviour and investments resulting from measures have been included.*

** *The total final user costs of all the sectors together are equal to the sum of the positive costs in the individual sectors. Final user costs in the traffic and transport sector are negative, and are therefore not included.*

groups will reduce emissions by an average of around 10% of the projected 2010 level.

Implementing the measures in the basic package will cost the Netherlands as a whole approximately € 450 million per year in 2010 (based on the national cost approach). Savings from reduced energy consumption in the traffic sector amount to around € 215 million per year, while the remaining CO_2 measures have net annual costs of around € 665 million. Measures to reduce non-CO_2 greenhouse gases add approximately € 65 million per year to the total costs. The annual costs for final energy users amount to around € 630 million in 2010 (Table 4.3). Over half this amount is attributable to the use of renewable energy sources (€ 328 million per year).

The national government is contributing financially, via subsidies and fiscal incentives, to the costs of the measures that target groups have to take. Resources are being made available to support permitting authorities and e.g. to step up enforcement of speed limits. Financial means are also available for communication purposes and to assess and define feasible options for a system of emissions trading. The funds concerned are € 227 million per year for positive fiscal incentives (announced in the 1998 coalition agreement), € 77 million from the money reserved for climate policy in NEPP3, € 168 million from the € 681 million that the previous cabinet had already made available for stepping up climate policy[1] and € 91 million/year for combined heat and power and solar energy in the 2001 tax plan.

4.3.3.3 The reserve package

In order to be able to respond quickly to unfavourable developments in the future, the plan also presents a package of measures to be held in reserve. These measures are being prepared in such a way that they can have the required effect in the period 2008-2012 if emission reductions fall short of what is needed to achieve the domestic target. However, the reserve measures will not automatically be put into effect if there is a shortfall. The cabinet will take decisions regarding implementation of such measures, if needed, at evaluation points in 2002 and 2005. The package consists of raising the regulatory energy tax and/or the excise duties on motor fuels, reducing N_2O emissions in the chemicals industry and underground storage of the CO_2 produced by a number of large industrial sources. Preparation of reserve measures is continuing, so that they may be implemented as and when necessary to meet the commitments.

4.3.3.4 The innovation package

Finally, part 1 of the plan includes an innovation package mainly aimed at innovations in technology and policy instruments to achieve farther-reaching emission reductions in the years after the first budget period of the Kyoto Protocol. Experience with climate policy since 1990 has shown that breaking the trend of growing CO_2 emissions is a slow business. The reasons for this are that policy instruments have to be shaped and implemented in order to set the required changes in motion. It also takes time to develop and demonstrate new technologies. Although CO_2 emissions are growing more slowly than the economy, it seems that neither the Netherlands nor most other Western countries have (yet) been able to really ‘decouple’ CO_2 emissions from economic growth. The cabinet considers technological and instrumental innovation a prerequisite for a transition to a low-carbon energy economy.

4.3.3.5 Cooperation with other countries

As previously indicated, *NCPIP part 2* explains the policies that will be implemented in order to achieve half of the reduction commitment via the Kyoto mechanisms. As many rules for applying the Kyoto mechanisms have yet to be defined and approved, there are various uncertainties as to the conditions under which those mechanisms may be used. With these uncertainties in mind, the government has decided to develop initiatives, where possible and sensible, in order to reduce emissions in cooperation with other countries.

The overall aim of these initiatives is to stimulate project development in time to achieve the considerable reductions required in 2008-2012. The government considers it important to gain experience in using the Kyoto mechanisms in order to be able to contribute to the ela-

[1] See Second National Communication, p. 64 and Update of the NC2, p.43.

boration of the rules. The same is true for the countries with which the Netherlands cooperates. Moreover, projects in developing countries and countries with economies in transition will promote general awareness of climate issues in these countries, as well as support for measures to address these issues. The activities staged by the Netherlands will be evaluated periodically, with the first evaluation planned for 2002. In the meantime, the deployment of the mechanisms by the Netherlands will be tested continuously as the international regulations pertaining to them evolve further.

4.4 Implemented policies and measures in the Netherlands and their effects

This section provides more details on the individual policies and measures implemented under the NCPIP. It also describes the most relevant tax measures that were already implemented before the NCPIP was approved. A complete overview of the current state of affairs is presented in Table 4.4.

4.4.1 Implementation of new policies and measures before the NCPIP

As mentioned in Section 4.3.1 tax measures were introduced in 1998 under the *NEPP3* in anticipation of the new climate policy under the NCPIP. The most important measures are summarised below per sector.

Energy sector

- Increasing the regulatory energy tax. This tax was increased by approximately € 1542 million per year between 1999 and 2001. Of the additional revenues, some € 227 million per year is allocated for positive incentive programmes on energy conservation and renewable energy. Around € 91 million is available for programmes for households and € 136 million for businesses.
- The 1998 tax plan extended special provisions for renewable energy in the regulatory energy tax. Electricity from renewables has been zero-rated since January 1, 1998, on the condition that this rate advantage is passed on to consumers who have a special contract for buying 'green electricity'. This zero-rating scheme was added to the existing payment discount for renewables (which has been increased since its introduction in 1996).

Waste sector

- The 1998 tax plan introduced a special arrangement for electricity generated by waste incineration plants. The energy companies pay 50% less than the normal energy tax rate to the central government for electricity originating from waste incinerators on the condition that this advantage is passed on to the waste incineration plant. This arrangement rewards the waste incinerator for the electricity generated from the biomass fraction of the waste.

Transport sector

- Since the mid-1960s, income tax allowed employers to reimburse employees (within limits) free of tax for the costs of commuting. An employee was often able to deduct such costs if they were not reimbursed tax-free. Traditionally, the amounts that could be reimbursed tax-free were set higher than the amounts that could be deducted in order to avoid disputes between tax authorities and the employer. The upper limits for tax-free reimbursement and tax deduction were derived from public transport cost and the commuting distance. Over the years, many changes were made to this arrangement, to reduce commuting distances and promote the use of public transport for commuting[1].

4.4.2 Implementation of the basic package: reduction of CO_2

Cross-sectoral measures

- Three tax incentives have been implemented to stimulate further growth in combined heat and power (CHP). Firstly, the existing corporate income tax deduction for energy investments (including investments in CHP)

[1] The most recent change occurred on January 1, 2001, when the tax deduction for commuting in a private car was eliminated (and the standard deduction for commuting by public transport was reduced proportionally). An additional change to the tax code as of January 1, 2001, was aimed at discouraging personal use of company cars. This change involved differentiation of the income imputed for using a company car for private purposes. The imputed income is now lower for less than average personal kilometres, and higher for above average personal kilometres.

Table 4.4 Polices and measures from the basic package of the National Climate Policy Implementation Plan.

Name of policy or measure	Objective and/or activity	GHG Affected	Type of instrument	Status	Implementing entity	Emission reduction in 2010, in Mton CO_2-eq*
Energy sector						
5% renewables in 2010	decrease emissions through increased market share for renewable energy	CO_2	1. subsidies 2. fiscal incentives 3. market liberalisation/ green certificates 4. agreement with provincial NGO's resiting of windmills 5. voluntary agreements with housing corporations	1. in effect 2. in effect 3. in effect 4. in preparation 5. in preparation	nat'l gov't, prov. gov'ts, energy companies, housing corporations	2.0
measures at coal-fired power plants	decrease emissions through fuel switch and efficiency improvement	CO_2	1. voluntary agreement with plant owners 2. fiscal incentives 3. regulatory/environ-mental permit	1. in preperation 2. in effect 3. in effect	nat'l gov't, owners of coal-fired plants	6.0
emissions from oil and gas production	identify reduction potential	CH_4		1. in study research institutes	nat'l gov't	unknown
Transport sector						
EU agreement on fuel efficient cars	reduce CO_2 emissions from new cars by 25% per kilometre between 1995 and 2008	CO_2	1. voluntary agreement	1. in effect	European Commission car manufacturers	0 - 0.4
CO_2 differentiation in vehicle tax and car labelling	encourage purchases of fuel-efficient cars	CO_2	1. fiscal measure 2. new car labelling	1. in preparation 2. in effect	nat'l gov't, car dealers	0.6
encouraging in-car instruments	promote monitoring instruments for fuel efficient driving behaviour	CO_2	1. fiscal incentives 2. voluntary agreements with car dealers and garages	1. in effect	nat'l gov't, car dealers, garages	0.5
tax measures to limit passenger traffic	discourage commuter traffic and personal use of company cars	CO_2	1. fiscal incentives	1. in effect	nat'l gov't	0.1-0.3

Table 4.4 Polices and measures from the basic package of the National Climate Policy Implementation Plan.

Name of policy or measurea	Objective nd/or activity	GHG Affected	Type of instrument	Status	Implementing entity	Emission reduction in 2010, in Mton CO_2-eq*
Transport sector						
increased tyre pressure	reduce road friction and energy consumption	CO_2	1. agreements 2. public information	1. in effect 2. in effect	nat'l gov't, car dealers, garages	0.3
road pricing	improve access to cities and reduce congestion	CO_2	1. experiment	1. in preparation	nat'l gov't	0.2
stepped up enforcement of speed limits	reduce speeding and save fuel	CO_2	1. targeted traffic control	1. in effect	nat'l gov't	0.3
traffic and transport projects in CO_2 reduction plan	improve logistics efficiency of goods transport, improve driving behaviour	CO_2	1. subsidies 2. communication	1. in effect 2. in preparation	nat'l gov't, NOVEM, Senter	0.2 - 0.3
reduction of emissions from catalytic converters	further European regulations	N_2O		1. in study		0.5
Industry sector						
energy savings in industry	attain 'world top' by 2012 in most energy-intensive sectors; take all measures in other sectors with internal rate of return > 15% after taxes	CO_2	1. Benchmarking covenant 2. long term agreements 3. regulatory/permits 4. fiscal incentives	1. in effect 2. in effect 3. in effect 4. in effect	nat'l gov't, prov. gov't, industry, NOVEM	2.3
reduction of HFC, PFC as (H)CFC alternatives	improve know-ledge about emissions and reduction possibilities and realise as much reduction potential as possible	HFC, PFC	1. research 2. regulations 3. agreements 4. subsidies 5. fiscal incentives	1. in study 2. in preparation 3. in preparation 4. in effect 5. in effect	nat'l gov't, prov. gov't, industry	4.0
reduction of PFCs from the alumini-um industry	make adjustments to production process	PFC	1. agreements 2. permits		nat'l gov't, prov. gov't, industry	1.2

Table 4.4 Polices and measures from the basic package of the National Climate Policy Implementation Plan.

Name of policy or measurea	Objective nd/or activity	GHG Affected	Type of instrument	Status	Implementing entity	Emission reduction in 2010, in Mton CO_2-eq*
Industry sector						
reduction of HFC's from processes	install/optimise afterburner	HFC	1. permit	1. in effect	prov. gov't, industry	2.5
SF_6 from chips industry and heavy current technology	identify reduction potential	SF_6		1. in study	nat'l gov't, industry, research institutes	unknown
Agriculture sector						
energy savings in greenhouse horti-culture	to improve energy efficiency by 65% between 1980 and 2010	CO_2	1. voluntary agreement 2. regulations 3. CO_2 buffer project 4. fiscal incentives 5. subsidies	1. in effect 2. in preparation 3. in preparation		2.0
Forestry						
CO_2 sequestration	accelerate afforestation in the Netherlands	CO_2	1. certification of CO_2 reduction from forests 2. fiscal incentives	1. in effect 2. in effect	nat'l gov't	0.1
Waste management						
emissions from former dumpsites	identify reduction potential	CH_4		1. in study	nat'l gov't, research institutes	unknown
Households						
Energy Performance Advice	save energy in existing house-holds	CO_2	1. voluntary advice 2. fiscal incentives	1. in effect 2. in effect	energy companies, nat'l gov't	2.0
encouraging energy-efficient appliances	increase penetration of most efficient appliances	CO_2	1. energy labelling 2. fiscal incentives	1. in effect 2. in effect	nat'l gov't, retailers	0.3
Non-residential buildings						
Energy Performance Advice	save energy in existing non-residential buildings	CO_2	1. voluntary advice 2. fiscal incentives 3. regulations	1. in effect 2. in effect	energy companies, nat'l gov't	1.0
Cross-sectional measures						
promotion of combined heat and power (CHP)	encourage construction of new and continued use of existing CHP capacity	CO_2	1. fiscal measures	1. in effect	nat'l gov't	assumed in Business as Usual

* Estimates relative to the Business as Usual Global Competition Scenario, as presented in the Climate Policy Implementation Plan. See Chapter 5 for more recent projections on the impacts of these measures.

was raised to 55% of the investment costs[1]. Secondly, the fuel tax on inputs for electricity production was transformed into a tax on kWh-outputs and integrated into the regulatory energy tax. Electricity from CHP for own-use was exempted from this operation, giving it a price advantage[2]. Finally, a payment discount (of € 0.0023 per kWh) was introduced into the regulatory energy tax for electricity generated in CHP installations that produce heat utilised in the Netherlands[3].

Transport sector

- Energy labels were introduced in January 2001, indicating fuel consumption and CO_2 emissions of new passenger cars. These labels report both absolute fuel consumption and the relative consumption compared to other types of cars of similar size. The labels are very similar to those already used to indicate energy efficiency on refrigerators and washing machines[4].

- The government has made € 11 million available for a multi-year programme aimed at promoting fuel-efficient purchasing and driving behaviour of individual vehicle drivers and fleet managers. NOVEM administers this programme (*The New Way of Driving*), which is being implemented in close cooperation with market parties. It includes activities such as driver training and dissemination of information. Results from the period September 1999 - December 2000 indicate CO_2 emission reductions of over 40 kiloton (see also Chapter 9).

Industry sector

- In July 1999 a *Benchmarking Covenant* was signed between national and provincial governments and representatives of industry. In this voluntary agreement, energy-intensive companies, with annual energy consumption of at least 0.5 PJ, agree to achieve (and/or hold) a position among the most energy-efficient industries in their type of business, in the world, no later than 2012. An international standard of comparison (a benchmark) is being developed for each industrial process covered by the agreement. For the chemicals industry e.g. 147 studies are being carried out worldwide to develop benchmarks for all relevant processes. In return, the government will not impose any additional specific energy conservation or CO_2 reduction measures on the participating companies. Currently 224 installations participate in the agreement, representing 80% of the eligible companies and 93% of the eligible energy consumption. A Verification Bureau Benchmarking facilitates the process.

- For less energy-intensive industries, negotiations with the government are currently ongoing, aimed at reaching second generation *Long-Term Agreements* (LTA) on energy efficiency. The government supports both the LTA's and the Benchmarking Covenant with the 'carrot' of fiscal incentives and the 'stick' of environmental permits.

- Environmental permits serve as the policy tool with which voluntary agreements are enforced and 'free riders' are avoided. Measures agreed under these agreements are taken over in the permit. Companies not participating in agreements are required (via their permits) to carry out all energy-saving measures with an internal rate of return of at least 15% after taxes. The national government has reserved € 14 million to enable permitting authorities (provinces and municipalities) to step up their activities to reinforce the role of energy measures in environmental permits.

- Tax incentives for energy investments. The *Energy Investment Tax Deduction* (EIA) encourages entrepreneurs to invest in relatively innovative energy-efficient technologies or in renewable energy. Part of the investments may, under certain conditions, be deducted from the company's profit tax. This facility[5] was introduced in 1997 and now has a budget of over € 185 million (2001). Approximately 27% of investments by

1 Given marginal tax rates of 52% and 35%, the net financial advantage amounts to 28% and 19% respectively.

2 Up to € 0.058 per kWh relative to electricity delivered via the grid. The actual advantage depends on the amount of electricity used.

3 € 59 million/year has been budgeted for this purpose.

4 Relative fuel consumption is divided into seven categories. 'A' represents the most efficient cars, while 'G' indicates the least efficient models of a given size.

5 The lists of eligible technologies and equipment for EIA and VAMIL are updated annually, following a procedure in which business may also propose inclusions to the list. A committee makes the final selection of equipment to be included.

Box 4.2 The LTA Policy Mix and its effects.

The LTA policy mix consists of an energy covenant, which is concluded between the industry sector and the government, and a series of supporting measures. These include some subsidy facilities and fiscal incentives that enable the participating companies to implement energy conservation measures.

The first generation of Long-Term Agreements on energy efficiency in industry covered the period 1989-2000. This policy instrument was described in NC_2 and has achieved its target of 20% energy efficiency improvements over the period (excluding feedstock). The average annual rate of efficiency improvement was around 2.2%. An evaluation study estimated that autonomous development would have resulted in only 1.3 % annual improvement. Most industries covered by the present Benchmarking agreement (with the exception of the power sector) participated in the Long-Term Agreements until 2000.

LTA progress is measured over the following investment categories:
- good housekeeping;
- replacement investments;
- energy-saving investments;
- CHP;
- Other measures.

industry benefit from this facility, 24% in the agricultural sector and 5% in transport. Other eligible sectors include banks and other business services, small businesses, the energy sector, etc. A similar facility, the *Energy Investment Program for the Non-Profit sectors* (EINP), exists for the non-profit sector. The budget in 2001 amounts to some € 21 million. A third facility, the VAMIL, is much broader and also includes innovative environmental technologies. This facility allows accelerated depreciation for a series of such technologies.

Energy sector

- An agreement (in principle) was reached in mid 2000 between the government and the owners of existing coal-fired electric power plants. The latter have committed themselves to replacing coal with biomass in 475 MW of installed coal-capacity. They will also participate in the benchmarking covenant for both gas-fired and coal-fired plants. As part of this agreement, the government has changed the fuel tax on fuel inputs in electricity production into a tax on kWh-output as part of the regulatory energy tax per January 1, 2001.

- Green electricity: see Chapter 9.

- Green funds. Under certain conditions, interest and dividend from green funds are exempted from income tax. This implies that these funds may offer lower interest rates in loans to private persons or companies. One of the conditions is that the funds obtain a 'declaration of approval' indicating that the funds are sufficiently invested in appropriate green projects. Many renewable energy projects are eligible as a green investment. An independent organisation assesses whether investment projects meet the criteria for issuing this declaration. The promotion of these funds is primarily handled by the commercial banks that operate the funds. Since the introduction of the green investment funds in 1996 over 130,000 households have invested several billion euro in these funds.

Household sector

- A voluntary *Energy Performance Advice* (EPA) for existing housing was introduced in 1999. This EPA charts the energy-related quality of a house, provides advice about the most appropriate energy-saving measures that can be taken and gives information on energy savings and costs of these measures.

- An *Energy Premium* for energy-efficient appliances and insulation came into effect in January 2000. This premium targets existing housing and provides a partial rebate to consumers who purchase the most efficient type of household appliances (the so-called A-label appliances) or certain kinds of insulation, double gla-

[1] The budget for positive incentives for households, resulting from raising the regulatory energy tax.

zing, etc. This programme has a structural budget of approximately € 91 million per year[1]. The 2001 tax plan made extra money available (some € 27 million per year from 2001 onwards) for including investments in renewables for households, such as solar panels and solar boilers. The *Energy Premium* has also been tied to the EPA. Households taking measures recommended in an EPA may receive a € 159 rebate from their energy company for the cost of the EPA, plus a bonus of 25% in the *Energy Premium* for the measures they take.

Forestry sector

- A payment discount has been introduced into the regulatory energy tax to accelerate afforestation. Under this scheme the *National Green Fund* makes agreements with various parties to plant new forests and to maintain them in a sustainable manner for a period of at least 50 years. The fund issues certificates for the number of hectares for which CO_2 sequestration rights have been acquired. An energy company wanting to acquire CO_2 sequestration rights can deduct € 4538 from the energy tax it owes to the government, provided that an equal amount of money is transferred to the *National Green Fund*. This enables the *Green Fund* to continue its activities by paying landowners with whom a contract has been signed. It is estimated that this scheme will reduce revenues from the energy tax by around € 9 million per year, depending on the number of hectares contracted.

4.4.3 Implementation of the basic package: reduction of non-CO_2 greenhouse gases

A *non-CO_2 reduction programme* (ROB) was announced in the NEPP3, to reduce emissions of the five non-CO_2 greenhouse gases in the Kyoto Protocol (CH_4, N_2O, HFCs, PFCs and SF_6). The basic package includes a reduction target for non-CO_2 greenhouse gases of 8 Mton per annum. In addition, the reserve package mentions a further reduction option of approximately 6 Mton N_2O in the chemical industry (the production of nitric acid, caprolactam and acrylonitril), to be implemented if and when this proves technically and economically feasible.

In realising this reduction target the ROB programme takes into account a number of conditions, i.e.:

- the programme aims at real greenhouse gas emission reductions. Therefore a method for calculating the *Total Equivalent Warming Impact* (TEWI) of projects has been developed and is being applied in evaluating measures and technologies;
- it aims at actual reductions that target groups can achieve with relatively little pain and effort;
- it aims to share the burden fairly among economic sectors;
- the programme operates within a long-term implementation strategy, accepted by the majority of the actors and compatible with (inter)national policy. The parties that will actually (have to) introduce measures are usually businesses.

The ROB programme currently consists of a number of generic activities (e.g. research into hitherto unknown but significant sources of non-CO_2 greenhouse gases, and participation in European policy development) and some 15 sector-oriented projects, e.g. cooling and air conditioning, foam blowing, semiconductor production, etc. These projects can be subdivided into:

- projects dealing with economic sectors that have been allocated a (sometimes tentative) reduction target;
- projects dealing with economic sectors that have not (yet) been allocated a reduction target in the basic package, because (in 1999) the actual emission data and the emissions reduction potential were considered highly uncertain.

Technical developments on N_2O in the chemical industry are being studied as well. Given the present uncertainties as to when technically and economically feasible technology will become available, this project forms part of the 'reserve' package. However, it is a 'special case' in that its implementation does not depend on disappointing emission developments in other policy areas, but on the successful development of a cost-effective solution.

Some of the projects cover measures that are included in the basic NCPIP package, others aim at investigating the reductions potential and costs for measures that may be taken into account when the basic package is evaluated or for a second budget period.

With regard to all sector-oriented projects three phases are distinguished, involving differences in 'problem

Box 4.3 Examples of measures included in the basic NCPIP package.

Transport sector: N_2O emissions
A research project has been set up to measure N_2O emissions from passenger cars (under field conditions) and will be finalised in 2001. The results will be presented to the EU in order to place this issue on the EU agenda. However, initial results show that further action might not be necessary, because N_2O emissions from passenger cars are most likely lower than expected.

Industry sector: PFC emissions
A process adjustment (changing from Side-Worked to Centre-Worked Prebake) has been approved and may be included in the environmental permits for the aluminium industry.

Industry sector: HFC emissions from processes
An important measure has already been implemented, i.e. incorporating an afterburner (affecting HFC-23 emissions) into the environmental permit for HCFC-22 production in the Netherlands. This measure was already included in the *Business as Usual Global Competition* (GC) Scenario, but its effectiveness has been improved from 50% to over 83%. The additional action and effect are included in the basic package.

ownership':

- In the first phase, the government initiates research to investigate the nature of the non-CO_2 emissions and reduction options in the sector concerned. The results are discussed with representatives of that particular economic sector. ROB projects in this stage are e.g. N_2O and CH_4 emissions in agriculture and N_2O from catalytic converters in cars.
- The project enters a second phase as soon as the economic sector acknowledges the significance of these emissions, and a reduction potential exists. A working group with key players from the sector and representatives from government and relevant government bodies is established to :
  1. improve the accuracy of emission data;
  2. develop a monitoring protocol consistent with international reporting standards;
  3. identify reduction options and advise on policy approaches.

  This approach accommodates the legitimate concerns of the economic sectors, so that policies can be selected that best fit the sectors' specific situation. Most ROB sector projects are at this phase. Examples include reducing CH_4 emissions from gas engines, oil and gas production and landfills, reducing F-gases from fire extinguishing agents, the semiconductor industry, refrigeration, mobile and stationary air conditioning, cleaning agents and solvents, production of foams and aerosols, and from high-voltage switchgear and power current technology.
- Phase three involves actual implementation of reduction measures. This stage is mainly directed by the economic sectors themselves. Projects include PFC emissions in the aluminium industry and HFC process emissions.

In the autumn of 2001, the entire ROB programme will be evaluated and an overall policy approach will be suggested for consideration when the Netherlands climate policy is evaluated. The government made available some € 120 million for the ROB programme for the period 1998-2008. In addition, the implementation of emission reduction measures will be stimulated through various existing financial arrangements, e.g. by including technologies in the VAMIL list allowing accelerated depreciation of investments, inclusion in the MIA list, allowing a one-time deduction of part of the investment from the company's profits, or the tenders under the CO_2 Reduction Programme. It is estimated that in the years 2002-2008, some € 75 million will be devoted to reducing emissions of non-CO_2 gases from the normal budgets for these facilities.

4.4.4 Implementation of the Innovation Package

Technological innovation

- The government has made some € 18 million available for a 10-year programme aimed at speeding up the introduction of new, climate-neutral gaseous and liquid energy carriers (GAVE Programme). The term 'climate neutral' indicates the goal of replacing petrol, diesel fuel and natural gas with fossil-based and renewable-based energy carriers with far-reaching CO_2 reduction potential in the period after 2010. The first phase, an inventory of possible climate-neutral energy carriers that could be candidates for demonstration projects, ended in March 2000. It concluded that climate-neutral substitutes for petrol, diesel fuel and natural gas offer a huge long-term CO_2 reduction potential in the Netherlands, amounting to over 50% of current emissions.

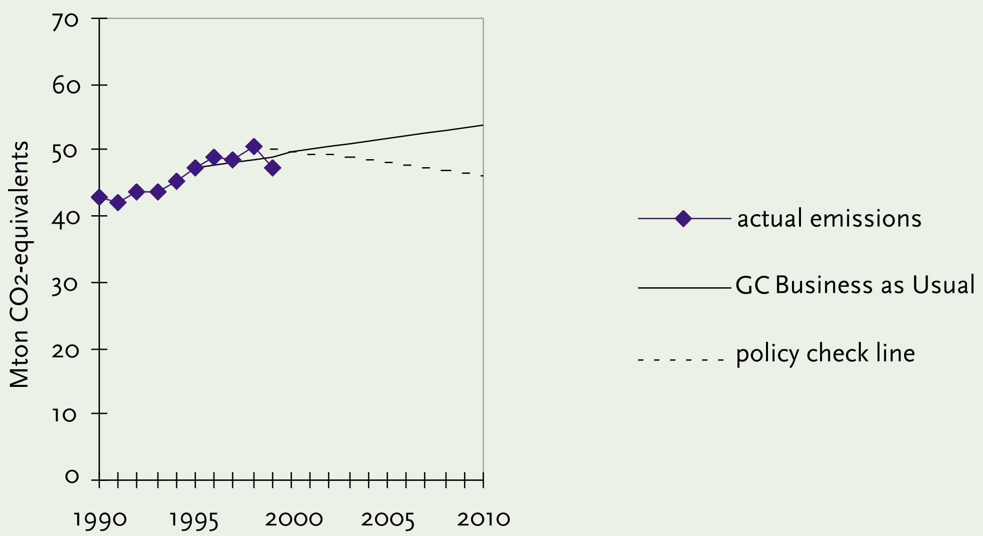
- The second phase aims to carry out demonstration projects to show that it is technically and organisationally possible to introduce and sustain climate-neutral energy carriers in the marketplace. Activities include subsidies for conceptual work and a call for tenders for investors in actual projects. The government also has plans to introduce a payment discount for climate-neutral energy carriers into the regulatory energy tax, comparable to that for renewable energy. An amount of € 4.5 million per year has been reserved for this purpose.

Innovation in policy instruments

- In August 2000, a commission of experts was installed to advise the cabinet on the feasibility of introducing CO_2 emission ceilings for households and sheltered sectors of the Netherlands' economy. The commis-

Box 4.4 Policy accounting.

Example from the climate policy accounting: the energy and waste sector



This figure provides an example of the kind of information presented to Parliament in the Climate Policy Accounting. The graph shows the emissions under the Business as Usual GC scenario and the policy check line for the sector as well as a summary of the sector's performance in the year under review.

The sector's performance in 1999 consisted of:
- signing an agreement in principle regarding reducing CO_2 emissions from coal-fired power plants;
- investments in renewable energy amounting to € 205 million reported under the energy investment deduction, while the programme for non-profit organisations reported investments of € 9.5 million;
- issuing green certificates for energy-related projects with a total equity of € 83.5 million under the Green Investments scheme;
- including investments totalling € 1.05 billion as of December 31, 1999 in the CO_2 reduction plan, resulting in annual emission reductions of 1.4 Mton in the energy sector;
- a discount of € 16.3 million in energy tax payment, given to renewable electricity producers, and € 2.7 million to waste incinerators for electricity generated from the biomass fraction of their waste;
- the qualification of 119 million kWh of renewable energy for the zero-rating scheme under the regulatory energy tax;
- avoiding 35 PJ of fossil fuel use during 1999 due to consumption of renewable energy, 2 PJ more than in 1998. This resulted in avoided CO_2 emissions of around 2.2 Mton.

sion's report is expected towards the end of 2001. The government requested advice on specific options for emission ceilings to be implemented in practice, and on issues such as the possible role of intermediaries, the level at which emission ceilings could be set, methods for allocating emission rights and the possibility of trade between sectors falling under a ceiling, and sectors of the economy for which no ceiling would be applicable. The commission's work concentrates on a national cap and trade system that must be shaped in such a way that it can be linked to, or integrated into, other possible national or supranational systems that may be introduced.

4.5 Climate Policy Accounting

The first annual 'climate policy accounting' letter was sent to Parliament in October 2000. This letter was the government's response to parliamentary requests for information about the effects of climate policy. The letter presented the actual development in direct emissions of greenhouse gases in the sectors industry, energy and waste, transport, households, non-residential buildings and agriculture. It presented two projections for each sector against which the actual development could be compared. In the first projection, a straight line was drawn between actual sector emissions for 1998 and the projection for 2010 in the *Business as Usual GC* scenario. In the second, a straight policy check line was drawn between actual emissions in 1998 and the projection for 2010 given the policies formulated in the *National Climate Policy Implementation Plan*. 1998 was chosen as the reference year since it was the last year before policies were stepped up in the Implementation Plan. Descriptions were provided of the policies affecting each sector and of the performance of the sector during the previous year, illustrating the relationship between emissions and policy efforts. This 'accounting' will be repeated annually during the years up to the first budget period, in order to keep Parliament informed about developments.

The accounting showed that total emissions of greenhouse gases increased around 6% between 1990 and 1995 (the base year of the *Global Competition scenario*). Total emissions were somewhat lower in 1999 than in the policy check line for that year, but remained above the target level for domestic emissions in 2010 of 231 Mton. As indicated earlier, the domestic target level for 2010 is the difference between the Kyoto target of 206 Mton (-6%) and the 25 Mton that will be reduced abroad via the Kyoto mechanisms.

4.6 The future: evaluation of climate policy in 2002

The system adopted in the NCPIP provides for evaluation points in 2002 and 2005. The purpose is to see whether policy implementation and emissions reduction are proceeding according to plan. Preparations for the first evaluation point began in 2001 by commissioning the preparation of a new reference estimate of emissions in 2010. Actual developments in a number of important factors over the past five years have deviated from the assumptions in the *Global Competition* scenario. The new reference estimate takes account of these developments. The evaluation will also assess the current state of affairs in emissions and policy development and will be sent to Parliament early in 2002.

As part of the preparation of the *Fourth National Environmental Policy Plan*, the Ministry (VROM) commissioned the national research institutes ECN and RIVM at the beginning of 2000 to make an inventory of the perspectives for drastic reduction of emissions relating to energy use and mobility in 2030. A CO_2 reduc-

Table 4.5 Reduction potential in 2030.

Perspective	Estimated maximum individual reduction potential in 2030 [Mton]
Changing economic structure	30
Modifying behaviour/consumption patterns	10
Efficiency improvement	40 – 60
Renewable source of energy	40 – 75
Clean fossil sources of energy	50 – 60
Nuclear energy	10 – 20

Source: EZ, 2000; VROM, 2000

tion target of 30% in 2030 relative to 1990 provided the analysis with a focal point. This target implies a reduction of around 120 Mton per year (the difference between emissions projected in 2030 according to the *GC Reference Scenario* and a 30% reduction in 2030 compared to 1990).

The following table shows the perspectives for CO_2, together with their estimated maximum reduction potential in 2030 (Table 4.5). The maximum potential is that which is deemed feasible if the perspective is put into practice as rapidly as possible, with government and target groups expending maximum effort over the entire period up to 2030. The perspectives sometimes relate to the same energy uses or emissions, resulting in an overlap in the potentials. The maximum overlap when all the perspectives are combined is around 70-80 Mton.

5 PROJECTIONS AND THE TOTAL EFFECT OF POLICIES AND MEASURES

5.1 Introduction

This chapter describes the projections for greenhouse gases for two scenarios: 'with measures' and 'with additional measures'. The scenarios are explained in Section 5.2. Section 5.3 summarises the effects of policies and measures according to the *National Climate Policy Implementation Plan* (NCPIP), which was drawn up by the government. This section also gives projections for ozone precursors and SO2. Section 5.4 describes a critical assessment of the calculated effects of these policies and measures by ECN and RIVM, taking into account their view on the feasibility of the policies and measures announced in the NCPIP. This section also includes an overview of the results of a recent update of the scenario for new insights into emission factors, as published by RIVM in the *Environmental Outlook 5* (RIVM, 2000). Section 5.5 provides more details on the methodologies used for construction of the scenarios.

The trends are based on one of the scenarios developed for the Long-Term Outlooks 1997 (CPB, 1997), notably the Global Competition (GC) scenario, which was also used to update the NC_2. At the moment, this scenario is under revision. However the final results of this revision will become only available after the submission of this Third National Communication (NC3).

The *Business as Usual GC-scenario*, which acts as the 'with measures scenario', includes projections up to 2020. It should be noted that effects of policies and measures included in the NCPIP, which here acts as the 'with additional measures scenario', were only assessed for the first commitment period of the Kyoto Protocol (up to 2010). For this reason, the 'with measures' scenario in this chapter gives figures up to 2020, while the 'with additional measures' scenario only includes data up to 2010.

Furthermore, it should be noted that emission data for 1990 en 1995 included in the tables in Section 5.3 are not always consistent with emission data reported in Chapter 3. Emission data for 1990 and 1995 presented in Section 5.3 are consistent with the NCPIP, and were used as a basis for calculating the effects of policies and measures included in that policy note, based on older estimates of historical emissions. The methodology for greenhouse gas emission inventories has meanwhile been updated to account for relevant new insights (new emission factors, improved allocation of sources, revised activity data). The results of this update were included in the *National Inventory Report 2001* and are reported in Chapter 3. For transparency reasons, the tables presented in Section 5.3 also contain the actual emission figures for 1990.

Chapter 3 indicated that further improvements in the emission monitoring methodology, as compared to the NIR 2001, have recently been incorporated into the *Environmental Balance 2001* (RIVM, 2001). However, these figures have not yet been incorporated into this Third National Communication. These improvements are taken into account in the revision of the scenario, the results of which will be available when this report is reviewed.

5.2 Scenario and key assumptions

Scenario 'With measures'

In the NCPIP, the GC- scenario was used as the Reference Scenario, i.e. as the "with measures scenario". The Long-Term Outlooks 1997 (CPB 1997) developed this scenario as well as the 'Divided Europe' and 'European coordination' scenarios. As previously stated, 'Global Competition' was chosen as the reference from these three scenarios, because it provides a robust background against which to assess the effects of policies and measures (see Box 5.1). The GC-scenario envisages the continuation of policies in place in the Netherlands before the Kyoto Protocol was signed. This scenario includes policies and measures implemented up to the *National Environmental Outlook 4* (RIVM, 1997) as described in the *Second National Communication* and the first phase of the CO_2 reduction plan (with budget € 450 million). The projected greenhouse gas emissions in the GC scenario were described in the NEO-4 and updated in the Options Document (ECN/RIVM 1998). This scenario is identical to the Reference scenario described in the *Update of the Second National Communication.*

Box 5.1 Summary of key variables and assumptions in the GC- scenario.

Variable	Value 1995-2010	Unit/period	Historical values	Unit/period
Economic growth	3.3	%/yr	2.2[3]	%/yr 1980-1995
Industrial production	4.3	%/yr	1.8	%/yr 1980-1995
Private consumption	2.9	%/yr	2.2	%/yr 1980-1995
Population	+6%	in 1995-2010	+9%	in 1980-1995
Housing units	+19%	in 1995-2010	+29%	in 1980-1995
Households	+15%	in 1995-2010	+30%	in 1980-1995
Passenger kilometers	+14%	in 1995-2010	+31%	in 1980-1995
Tonne kilometers [1]	+57%	in 1995-2010	+32%	in 1980-1995
Livestock population	+82%	in 1995-2010	+16%	in 1980-1995
Oil price [2]	65%	in 1995-2010	-70%	in 1980-1995
Final energy use	1.6	%/yr	1.8	%/yr 1985-1995
Savings final energy use	-1.3	%/yr	-1.0	%/yr 1985-1995
Structure effect	-0.6	%/yr	0.2	%/yr 1985-1995
Growth of cogeneration	+320%	in 1995-2010	-	in 1980-1995

1 Road, rail and inland shipping.
2 17 and 28 US$/bbl in 1995 and 2010, respectively.
3 In 1996-2000 annual growth was 3.0%, 3.8%, 4.1% and 4.0% respectively
Source: NEO 4

Scenario 'With additional measures'

The *Additional policy* scenario includes the measures from the NEPP3 and all measures from the basic package of Part I of the NCPIP. All measures included in this scenario are described in chapter 4.

Table 5.1 CO_2 emissions (in Mton) in the Reference and Additional Policy scenario in the period 1990-2020.

IPCC category	Target group	Historical emissions			Reference Scenario[1]					Additional Policy[3]		
		1990 actual	1990 scenario	1995 scenario	2000	2005[2]	2010	2015[2]	2020	2000[2]	2005[2]	2010
1A1a	Energy and waste management	41	43	47	48	51	54	54	53	47	46	46
1A2; 1A1c; 2	Industry and refineries[4]	55	54	56	59	61	62	69	75	57	59	60
1A3	Transport	29	29	32	34	36	38	43	47	33	35	36
1A4a	Trade, services, government	8	9	10	10	11	12	14	15	10	11	11
1A4b	Households	23	22	22	23	23	23	23	23	22	21	21
1A4c	Agriculture	9	9	9	11	13	14	15	16	10	11	12
1A5	Other	1	2	4	4	4	4	4	4	4	4	4
	Total	**167**	**168**	**180**	**189**	**198**	**207**	**220**	**233**	**183**	**187**	**190**
	Total, not corrected for temperature	**161**	**161**	**177**	**189**	**198**	**207**	**220**	**233**	**183**	**187**	**190**

1 The effect of the first phase of the CO_2 Reduction Plan in 2010 (3 Mton) has been allocated to the sectors industry (2 Mton) and energy (1 Mton). No effect of the CO_2 Reduction Plan has been taken into account for 2015 and 2020.
2 Data for 2005 and 2015 as well as 2000 have been interpolated for the additional policy scenario.
3 The policy effects for 2015 and 2020 have not been estimated in the Climate Policy Implementation Plan.
4 Including feedstocks.
Sources: RIVM 1997, ECN/RIVM 1998, VROM 1999

Box 5.2 Summary of key variables and assumptions in the Reference Scenario for CH_4 and N_2O.

CH_4:
- Energy sector: decreasing natural gas production due to increasing imports, reduction of emission factors due to enhanced flaring and gas recompression, further reduction of leakage in gas distribution networks;
- Agriculture: the impact of the Restructuring Fund for Intensive Animal Husbandry, as well as the Integral Paper on Manure and Ammonia Policy, leading to reduced livestock numbers;
- Waste management: specific policies on waste prevention and recycling, leading to an increase in waste incineration and a decrease in the amounts of waste landfilled, as well as in the degradable organic carbon fraction of this waste; enhanced landfill gas recovery;
- In the GC Reference scenario in 2010 CH_4 emissions are 60 mln kg (1.3 Mton CO_2-eq.) lower than in the EC Reference scenario..

N_2O:
- Industry: very small increase in production volume at nitric acid production plants; emission factors unchanged because no N_2O-reducing technique is available;
- Transport: increase of mobility by 0.8% per year; reduction of emission factors due to shorter warm-up time of three-way catalysts;
- Agriculture: smaller numbers of livestock, leading to less manure and less consumption of chemical fertilisers;
- 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.

Source: RIVM, 1997a,b

5.3 Projections and government assessment of effects of policies and measures

5.3.1 CO_2 emissions and reductions

Table 5.1. shows the CO_2-emissions in the *Reference* and *Additional Policy* scenario as described in the NCPIP. The effect of the additional measures in the NCPIP is in total 17 Mton CO_2 in 2010. This includes the effect of the increase of the fuel and energy taxes as announced in the NEPP3 and the *Coalition Agreement* of 1998 and described in chapter 4. It should be noted that the CO_2 emissions in 2010 under the additional policy scenario are higher than the actual emissions in 1990. This is due to the choice of the Government to achieve half of the reduction needed in 2010 by application of the Kyoto mechanisms and to the projected reduction of the non-CO_2 emissions.

5.3.2 CH_4 emissions and reductions

Table 5.2 shows the projected CH_4 emissions (in mln kg) in the *Reference Scenario* and the *Additional Policy Scenario*. Projected emission reductions in both scenarios are described in the *update of the NC2* (see Box 5.2).

Table 5.2 CH_4 emissions (in million kg) in the Reference and Additional Policy Scenario in the period 1990-2020.

IPCC category	Target group	Historical emissions			Reference Scenario					Additional Policy[2]		
		1990 actual	1990 scenario	1995 scenario	2000	2005[1]	2010	2015[1]	2020	2000	2005[1]	2010
1A2; 2	Industry	9	7	8	8	10	11	12	12	8	10	11
1A3	Transport	8	8	6	6	7	7	8	8	6	7	7
1A4b	Households	17	17	18	16	16	16	16	16	16	16	16
1B2; 1A1	Energy sector	180	181	178	128	101	74	59	43	128	101	74
4; 1A4c	Agriculture	507	507	479	440	399	358	347	335	440	399	358
6	Waste management	568	562	479	363	271	179	120	61	363	271	179
7; 1A4a	Other	3	10	5	6	7	7	7	7	7	7	7
	Total	**1292**	**1292**	**1173**	**967**	**811**	**652**	**569**	**482**	**967**	**811**	**652**
	Natural emissions	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**	**125**

1 *Data for 2005 and 2015 are interpolated values.*

2 *The policy effects for 2015 and 2020 have not been estimated in the Climate Policy Implementation Plan.*

Sources: RIVM 1997, ECN/RIVM 1998, VROM 1999, RIVM 2001

Table 5.3 N_2O emissions (in million kg) in the Reference and Additional Policy Scenario in the period 1990-2020.

IPCC category	Target group	Historical emissions			Reference Scenario					Additional Policy[2]		
		1990 actual	1990 scenario	1995 scenario	2000	2005[1]	2010	2015[2]	2020	2000	2005[1]	2010
1A1	Energy sector	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.1	0	0	0
1A3	Transport	5	5	7	11	9	6	7	7	11	7	3
2; 1A2	Industry	32	32	32	33	35	36	38	39	33	35	36
4	Agriculture	22	22	28	26	24	21	20	19	24	22	20
3; 6; 1A4	Other	1	1	1	1	1	1	1	1	1	1	1
7	Polluted surface water	4	4	4	4	4	4	4	4	4	4	4
	Total	**64**	**64**	**72**	**75**	**72**	**68**	**69**	**70**	**73**	**69**	**64**
	Natural emissions	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**	**2**

1 Data for 2005 and 2015 are interpolated values.

2 The policy effects for 2015 and 2020 have not been estimated in the Climate Policy Implementation Plan.

Sources: RIVM 1997, ECN/RIVM 1998, VROM 1999, RIVM 2001

No specific supplemental policy to the *Reference scenario* is defined in the NCPIP. However, it should be noted that one of the measures announced in NEPP3 (i.e. restructuring of pig farming) was not implemented. In the *update of the Second National Communication*, this had an estimated effect of reducing CH_4 emissions by 57 mln kg (1.3 Mton CO_2 eq.).

As described in Chapter 4, the non-CO_2 reduction programme examines several emission reduction options for the waste, agriculture and energy sectors. If these studies show that reduction options can be implemented at an acceptable cost, they will be considered during intermediate evaluations of the NCPIP.

5.3.3 N_2O emissions and reductions

The *Reference Scenario* and *Additional Policy Scenario*, as described in the *Update to NC2*, are still valid (see Box 5.2). New developments are also included:

- By 2010, N_2O emissions from the agricultural sector will fall (in the *Additional Policy Scenario*) by around 1 million kg N_2O (0.3 Mton CO_2-eq.) as a result of introducing the mineral registration system MINAS. As described above, the restructuring of pig farming, as described in the NC2 update, has not been implemented.
- In addition, one specific measure is announced in the Climate Change Policy Plan, which accounts for around 1.5 - 3 million kg N_2O (0.5 -1 Mton CO_2-eq.). As described in Chapter 4, one initiative began making an inventory of N_2O emissions from road traffic. The results will be discussed at EU level, aiming at strengthening EU emission standards for N_2O from catalytic converters.

Box 5.3 Key assumptions in the *Reference Scenario* for HFCs, PFCs and SF_6.

- Pre-Montreal Protocol demand increases as envisaged in the European Renaissance scenario (with high energy prices).
- Implementation of the 1990 version of the Montreal Protocol: the use of CFCs, halons and carbon tetrachloride (CTC) in the Netherlands is halted in 1995. The use of HCFCs in 2015 is zero.
- Implementation of existing regulations in the Netherlands for leakage control in stationary refrigeration (VROM, 1995).
- In the period 1995-2020, CFCs, halons and methyl chloroform (MCF) are mainly replaced by HCFCs. However, in 2000 about 9% is replaced 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 in 2000 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.

Sources: RIVM 1997 a, b

Table 5.4 Emissions and projections of HFCs, PFCs and SF_6 in mln kg and mln kg CO_2 eq. in the Reference and Additional Policy Scenario in the period 1990-2020.

IPCC	Compound	Historical emissions			Reference Scenario					Additional Policy[2]		
		1995 actual	1990 scenario	1995 scenario	2000	2005[1]	2010[1]	2015[1]	2020	2000	2005	2010
2E	HFC-23	536	410	540	279	289	299	308	318	63	73	83
2F	HFC-125	24	20	20	29	50	71	91	112	29	23	17
2F	HFC-134a	262	30	164	688	1073	1458	1842	2227	688	746	804
2F	HFC-143a	9	5	5	29	147	265	383	501	29	121	212
2E	Other HFCs	26	25	25	314	1058	1798	2540	3280	314	236	158
2C	PFCs	269	330	330	371	390	410	429	448	371	267	162
2F	SF_6	8	58	61	68	75	82	88	95	68	75	82
	Total [mln kg]	**1133**	**878**	**1145**	**1780**	**3081**	**4382**	**5683**	**6984**	**1562**	**1541**	**1518**
	Total [mln kg CO_2 eq.]	**8765**	**8500**	**10300**	**8900**	**10200**	**13700**	**17600**	**21400**	**6400**	**6150**	**5900**

1 Data for 2005, 2010 and 2015 have been interpolated.

2 The policy effects for 2015 and 2020 have not been estimated in the Climate Policy Implementation Plan.

Sources: RIVM 1997, ECN/RIVM 1998, VROM 1999, RIVM 2001

5.3.4 Emissions and reductions of HFCs, PFCs and SF_6

The *Reference Scenario* for HFCs, PFCs and SF_6, as described in the *Update to NC2*, has not been changed (see Box 5.3). It should be noted that, due to uncertainties in emission and reduction data for 'other HFCs', only the group totals are mentioned in the table.

Several measures concerning F-gases will be implemented according to the NCPIP (see also Chapter 4):

- adjustments in the production process of primary aluminium, leading to PFC emission reductions of some 178 ton (around 1.2 Mton CO_2-eq.) by 2010. These adjustments have been introduced with one company (already included in the *Reference Scenario*) and are now also targeted for a second company;
- installation of an afterburner at the companies producing HCFCs, reducing the HFC-23 emissions by up to 90%, or 2.5 Mton CO_2-eq. by 1999 (a reduction of 50% was already included in the *Reference Scenario*);
- reduction of HFCs and PFCs as alternatives for (H)CFCs and halons, accounting for around 4 Mton CO_2-eq. reduction in 2010 compared to the *Reference Scenario*.

5.3.5 Emissions of Ozone Precursors and SO_2

SO_2 emissions have dropped considerably since 1990 due to environmental policies such as fuel shifts and reducing the sulphur content in fuel. In the *Additional Policy Scenario*, reductions will be achieved mainly by ongoing fuel shifts and further reductions of sulphur contents.

NO_x emission reductions are mainly due to (European) emission standards for the transport sector and large combustion plants. Stricter standards for the transport sector (Euro IV, Euro V) lead to further reductions, as included in the *Additional Policy Scenario*. This scenario also encompasses low-NO_x burners and SCR in all relevant sectors. Energy savings also contribute to NO_x emission reductions.

Table 5.5 Summary of projections of emissions of CO, NO_x, NMVOC and SO_2 in mln kg in the Reference and Additional Policy Scenario in the period 1990-2020.

Compound	Emissions			Reference Scenario (with measures)					Additional Policy Scenario				
	1990 actual	1990 scenario	1995 scenario	2000	2005[1]	2010[1]	2015[1]	2020	2000	2005	2010	2015	2020
CO	1139	1058	885	665	600	534	513	492	NA	NA	NA	NA	NA
NO_x	563	580	490	448	419	390	402	414	421	345	270	265	260
NMVOC	500	500	368	267	250	233	241	250	281	235	189	191	192
SO_2	193	202	142	94	93	92	95	97	91	78	65	65	65

1 Data for 2005, 2010 and 2015 have been interpolated.

Source: RIVM, 2000

Table 5.6 Total emissions in mln kg CO_2 equivalents in the period 1990-2020.

Compound	**Historical emissions**			**Reference Scenario (with measures)**					**Additional Policy**[2]		
	1990 actual	1990 scenario	1995 scenario	2000	2005[1]	2010[1]	2015[1]	2020	2000	2005	2010[1]
CO_2	161	161 [3]	177 [3]	189	198	207	220	233	183	187	190
CH_4	27	27	25	20	17	14	12	10	20	17	14
N_2O	20	20	22	23	22	21	21	21	23	21	20
Subtotal	**208**	**208**	**224**	**232**	**237**	**242**	**253**	**264**	**226**	**225**	**224**
HFCs	5	5	7	5	6	9	13	16	2	3	3
PFCs	2	3	2	3	3	3	3	3	3	2	1
SF_6	0	1	1	2	2	2	2	2	2	2	2
Subtotal	**8**	**9**	**10**	**9**	**10**	**14**	**18**	**21**	**6**	**6**	**6**
Total [CO_2 eq.]	**216**	**217**	**234**	**241**	**247**	**256**	**271**	**285**	**232**	**231**	**230**

1 Data for 2005, 2010 (for F-gases) and 2015 are interpolated.

2 The policy effects for 2015 and 2020 have not been estimated in the Climate Policy Implementation Plan.

3 Not corrected for the temperature.

NMVOC emissions are expected to fall by 50% between 1995 and 2010 due to stricter emission standards as result of a NMVOC programme.

5.3.6 Total CO_2 equivalent emissions

Table 5.6 shows the total emissions of greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) in CO_2 equivalents, based on the GWP for a 100-year time horizon. Compared to the base years, the projected emissions in 2010 in the *Additional Policy* scenario will be around 5% higher. In order to meet the emissions reduction objective of -6% in the first commitment period, an additional reduction of 11% (25 Mton CO_2 equivalents) will be achieved via the Kyoto mechanisms (JI, CDM and emissions trading).

Figure 5.1 illustrates the total greenhouse gas emissions in the Netherlands up to 2010 in the *Reference Scenario* and *Additional Policy Scenario*. The latter is derived by subtracting the effect of all domestic measures as described in the NCPIP from the *Reference Scenario* (adding up to 25 Mton CO_2-eq. in 2010). This figure also shows the effect of using the Kyoto mechanisms (also 25 Mton CO_2-eq.).

Finally, the figure shows the actual emissions development over the period 1990-1999. Greenhouse gas emissions increased up to 1996 and then fell during the period 1997-1999. The latter is mainly the effect of falling CO_2 emissions. The steep drop in 1999 was caused by the much higher import of electricity related to the liberalisation of the electricity market. As emissions figures in the

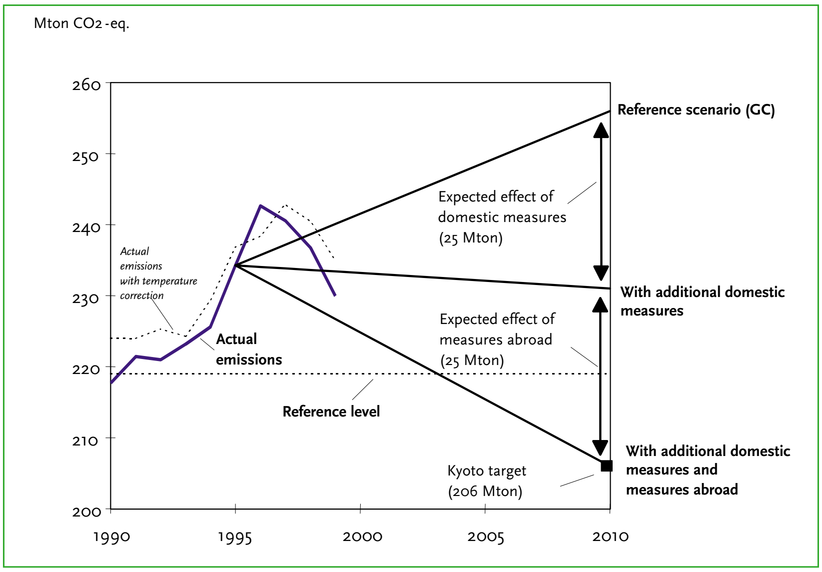


Fig. 5.1 Projected GHG emissions according to the National Climate Policy Implementation Plan in the period 1990-2010.

Source: VROM, 1999 (updated)

Table 5.7 Emissions reduction in 2010 in Mton CO_2-eq. according to the NCPIP and the assessment by the national research institutes ECN/RIVM.

Measure	Climate Policy Implementation Plan	Assessed as 'hard' by ECN/RIVM	Assessed as 'soft' by ECN/RIVM
CO_2			
Different measures aimed at energy saving in traffic	2.2-2.9	1.3	0.7
Energy efficiency industry	2.3	1.3	1.0
Energy savings in greenhouse horticulture	2.0	1.5	0.5
Energy efficiency existing houses	2.0	1.0	1.0
Energy efficiency existing non-residential buildings	1.0	0.7	0.3
Energy efficiency appliances	0.3	0.6	0.0
Measures at coal-fired power plants	6.0	0	6.0
5% renewable energy in 2010	2.0	0.8	1.2
Accelerated afforestation	0.1	0.1	0.0
Other greenhouse gases			
Reduction of the use of HFCs, PFCs and SF_6	4.0	4.0	0.0
Reduction of PFCs from aluminium industry	1.2	1.2	0.0
Reduction of HFCs from processes	2.5	2.5	0.0
Reduction of N_2O from catalytic converters in cars	0.5	0.0	0.5
Total	**25**	**15**	**11**

Source: ECN/RIVM, 1999

Netherlands climate policy are corrected for temperature, these figures are also shown as a dotted line.

5.4 Assessment of aggregate effects by national research institutes

5.4.1 Assessment of NCPIP

In September 1999, shortly after the government published the NCPIP, the national research institutes ECN and RIVM published a critical assessment of the expected effect of the policies proposed in the plan (ECN/RIVM 1999). The institutes stated that, of the measures published in *NCPIP part 1* (the 25 Mton domestic reduction target) approximately 15 Mton was 'hard', i.e. could be expected to be realised by the policy instruments presented in the plan. However, the assessment also indicated that realisation of the other 10 Mton was uncertain, either because extra policy instruments were necessary or because the effectiveness of the policy instruments chosen was, as yet, unclear.

Table 5.7 summarises the emission reductions of the basic NCPIP package according to the plan itself and the assessment by ECN/RIVM (in Mton CO_2 equivalents). The main measures that ECN/RIVM considered to be 'soft' are the proposed voluntary agreement with the owners of the coal-fired power plants, part of the 5% renewable energy goal for 2010, part of the measures in the traffic sector, part of the energy efficiency improvement in the industry and part of the energy savings in existing buildings.

5.4.2 Updated Global Competition (GC) scenarios

In 2000, the RIVM published the *Fifth National Environmental Outlook*, which contains an analysis of the expected developments of the Netherlands greenhouse gas emissions up to 2030. No new economic scenarios were developed in this outlook. Instead, the existing long-term scenarios from the Long-Term Outlooks 1997 (CPB 1997) were used. RIVM extended the scenarios from 2020 to 2030 and updated them to cover new insights into emission factors as well as social and economic developments (see Box 5.4).

Greenhouse gas CO_2

To project the emissions of the greenhouse gases, the GC-scenario was again used as the main starting point. An uncertainty range was added to the projection of greenhouse gas emissions to reflect uncertainties in both exogenous developments and in policy implementation. The exogenous developments taken into account

Box 5.4 Summary of key variables and assumptions in the modified and expanded GC Scenario.

Variable	Updated GC values	Original GC values for 1995-2030 period	Unit/period for 1995-2010 period
Economic growth	3.1	3.3	%/yr
Industrial production	3.5	4.3	%/yr
Private consumption	3.3	2.9	%/yr
Population	0.3	0.4	%/yr
Housing units	0.8	1.3	%/yr
Households	0.8	1.0	%/yr
Passenger kilometers	1.8	0.9	%/yr
Tonne kilometers [1]	3.6	3.8	%/yr
Livestock population	0.3	5.5	%/yr
Oil price [2 3 4]	+50%	+65%	up to 2020 and 2010, respectively
Final energy use	1.2	1.6	%/yr
Savings final energy use	-1.4	-1.3	%/yr
Structure effect	-0.4	-0.6	%/yr
Growth of cogeneration [5]	+350%	+320%	up to 2030 and 2010, respectively

1 Road, rail and inland shipping
2 26 and 28 US$/bbl in 2020 and 2010, respectively.
3 Sharp liberalisation of the electricity markets, resulting in a lower price increase for bulk users.
4 Sharp liberalisation of the natural gas markets according to the proposal developed by the EU.
The policy link between natural gas and oil prices ceases to exist.
5 As a consequence of developments in energy price.
Source: Scenario Explorer / NEO 5

in the uncertainty range are the:

- development of energy use in the transport sector relating to fuel prices;
- development of CHP;
- the import of electricity;
- the volume growth of refineries;
- growth of electricity use in households and offices;
- developments in energy-intensive industries;
- developments in the greenhouse horticulture sector.

The climate policy assessed as ‘hard’ by ECN/RIVM was taken into account when assessing the main starting point. The measures considered by these institutes to be ‘soft’ (all CO_2 measures) were included in the uncertainty range. Figure 5.2 shows the results.

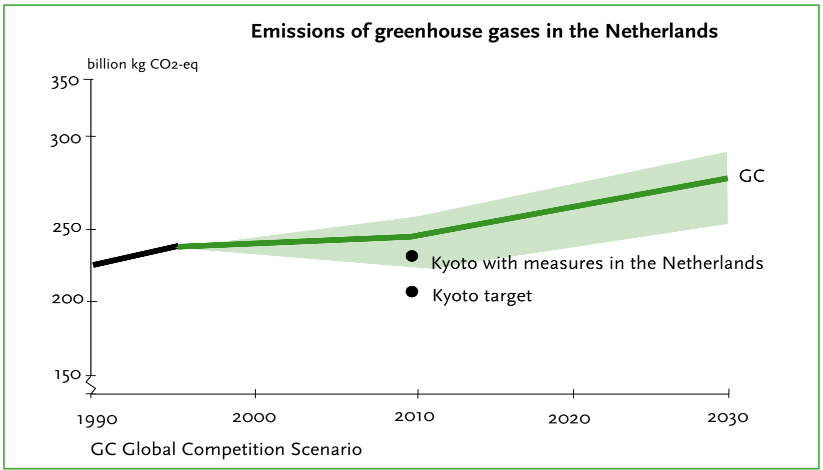


***Fig. 5.2** Emissions of greenhouse gases in the Netherlands according to the GC scenario with a bandwidth for uncertainties in policy and social developments in the period 1990-2030.*

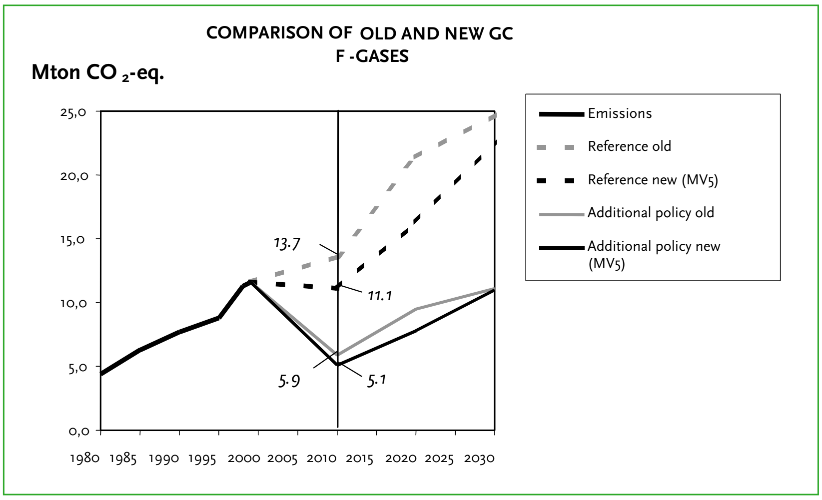


Fig. 5.3 Projected emissions for F-gases in Mton CO_2-eq. in the period 1990-2030; old and new Reference scenario compared.

Non-CO_2 greenhouse gases

In the *Fifth National Environmental Outlook*, only emissions and projections for HFCs, PFCs and SF_6 have changed. The previous (fourth) Outlook and the NCPIP used an old scenario for F-gases, the *European Renaissance* (ER) scenario, since the original GC-scenario did not provide projections for these gases. The ER scenario for F-gases was updated in the fifth Outlook, using the results of several studies and actual emission reports. As a result, the calculated effects of measures relating to F-gases also had to be updated. The resulting main differences between the old and new projections, as well as the calculated effects of policies, are indicated in Figure 5.3. These reasons include:

- growth rates for F-gases are linked to the growth rate for industrial production. The ER scenario used lower economic growth than the GC scenario (1.5-1.9% and 3.1.% respectively;
- the leakage rates for stationary refrigeration were newly assessed at 10% (in 2000) decreasing to 4% (after 2005). The old ER scenario used 17%;
- a higher percentage of cars have air-conditioning - this is now made compatible with the assumptions in the GC scenario;
- the ER scenario assumed that (H)CFCs in closed foam blowing would be fully replaced by HFCs. The updated scenario assumes that alternatives such as pentane, would be used, except for applications for which no HFC alternatives exist;
- new (confidential) data on emissions as a result of producing semi-conductors was provided by companies;
- the updated scenario assumes that both aluminium production plants will be closed by 2005; the old scenario assumed that one plant would remain open in 2005;
- new monitoring data became available for better assessment of SF_6 emissions. Only potential emissions were previously reported.

5.4.3 New projections in the biennial reference outlook

Since the GC-scenario was published in 1997, many developments relevant to the Netherlands greenhouse gas emissions have diverted from the expectations and assumptions. Important examples are:

- reduced growth of the energy-intensive industry and the greenhouse horticulture sector;
- more imported electricity;
- a deteriorating situation for CHP.

Furthermore it should be noted that, since the ECN/RIVM assessment into the effects of the NCPIP, progress has also been made on implementing the 'soft' measures, i.e.:

- a (principle) agreement has been reached between the government and the owners of the coal-fired power plants;
- the liberalisation of the market for 'green' electricity was announced as from July 1, 2001;
- additional financial incentives for CHP have been made available;
- new (as yet unpublished and not yet verified/validated) insights into the emissions of some sectors have become available, e.g. for N_2O emissions from the produc-

tion of nitric acid, HFC emissions from mobile sources and N_2O emissions from catalytic converters.

To gain a better insight into the effects of all these developments on the emissions of greenhouse gases in 2010, the government has commissioned a study by ECN, RIVM and CPB, entitled *'Reference Outlook Energy and Greenhouse Gases 2001-2010'*, which will be updated every two years. The results of the first *Reference Outlook* will be available by the end of 2001 and will be an important input for evaluating climate policy in 2002, as announced by the government when publishing the NCPIP. This evaluation should be available when this *Third National Communication* is reviewed.

5.5 Methodology

Basic construction of scenarios

Scenarios for CO_2 and other greenhouse gas emissions are constructed by projecting volume trends (in activity data , AD) and trends in corresponding emission factors (EF) (RIVM, 2001b). Thus, the basic formula to estimate future emissions is:

$$\textbf{Emission}_{\text{source S, compound C}}\ \textbf{(year t)} = {}_{\text{AD source S}}\ \textbf{(year t)} * \textbf{EF}_{\text{S,C}}\ \textbf{(year t)}$$

This formula is used at all relevant sub-classification levels of production sectors and consumption categories, adding up to total production and consumption figures on a national scale. Volume trends are a function of economic, demographic, behavioural and structural variables, whereas emission factors are influenced by technological developments. Both, activities and emission factors can be affected by policy measures. RIVM's inventory of technological developments and their impacts is based on literature studies and on expertise. Prognoses up to 2020 mainly involve conventional technology.

To facilitate a consistent emission calculation for various compounds and sub-sources, the *Environmental Information and Planning Model* ('RIM+', Laan, Bruinsma et al, 1993 and 1996) of RIVM was used. This model consists of:

- a database with source data organised in a so-called *'process approach'*;
- a data maintenance module;
- a policy alternative definition module in which activity trends and policy measures can be defined and applied to specific sources in great detail;
- an emission scenario calculation module for performing emission calculations for a specific policy alternative. This essentially uses the formula mentioned above and totals all emissions from sub-sources.

In some cases RIM+ model calculations were supplemented with spreadsheet model calculations, e.g. for methane from landfills and for emissions from the use of F-gases; these are more complicated since they require integration of emissions originating from activities in past years (Spakman et al., 1997; Mathijsen and Kroeze, 1996).

To convert economic trends into material flows (i.e. value added in an industry sector into physical production such as steel production), material intensity factors and trends herein are calculated with the STREAM model of the CPB (Mannaerts, 1995 and 2000).

Inclusion of energy in the scenarios

Autonomous social developments are reflected in growth series for activity data (industrial production, passenger-km, livestock numbers, etc.). These developments result in turn in a demand for energy, including non-energy-use of fuels (e.g. feedstock). Efficiency improvements also play an important role. These are modelled, based on assumptions about developments in energy prices and the incentive these produce for investing in energy conservation. Subsequently the energy supply is modelled.

Scenario data for energy consumption and production were generated through the NEMO (Koopmans et al., 1999; Koopmans and Te Velde, 2000) model from the CPB and the SAVE model from ECN (Boonekamp, 1994). Also the energy supply model SELPE by ECN is used; this takes into account the effect of environmental and energy policies. NEMO and SAVE were originally designed to project energy use and energy efficiency improvement with economic key parameters and energy prices as input. The SELPE model was designed to model an appropriate energy supply system to a given energy demand. Several input parameters are used e.g. energy price (SELPE, 2001).

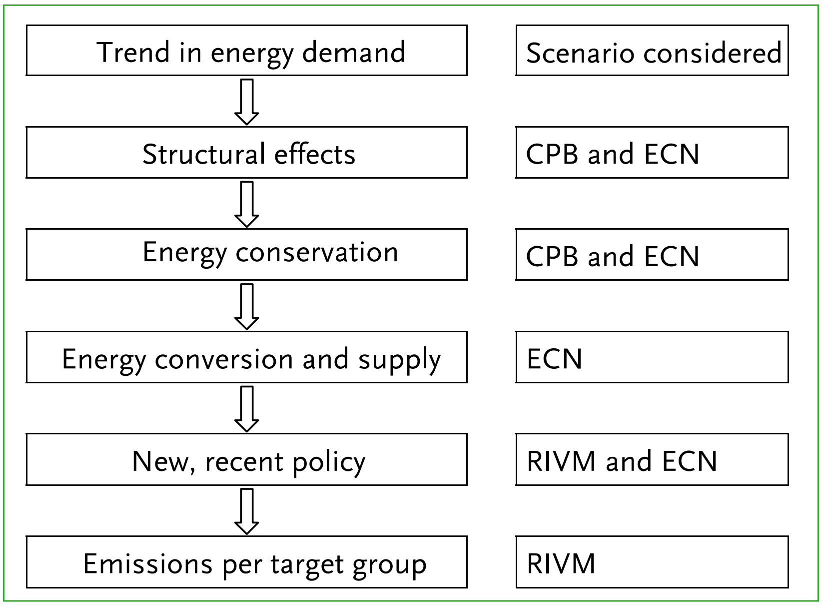


Fig. 5.4 Sequence of calculations and input of various institutes.

The trends in energy demand, structural effects and energy saving, are established within a scenario through an iterative process between CPB (NEMO) and ECN (SAVE). These two models are complementary: NEMO is a top-down model and SAVE a bottom-up model. These type of models are more or less complementary and thus 'balance' to a large extent the inherent strengths and weakness. Energy consumption in the SAVE model is assessed from economic parameters in an econometric way. The SAVE model applies global demand-price-curves and price elasticity parameters. These parameters are derived from cost curves for energy saving measures. Energy demand is modelled in a straightforward way. Energy-saving measures are 'switched on' in this model based on their cost-effectiveness, the latter depending on energy prices. Data on price elasticity (from NEMO) and on cost curves (from SAVE) are obtained from scientific research by universities and research institutes.

ECN models the energy supply using the SELPE model, paying special attention to energy conversion technologies and the fuel mix. Where applicable, RIVM adds new, recent policies to the scenario forecasts. These new policies may have an impact on all the aforementioned aspects. In recent years climate policy also includes measures relating to energy supply and non-CO_2 greenhouse gases. The chart below shows roughly the sequence of the calculations and the input of the various institutes for energy-related emissions.

Integration of policy effectiveness into the scenarios

The key assumptions in the GC scenario are described in Box 5.1. When modelling the scenarios, the effectiveness of the policies also has to be estimated. This is achieved for the various types of measures, as follows:

- *Taxes:* price elasticity is used as basis. This is established on a continuous basis through economic research. Schemes such as the EIA – and subsidies – have an effect on price or interest rate used and result in energy-saving investments.
- *Agreements* between the government and sectors of industry, are sometimes incorporated through a fictitious increase in the internal interest rate a company utilizes for making replacement investments. In principle, a company only makes economically justifiable investments. Long-term agreements provide an extra incentive.
- *Regulations* such as the energy performance standard (EPN) for new residential and other buildings are supposed to be implemented on a broad scale; this has implications for energy use, e.g. for space heating.

6 VULNERABILITY ASSESSMENT, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

6.1 Expected impacts of climate change

The possible consequences of climate change for the Netherlands, based on the IPCC's conclusions, have been identified in the KNMI's third climate report . This chapter focuses on two of the most urgent consequences of climate change for the Netherlands, namely its vulnerability due to rising sea levels and increased concentration in water flux through the rivers Rhine, Meuse and Schelde during winter. In contrast, less concentration in water flux is expected during summer, which could cause problems for inland shipping.

The geographical location of the Netherlands makes it highly susceptible to rising sea levels and related changes caused by extreme weather and hydrological conditions. The total outer coastline of the Netherlands is 350 km long, 300 km of which consists of dunes and beaches, while the remainder is protected by dykes and dams. The densely populated and industrialised delta of the rivers Rhine, Meuse and Schelde is protected against high floods by dykes. Part of the coastal zone consists of the Wadden Sea, which is a wetland area of great natural value (at international level), the morphology of which is, by definition, sensitive to changes in sea levels and water-flow patterns.

The natural coastline faces structural erosion due to the current rise in sea levels of approximately 20 cm per century, as well as from human interference. Water and sediment is exchanged between the North Sea and Wadden Sea through a number of tidal inlets. As a result, the sediment budget of the North Sea shores is directly related to that of the Wadden Sea (RWS, 1994). The Wadden Sea is a sink for sediment, partly because the current rise in sea levels induces sedimentation in the tidal basins. Sediment is eroded from the North Sea shores and deposited in the Wadden Sea.

The Wadden Sea is a shallow tidal sea, sheltered from the North Sea by barrier islands. Changes in the morphology within the Wadden Sea are part of the normal dynamics and are not affected by the current sea-level rise. Any increase in the rate of sea-level rise would lead to extra sediment being deposited in the tidal basins. An increase in the rate of sea-level rise (up to 50-70 cm per century) will not have a profound effect on its morphology. However, increases beyond this level may eventually lead to changes in the morphology of the tidal basins. Furthermore, an increasing number of storm surges is a threat to the salt marshes in the Wadden Sea (Brinkman, 2001), particularly the surface area of intertidal flats will decrease in favour of sub-tidal flats, which will, in turn, affect the ecology of the Wadden Sea. Given the slow response of the morphology to an increase in the rate of sea-level rise the effects will only be visible after 50-100 years. Again, the most profound effect of such a high rate of sea-level rise will be increased erosion on the shores of the barrier islands.

6.2 Vulnerability Assessment

A recent evaluation of the current policy of 'dynamic preservation' of the Netherlands coastline was made in 2000 (RWS coastal policy, 2000). This policy was implemented in 1990 and aims to combat the structural erosion of the coast, which is currently safe from flooding. However, as a result of climate change, such as accelerated sea level rise and heavier storms, stronger and wider dunes and dykes will be needed in the future. The present *Coastal Defence Policy* anticipates these changes by reserving space for these needs and by preventing, where possible, the building of fixed structures in these areas. A benefit of this policy is the availability of more room for natural processes in the coastal zone.

The Netherlands also supports general activities that contribute to vulnerability assessment both in the Netherlands and abroad. Many of these activities relate to coastal zones. Examples include:

- the research contributions to the *International Project Office of the International Geosphere-Biosphere Programme* (IGBP) core project on Land-Ocean Interactions in the Coastal Zone (LOICZ) and the

[1] Source: NRP

Coastal Zone Management Centre of the Netherlands (CZM-C). CZM-C helps a.o. to implement regional documents of the *Global Water Vision*, as presented at the 2nd *World Water Forum* in The Hague in March 2000 (see Chapter 8 for more details);
- assisting developing countries, e.g. via the Netherlands Climate Change Studies Assistance Programme (NCCSAP) (see also Chapter 7).

Finally, an integrated assessment of vulnerability to climate change and adaptation options is being developed as a part of the *National Research Programme* (NRP) on *Global Air Pollution and Climate Change* ('NRP-Impact', see Chapter 8). This project will provide an overview of climate change impacts on several economic sectors, human health and natural systems, and subsequently develop a set of adaptation options for the Netherlands.

In addition to rising sea levels and flooding from rivers, also further consequences are being investigated by the NRP. Groundwater is possibly becoming brackish in the coastal zones, due to rising sea levels. This is considered to be a threat to drinking-water supply and agricultural activities. Furthermore, tourism could profit from the expected rising temperature, especially in coastal areas, but storms could diminish these advantages. Forests, ecosystems and agriculture can adapt to more southern species, but possibly at the expense of current species. Finally, threats examined include forest fires, epidemics and higher insurance rates due to the increasing number of extreme weather phenomena.

6.3 Adaptation measures

As a result of the *Coastal Defence Policy* the loss of material in the zone between minus 7 m and plus 3 m will be compensated for by nourishment on the beach and, if possible, in the shallow-water zone. Besides this the total coastal system (the area between minus 20 m and plus 3 m) is also losing material, with total losses estimated to be double the loss in the shallow zone. This loss will also be compensated for. As a result of an increased relative sea-level rise scenario of 60 cm per century, the amount of sand needed will increase by 30%.

A commission was appointed after the extreme discharges and related risks of inundation by the rivers Rhine and Meuse. This group advised the government to further anticipate future developments in climate, ground subsidence, population and economic values, rather than responding to individual incidents, and also to develop spatial measures for the water systems (RWS water, 2000). The government took this advice and concluded that safety must be guaranteed and the chance of flooding may not increase. A good mix of spatial and technical measures should be applied, with a preference for spatial measures. These spatial measures include widening riverbanks and deploying water storage and retention areas. Being strongly dependent on upstream activities, trans-boundary cooperation is also taking place with the other countries in the catchment area, to implement necessary measures.

The main features of governmental policy are:
- to stimulate public awareness of the problems and risks relating to water;
- a new approach to safety and flooding based on the following three principles:
  a) to anticipate instead of reacting;
  b) not to transfer water management problems to others by following a three-stage strategy: holding, storage and removal;
  c) implement more spatial techniques;
- new investments in water management of national and regional water systems.

Furthermore, the safety characteristics of all dykes and other protecting infrastructure are reviewed every five years. The relevant criteria and boundary conditions develop over time, partly due to the consequences of e.g. climate change and changes in land use.

7 FINANCIAL ASSISTANCE AND TECHNOLOGY TRANSFER

7.1 Introduction

The Netherlands recognises the need to assist developing countries and countries with economies in transition, not only to comply with its own obligations under the Framework Convention on Climate Change but also to enable these countries to develop effective strategies to mitigate climate change and adapt to the adverse effects thereof. This chapter gives an overview of the Netherlands assistance in this respect.

7.2 Resources and targets

Provision of resources (new and additional)

The Netherlands government has decided to set its Official Development Assistance (ODA) budget at 0.8% of GNP, including expenditures for assistance in the field of environment based on the principles of Agenda 21. A sum amounting to 0.1% of GNP has been earmarked for such expenditures since 1997. The 0.1% target was met in 1998, 1999 and 2000, thus carrying out the Rio commitment to make available new and additional means on top of regular development assistance budgets. The quantifiable targets that determine the course of development cooperation policy, also include the 0.2% allocation for assistance to the least developed countries and a minimum of € 46 million per annum for assistance in sustainable management of tropical rainforests.

The Netherlands also lives up to the target, as agreed in the Rio Declaration, to make available 0.7% of its GNP as ODA. Table 7.1 gives an overview of all environmental expenditures within the ODA. These financial resources are made available through a combination of multilateral, bilateral and non-governmental channels.

For technical reasons it is not yet possible to single out assistance involving mitigation and adaptation to climate change from many development assistance projects and programmes. The Netherlands and OECD partners are currently developing a set of 'markers' that will allow them to distinguish between climate-related funding and other environment-related funding, and to distinguish between funding for mitigation and for adaptation.

Table 7.1 Breakdown of environment-related expenditures within Official Development Assistance in € million.

Expenditures (million €)	**1997**	**1998**	**1999**	**2000**
Multilateral institutions				
GEF/ Montreal fund	7.3	7.3	8.5	9.7
UNEP	0.9	0.9	1.2	2.1
UNFCCC		0.2	0.2	0.2
Desertification Treaty			0.1	0.1
IFAD (10%) [1]	0.3	0.6	0.7	0.6
World Bank partnership (30%)		2.5	20.4	8.9
UNDP (20%)	15.4	15.0	14.1	15.0
European Development Fund (5%)	3.4	6.5	4.0	5.4
International Development Association (10%)	16.5	20.3	23.1	15.9
Regional development banks and funds (5%)	2.0	2.7	2.7	2.0
Environmental programmes				
Country programmes	120.9	128.9	126.9	169.3
Miliev programme	13.9	32.2	39.6	36.3
Education	0.9	0.9	0.9	0.9
Other (5-15%)	115.5	121.7	118.5	140.1
Environment total	**296.8**	**339.7**	**360.8**	**406.4**
ODA total	**2,760.0**	**2,919.4**	**3,126.3**	**3,465.8**
GNP (x 1000)	**323.5**	**344.3**	**372.5**	**407.5**
Environment as % of GNP	**0.09%**	**0.10%**	**0.10%**	**0.10%**

[1] The percentages in brackets indicate the proportion of environment-related expenditures within the total contributions.

Focus (countries and topics)

The Netherlands has longer term development cooperation programmes with Bangladesh, Burkina Faso, Bolivia, Egypt, Eritrea, Ethiopia, Ghana, India, Indonesia, Macedonia, Mali, Mozambique, Nicaragua, Palestinian Authority, Sri Lanka, South Africa, Surinam, Tanzania, Uganda, Vietnam, Yemen and Zambia. From these countries, Mozambique, Ghana, India, Sri Lanka, Macedonia, Surinam and Vietnam decided, in consultation with the Netherlands, to have a special focus in the bilateral cooperation programme on environment. For the other countries the cooperation on environmental issues results from cooperation concerning aspects such as water management, rural development, agriculture and health.

In addition to these longer term development cooperation programmes with the aforementioned countries, the Netherlands cooperates with a number of countries on environmental issues: Brazil, Cape Verde, China, Colombia, Ecuador, Guatemala, Mongolia, Nepal, Pakistan, Peru, the Philippines and Senegal. Cooperation also exists with Benin, Bhutan and Costa Rica on the basis of Sustainable Development Treaties.

Climate programme

In view of the need for a structural approach to the climate issue, the Netherlands Development cooperation has set up a structural climate programme, anchored in the Convention on Climate Change and its Kyoto Protocol, compatible with existing Netherlands development cooperation policy. The programme aims to support countries planning to formulate and implement their own climate change policy. In consultation with, and at the request of, developing countries mentioned above, they will receive support in:

- building the capacity and developing the institutions required for formulating and implementing climate policy, including (in some cases) for participating in CDM;
- contributing towards limitation of greenhouse gas emissions;
- adapting to the adverse effects of climate change.

These three themes are elaborated further in Sections 7.3, 7.4, and 7.5 respectively.

7.3 Assistance in preparing National Communications

National Communications are essential for the coordination of international climate policy. The *Netherlands Climate Change Studies Assistance Programme* (NCCSAP) was launched in 1996. This programme aims to help developing countries to prepare their National Communications and to undertake capacity building, education and training activities. Assistance has been provided to many countries (see also Tables 7.2 and 7.4).

Under a previous programme, Bangladesh, Egypt, Nicaragua and Vietnam were assisted in the field of coastal zone management in relation to climate change. In particular, the Netherlands assisted in preparing the

Table 7.2 Overview of the inventory and mitigation studies undertaken in the NCCSAP countries and the assistance provided in preparing National Communications.

Country	GHG emissions		Policy
	Emission Inventory	Mitigation	National Communication
Bolivia	•	•	•
Costa Rica			•
Ghana			•
Kazakhstan*	•		•
Mongolia*		•	•
Senegal			•
Surinam	•		
Yemen			•
Zimbabwe		•	

* Preparation of national action plans or other policy documents.

National Communications of Bolivia, Costa Rica, Ghana, Senegal and Yemen (see Table 7.2). In the period 1996-2000, € 4.7 million was made available through the NCCSAP. Approximately half related to vulnerability and adaptation studies and the rest to emission inventories, mitigation studies and the preparation of policy documents.

7.4 Assistance for mitigation

7.4.1 Introduction

The Netherlands is actively engaged in providing assistance for mitigation activities in the developing countries and in the Central and Eastern European countries. Such activities mainly occur in the energy, transport, industry, agriculture and forest management sectors. The Netherlands' mitigation programme focuses on ensuring that investment projects in the aforementioned sectors are climate friendly. The Netherlands also supports developing countries in acquiring climate-friendly technology and know how. This will be elaborated in the following sections.

7.4.2 Multilateral and bilateral assistance, including assistance to Central and Eastern Europe

The Netherlands contributes to a variety of multilateral and intergovernmental institutions that assist developing countries. These include institutions with global coverage as well as regionally oriented institutions and, where appropriate, non-governmental organisations. In the period 1997-2000, the Netherlands government also contributed € 8.2 million per year (on average) from the development cooperation budget as contribution to the *Global Environment Facility* (GEF), as operating entity of the financial mechanism of the Framework Convention on Climate Change.

Developing countries

The energy sector plays a major role in mitigating greenhouse gases. The main goals of the Netherlands development cooperation in the energy sector are:
- in the short term: poverty alleviation and improving energy-related living conditions;
- in the medium term: reduction of natural resources depletion and degradation of the local environment;
- in the long term: reducing the threat of climate change.

Examples of successful projects to which the Netherlands has contributed include:
- solar energy projects in Senegal, Bolivia and Philippines;
- the Asia Alternative Energy Programme (with the World Bank and other donors);
- the Renewable Energy and Energy Efficiency Fund (led by IFC);
- the Indian Renewable Energy Development Agency Limited (founded by the Indian government);

Box 7.1 Options for action in the development programmes.

Important options for action in the development programmes are:

- Pricing of energy: energy services should reflect marginal costs.
- Management of technological innovation: increase energy efficiency, substitution of fossil fuels, capacity building and technology transfer.
- Solar energy: especially for lighting and communication.
- Wind power: policy formulation, feasibility studies, contributing to investments.
- Strengthening of energy agencies: establishment of agencies, strengthening managerial capacities, stimulation of R&D and provide funding for demonstration programmes on energy efficiency and renewable energy.
- Rural electrification, the most relevant area within the utility sector due to its contribution to decreasing poverty, in particular by narrowing down rural-urban differences.
- Biomass, being the energy source of the rural and urban poor. However, the very resource base of biomass is under threat. This leads to higher prices, land erosion and a reduction in forest areas. Options for action include rationalisation of biomass fuel through sustainable forest management by local communities and agro-forestry supported by adequate policy measures at national level. This will ensure a more sustainable exploitation of forests and, as a result, a more uniform supply of biomass at realistic prices.

- the Regional Programme for the Traditional Energy Sector (under the auspices of the World Bank) and the Regional Wood Energy Development Programme (implemented by FAO).

Within the framework of the PSOM (Programme of Stimulation to Upcoming Markets) the Netherlands has initiated cooperation on energy and climate issues. This concerns in particular the stimulation of expertise at governmental level (capacity building) and the implementation of specific energy projects. PSOM contributed € 1 million to a photovoltaic (PV) solar energy project in Zimbabwe (1999), € 0.9 million to PV and biomass projects in Ghana and € 1.1 million to LPG and heating projects in China (2000). There is also a PSOM programme of cooperation with Indonesia that contributed € 0.7 (in 1999) and € 0.9 million (in 2000) to projects on water purification, public lighting and cooling technologies.

Central and Eastern Europe

The Netherlands has intensified cooperation with Central and Eastern European countries on energy and climate issues. To this end, it has built on the initiatives already developed, e.g.:
- continuation and intensification of the section on Energy and Environment of the *Programme of Eastern European cooperation* (PSO);
- support to 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 in 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.

The Supporting the *Cooperational Organisation of Rational Energy use* (SCORE) project was introduced to specifically help expand support for energy conservation in this region. SCORE is a society-to-society programme aimed at assisting the social transformation in the Central and Eastern European countries through projects and actions for improving environmental protection and energy end-use sectors. The programme has been implemented in Hungary, Latvia and Poland since 1997. The demand side of energy supply had priority here. The first step was an inventory of the conservation options. Subsequently, advice and training of local authorities on the 'no regret' options formed an important element of the project. In May 2000, the first phase of SCORE (preparation of a SCORE Country Document) started in two new countries, Bulgaria and Romania.

The *Energy and Environment Programme for cooperation with countries in Central and Eastern Europe* (PSO) was intensified for 1997 and beyond. PSO supports the transition of Central and Eastern European countries to market-oriented and sustainable economies. Under this programme the Netherlands government funds projects, assigned to Dutch companies, for the transfer of knowledge and expertise. Projects are currently being developed in Albania, Armenia, Azerbaijan, Bulgaria, Bosnia Herzegovina, Georgia, Croatia, Kazakhstan, Macedonia, Moldova, Montenegro, Ukraine, Russian Federation (Volga-region, Ural-region and North-West) and Romania. In 1997, 1998, 1999 and 2000 respectively € 10.8, 14.7, 15.0 and 18.7 million were spent on energy and environment-related projects (including Activities Implemented Jointly) within PSO.

7.4.3 Capacity building for mitigation

Under the pilot phase for Activities Implemented Jointly (Decision 5/CP.1) the Netherlands and partner countries have gained experience with joint activities to mitigate or sequestrate greenhouse gas emissions. In the period between 1996 and 2000 and within its *AIJ-Pilot Projects Programme*, the Netherlands have cooperated with a number of developing countries in an effort to build capacity in developing countries through learning-by-doing. The programme allowed authorities, private companies and institutions to acquire experience with this instrument, which facilitates emission reductions on the basis of nationally accepted development programmes. Until the programme was closed for new applications in 2000, the Netherlands has continued to implement pilot projects already identified, particularly those in Africa. A list of pilot projects under implementation is included in Table 7.3. The Netherlands has disbursed € 10 million for AIJ pilot projects, while another € 10 million have

Table 7.3 Overview of AIJ Pilot projects, funded by the Netherlands for capacity building purposes.

Country	Project	Status
Bangladesh	Improved Urban Waste Management	Initiated
Bolivia	Natural gas for power generation	Concluded
	LPG for urban transport	In preparation
	Energy saving lamps in Trinidad	In preparation
	Solid waste management	In preparation
Brazil	Charcoal from Babacu plant	In preparation
	Energy-efficient low-cost housing	In preparation
China	Energy-efficient greenhouses	In preparation
Costa Rica	Wastewater treatment in agro industry	Concluded
	Wind farm	Initiated
Honduras	Compact fluorescent lamps	Initiated
India	Biomass gasification for rural power supply	Initiated
	Improved diesel pump sets	In preparation
South Africa	Energy efficiency in the steel industry	Concluded
	Energy efficiency in low-cost housing	Initiated
	Mini-hydro for rural electrification	In preparation
Zambia	Energy efficiency in brick making	In preparation
Ghana	Efficient lighting in government buildings	In preparation
Senegal	Decentralised rural electrification	In preparation
Senegal	Energy efficiency in buildings	In preparation
Uganda	Bagasse waste for charcoal	Concluded
Vietnam	Biomass gasification	In preparation
Vietnam	LPG in taxis	In preparation

been allocated to over 20 projects. An extensive description of the AIJ-Pilot Projects Programme of the Netherlands is included in Annex B to this report.

As part of the *International Nature Policy Project* (PIN), support is given to developing 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 mitigating climate change. Under the programme substantial support has been given to a number of countries such as the Baltic Republics, the Ukraine, the Russian Federation and countries of West Africa.

7.4.4 Technology transfer for mitigation

The development cooperation policy in the *energy sector* recognises that in facing the threat of global warming, all countries, both 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. The Netherlands is thus engaged in 'greening the Energy Sector Portfolio of Multilateral Banks'. The Netherlands focuses on poverty alleviation by promoting and developing sustainable and affordable energy services for the poor, particularly in relation to the least developed and small island countries.

As part of this policy, the Netherlands, UNDP, the World Bank and the USDOE have developed the concept of FINESSE to contribute to the development of green energy for small-scale urban and rural users. This concept became operational in 1992 when the *World Bank* established the *Asia Alternative Energy programme* (ASTAE) to mainstream such energy in the Bank's portfolio. The Netherlands contributed € 6.2 million for five years (1995-2000) to the *African Development Bank* for expansion of its activities under the FINESSE concept. With the *Asian Development Bank* the Netherlands is in the process of establishing and contributing € 4.6 million to a Trust Fund to support the *Promotion of Renewable Energy, Energy Efficiency and Greenhouse Gas Abatement Programme*. The Netherlands has contributed € 8.1 million to a four-year Partnership Programme on Environment from 1999-2003, as a follow up to the Trust Fund established between 1993-1999.

The primary focus of sustainable land use and (agro)forestry projects is on sustainable rural development, without endangering local resources and biodiversity. However, projects and components can be directly or indirectly relevant to climate change. 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. Sustainable land use and forestry are very significant for the vulnerability and adaptation to impacts of climate change. For example, several forestry projects are supported (including the PIN programme mentioned above) to help capture and store CO_2. Some projects are also important for effective coastal zone management, such as those for mangrove forests.

7.4.5 Role of the private sector

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 an important role because ownership of these climate-friendly technologies generally lies with the private sector rather than with governmental or multilateral institutions.

The Netherlands stimulates the development of a favourable environment for the private sector to participate in the transfer of climate-friendly technologies to developing countries. The *Miliev Programme* is specifically developed to support initiatives by the Netherlands private sector to improve environmental conditions in developing countries through technology transfer. This programme supports the 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 from the climate change perspective, include wind generator projects and low-NO_x burner dissemination. The Miliev Programme has disbursed € 96 million in 1999. The programme facilitates the purchase of, inter alia, climate-friendly technology from the Netherlands by subsidising 60% of the costs, e.g. energy-efficient city buses have been transferred to Ethiopia, and windmills to China and India.
In order to stimulate investors to invest in green projects, the Netherlands introduced the concept of green certificates. If a company invests in a green project elsewhere it can acquire a green certificate which exempts it from paying taxes in the Netherlands as long as at least 70% of the funds for the investment originate from a Green Fund.

In 1996 the *Triodos Bank Group* established the *Solar Investment Fund* to finance intermediary organisations in selected countries to distribute solar home systems to individual users. This Fund had an initial capital of € 1 million, provided by the Minister of Development cooperation for the period 1996-1999. Four projects have so far been funded. The bank has now established the *Solar Development Group* and the *non-profit Solar Development Capital* to continue with such projects.

7.5 Assistance for adaptation

7.5.1 Introduction

The Netherlands also supports developing countries in their efforts to deal with the adverse effects of climate change, as elaborated in the following sections.

7.5.2 Multilateral and bilateral assistance for adaptation

The main potential vehicle for multilateral assistance for adaptation is the GEF, as these funds are currently used mostly for emission limitation and capacity building. A phased approach has been adopted for adaptation measures, which includes financing enabling studies, capacity building and institutional development.
Other multilateral channels (World Bank, Regional Development Banks) are also expected to pay increasingly more attention to adaptation, in response to expressed priorities of developing countries. Activities under bilateral assistance are described below.

7.5.3 Capacity building for adaptation

A number of countries have requested Netherlands' support in carrying out vulnerability assessments to climate change, with a focus on coastal zones as part of the adaptation measures. These 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 including climate change. Vulnerability assessments have been completed, with assistance from the Netherlands, in Bangladesh, Egypt, Poland and Vietnam in the period up to 1997. *The Coastal Zone Management Centre* (CZM-C) supports programmes, mainly in low-lying, vulnerable coastal areas, such as deltas and estuaries, in developing countries such as India, Bangladesh and Vietnam. Based on earlier contacts with Kazakhstan, Ukraine, Bulgaria and Romania, CZM-C is working out a new strategy for its activities in these regions. The coastal zone vulnerability studies were succeeded by the *Netherlands Climate Change Studies Assistance Programme* (NCCSAP), which was discussed in Section 7.3.

The *Netherlands Institute for Infrastructural, Hydraulic and Environmental Engineering* (IHE) provides education and training to advanced students from developing countries and from countries with economies in transition. This is focused on various aspects of water management, including coastal zone management.

7.5.4 Technology transfer for adaptation

The *Ministry of Transport, Public Works and Water Management* (V&W) has launched the Partners for Water programme 2000-2004, to stimulate Netherlands industry and educational institutes to invest in integrated water management and coastal zone management, taking into account the potential impact of climate change in developing countries and in the accession countries to the European Union. Some collaboration already exists within the framework of a foundation called the *Netherlands Water Partnership* (NWP), which focuses on capacity building and technology transfer. V&W will make available € 5 million per year to finance involvement in the foreign water sector.

7.5.5 Role of the private sector

As indicated above, the private sector is involved in many projects and programmes. One of these programmes is the NWP, a cooperation between the government and the private sector. This joint initiative strives for full use of existing Netherlands capacity in the water sector and cooperates with industry in investing in developing countries and countries with economies in transition. The NWP is an independent non-profit organisation, whose Board includes representatives from the public sector (central, provincial and municipal governments; knowledge and research institutes; water boards and non-governmental organisations) and the private sector, including water supply companies, consultancy firms, contractors, manufacturing industry and the banking sector.

Table 7.4 Overview of the vulnerability and adaptation studies undertaken in the NCCSAP-countries.

Country	Agriculture	Forestry, Natural areas	Coastal zones	Water Resources
Bhutan[1]	•	•		•
Bolivia	•	•		•
Colombia			•	
Costa Rica	•	•	•	
Ecuador			•	
Ghana			•	•
Kazakhstan		•[2]		•
Mali	•			•
Mongolia	•			
Senegal	•		•	
Surinam			•	
Yemen	•		•	•
Zimbabwe	•			

[1] Studies have not yet started

[2] Study concerned mudflows and avalanches

Table 7.5 Summary of bilateral and regional activities relating to the implementation of the Convention, 1997. (Abbreviations are explained at the end of the table.)

Partner Country/Region	General Environment	Mitigation	Adaptation
Non Annex 1 Countries			
Albania		PSO	
Armenia		PSO	
Azerbaijan		PSO	
Bosnia Herzegovina		PSO	
Bangladesh	LTD	AIJ	X:C
Benin	SDT		
Bhutan	SDT		X:AFW
Burkina Faso	LTD		
Bolivia	LTD	GHG, MG, SEP, AIJ	NCA, X:AFW
Brazil	EI		
Cape Verde	EI		
China	EI	AIJ	
Columbia	EI		X:C
Costa Rica	SDT	AIJ	NCA, X:AFC
Ecuador	EI		X:C
Egypt	LTD		X:C
Eritrea	LTD		
Ethiopia	LTD		
Georgia		PSO	
Ghana	LTD	SEP, AIJ	NCA, X:CW
Guatemala	EI		
Honduras		AIJ	
Hungary		SCORE	
India	LTD	AIJ	
Indonesia	LTD		
Kazakhstan		GHG, PSO	NCA, X: FW
Mali	LTD		X:AW
Moldova		PSO	
Mongolia	EI	MG	NCA, X:A
Mozambique	LTD		
Nepal	EI		
Nicaragua	LTD		X:C
Pakistan	EI		
Palestinian Authority	LTD		
Peru	EI		
Philippines	EI	SEP	
Senegal	EI	SEP, AIJ	NCA, X:AC
Sri Lanka	LTD		
South Africa	LTD	AIJ	
Surinam	LTD	GHG	X:C
Tanzania	LTD		
Uganda	LTD	AIJ	
Vietnam	LTD	AIJ	X:C
Yemen	LTD		NCA, X:ACW
Zambia	LTD	AIJ	
Zimbabwe		MG, SEP	X:A

Table 7.5 (Continued)

Partner Country/Region	General Environment	Mitigation	Adaptation
Annex 1 Countries			
Bulgaria		PSO	
Croatia		PSO	
Latvia		SCORE	
Poland		SCORE	
Romania		PSO	
Russian Federation		PSO	
Ukraine		PSO	

Explanation of abbreviations used in the table above:

LTD	Activities on basis of Longer Term Development co operation
EI	Environmental Issues in addition to LTD
SDT	Sustainable Development Treaties
NCA	National Communication Assistance
GHG	Green House Gas emission inventory
MG	Mitigation General activities
SEP	Solar Energy Project(s)
SCORE	Supporting the Co operational Organisation of Rational Energy use
PSO	Energy and Environmental programme for East- and Central Europe
AIJ	Activities Implemented Jointly
X:	Adaptation studies: A = Agricultural; F = Forestry/natural areas; C = Coastal zone; W = Water resources

8 RESEARCH AND SYSTEMATIC OBSERVATION

8.1 General policy on research and systematic observation

Research activities in the Netherlands cover a range of climate processes, climate system studies and policy support studies. The research activities are characterised by:

- intensive participation in international programmes;
- clustering and concentrating on a few larger national research programmes;
- cooperation and coordination in so-called topic centres.

The following sections describe each of these elements and provide a brief overview of important research activities. The Netherlands contribution to systematic observation is described in Annex C to this report.

8.2 Research

8.2.1 International contributions

The Netherlands provides a significant contribution to international research programmes, including the *World Climate Research Programme* (WCRP), the *International Geosphere-Biosphere Programme* (IGBP), the *International Human Dimensions of Global Environmental Change Programme* (IHDP) and the *Biodiversion Programme* of the Rio Conference of 1992 (DIVERSITAS).

Extensive support is also given to the work of the *Intergovernmental Panel on Climate Change* (IPCC). RIVM provides office facilities and support for one of the co-chairs and for the Technical Support Unit of IPCC Working Group III. Furthermore Netherlands scientists contributed as (lead) authors to the Third IPCC Assessment Report and to the IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories.

8.2.2 National Research Programmes

The most relevant *National Research Programmes* for climate-change-related research are briefly described below.

National Research Programme on Global Air Pollution and Climate Change (NRP)

The NRP encourages and finances climate research in the Netherlands. The programme focuses on four themes:

- the dynamics of the climate system;
- the vulnerability of natural and societal systems to climate change;
- societal causes and solutions;
- integration and assessment.

Box 8.1 NRP assessment of the impacts and adaptation options.

One of the studies under the NRP aims to assess the impacts, vulnerabilities and adaptation options with regard to climate change in the Netherlands. This project is called NRP Impact and focuses on the main economic sectors (including energy, transportation, tourism, agriculture, fishery, and forestry), natural ecosystems (including bio-diversity) and rural landscapes, and human health aspects. Impacts and adaptation options will be assessed and evaluated in a dialogue with the main stakeholders, based on projections for future climate change and socioeconomic developments in the context of Western Europe. The five main objectives of the proposed project are:

- to provide an overview of current scientific- and stakeholder-insights and perceptions of impacts and vulnerabilities for the Netherlands (including trends already observed), based on given climate and socioeconomic scenarios;
- to make an integrated assessment of cross-sector interactions of climate change impacts;
- to explore possible future impacts and vulnerabilities for each sector, taking account of the cross-sector interactions;
- to develop a set of (sector and cross-sector) adaptation possibilities, and identify the main actors involved, through a participatory process with the main stakeholders;
- to make a synthesis report with an overview of the main impacts, vulnerabilities and adaptation options for each sector, and for cross-sector issues.

Over 30 research groups participate in the NRP. The first phase of this programme was completed in 1995. The *Second National Communication* provided more information on this. The budget for the second phase of this programme (1995-2001) amounts to approximately € 26 million.

In the second phase, two major integrated assessments are being carried out. One of these studies focuses on the impacts of, and adaptation to, climate change in the Netherlands (see Box 8.1). The other explores the possibilities of more far-reaching emission reduction targets (see Box 8.2). An important element in the approach of both projects includes dialogues with stakeholders (see also Chapter 9). A final report of the programme will be published by November 2001.

The *Third National Environmental Policy Plan* proposes the continuation of climate research in the Netherlands. Funding basically comes from the Ministry of Housing, Spatial Planning and the Environment (VROM), and also from the Ministry of Education and Science. The scope and structure of this programme will be discussed after the second phase of NRP-MLK has been evaluated.

NWO global change programme

The *Netherlands Organisation for Scientific Research* (NWO) participates both in funding and in coordination of the national research programme NRP-MLK. In addition to this role, the NWO Research Councils, the Foundation for the Advancement of Tropical Research WOTRO, NWO's oceanographic institute NIOZ and Space Research Foundation SRON, fund a variety of special research programmes on global change issues, which are being implemented by universities and scientific institutes. Most of these programmes explicitly contribute to the international research programmes WCRP, IGBP and IHDP. Specific programmes focus on:

- the Antarctic (within the framework of SCAR and ESF-EPICA);
- coastal zones in Southeast Asia (e.g. within the framework of the Southeast Asian Regional Committee on START (SARCS) and IGBP-LOICZ);
- ocean circulation, both in the North Atlantic, South Atlantic and Indian Ocean (e.g. MARE programme, together with South Africa);
- climate variability, earth observation, and energy.

Capacity building is explicitly included in the goals of overseas programmes.

Furthermore, NWO coordinates and contributes to the Netherlands funding of the International Project Office of IGBP-LOICZ. The Open Science Conference of IGBP, WCRP and IHDP was held in the Netherlands in 2001, with funding from NWO, KNAW and the Ministry of Education.
The total NWO funding of global climate change research amounts to approximately € 4 million per year.

Box 8.2 NRP assessment of Climate OptiOns for the Long term (COOL).

One of the assessment projects under the NRP is called COOL (Climate OptiOns for the Long term) and envisions developing long-term strategies for climate policy in the Netherlands, in both a European and global context. Structured dialogues will take place with policy-makers and stakeholder organisations at each of the three levels.

The COOL project delivered the following substantive results:
- an assessment of long-term options for reducing greenhouse gas emissions, which has benefited from a stakeholder dialogue (conducted parallel with COOL);
- strategic visions on the implementation of long-term options at sector level in the Netherlands;
- insights into the long-term risks, long-term response options, and short-term actions and their linkages, at three scales (national, European and global);
- insights into policy linkages between the three levels of decision making, in support of the Dutch stance on international climate policies;
- a report on long-term climate policy options in the Netherlands in the European and global context.

The project also aims to produce the following methodological results:
- improved insights into the factors enhancing the effectiveness of processes in the science-policy dialogue;
- better understanding of how to optimise the use of scientific knowledge;
- an understanding of how policy development on climate change differs and interacts at different levels of policy making.

KNAW contribution to climate change research

As described in the *Second National Communication the Royal Netherlands Academy of Arts and Sciences* (KNAW) also contributes to the research infrastructure in the Netherlands. It does so through the activities of two relevant committees:

- the *IGBP/WCRP Committee* for the *International Geosphere-Biosphere Programme* (IGBP) and the *World Climate Research Programme* (WCRP). This coordinates the national activities within the framework of these international programmes;
- the *HDP Committee*, which plays a similar role in stimulating Netherlands participation in the *International Human Dimensions of global environmental changes Programme* (IHDP).

8.2.3 Topic centres for climate change research in the Netherlands

Centre for Climate Change and Biosphere Research (CCB)

In 1997 a new topic centre was established in the Netherlands: the *Centre for Climate Change and Biosphere Research*. Seven organisations associated with the Wageningen University and Research Centre participate in this research programme.[1] The CCB programme aims to strengthen and coordinate the cooperation between researchers in the field of fundamental, applied and policy-oriented climate change research. It also serves as a focal point for policy-makers, NGO's and others seeking information on biosphere aspects of climate impact assessment, and enhances expert-input from the *Wageningen University and Research Centre* (WUR) in national and international climate change programmes (notably the IGBP) and policy assessments.

The Netherlands Centre for Climate Research (CKO)

The CKO is a joint venture between the Institute for Marine and Atmospheric Research (IMAU) of the University of Utrecht, RIVM and KNMI. The main aim is to improve coordination and cooperation among the parties in the field of climate research. The parties involved have formed a Supervisory Board to oversee the implementation of the cooperation agreement. In addition, a Programme Board has been created to guide the implementation of the agreement. Representatives from other institutes (SRON and TNO) attend the meetings as observers. The secretariats of both boards are located at KNMI.

The Institute for Marine and Atmospheric Research concentrates on a fundamental research programme. Strategic and applied research are carried out at KNMI, while aspects relating to air quality and the chemical composition of the atmosphere are being studied at RIVM.

International Project Office of LOICZ

The *Land-Ocean Interactions in the Coastal Zone* (LOICZ) is one of 11 programme elements of the IGBP. The NWO *Netherlands Institute for Sea Research* (NIOZ) houses the *International Project Office* (IPO) of the LOICZ. This office is also supported through the Ministries of Education and Science and of Traffic, Public Works and Water management. The present commitment expires at the end of 2002. Research carried out under the LOICZ umbrella focuses on understanding the role of coastal zones and coastal seas in the global climate system[2] (see also Chapter 6).

Coastal Zone Management Centre of the Netherlands (CZM-C)

The CZM-Centre is an international centre, located at the Ministry of Transport, Public Works and Water Management and supported by six ministries. The centre provides a platform for cooperation and transfer of information on the sustainable management of coastal resources (see also Chapter 6). CZM-C has also become more active in the field of European coastal and marine data exchange, with projects supported by the European Commission (e.g. Coastbase, Leonardo da Vinci)[3].

[1] Wageningen Institute for Environment and Climate Research (WIMEK); Production Ecology & Resource Conservation Graduate School (PE & RC); Alterra; Green World Research (ATO); Agrotechnical Research Institute (IMAG); Institute of Agricultural and Environmental Engineering (Plant Research International); the Agricultural Economics Research Institute (LEI).

[2] Further information on website: http://www.nioz.nl/loicz/

[3] Further information on web site http://www.netcoast.nl/

8.2.4 Main research themes: an overview

8.2.4.1 General climate research

As indicated, research efforts in the Netherlands cover a wide range of activities. Most of the research themes described in the *Second National Communication* are still important. A brief summary of the main focus:.

- Climate process and climate systems. This involves observational, experimental and modelling research within the framework of WCRP and IGBP. This research is supported by data collection from satellites and correlated data analysis.
- Monitoring and systematic observation. This focuses on data collection and monitoring, both at a national scale (the emission registration system) and an international scale (e.g. the EDGAR database, which is maintained in close cooperation with the *Global Emissions Inventory Activity* (GEIA). GEIA is part of IGBP. The Netherlands maintains a series of databases, in which collected data is stored for use in policy making and climate change research (see Box 8.3).
- Modelling and prediction. This includes modelling for emission projections as described in Chapter 5, the contributions to climate models, the modelling of (economic) impacts of emission reduction strategies and the modelling of effects of climate change (e.g. the IMAGE model, which is also applied for IPCC assessments). See Box 8.3 for further information.
- Research on impacts. This involves research and policy-related studies on water management, rising sea levels and vulnerability of ecosystems. The Netherlands also supports a number of impact studies in non-Annex 1 Parties under the *Netherlands Climate Change Studies Assistance Programme*, as a means of building capacity in these countries to report on adaptation (see also Chapter 7).

8.2.4.2 Socioeconomic analysis

To support the development of policies and measures to fulfil commitments under the Kyoto Protocol, the government has commissioned various types of policy support research activities. Many of these are carried out by

Box 8.3 Models and databases maintained in the Netherlands.

Models	
ECBILT	coupled ocean-atmosphere model (KNMI)
EMISSION EXPLORER	emission information and projection model (RIVM)
FAIR	framework to assess international regimes for burden sharing
IMAGE:	Integrated Model to Assess the Greenhouse Effect, a global dynamic simulation model for quantitative policy assessments of global change (RIVM)
MARKAL:	an IEA LP planning model for energy production, technology and end-use markets (ECN)
NEMO:	econometric model relating energy consumption to data of economic and technological development, and energy policy (CPB)
SAVE:	energy demand simulation models (ECN)
SELPE:	LP energy supply model (ECN)
WORLDSCAN:	macroeconomic model generating economic growth for world regions (CPB)
Databases	
PER:	Pollutant Emission Register, national data retrieval system for emissions of point and area sources (VROM/RIVM)
EMISSION EXPLORER:	emission information and projection model (RIVM)
ICARUS:	information system on energy conservation and efficient use of resources, based on a sector approach. Database and scenario model contain energy-saving and CO_2-reduction measures (RUU/NWS)
NEEDIS:	database containing sector 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 sector emissions of greenhouse gases and ozone-depleting compounds by country as well as on a 1x1 grid. EDGAR's structure means that 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 for testing the IMAGE 2 model (RIVM).

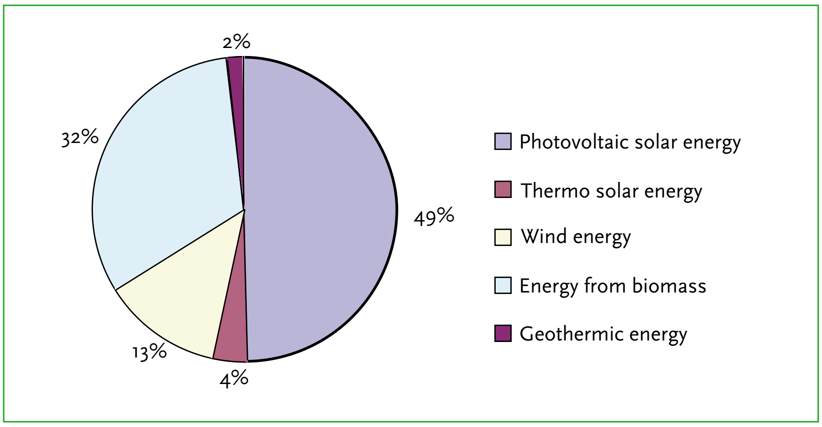


Fig. 8.1 R, D&D funds for renewable energy per topic.
Source: Novem, 2001 (preliminary figures)

RIVM and ECN to form a basis for the National Climate Policy Implementation Plan and for selecting between policy instruments. Information and knowledge on emission reduction options, their cost effectiveness and possible ways to implement these options is continuously being gathered and updated by the institutes. This should support the government in adapting the emission reduction strategy if necessary.

The Netherlands' government is also seeking innovation in policy instruments, given the intractability of the problem, and the wish to study the possibilities of farther-reaching emission reductions in the longer term. In this perspective, for example, the instrument of emissions trading for application at a national scale is currently being explored. As a possible contribution to discussions on global emission reductions in the longer term, RIVM has developed a model known as the FAIR model. This is derived from the IMAGE model and aims to act as a tool in discussions on participation of Annex 1 and non-Annex 1 Parties. Key elements are the environmental objectives of the UNFCCC and options for a fair burden sharing of the emission reductions.

8.2.4.3 Technology research and development

CO_2 greenhouse gases

The government allocates substantial resources to energy-related research and development. After an increase over the period 1995-1997 government expenditures remain at a more or less stabilised level of approximately € 143 million[1] (in 2000). The funds come from various ministries.

The following trends have been noticed over the last few years:
- a slight decrease in research and development into energy conservation. At present some 41% of public energy research expenditures or around € 57 million is spent on energy conservation. Energy conservation in industry uses some € 26 million, built environment[2] some € 15 million, transport € 7 million, the remainder going to other sectors (agriculture, heat pump research, etc.);
- R,D&D funds for renewable energy have increased substantially; € 46 million is currently allocated. Figure 8.1 shows the relative shares per topic.

Non-CO_2 greenhouse gases

Reducing non-CO_2 greenhouse gases also requires a considerable amount of money for research, development and demonstration. A cornerstone herein is the *Reduction Programme non-CO_2 Greenhouse Gases* (ROB), which includes assessing practical measures to achieve significant reductions. More information on the ROB programme can be found in Chapter 4.

[1] Preliminary figures.
[2] Low-energy housing is a main topic in R,D&D.

8.3 Systematic observation

The Netherlands actively participates in the various fields of climate-related monitoring, both nationally and within European and global programmes. An integrated national programme for implementing the Netherlands contribution to GCOS has not yet been established. However, steps are being taken to develop and implement such a strategy:

- in 1998 an authoritative national study (NIMM) was undertaken evaluating the Netherlands contribution to international monitoring systems. This report deals with five areas for monitoring activities: oceans, coast & delta, land, weather & climate and atmospheric composition. The study strongly recommends striving for integrated approaches at a national level, in accordance with IGOS. To that effect it proposed designating national focal points for GCOS, GOOS and GTOS. From the year 2000 onwards the Royal Netherlands Meteorological Institute (KNMI) acts as focal point for GCOS in the Netherlands;
- the NIMM study recommends substantial strengthening of climate-related monitoring, requiring investments and organisational structuring. Plans are currently being developed to implement a prototype of the monitoring system recommended in the report.

The Netherlands meets the GCOS requirements. The GCOS monitoring principles and best practices are known at the professional level and are taken into account. At present there is no explicit national policy for capacity building in relation to GCOS, though such activities take place frequently on a project level. Project descriptions will be made available from www.knmi.nl/gcos.
The Netherlands activities to GCOS are described separately in Annex C.

9 EDUCATION, TRAINING AND PUBLIC AWARENESS

9.1 Introduction

This chapter covers trends and developments in education, training and public awareness on climate change. Over the past decade the attitude of the general public in the Netherlands first showed an increasing interest in this issue, followed by a slight decline. However, the public maintains a relatively high interest in the subject. Recent policy has aimed at revitalising public interest. The emphasis in communication has shifted over the past two decades from creating awareness of the problems to gaining and maintaining support for implementing solutions. Nowadays, not only national or international policies are stressed in communication, but also practical and easy-to-implement solutions for e.g. households and other involved parties. Section 9.2 describes these general developments and trends. The subsequent sections go into more detail on specific actions.

9.2 General trends

In 1999 and 2000 surveys by the Social Cultural Planning Bureau looked at public awareness and environmental problems. The first survey showed that there is a large gap between attitudes towards the environmental problem and actual behaviour. The second survey demonstrated that household responsibility for climate change is increasingly less recognised. The public primarily holds others, e.g. industry, other countries, etc. responsible for solving the problem. There is a certain fatigue among the general public: people realise that the problems exist, but do not feel they can influence them. In the long term, the public may lose interest.
In 1999 the government issued the *National Climate Policy Implementation Plan* (NCPIP), which shows that measures to curb the problem are available and that they are financially viable. This document also recognises that additional communication efforts are necessary, because the implementation of policy measures will only succeed if the general public is involved and when there is a sufficient sense of urgency in handling the problem.

The Netherlands' government presented for example a new mass-media campaign at the Climate Conference in The Hague, during the meeting on Article 6 of the UNFCCC. This campaign focuses less on the causes and solutions of climate change, but highlights what climate change means to people's individual lives. The focus is on alternative behaviour in day-to-day living. Achievable effects can be seen on a CO_2 barometer. The campaign encompasses mass-media attention, with advertisements on national television and in magazines and newspapers, billboards, information on the Internet and a brochure. The Ministry of Housing, Spatial Planning and the Environment, maintains a website containing information on the possibilities for reducing CO_2 emissions. In the campaign, attention is given to the practical contributions that individuals can make in abating climate change. The key message is: "our climate is precious, valuable and important to our quality of life. It is unthinkable that we should ruin the climate. Climate change is everyone's concern. Something must be done about it"[1].

9.3 Education and training

A programme 'Learning for Sustainability' has been developed to increase the availability and quality of education on natural and environmental aspects. For the period 2000-2004 the programme focuses on integrating sustainable development in a broad sense into educational and other social sectors. The programme has been developed in a collaborative effort between ministries and other (provincial) government bodies.

More specific education and training is usually related to practical options for greenhouse gas mitigation. Training packages are often developed on innovative technologies and/or other options for relevant target groups, as an integral part of more general programmes and measures. Examples include the following:

Transport sector
Some policies that include training on changing attitudes and behaviour are described elsewhere in this chap-

[1] Campaign titles were: You've got to be crazy to ruin the climate, and: Climate Change, what are we doing about it?

ter. In particular, the New Way to Drive programme has a major professional education and training focus in the transport sector.

Buildings/housing
A special information centre specialises in sustainable construction of houses and buildings. This centre also stimulates the integration of know-how into educational and training packages.

Energy and industry
Training packages on renewable energy have been developed for relevant target groups, while packages for industry, on relevant innovative energy conservation technologies, are used in professional and technical training. An association of technical teachers actively promotes the exchange of (experiences with) educational material on energy efficiency.

9.4 Public information campaigns

Since the last *National Communication* in 1997, several information campaigns have focused on the general public. Besides the campaigns mentioned in Section 9.2, campaigns were carried out to support the implementation of measures such as the Energy Premium, Energy Performance Advice and Green funds (see Chapter 4). More focused campaigns were also directed at households and transport, aiming to change attitudes and behaviour, and used to support the introduction of new policy measures. The focus was on improving energy efficiency and increasing the use of renewable energy. The campaigns stressed low cost and 'easy to implement' actions that offer citizens attractive alternatives for action. Within the information campaigns, we can distinguish 'mass-media campaigns' and 'group focused' campaigns.

Important **mass-media information** campaigns are:

- *Green electricity*
  Energy distribution companies offer green electricity (from renewable sources) to households. Because there is no regulatory tax on green electricity the prices are relatively low. This option is backed by promotional campaigns for green energy, carried out by energy distribution companies as a commercial activity. Households are free to choose the company they want to supply the Green Energy[2]. The WWF organised a major campaign around green energy in 1999, supported by VROM. This campaign resulted in 20,000 new clients purchasing green energy.

- *The New Way to Drive*
  In 2000 three ministries started a programme and campaign called *The New Way to Drive* (see Chapter 4). The programme encompasses a campaign providing advice for a more pleasant, comfortable and safe driving style, taking into account modern engine technology, maintaining tyres at the correct pressure and using advantages offered by fuel-saving accessories (such as cruise control, board computers etc.). *The New Way to Drive* is being implemented at a rapid pace. As early as the end of 2001 this new driving style will have been fully integrated in the lessons provided by most driving schools. An increasing number of experienced drivers are also taking courses to improve their driving style, based on *The New Way to Drive*.

- *Green labelling of cars*
  A large-scale press- and communication campaign was launched to inform the general public about energy labels on new cars. Trade and consumer organisations as well as the ministries involved, are working side by side to inform the public and the automobile industry.

Important '**group focused information**' campaigns are:

- *Energy-efficient lifestyle and eco-teams*
  The so-called Perspective Project was implemented from between 1995 and 1998, as described in the previous *National Communication*. To disseminate the results of this experiment on a large scale, VROM supports the Eco-team Programme of the international organisation Global Action Plan. This method provides households with practical steps and options.

- *The Bet*
  Netherlands' youth organisations have made a bet with the Netherlands' government that they can reduce

[2] The full liberalisation of the energy markets for households is foreseen in 2005.

CO_2 by 8% in six months time. The reduction target amounted to one million kilogram CO_2. A publicity campaign was conducted through workshops at various schools, a website and press releases. The Bet commenced at the start of CoP6 in November 2000 and ended in mid 2001. The youth organisations won the bet by achieving a CO_2 reduction of around 19%.

Other campaigns

In October 2001, a campaign has been started to improve insulation in housing. Media tools include: television, radio, Internet and a brochure. The main message is: insulation leads to energy saving, money saving and – last but not least – to climate change improvement.

9.5 Support programmes, resource and information centres

To be effective in changing attitudes and behaviour, as well as to gain and maintain sufficient support for climate policies, it is necessary to more or less continuously assess and renew measures for improving public awareness and behavioural change. A series of measures are being implemented to this end, many as integral parts of other measures. Some specific measures are:

The Enter Facility

The Enter Facility aims to develop and test new methods for structurally changing the energy-efficiency behaviour of householders. To this end the facility supports (innovative) projects that may achieve this and have with strong demonstration potential. Under certain conditions such projects may qualify for subsidy. Not only direct energy use is taken into account, but also indirect energy uses in products bought by households (e.g. energy use in cultivation, transport, packaging, waste treatment etc.). The facility was created by two Ministries (EZ and VROM) and is implemented through NOVEM.

Dialogue between scientists and policy-makers

An important element of research on climate change is the improved dialogue between researchers, policymakers and other stakeholders. As an integral part of the NRP and the COOL project (as described in Chapter 8), these projects set up structured dialogues with policy-makers, stakeholders and scientists to assess options for long-term climate strategies (see also Box 8.2 in Chapter 8). The results of the dialogues will be evaluated and synthesised in 2001.

Grant scheme for social organisation and the environment

This grant scheme has been developed to increase the awareness of environmental issues and increase the public support for sustainable development. Social organisations can apply for subsidies under this scheme. Based on a tender system, approximately 50% of the 150 requests received yearly, are being honoured.

9.6 Information campaigns by NGOs

As previously indicated, public and non-governmental organisations are closely involved in many of the campaigns and actions. Apart from the aforementioned campaigns, several other campaigns were conducted by NGOs. An important example is the *Solaris project*, implemented by *Greenpeace* together with municipalities and energy distribution companies. This project aims to stimulate the use of solar energy.

9.7 Participation in international activities

The *Sixth UN conference on climate change under the UNFCCC* (CoP6) took place in November 2000 in The Hague, headed by the Netherlands' Minister of the Environment, Mr Jan Pronk. The media paid much attention to this conference and to the issue of climate change. An interactive website was hosted for the participants and for the community.

An IMAX film about climate change has been made for the conference and was released at the opening ceremony. In the coming years, this film will be shown in several IMAX theatres around the world.

Young people from around the word held a youth meeting during the conference, culminating in a youth declaration being read to the plenary meeting of the conference. During the World Conference, 118 youth delegates (from 61 countries) announced the creation of a *World Youth Organisation against Climate Change*, which aims to increase youth awareness of climate change by working locally within a united global network.

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ANNEX A

A.1 CRF Trend Tables 10 for greenhouse gases

This annex includes sheets from the CRF data files, presenting unrounded figures. The number of digits shown does not represent the uncertainty estimated for the emissions (see Chapter 3). Please note that all data for 1999 are preliminary. Sheets are presented for:

- CO_2
- CH_4
- N_2O
- HFCs, PFCs and SF_6

All gases and source categories are in CO_2-eq.

Table A.1 Emissions of greenhouse gases in the Netherlands; CRF Trend Table 10: CO_2.

Greenhouse gas source and sink categories	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
					(Gg)						
1. Energy	**159,160.92**	**159,160.92**	**165,320.00**	**163,800.00**	**166,240.00**	**166,940.00**	**175,194.00**	**183,021.10**	**179,283.44**	**178,948.69**	**172,145.96**
A. Fuel Combustion (Sectoral Approach)	158,535.67	158,535.67	164,860.00	163,430.00	165,890.00	166,750.00	174,224.00	182,021.10	178,265.58	177,395.37	170,618.58
1. Energy Industries	52,117.15	52,117.15	52,190.00	54,130.00	53,800.00	55,980.00	57,314.00	58,900.00	57,901.63	59,957.39	57,040.60
2. Manufacturing Industries and Construction	41,880.84	41,880.84	42,660.00	42,510.00	39,920.00	40,950.00	43,430.00	42,100.00	44,534.66	43,981.62	43,549.41
3. Transport	29,095.35	29,095.35	28,550.00	29,830.00	30,460.00	30,800.00	32,030.00	33,821.10	33,059.66	33,998.61	34,699.54
4. Other Sectors	34,320.11	34,320.11	40,390.00	37,330.00	40,060.00	38,460.00	38,930.00	45,200.00	36,431.30	35,852.14	35,300.67
5. Other	1,122.23	1,122.23	1,070.00	-370.00	1,650.00	560.00	2,520.00	2,000.00	6,338.33	3,605.61	28.37
B. Fugitive Emissions from Fuels	625.26	625.26	460.00	370.00	350.00	190.00	970.00	1,000.00	1,017.86	1,553.32	1,527.37
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	625.26	625.26	460.00	370.00	350.00	190.00	970.00	1,000.00	1,017.86	1,553.32	1,527.37
2. Industrial Processes	**1,901.47**	**1,901.47**	**1,500.00**	**1,270.00**	**1,210.00**	**1,440.00**	**1,570.00**	**1,700.00**	**1,726.54**	**1,767.75**	**1,784.38**
A. Mineral Products	746.73	746.73	700.00	750.00	1,050.00	1,050.00	1,130.00	900.00	1,087.17	1,048.50	1,075.36
B. Chemical Industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	277.22	257.23	257.23
C. Metal Production	0.62	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.61	21.50
D. Other Production	209.51	209.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Consumption of Halocarbons and SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Other	944.61	944.61	800.00	520.00	160.00	390.00	440.00	800.00	362.15	439.42	430.29
3. Solvent and Other Product Use	**0.00**	**0.00**	**100.00**	**100.00**	**0.00**	**0.00**	**0.00**	**0.00**	**10.54**	**11.40**	**10.86**
4. Agriculture	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Enteric Fermentation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Manure Management	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Rice Cultivation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Agricultural Soils	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Prescribed Burning of Savannas	IE	IE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Field Burning of Agricultural Residues	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry	**-1,500.00**	**-1,500.00**	**-1,600.00**	**-1,600.00**	**-1,600.00**	**-1,700.00**	**-1,700.00**	**-1,700.00**	**-1,700.00**	**-1,700.00**	**-1,700.00**
A. Changes in Forest and Other Woody Biomass Stocks	-1,500.00	-1,500.00	-1,600.00	-1,600.00	-1,600.00	-1,700.00	-1,700.00	-1,700.00	-1,700.00	-1,700.00	-1,700.00
B. Forest and Grassland Conversion	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Abandonment of Managed Lands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. CO_2 Emissions and Removals from Soil	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
E. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste	**110.73**	**110.73**	**0.00**	**0.00**	**0.00**	**0.00**	**366.00**	**0.00**	**144.98**	**184.80**	**184.45**
A. Solid Waste Disposal on Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Waste-water Handling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	110.73	110.73	0.00	0.00	0.00	0.00	366.00	0.00	144.98	184.80	184.45
7. Other	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Solvent and other product use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Polluted surface water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Emissions/Removals with LUCF	**159,673.12**	**159,673.12**	**165,320.00**	**163,570.00**	**165,850.00**	**166,680.00**	**175,430.00**	**183,021.10**	**179,465.50**	**179,212.64**	**172,425.64**
Total Emissions without LUCF	**161,173.12**	**161,173.12**	**166,920.00**	**165,170.00**	**167,450.00**	**168,380.00**	**177,130.00**	**184,721.10**	**181,165.50**	**180,912.64**	**174,125.64**
Memo Items:											
International Bunkers	**40,010.00**	**40,010.00**	**41,290.00**	**42,400.00**	**44,280.00**	**42,860.00**	**44,150.00**	**45,500.00**	**48,509.00**	**49,318.78**	**51,209.85**
Aviation	4,450.00	4,450.00	4,960.00	5,910.00	6,500.00	6,720.00	7,670.00	8,300.00	8,979.00	9,520.95	10,066.43
Marine	35,560.00	35,560.00	36,330.00	36,490.00	37,780.00	36,140.00	36,480.00	37,200.00	39,530.00	39,797.83	41,143.42
Multilateral Operations	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
CO_2 Emissions from Biomass	**3,100.00**	**3,100.00**	**2,700.00**	**2,600.00**	**3,300.00**	**3,500.00**	**3,600.00**	**4,500.00**	**5,313.85**	**5,350.00**	**5,447.45**

** IE is Included Elsewhere*
*** NE is Not Estimated*
**** NO is Not Occurring*

Table A.2 Emissions of greenhouse gases in the Netherlands; CRF Trend Table 10: CH_4.

Greenhouse gas source and sink categories	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
					(Gg)						
Total Emissions	1,292.73	1,292.73	1,308.70	1,256.20	1,224.70	1,203.10	1,172.40	1,163.14	1,102.77	1,061.77	1,033.50
1. Energy	**214.05**	**214.05**	**223.80**	**199.10**	**192.40**	**202.30**	**209.30**	**214.44**	**186.56**	**176.78**	**174.12**
A. Fuel Combustion (Sectoral Approach)	34.97	34.97	35.70	36.00	34.40	33.80	35.30	36.90	30.10	30.69	29.89
1. Energy Industries	1.26	1.26	3.20	3.80	3.40	3.70	4.90	5.70	3.06	4.40	4.11
2. Manufacturing Industries and Construction	5.78	5.78	3.50	4.90	3.20	2.60	2.80	1.51	1.59	1.81	1.59
3. Transport	7.92	7.92	6.90	6.80	6.40	6.30	6.30	5.67	5.28	4.86	4.57
4. Other Sectors	20.00	20.00	22.10	20.50	21.40	21.20	21.30	24.02	20.17	19.62	19.61
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
B. Fugitive Emissions from Fuels	179.08	179.08	188.10	163.10	158.00	168.50	174.00	177.54	156.46	146.10	144.23
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	179.08	179.08	188.10	163.10	158.00	168.50	174.00	177.54	156.46	146.10	144.23
2. Industrial Processes	**3.40**	**3.40**	**3.50**	**3.70**	**4.90**	**5.30**	**4.90**	**5.74**	**2.73**	**2.41**	**2.48**
A. Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.14	0.13	0.13
B. Chemical Industry	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.20	2.46	2.22	2.29
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00
D. Other Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6	0	0	0	0	0	0	0	0	0	0	0
F. Consumption of Halocarbons and SF_6	0	0	0	0	0	0	0	0	0	0	0
G. Other	3.40	3.40	3.50	3.70	4.90	5.30	4.90	0.13	0.12	0.06	0.06
3. Solvent and Other Product Use	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
4. Agriculture	**504.88**	**504.88**	**517.00**	**505.00**	**497.00**	**483.00**	**475.70**	**463.39**	**446.23**	**432.35**	**422.86**
A. Enteric Fermentation	401.90	401.90	412.00	401.00	393.00	382.00	376.70	365.30	352.64	339.35	331.82
B. Manure Management	102.98	102.98	105.00	104.00	104.00	101.00	99.00	98.09	93.59	93.00	91.05
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Abandonment of Managed Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste	**568.40**	**568.40**	**562.40**	**546.40**	**528.40**	**510.20**	**480.50**	**477.57**	**465.29**	**448.30**	**432.10**
A. Solid Waste Disposal on Land	562.10	562.10	556.10	540.10	522.10	505.10	479.00	477.00	463.98	444.50	428.30
B. Waste-water Handling	6.30	6.30	6.30	6.30	6.30	5.10	1.50	0.57	1.30	3.78	3.78
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.02
7. Other (please specify)	**2.00**	**2.00**	**2.00**	**2.00**	**2.00**	**2.30**	**2.00**	**2.00**	**1.97**	**1.93**	**1.94**
Solvent and other product use	2.00	2.00	2.00	2.00	2.00	2.30	2.00	2.00	1.97	1.93	1.94
Polluted surface water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items:											
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Aviation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass											

** IE is Included Elsewhere*
*** NE is Not Estimated*
**** NO is Not Occurring*

Table A.3 Emissions of greenhouse gases in the Netherlands; CRF Trend Table 10: N_2O.

Greenhouse gas source and sink categories	Base year	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
					(Gg)						
Total Emissions	**63.73**	**63.73**	**66.90**	**69.30**	**68.90**	**70.80**	**72.20**	**71.76**	**73.67**	**72.82**	**73.19**
1. Energy	**5.22**	**5.22**	**6.90**	**7.90**	**7.90**	**8.00**	**8.16**	**7.70**	**7.81**	**6.82**	**6.53**
A. Fuel Combustion (Sectoral Approach)	5.22	5.22	6.90	7.90	7.90	7.60	8.16	7.70	7.81	6.82	6.53
1. Energy Industries	0.45	0.45	0.50	0.50	0.50	0.20	0.56	0.44	0.48	0.48	0.41
2. Manufacturing Industries and Construction	0.13	0.13	0.10	0.10	0.10	0.10	0.10	0.07	0.06	0.06	0.05
3. Transport	4.54	4.54	6.20	7.20	7.20	7.20	7.40	7.12	7.19	6.21	5.98
4. Other Sectors	0.09	0.09	0.10	0.10	0.10	0.10	0.10	0.07	0.08	0.08	0.08
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00
2. Industrial Processes	**31.53**	**31.53**	**32.30**	**30.40**	**30.00**	**31.60**	**31.60**	**31.70**	**34.98**	**35.99**	**36.15**
A. Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Chemical Industry	31.53	31.53	32.30	30.40	30.00	31.60	31.60	31.70	34.98	35.99	36.15
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Other Production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6											
F. Consumption of Halocarbons and SF_6											
G. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3. Solvent and Other Product Use	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.57**	**0.54**	**0.53**
4. Agriculture	**22.19**	**22.19**	**22.90**	**26.20**	**26.20**	**26.40**	**27.60**	**27.50**	**25.94**	**25.13**	**25.66**
A. Enteric Fermentation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Manure Management	0.66	0.66	0.70	0.70	0.80	0.80	0.80	0.70	0.68	0.65	0.64
C. Rice Cultivation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Agricultural Soils	21.53	21.53	22.20	25.50	25.40	25.60	26.80	26.80	25.26	24.48	25.02
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Land-Use Change and Forestry	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Abandonment of Managed Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.50**	**0.54**	**0.56**	**0.57**	**0.53**	**0.53**
A. Solid Waste Disposal on Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Waste-water Handling	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.56	0.57	0.53	0.53
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00
7. Other (please specify)	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**	**3.80**
Solvent and other product use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		0.00	0.00
Polluted surface water	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80	3.80
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items:											
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Aviation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass											

** IE is Included Elsewhere*
*** NE is Not Estimated*
**** NO is Not Occurring*

Table A.4 Emissions of greenhouse gases in the Netherlands; CRF Trend Table 10: HFCs, PFCs and SF_6.

Greenhouse gas source and sink categories	Base year[1]	1990	1991	1992	1993 (Gg)	1994	1995	1996	1997	1998	1999	Chemical	GWP
Emissions of HFCs													
CO_2 equivalent (Gg)	**6,723.62**	**5,143.69**	**4,862.89**	**4,594.49**	**5,106.90**	**6,449.27**	**6,723.62**	**7,524.23**	**7,884.10**	**8,695.17**	**8,835.73**	**HFC's**	
HFC-23	536.00	436.00	412.00	388.00	433.00	536.00	536.00	573.40	573.40	631.36	631.36	HFC-23	11700
HFC-32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-32	650
HFC-41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-41	150
HFC-43-10mee	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-43-10mee	1300
HFC-125	24.04	7.18	7.18	7.18	7.18	19.74	24.04	35.54	47.24	51.80	60.50	HFC-125	2800
HFC-134	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-134	1000
HFC-134a	261.80	9.00	9.00	18.00	5.43	73.70	261.80	477.30	692.60	718.40	771.40	HFC-134a	1300
HFC-152a	24.00	4.96	4.96	9.93	26.02	24.00	24.00	41.60	26.00	0.00	0.00	HFC-152a	140
HFC-143	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-143	300
HFC-143a	9.32	2.63	2.63	2.63	2.63	6.22	9.32	18.22	28.22	50.00	60.00	HFC-143a	3800
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-227ea	2900
HFC-236fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-236fa	6300
HFC-245ca	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	HFC-245ca	560
HFC Unspecified	2.00	0.00	0.00	0.00	0.00	0.00	2.00	6.80	10.60	13.10	16.20	HFC Unspecified	3000
Emissions of PFCs													
CO_2 equivalent (Gg)	**1,866.76**	**2,431.78**	**2,436.78**	**2,098.69**	**2,118.36**	**1,890.43**	**1,866.76**	**2,042.11**	**2,153.98**	**2,468.50**	**2,589.56**	**PFC's**	
CF_4	223.00	301.00	301.00	258.00	260.00	228.00	223.00	247.00	261.00	296.00	308.00	CF_4	6500
C_2F_6	38.00	48.00	48.00	41.00	41.00	38.00	38.00	39.00	40.00	48.00	51.00	C_2F_6	9200
$C3F_8$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	$C3F_8$	7000
$C4F_{10}$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	$C4F_{10}$	7000
$c\text{-}C_4F_8$	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	$c\text{-}C_4F_8$	8700
C_5F_{12}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	C_5F_{12}	7500
C_6F_{14}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	C_6F_{14}	7400
PFC unspecified	8.06	4.01	4.61	5.30	6.09	7.00	8.06	9.26	10.65	12.25	14.09	PFC unspecified	8400
Emissions of SF_6													
CO_2 equivalent (Gg)	**174.47**	**144.60**	**100.38**	**106.36**	**109.94**	**147.94**	**174.47**	**160.37**	**181.88**	**132.41**	**136.71**		
SF_6	7.30	6.05	4.20	4.45	4.60	6.19	7.30	6.71	7.61	5.54	5.72	SF_6	23900

Note: The emissions of individual compounds are reported here in mass units, not in CO_2-eq.

Table A.5 Emissions of greenhouse gases in the Netherlands; CRF Trend Table 10: N_2O.

Greenhouse gas emissions	Base year[1]	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)										
Net CO_2 emissions/removals	159,673.12	159,673.12	165,320.00	163,570.00	165,850.00	166,680.00	175,430.00	183,021.10	179,465.50	179,212.64	172,425.64
CO_2 emissions (without LUCF)[2]	161,173.12	161,173.12	166,920.00	165,170.00	167,450.00	168,380.00	177,130.00	184,721.10	181,165.50	180,912.64	174,125.64
CH_4	27,147.24	27,147.24	27,482.70	26,380.20	25,718.70	25,265.10	24,620.40	24,425.94	23,158.18	22,297.19	21,703.53
N_2O	19,757.25	19,757.25	20,739.00	21,483.00	21,359.00	21,948.00	22,382.00	22,245.29	22,839.13	22,572.98	22,689.87
HFCs	6,723.62	5,143.69	4,862.89	4,594.49	5,106.90	6,449.27	6,723.62	7,524.23	7,884.10	8,695.17	8,835.73
PFCs	1,866.76	2,431.78	2,436.78	2,098.69	2,118.36	1,890.43	1,866.76	2,042.11	2,153.98	2,468.50	2,589.56
SF_6	174.47	144.60	100.38	106.36	109.94	147.94	174.47	160.37	181.88	132.41	136.71
Total (with net CO_2 emissions/removals)	**215,342.46**	**214,297.68**	**220,941.76**	**218,232.73**	**220,262.90**	**222,380.74**	**231,197.25**	**239,419.04**	**235,682.76**	**235,378.89**	**228,381.04**
Total (without CO_2 from LUCF)[2]	**216,842.46**	**215,797.68**	**222,541.76**	**219,832.73**	**221,862.90**	**224,080.74**	**232,897.25**	**241,119.04**	**237,382.76**	**237,078.89**	**230,081.04**

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

1 Fill in the base year adopted by the Party under the Convention, if different from 1990.

2 The information in these rows is requested to facilitate comparison of data, since Parties differ in the way they report CO_2 emissions and removals from Land-Use Change and Forestry.

3 Net emissions.

A.2 Trend Tables for precursors

This annex includes information sheets from the CRF data files, presented in trend table format as unrounded figures. The number of digits shown does not represent the uncertainty estimated for the emissions (see Chapter 3). Please note that all data for 1999 are preliminary. Sheets are presented for:

- NO_x
- CO
- NMVOC
- SO_2

Table A.6 Emissions of greenhouse gases in the Netherlands: CRF Trend Table 10: No_x.

Greenhouse gas source and sink categories	1990	1991	1992	1993 (Gg)	1994	1995	1996	1997	1998	1999
Total National Emissions and Removals	**563.50**	**551.40**	**539.00**	**518.90**	**493.20**	**497.40**	**480.80**	**459.49**	**422.94**	**408.35**
1. Energy	**549.30**	**537.90**	**525.90**	**505.10**	**482.40**	**485.40**	**461.10**	**442.49**	**407.89**	**390.69**
A. Fuel Combustion — Reference Approach										
Sectoral Approach	548.20	536.70	524.60	504.10	481.90	484.70	460.60	441.64	407.08	390.39
1. Energy Industries	102.80	95.60	95.90	91.80	81.40	75.70	70.70	62.31	56.68	52.00
2. Manufacturing Industries and Construction	65.70	60.40	61.40	54.60	54.40	52.40	44.20	42.56	36.86	32.12
3. Transport	336.90	336.20	325.50	311.80	304.40	314.90	300.00	299.57	275.94	269.11
4. Other Sectors	42.80	44.50	41.80	45.90	41.70	41.70	45.70	37.20	37.60	37.15
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	1.10	1.20	1.30	1.00	0.50	0.70	0.50	0.85	0.81	0.30
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	1.10	1.20	1.30	1.00	0.50	0.70	0.50	0.85	0.81	0.30
2. Industrial Processes	**13.50**	**13.10**	**12.70**	**13.40**	**10.40**	**9.20**	**17.80**	**15.04**	**13.01**	**15.61**
A. Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	1.20	0.00	1.00	1.05
B. Chemical Industry	IE	0.00	0.00	0.00	0.00	0.00	8.90	0.00	5.60	8.91
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	7.30	0.00	6.20	5.44
D. Other Production[3]	IE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	13.50	13.10	12.70	13.40	10.40	9.20	0.40	15.04	0.21	0.21
3. Solvent and Other Product Use	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.10**	**0.08**	**0.08**	**0.08**
4. Agriculture	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Enteric Fermentation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Manure Management	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Rice Cultivation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Agricultural Soils	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Prescribed Burning of Savannas	0.00	0.00	0.00	0.00	NO	0.00	0.00	0.00	0.00	NO
F. Field Burning of Agricultural Residues	NO	0.00	NO	0.00	NO	0.00	0.00	NO	NO	NO
G. Other	NO	0.00	0.00	0.00	0.00	0.00	0.00	NO	NO	NO
5. Land-Use Change and Forestry	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**NO**	**NO**
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO
C. Abandonment of Managed Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste	**0.30**	**0.30**	**0.30**	**0.30**	**0.30**	**2.70**	**1.80**	**1.88**	**1.96**	**1.97**
A. Solid Waste Disposal on Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Wastewater Handling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0.30	0.30	0.30	0.30	0.30	2.70	1.80	1.88	1.96	1.97
7. Other (please specify)	**0.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Solvents and other product use	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Polluted surface water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items:										
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**NE**	**NE**	**NE**
Aviation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass										

** IE is Included Elsewhere*
*** NE is Not Estimated*
**** NO is Not Occurring*

Table A.7 Emissions of greenhouse gases in the Netherlands: CRF Trend Table 10: CO.

Greenhouse gas source and sink categories	1990	1991	1992	1993 (Gg)	1994	1995	1996	1997	1998	1999
Total National Emissions and Removals	**1,140.60**	**1,022.50**	**966.30**	**948.60**	**905.10**	**909.00**	**835.90**	**791.54**	**721.79**	**679.40**
1. Energy	**981.80**	**891.30**	**861.60**	**846.10**	**799.90**	**811.60**	**661.60**	**648.97**	**577.55**	**547.07**
A. Fuel Combustion Reference Approach										
Sectoral Approach	975.60	883.10	855.90	840.10	792.30	802.10	653.50	642.37	571.31	541.52
1. Energy Industries	16.60	18.90	16.40	15.40	17.00	17.30	45.50	21.53	22.49	28.16
2. Manufacturing Industries and Construction	114.20	108.30	114.80	139.10	114.30	120.50	31.30	33.43	20.42	17.00
3. Transport	748.90	658.40	626.40	582.30	559.90	563.70	510.90	525.01	472.42	440.76
4. Other Sectors	95.90	97.50	98.30	103.30	101.10	100.60	65.80	62.41	55.99	55.61
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	6.20	8.20	5.70	6.00	7.60	9.50	8.10	6.60	6.23	5.56
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	6.20	8.20	5.70	6.00	7.60	9.50	8.10	6.60	6.23	5.56
2. Industrial Processes	**153.60**	**127.40**	**101.10**	**99.10**	**101.70**	**94.80**	**171.70**	**139.90**	**141.47**	**129.52**
A. Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	1.10	0.00	1.58	1.72
B Chemical Industry	IE	0.00	0.00	0.00	0.00	0.00	32.40	0.00	23.27	24.71
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	132.80	0.00	114.82	101.28
D. Other Production[3]	IE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Consumption of Halocarbons and SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Other	153.60	127.40	101.10	99.10	101.70	94.80	5.40	139.90	1.81	1.81
3. Solvent and Other Product Use	**2.40**	**2.40**	**2.20**	**2.00**	**2.10**	**2.10**	**1.90**	**2.02**	**2.04**	**2.06**
4. Agriculture	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Enteric Fermentation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Manure Management	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Rice Cultivation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Agricultural Soils	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Prescribed Burning of Savannas	0.00	0.00	0.00	0.00	NO	0.00	0.00	0.00	0.00	NO
F. Field Burning of Agricultural Residues	NO	0.00	NO	0.00	NO	0.00	0.00	NO	NO	NO
G. Other	NO	0.00	0.00	0.00	0.00	0.00	0.00	NO	NO	NO
5. Land-Use Change and Forestry	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**NO**	**NO**
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO
C. Abandonment of Managed Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste	**1.40**	**1.40**	**1.40**	**1.40**	**1.40**	**0.50**	**0.70**	**0.65**	**0.74**	**0.74**
A. Solid Waste Disposal on Land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Wastewater Handling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	1.40	1.40	1.40	1.40	1.40	0.50	0.70	0.65	0.74	0.74
7. Other (please specify)	**1.40**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Solvents and other product use	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Polluted surface water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items:										
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**NE**	**NE**	**NE**
Aviation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass										

** IE is Included Elsewhere*
*** NE is Not Estimated*
**** NO is Not Occurring*

Table A.8 Emissions of greenhouse gases in the Netherlands: CRF Trend Table 10: NMVOC.

Greenhouse gas source and sink categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
				(Gg)						
Total National Emissions and Removals	**500.20**	**460.60**	**436.20**	**150.40**	**387.70**	**369.70**	**347.90**	**323.45**	**287.61**	**281.62**
1. Energy	**267.80**	**247.60**	**237.60**	**223.00**	**216.80**	**216.60**	**200.30**	**188.45**	**170.58**	**163.24**
A. Fuel Combustion Reference Approach										
Sectoral Approach	220.20	200.20	194.20	181.10	174.50	173.80	158.30	151.80	139.50	132.61
1. Energy Industries	3.90	4.10	4.30	3.60	3.90	5.00	7.00	2.84	3.23	3.10
2. Manufacturing Industries and Construction	4.70	4.30	5.80	2.90	2.60	2.80	1.30	2.31	2.45	2.11
3. Transport	200.50	180.30	172.40	162.00	156.50	154.20	134.90	133.05	121.73	114.35
4. Other Sectors	11.10	11.50	11.70	12.60	11.50	11.80	15.10	13.60	12.10	12.05
5. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels	47.60	47.40	43.40	41.90	42.30	42.80	42.00	36.65	31.07	30.63
1. Solid Fuels	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas	47.60	47.40	43.40	41.90	42.30	42.80	42.00	36.65	31.07	30.63
2. Industrial Processes	**130.40**	**120.90**	**115.40**	**100.00**	**88.20**	**79.50**	**73.40**	**71.77**	**67.39**	**60.08**
A. Mineral Products	0.00	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.27	0.27
B. Chemical Industry	IE	0.00	0.00	0.00	0.00	0.00	17.90	0.00	13.78	13.58
C. Metal Production	0.00	0.00	0.00	0.00	0.00	0.00	3.10	0.00	3.02	3.00
D. Other Production[3]	IE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Consumption of Halocarbons and SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Other	130.40	120.90	115.40	100.00	88.20	79.50	52.00	71.77	50.32	43.23
3. Solvent and Other Product Use	**101.40**	**91.70**	**82.80**	**79.80**	**82.30**	**71.70**	**72.30**	**61.40**	**57.79**	**56.41**
4. Agriculture	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**0.00**	**0.16**	**0.16**	**0.16**
A. Enteric Fermentation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Manure Management	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Rice Cultivation	0.00	0.00	0.00	NO	0.00	0.00	0.00	0.00	0.00	NO
D. Agricultural Soils	0.20	0.20	0.20	0.20	0.20	0.20	0.00	0.16	0.16	0.16
E. Prescribed Burning of Savannas	0.00	0.00	0.00	NO	0.00	0.00	0.00	0.00	0.00	NO
F. Field Burning of Agricultural Residues	NO	0.00	NO	0.00	NO	0.00	0.00	NO	NO	NO
G. Other	NO	0.00	0.00	0.00	0.00	0.00	0.00	NO	NO	NO
5. Land-Use Change and Forestry	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**NO**	**NO**
A. Changes in Forest and Other Woody Biomass Stocks	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	NO
C. Abandonment of Managed Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste	**0.20**	**0.20**	**0.20**	**0.20**	**0.20**	**1.70**	**1.90**	**1.66**	**1.69**	**1.71**
A. Solid Waste Disposal on Land	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.78	0.75	0.72
B. Wastewater Handling	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Waste Incineration	IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other	0.20	0.20	0.20	0.20	0.20	1.70	1.10	0.88	0.94	0.99
7. Other (please specify)	**0.20**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Solvents and other product use	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Polluted surface water	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items:										
International Bunkers	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**NE**	**NE**	**NE**
Aviation	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass										

** IE is Included Elsewhere*
*** NE is Not Estimated*
**** NO is Not Occurring*

Table A.9 Emissions of greenhouse gases in the Netherlands: CRF Trend Table 10: SO_2.

Greenhouse gas source and sink categories		1990	1991	1992	1993 (Gg)	1994	1995	1996	1997	1998	1999
Total National Emissions and Removals		**193.60**	**163.50**	**157.20**	**150.40**	**136.50**	**144.70**	**132.20**	**117.45**	**106.78**	**100.36**
1. Energy		**167.00**	**140.90**	**138.30**	**133.60**	**120.10**	**129.00**	**113.20**	**100.38**	**92.81**	**86.12**
A. Fuel Combustion	Reference Approach										
	Sectoral Approach	159.20	131.20	126.70	122.10	109.50	118.70	102.70	90.30	84.80	78.72
1. Energy Industries		108.70	88.60	81.10	77.40	66.20	67.90	63.70	54.84	52.56	48.32
2. Manufacturing Industries and Construction		26.20	17.50	20.00	17.60	16.20	15.70	10.90	11.46	7.79	6.18
3. Transport		20.00	21.00	21.40	21.30	21.70	31.00	26.70	22.65	23.25	23.12
4. Other Sectors		4.30	4.10	4.20	5.80	5.40	4.10	1.40	1.35	1.20	1.10
5. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Fugitive Emissions from Fuels		7.80	9.70	11.60	11.50	10.60	10.30	10.50	10.08	8.01	7.40
1. Solid Fuels		0.00	IE	IE	IE	IE	IE	IE	IE	IE	IE
2. Oil and Natural Gas		7.80	9.70	11.60	11.50	10.60	10.30	10.50	10.08	8.01	7.40
2. Industrial Processes		**26.00**	**22.40**	**18.80**	**16.70**	**16.20**	**14.80**	**17.90**	**16.02**	**13.21**	**13.48**
A. Mineral Products		0.00	0.00	0.00	0.00	0.00	0.00	2.80	0.00	2.24	2.31
B. Chemical Industry		IE	0.00	0.00	0.00	0.00	0.00	4.50	0.00	2.75	3.94
C. Metal Production		0.00	0.00	0.00	0.00	0.00	0.00	10.10	0.00	7.61	6.61
D. Other Production[3]		IE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Production of Halocarbons and SF_6		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Consumption of Halocarbons and SF_6		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Other		26.00	22.40	18.80	16.70	16.20	14.80	0.50	16.02	0.61	0.61
3. Solvent and Other Product Use		**0.30**	**0.20**	**0.10**	**0.10**	**0.20**	**0.00**	**0.20**	**0.23**	**0.02**	**0.03**
4. Agriculture		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
A. Enteric Fermentation		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Manure Management		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Rice Cultivation		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Agricultural Soils		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Prescribed Burning of Savannas		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
F. Field Burning of Agricultural Residues		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5. Land-Use Change and Forestry		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**NO**	**NO**
A. Changes in Forest and Other Woody Biomass Stocks		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Forest and Grassland Conversion		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Abandonment of Managed Lands		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. CO_2 Emissions and Removals from Soil		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E. Other		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6. Waste		**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.90**	**0.90**	**0.82**	**0.74**	**0.74**
A. Solid Waste Disposal on Land		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B. Wastewater Handling		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Waste Incineration		IE	IE	IE	IE	IE	IE	IE	IE	IE	IE
D. Other		0.00	0.00	0.00	0.00	0.00	0.90	0.90	0.82	0.74	0.74
7. Other (please specify)		**0.30**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Solvents and other product use		0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Polluted surface water		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Memo Items:											
International Bunkers		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**0.00**	**NE**	**NE**	**NE**
Aviation		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Marine		NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Multilateral Operations		**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass											

** IE is Included Elsewhere*
*** NE is Not Estimated*
**** NO is Not Occurring*

A.3 Completeness Tables for 1990

Table A.10 CRF Completeness Table 9 for 1990.

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

		Sources and sinks reported elsewhere (IE)[3]		
GHG	**Source/sink category**	**Allocation as per IPCC Guidelines**	**Allocation used by the Party**	**Explanation**
CO_2	Coke production	1.A.1 Energy industries	1.A.2 Manufacturing industries	Source allocated to Target Group Industry
	Off-road vehicles (agriculture)	1.A.4 Small combustion	1.A.3 Transport	Source allocated to Target Group Transport
	Off-road vehicles (construction)	1.A.2 Manufacturing Industries	1.A.3 Transport	Source allocated to Target Group Transport
	Waste combustion (fossil fuel related carbon)	1.A.1 Energy industries	6.D Waste / Other	Possibly incorrect allocation in 1995-1999 due to aggregation of sources
	Biogas combustion	CO_2 from biomass	1.A Fuel combustion	Accidental allocation error in the national system
CH_4				
N_2O				
HFCs				
PFCs				
SF_6				

ANNEX B

Experiences with Activities Implemented Jointly and the Kyoto mechanisms

B.1 Activities implemented jointly under the climate convention

Under the pilot phase for Activities Implemented Jointly (Decision 5/CP.1) the Netherlands and partner countries have gained experience with joint activities to mitigate or sequestrate greenhouse gas emissions. The Netherlands has implemented a Pilot Phase Programme on AIJ between 1996 and 2000. The programme has allowed authorities, companies and institutions to acquire experience with this instrument, which facilitates emission reductions via joint projects. On the basis of this experience, the instrument has been further developed at international level. Although no credits have accrued from the projects during the pilot phase (in accordance with decision 5/CP.1), the programme has provided insight into the possibilities for achieving part of the climate change commitment abroad in a cost-effective manner. Until the programme was closed for new applications in 2000, the Netherlands continued initiating new pilot projects for capacity building purposes in developing countries, particularly in Africa. Chapter 7 contains a list of pilot projects in developing countries, being implemented or prepared by Netherlands' companies in cooperation with the government.

Annual reports on the progress of the Pilot Phase Programme have been presented to Parliament and to the Conference of the Parties to the UNFCCC. The pilot phase was reviewed in 1999. For the purposes of this evaluation, in 1999 the Netherlands prepared a report to the Conference of the Parties to the UNFCCC, which described the main experiences of the Pilot Phase Programme (FCCC/SB/1999/MISC.1). These experiences were also defined in the second part of the *Netherlands Climate Policy Implementation Plan* (VROM, 2000). A shortlist is included in *Box B.1*.

B.2 Programmes on mechanisms under the Kyoto protocol

Under the *National Climate Policy Implementation Plan* (NCPIP part 1, VROM 1999) the Netherlands' government agreed that 50% of the emissions reduction commitment (equalling around 25 Mton CO_2-equivalents per year in the commitment period) should be achieved via the Kyoto mechanisms. The government introduced two new programmes for this purpose: one for Article 6 projects (Joint Implementation) and another for CDM projects. The budget indicated

Box B.1 Experiences of the Netherlands' AIJ Pilot Phase Programme.

- Registration and verification: the Joint Implementation Registration Centre (JIRC) has been set up to register AIJ projects, and to verify and certify the emission reductions achieved. The JIRC performed functions similar to the operational entities under the CDM, and the independent entities under JI. The centre ceased to exist in 2000.
- Reporting and host country approval: the reporting procedure required host country approval of the pilot projects. Host country approval proved to be complex for some countries, because no institutional structure and procedure existed for such approval (in some countries a Parliamentary decision was necessary). Therefore not all pilot projects were reported to the Conference of the Parties of the UNFCCC.
- Credit sharing: credit-sharing discussions and simulations have taken place in several pilot projects, which proved to be very valuable. In other projects credit sharing negotiations took place with a view to implementing Article 6 projects in the near future.
- Cost effectiveness of small projects is lower than for large projects, because of relatively high transaction costs (baseline studies, monitoring) of small projects.
- Capacity building for AIJ has benefited the governments of developing countries.
- Outreach on AIJ: establishing the foundation Joint Implementation Network (JIN) proved very valuable in learning more about the concept of AIJ. JIN's Joint Implementation Quarterly (JIQ) has reached stakeholders in over 130 countries.

€ 137 million for JI projects (€ 34 million each year for four years, starting in 1999) and € 227 million for CDM projects in 2001 (€ 91 million) and 2002 (€ 136 million). Subsequently € 56 million will be made available per year until 2010 for reducing emissions through the Kyoto mechanisms.

Joint Implementation (JI)

General

The Ministry of Economic Affairs is responsible for implementing the policies on JI and International Emissions Trading in the Netherlands. On the basis of experiences gained during the AIJ pilot phase, the Netherlands agreed the following approach for JI: CO_2 reductions under JI (Emission Reduction Units - ERUs) and under the CDM (Certified Emission Reductions Units - CERs) are considered to be a commodity with a certain economic value. The Netherlands' government wants to buy ERUs and CERs in order to meet its Kyoto commitments. As a result of EU legislation and WTO rules, the government agreed to buy emission reduction units via a public procurement procedure.

The first Emission Reduction Units procurement tender (ERUpt) was opened by Senter (a governmental agency) in May 2000, on behalf of the Ministry of Economic Affairs. The Netherlands provided up-front finance in return for the ERUs being generated between 2008-2012. For this tender a budget of € 45 million was made available to provide an incentive for Annex 1 companies to invest in JI projects. Before the tender was published, the Netherlands had negotiated Memoranda of Understanding (MoUs) with host governments in Central and Eastern Europe, as an umbrella agreement under which European companies could establish JI projects. Each project proposal required host country approval, to qualify for the project review. To facilitate this host country approval procedure, comprehensive capacity building was performed in the countries where MoUs were signed.

Twenty-six expressions of interest (draft project proposals) were submitted for ERUpt: CO_2 emissions may be reduced by as much as 9.11 Mton through investments that nine Netherlands' and foreign companies are prepared to make. A first selection was made at the end of 2000. Nine project initiators were asked to prepare a final project proposal. The projects were located in the Czech Republic, Latvia, Poland, Romania and the United Kingdom. The technologies involved are cogeneration (district heating), wind energy, hydropower, biomass, afforestation and landfill gas extraction. The contract value of the nine projects amounts to € 72 million on a total investment volume of € 495 million. This means that ERUpt will contribute an average of 15% to the income obtained from the investments. The first contracts for the sale of carbon credits under the first ERUpt tender were signed on April 17, 2001. In total 4.1 million carbon credits were purchased at an average price of € 8.75.

More competition is expected in forthcoming tenders, the first of which will be opened on December 1, 2001. Tenders are expected to result in lower prices. In the first place many more suppliers are expected to follow the example set by the first participants, by also entering the market. Moreover greater emphasis will be placed on price as a yardstick for awarding a contract. Senter is developing an information system that will make the supply side of the market more transparent. This will enable competitors to know what other suppliers are offering, so they can make a more competitive bid.

The Ministry of Economic Affairs is also looking at other ways to support JI, e.g. a possible cooperation with the EBRD, the World Bank and commercial banks. It is also investigating the possibilities of International Emissions Trading in combination with JI.

Prototype Carbon Fund

The Netherlands' government (Ministry of Economic Affairs) is also an active participant and contributor to the prototype carbon fund set up by the World Bank. On behalf of the participants in the fund, the World Bank supports JI or CDM projects in return for high quality carbon credits that are passed on to the participants. Hands-on experience with ongoing JI and CDM projects and project procedures is made available to interested parties via a website, and as a contribution to the UNFCCC discussion on the Kyoto Mechanisms.

JI Capacity building: cooperation with host countries

To make JI (ERUpt) a success, some important conditions have to be met. Good cooperation between the Netherlands and the host countries is essential. To define this cooperation, Memoranda of Understanding have been signed with Romania, Bulgaria, Slovakia and Croatia. These MoUs form the basis for the JI cooperation and give investors confidence that the host country is interested in JI. The Netherlands aims to sign MoUs with more countries before the second tender starts.

To support host countries in dealing with JI, (independent) JI-units in Romania and Bulgaria are partly financed for a limited period of time. Local staff at these units have received training in JI, project assessment, criteria development etc. Their main task is project assessment and coordination of communication between all involved parties in the host country. They also advise the Minister of Environment in the host country on whether or not to approve a project and the conditions (credit sharing arrangement). Important other aspects of their work include publicity, public relations and assisting their government with JI policy. The JI units must become financially independent within one or two years.

Independent validation and verification

One of the other crucial aspects of the JI programme is validation and verification of the projects. The UNFCCC negotiating process is currently developing clear guidance on items such as baselines, additionality and monitoring. To gain an early start with JI the Ministry of Economic Affairs asked Det Norske Veritas, together with the Netherlands´ Energy Research Foundation (ECN), to develop guidelines for validation and verification of JI projects. These guidelines were finished before the first ERUpt started and will be evaluated at the end of the first tender. Practical experience with methodological issues in JI is essential for improving aspects such as baseline methodology. Ahead of decisions on modalities for JI, the Netherlands´ guidelines prescribe a conservative estimation of the emission reductions. Moreover, independent certification bodies will validate the projects. (The Netherlands´ guidelines are available from www.senter.nl/erupt).

CDM

The Netherlands' Ministry of Housing, Spatial Planning and the Environment (VROM) is responsible for purchasing CERs from CDM projects. A special CDM division was established within the Ministry as part of the Directorate for International Environmental Affairs on April 1, 2001. As public money is involved and procurement rules are applicable, the Ministry is not entitled to buy CERs at random from the market. Therefore cooperation will be sought with several types of intermediate implementing organisations, hereafter called 'intermediaries'.

Three separate tracks are currently under development.

- Acquiring CERs through Multilateral International Financial Institutions, e.g. the World Bank/IBRD, IFC and Regional Development Banks. Due to their position and international legal status these organisations are all expec-

ted to be able to approach the market and negotiate the purchase of CERs on behalf of the Netherlands.
- Acquiring CERs through international tendering by Senter; the tender will be named CERUPT (Certified Emission Reduction Unit Procurement Tender). The CERUPT tender will strictly follow procedures and conditions set in advance, according to European (and WTO) procurement regulations. In July 2001 Senter was assigned to perform this task and it is expected that the tender procedure will be opened on November 1, 2001. Conditions for participating in the tender will be published in advance.
- Acquiring CERs through private financial institutions, which will be selected through a tender.

By setting these conditions VROM intends to prevent a strong competition between the intermediaries involved. As emphasised, VROM will only commit itself to payments based on tangible projects meeting the previously defined criteria. Nevertheless (co)financing preparatory activities, such as project-related capacity building may be possible. CDM budgets are not meant for financing more general climate projects such as non-project-related capacity building and adaptation; these projects remain the prime responsibility of the Ministry of Foreign Affairs / Development Cooperation.

ANNEX C

Global Climate Observation System
Detailed Netherlands national report on global climate observation systems

C.1 General approach to systematic observation

The Netherlands actively participates in the various fields of climate-related monitoring, both nationally and within European and global programmes. An integrated national programme for implementing the Netherlands contribution to GCOS has not yet been established. However, steps are being taken to develop and implement such a strategy:

- in 1998 an authoritative national study (NIMM) was undertaken evaluating the Netherlands contribution to international monitoring systems (English summary available from www.knmi.nl/gcos). This report deals with five areas for monitoring activities: oceans, coast & delta, land, weather & climate and atmospheric composition. The study strongly recommends striving for integrated approaches at a national level, in accordance with IGOS. To that effect it proposed designating national focal points for GCOS, GOOS and GTOS. From the year 2000 onwards the *Royal Netherlands Meteorological Institute* (KNMI) acts as focal point for GCOS in the Netherlands;
- the NIMM study recommends substantial strengthening of climate-related monitoring, requiring investments and organisational structuring. Plans are currently being developed to implement a prototype of the monitoring system recommended in the report. To this end national atmospheric, oceanographic and terrestrial-oriented institutes are moving towards founding a virtual centre that, among others, will focus on integrated climate monitoring.

The Netherlands meets the GCOS requirements. The GCOS monitoring principles and best practices are known at the professional level and are taken into account. Free data exchange is encouraged, within the limits of international regulations (e.g. the ECOMET rules). At present there is no explicit national policy for capacity building in relation to GCOS, though activities take place frequently on a project level. Project descriptions will be made available from www.knmi.nl/gcos. Section C.2 gives more details on GCOS in the Netherlands, mainly by providing explanations to the various tables in this Annex. The tables are presented at the end of each section.

C.2 Meteorological and atmospheric observation

Network atmospheric observation systems (table S1)

KNMI now operates a network of 36 ground observation stations (Area Netherlands), of which the hourly values of almost all elements listed in *Table S1* (Land surface) are archived. Within this network a subset of 15 stations is considered suitable for climate monitoring as they have long (> 30yrs) observational periods. One station has been designated as GCOS-GSN station (De Bilt: 06260), five stations as Climate Reporting stations (De Bilt: 06260 >= 1906, De Kooy: 06235 >= 1972, Eelde: 06280 >= 1947, Vlissingen: 06310 >= 1907 and Beek: 06380 >= 1947)[1]. The monthly time series of these 5 stations are reported to GHSN (Global Historical Station Network).

In addition to this network KNMI also operates some 325 climatological precipitation stations giving daily precipitation records (rain 08.00 – 08.00 UTC). Some 220 of these stations have long observational series (over 30 years) and are suitable for climate monitoring. The monthly amounts from 100 of these stations are reported periodically to GPCC (Global Precipitation Climatology Centre, DWD).

[1] >= yyyy indicates the first year for which digitised hourly data are available.

Cabauw Observatory

Observational programmes have been running at Cabauw Observatory since 1973. In-situ measurements of profiles of basic atmospheric parameters at various points up a 213-metre high tower and in the field around the tower were later complemented with remote-sensing measurements. In many periods also measurements of surface fluxes were carried out. A continuous dataset since 1973 is not available due to interruptions caused by renovations, and because special research was carried out at certain times. However, quality controlled datasets are available for several periods. A long-term profile and surface flux measurement programme was run from 1986-1997, of which a detailed homogeneous dataset was prepared. These data found their way into the literature and were also used by the KNMI operational weather service. During 1998 and 1999 test measurements were performed at the 80-metre level of the meteorological tower to judge the performance of the new operational instruments in the tower; this was necessary for a complete renovation of the instrumentation. The current observational programme consists of measuring profiles of wind speed, wind direction, temperature and dewpoint at the 200, 140, 80, 40, 20, 10 and 1.5-metre levels. Only temperature and dewpoint are observed at the 1.5-metre level. Amounts of precipitation, surface pressure, ingoing and outgoing short-wave and long-wave radiation are also measured.

RASS wind profiler measurements of wind speed and direction, as well as virtual temperature in the atmospheric boundary layer (depending on atmospheric conditions) are continuously available. Cloudbase height measurements are routinely measured by a lidar ceilometer.

An initiative has started to further develop Cabauw into a national site for atmospheric research. Over 10 research groups from universities and research institutes are joining the discussion on the CESAR project (*Cabauw Experimental Site for Atmospheric Research*), which is expected to result in a considerable enhancement of the instrumentation at the Cabauw Observatory. The development of the observatory as a climate monitoring station and the possible implementation of instruments to participate in the Baseline Surface Radiation Network is still being discussed.

Available homogeneous datasets (Table S2)

All hourly climatic data (and its aggregations: daily, monthly) are available for the community. For terms and specifications we refer to the KNMI catalogue (http://www.knmi.nl/product/catalogus/). The majority of the archived data has been thoroughly quality controlled. The level of homogeneity of derived time series has not always been assessed. Assessments of quality and other meta data of the observational series of precipitation, sunshine and radiation and wind are given in a series *Klimaat van Nederland*, Vol. 1, 2, 3 edited by KNMI (Netherlands language).

The so-called KNMI HYDRA wind dataset contains the homogenised hourly time-series of potential wind speed and wind direction of 45 stations, from 1949 to present (freely accessible and downloadable from the Internet http://www.knmi.nl/samenw/hydra.

Within the framework of the EUMETNET ECSN programme the ECA project (European Climate Assessment, of which KNMI is a member) operates a website (www.knmi.nl/samenw/eca) giving access to the analyses and presentations of some 150 long (40 years) daily time-series of temperature and air pressure covering Europe (area VI). The EUMETNET ECSN project ECD (*ECSN Climate Dataset*) is now focusing on distributing an expanded ECA dataset, thereby following the terms of WMO Resolution 40.

The KNMI Climate Explorer (http://www.knmi.nl/onderzk/oceano/climexp) gives access to a global dataset of monthly time series of temperature, precipitation and air pressure.

The following historical datasets[2] are available on special request in digitised format:
- daily instrumental readings of temperature, air pressure, wind speed, wind direction and state of the sky from 11 observational locations in the Netherlands, from 1706-1860;
- LCT, the Low Countries Temperature series: seasonal and annual temperatures (Central Holland, period from 800 AD onwards).

Satellite Application Facility on Climate Monitoring

In order to optimise the use of the Meteosat Second Generation (MSG), the new series of European geostationary meteorological satellites, EUMETSAT has funded six Satellite Application Facilities (SAF) to develop applications. The SAF of Climate Monitoring is a collaboration between eight institutes working on retrieving parameters from MSG that are relevant to the climate research community. Main topics are radiation components, cloud properties, humidity fields and sea state. KNMI contributes its expertise in quantitative cloud analysis, which is used to improve and validate the retrievals of physical cloud parameters from MSG and the polar orbiting meteorological satellites AVHRR and METOP. The following physical cloud properties are retrieved: presence, temperature, height, optical thickness, liquid water path and thermodynamic phase. Reference data for validation is obtained from intensive measurement campaigns such as CLARA96 and CLIWANET.

New passive imager design

KNMI is also involved in designing a new passive imager. ESA is planning new generations of satellite platforms for meteorological and research use with a passive visual and infrared imager on each platform. Images obtained via this instrument are currently used during the weather forecast to illustrate the current and past weather. The new generation of passive imagers will provide more quantitative information on the state of the atmosphere and underlying surface. Quantitative analysis enables new applications in land use, agriculture, oceanography etc. KNMI has been asked to contribute to the design of this new generation of passive imagers in order to optimise its use in climate research and meteorology. The KNMI focus is on quantitative cloud analysis and aerosols.

Atmospheric constituents observing systems for climate

Table S5 shows information on atmospheric constituents observing systems for climate.

Ground-based measurements of ozone

KNMI operates two ozone stations: one in De Bilt, the Netherlands and one in Paramaribo, Suriname. Both stations have a Brewer instrument continuously measuring the ozone columns and UV spectrum. The Brewer measurements in De Bilt have been carried out since January 1, 1994 and in Paramaribo since April 3, 1999. The ozone sondes measurements in De Bilt have been used since the end of 1992 and in Paramaribo since September 1, 1999. Ozone soundings are performed weekly. All data are submitted to the WOUDC (World Ozone and UV Data Centre, part of WMO) and contained in the GAW programme. The ozone sondes of both stations are part of the NDSC (Network of Detection of Stratospheric Change). All these measurements have adequate (standard) procedures for quality control.

[2] Apply to: KNMI, Climatological Services, PO Box 201, 3730 AE De Bilt (Netherlands).
More information concerning historical datasets can be found on: http://www.knmi.nl/onderzk/hisklim/intro-en.html

Satellite measurements of ozone and other gases

The satellite measurements of ozone and other gases in which KNMI, SRON and RIVM are involved are generally not national property. KNMI's involvement in climate monitoring concerns the following fields:
- definition of user requirements with respect to climate monitoring for new missions (OMI on EOS-Aura, GOME-2 on METOP and ACECHEM, a candidate core mission within ESA's Earth Explorer programme);
- development of level 0-1 and level 1-2 retrieval algorithms for retrieving trace gas densities (GOME on ERS-2, SCIAMACHY on Envisat, OMI, and GOME-2);
- validation of level 1 and level 2 measurements for GOME, SCIAMACHY, OMI and GOME-2;
- production and/or distribution of level 2 data for GOME, SCIAMACHY, OMI, and GOME-2 (also via the Netherlands Atmospheric Data Centre);
- chemical data assimilation of ozone and NO_2; the EU project GOA (PI[1] KNMI) results in a homogeneous dataset of 2D (lat., long.) total ozone fields made up of five years of GOME data, a one-year set of 3D ozone fields and NO_2 troposphere amounts;
- high-level Dutch scientific involvement in the instruments: OMI (PI), SCIAMACHY (co-PI), GOME (SAG)[2], GOME-2 (SAG).

Global satellite measurements of ozone and other gases are ideal for climate monitoring, provided that there is a good validation and quality control. The assimilation of these measurements into well-verified and validated state-of-the-art chemical transport models results in an accurate 4D description of the atmospheric composition.

The aforementioned tasks are all financed by national and international projects (except for operating the ozone station in De Bilt). There is therefore no guarantee that these tasks will be continued. An additional effort (money and time) is needed to compose the 4D datasets.

Ground-based measurements of other air pollution components

The Laboratory of Air Research at RIVM operates the Netherlands' National Air Quality Monitoring Network (LML) to monitor ambient air quality and supervise implementation of air quality standards. The LML programme includes the following components (figures between brackets indicate the number of monitoring locations):
- gaseous components;
- carbon monoxide (23), ozone (38), nitrogen oxides (46), sulphur dioxide (37), ammonia (8), volatile organic compounds C6 – C16 (9), fluorides (5);
- particulate matter, fine dust PM10 (19), black smoke (15), acidifying aerosols (ammonium, chloride, nitrate, sulphate) (7), aerosol bound heavy metals (arsenic, cadmium, lead, zinc) (4);
- chemical composition of wet precipitation (acidifying components, heavy metals) (15).

The results are available from www.lml.rivm.nl.

Moreover, within the framework of the UNECE EMEP programme and OSPARCOM the following components are monitored at one location:
- very volatile organic compounds C_2 – C_6;
- chemical composition of wet precipitation (mercury, lindane, daily values of acidifying components).

[1] Principal Investigator
2 Science Advisory Group

Ground-based measurements of greenhouse gases

Within the framework of the Dutch National Air Quality Monitoring Network (LML) the (greenhouse) gases CO, CO_2 and CH_4 are measured continuously at one location. Among others, the results are reported within the GAW programme.

Remote sensing measurements of ozone
The Laboratory of Air Research at RIVM operates a DIAL system for the vertical profiling of ozone up to the stratosphere (50 km). The DIAL system is located in New Zealand as part of the NDSC (Network of Detection of Stratospheric Change). An analogue system for profiling troposphere ozone (1-15 km) is operated in Bilthoven, within the framework of Eurotrac-TOR.

Remote sensing measurements of aerosols
RIVM recently started to operate an aerosol / cloud lidar measurement system (1-10 km) to explore the relevance for climate change. Among others, KNMI and ECN are also involved in this project.

Table C.1 Participation in the global atmospheric observing systems

	GSN	GUAN	GAW	GHSN
How many stations are the responsibility of the Party?	1		2	5
How many of those are operating now?	1			
How many of those are operating to GCOS standards now?	1			
How many are expected to be operating in 2005?	5			
How many are providing data to international data centres now?	1		2	

Table S1. Atmospheric observing systems for climate at the land surface (meteorological land surface observations).

Systems	Climate Parameters* (e.g. Temp, Precip, other)	Total # Stations	Appropriate for Characterising National Climate?			Time Series #stations/platforms (# Data Digitised)			Adequate Quality Control Procedures?			Metadata available	Continuity
			Fully	Partly	No	30-50y	50-100y	>100y	Fully	Partly	No	Total # Stations (% Digitised)	# expected operational in 2005
Stations Useful for National Climate Monitoring Purposes	All params given in appendix 3	36		X		10(10)	5(5)			X		15 (10%) which means that ca. 10% of the available metadata is digitised	14
	Daily 08-08 hr. UT precipitation sum	325		X		180(180)	40(40)			X		325 (10%) see above	325
Stations Reporting Internationally	100 08-08 precipitation stations and 5 climate reporting stations	105				105(105)				X			105
CLIMAT Reporting Stations		5					5(5)			X			5
Reference Climate Stations													

Table S2. Available homogeneous data sets for meteorological land surface observations.

Data Set Name	Climate Parameters	# Stations or Grid Resolution and Region covered	Time Period	References
KIS	All elements table S1	15, Netherlands	1900-present	http://www.knmi.nl/product/catalogus/ KNMI-Climatological Services, PO box 201, 3730 AE De Bilt Netherlands
HYDRA	Hourly wind speed and wind direction	45, Netherlands	1949-present	http://www.knmi.nl/samenw/hydra KNMI-Climatological Services, PO box 201, 3730 AE De Bilt Netherlands
Climate Explorer	Monthly temperature, precipitation and air pressure	Global	1900-present	http://www.knmi.nl/onderzk/oceano/climexp
ECA	Daily temperature and precipitation indices	150, RAVI	1900-present	http://www.knmi.nl/samenw/eca
LCT	Seasonal and annual temperatures Central Holland	1	AD 800-present	KNMI-Climatological Services, PO box 201, 3730 AE De Bilt Netherlands
HWW	Daily clock readings of temperature, air pressure, wind speed, wind direction, state	11	1706-1854	KNMI-Climatological Services, PO box 201, of the sky3730 AE De Bilt Netherlands

Table S3 Atmospheric observing systems for climate above the surface (meteorological upper air observations).

Systems Useful for NationalClimate Monitoring Purposes	Total # Stations or platforms	Appropriate for Characterising National Climate?			Time Series #stations/platforms (#Data Digitised)				Adequate Quality Control Procedures?			Metadata available Total # Stations (% Digitised)	Continuity # expected operational in 2005
		Fully	Partly	No	5-10y	10-30y	30-50y	>50y	Fully	Partly	No		
Radio sound stations	1		X			1 (1)				X		1(10%)	0
Wind-only stations	7		X										
Stations reporting Internationally													105
CLIMAT TEMP reporting stations	1					1 (1)				X			0
ASAP stations													
Profilers*	1					1			X			1 (100%)	1
Aircraft (land locations)*													
GPS*	5				5				X			5 (100%)	5
Others (e.g. satellite-based)*													
Meteorological tower	1	X				1 (1)			X			1 (20%)	1
Total Upper Air Network													

Table S4. Available homogeneous data sets for meteorological upper air observations.

Data Set Name	Climate Parameters	# Stations or Grid Resolution and Region covered	Time Period	References
See comments S1 and S2				
Radiosonde	wind, temp, hum.	De Bilt 06260	from 1961	
Cabauw Observatory	see text	Cabauw 06348	start 1973	

Table S5. Atmospheric constituent observing systems for climate.

Constituent	Total # Stations or platforms	Appropriate for Characterising National Climate?			Time Series #stations/platforms (#Data Digitised)				Adequate Quality Control Procedures?			Metadata available Total # Stations (% Digitised)	Continuity # expected operational in 2005
		Fully	Partly	No	10-20y	20-30y	30-50y	>50y	Fully	Partly	No		
Carbon dioxide	1		X		< 10 y				X			yes	yes
Ozone (surface)	38	X				X			X			yes	yes
Ozone (column)	1	X			< 10 y				X			yes	yes
Ozone (profile)	2		X		ca. 10 y				X			yes	yes
Atmospheric Water Vapor	-								X			yes	yes
Other Greenhouse Gases	CH_4: 1		X		< 10 y				X			yes	yes
	CO: 1		X		< 10 y				X			yes	yes
Aerosols	3		X		< 10 y				X			yes	yes
Other	NO_x: 45	X				X			X			yes	yes
	CO: 23	X				X			X			yes	yes

Table S6. Available homogeneous data sets for atmospheric constituents.

Data Set Name	Constituent	# Stations or Grid Resolution and Region covered	Time Period	References
see comments in text of this annex	Carbon dioxide			
	Ozone			
	Water Vapor			
	Other Greenhouse Gases			

C.3 Oceanographic Observations

NIOZ contributions to GOOS

The Netherlands Institute for Sea Research (NIOZ) is actively involved in a number of research programmes that contribute to the GOOS objectives. Monitoring of ocean currents and properties is performed in the framework of the Dutch contribution to CLIVAR. These activities are partly funded by NWO and are carried out in close collaboration with IMAU (Utrecht University) and KNMI. Present activities include:

- *Clivarnet Atlantic Monitoring Programme* (CAMP) in which a former WOCE hydrographic section (AR7E, Ireland – Greenland) is monitored biannually (2000, 2002, 2004) by NIOZ. Observations include various 'standard' properties such as salinity, temperature, nutrients, oxygen, CO_2;
- *Mixing of Agulhas Rings Experiment* (MARE), in which the hydrographic properties of an Agulhas Ring were monitored three times in 2000 and 2001. This ocean-going study focuses on the inter-basin exchange between the Indian and Atlantic ocean;
- *Agulhas Current Source Experiment* (ACSEX) which includes an array of current meter moorings in the Mozambique Channel for two years (2000-2001) and hydrographic observations in the ocean around Madagascar in 2000 and 2001.

Apart from these ocean-going observational programmes NIOZ performs long-term observations in the Dutch coastal zone and the Wadden Sea that contribute to the GOOS objectives. These long-term time series include:

- temperature and salinity observations in Marsdiep tidal inlet, since 1860;
- currents in Marsdiep tidal inlet, ferry observations since 1998;
- macro-fauna on tidal flats in the Wadden Sea, yearly since 1970;
- phytoplankton in Marsdiep tidal inlet, weekly since 1970.

Table 2. Participation in the global oceanographic observing systems.

	VOS	SOOP	TIDE GAUGES	SFC DRIFTERS	SUB-SFC FLOATS	MOORED BUOYS	ASAP
How many platforms is the Party responsible for?	200		19			5	
How many are providing data to international data centres?	200		5			0	
How many are expected to be operating in 2005?	200		19			5	

Note 1 : Estuaries (Wadden Sea, Schelde River, etc.) not included.

Note 2 : The international data centre is the Permanent Service for Mean Sea Level.

Table S7. Oceanographic observing systems for climate.

System Component	Total # Stations	Appropriate for Characterising			Time Series #stations/platforms National/Regional Climate?			Adequate Quality Control Procedures? (#Data Digitised)			Metadata available	Continuity
		Fully	Partly	No	30-50y	50-100y	>100y	Fully	Partly	No	Total #Stations (%Digitised)	# expected operational in 2005
Sea Level e.g., Tide gauges	19	x			2		5	x			19 (100%)	No changes
SST (e.g., Moored Buoys)	11	x			2		1	x			11(100%)	No changes
Meteorological Obs (e.g., Temp, Precip, Pressure)	200 VOS ships		x						x		200 (10%)	200
Sub-Surface Profiles												
Ocean Circulation												
Carbon Fluxes												
Energy Fluxes												

Note 1: Estuaries (Wadden Sea, Schelde River etc.) not included.

Note 2: Sea Level: i.e. Time-Series of times and heights of all high and low waters. Hourly water level data are available only for the last 30 years.

Table S8. Available homogeneous data sets for oceanographic observations.

Integrated Data Sets Name and Brief Description	Climate Parameter	Platforms and/or Grid Resolution And Region covered	Time Period	References
Two time series SST and air temperature	SST T	2 locations (light-vessel) along Dutch coast	1859 (1898) -1990	Korevaar, C.G., "North Sea Climate", 1990, Kluwer

C.4 Terrestrial Observations

Table 3. Participation in the global terrestrial observing systems.

	GTN-P	GTN-G	FLUXNET	Other
How many sites are the responsibility of the Party?				
How many of those are operating now?				
How many are providing data to international data centres now?				
How many are expected to be operating in 2005?				

Table S9. Terrestrial observing systems for climate.

System Component	Total # Stations	Appropriate for Characterising			Time Series #stations/platforms National/Regional Climate?			Adequate Quality Control Procedures? (#Data Digitised)			Metadata available	Continuity
		Fully	Partly	No	30-50y	50-100y	>100y	Fully	Partly	No	Total #Stations (%Digitised)	# expected operational in 2005
River Discharge (Streamflow Gauges)	23	X						X			23	23
Ground Water Storage (e.g., Bore-holes)												
Snow												
Glaciers												
Permafrost												
Ice												
FluxNet												
Radiation												
Soil												
Other												

Table S10. Ecological observing systems for climate.

Systems useful for national climate monitoring	Total # Stations	Appropriate for Characterising National Climate?			Time Series #stations/platforms (#Data Digitised)			Adequate Quality Control Procedures?			Metadata available	Continuity
		Fully	Partly	No	30-50y	50-100y	>100y	Fully	Partly	No	Total #Stations (%Digitised)	# expected operational in 2005
Phenological	1 (1800 volunteers)	x				x			x		- (in progress)	1 (more volunteers)
Biomass Change	National forest inventory (3000 plots		x		x			x			x	x
Vegetation Type	ICP forest health monitoring		x		x			x			x	
	Forest Reserves programme		x		x			x			x	
	Many ad hoc research related monitoring			x	x					x	Often sparse	
Land Cover												
Fire Distribution	Central Bureau Statistics		x		x			x			x	
Land Use Change	Central Bureau Statistics		x		x			x			x	
PaleoClimate												
Pollen monitoring	2		x		2			x			2	2

Table S11. Available homogeneous data sets for terrestrial and ecological observations.

Data Set Name	Climate Parameter	# Stations or Grid Resolution and Region covered	Time Period	References

c.5 Space-based Observing Programmes

The Netherlands participates in the ESA and EUMETSAT Space Programmes for Earth Observation. Data retrieval and production for internal use is carried out at KNMI. The products are made available to the general public[1].

The following specific scientific activities for atmosphere research are also undertaken:

- ESA/ERS-2. The products of the GOME instrument include: near real time products (total ozone columns, stratospheric ozone profiles, assimilated ozone columns, clear-sky UV index and cloud information) (ref. http://www.knmi.nl/gome_fd). These products are also available for NO_2 on an experimental basis, as well as offline ozone profiles (total atmosphere).

- ESA/ENVISAT (starting end 2001). The SCIAMACHY instrument provides: calibration/validation, near real-time atmospheric ozone profiles, clear-sky UV index, assimilated fields of several trace gases, cloud information (cloud top pressure, cloud fraction).

All products are quality controlled and stored in the KNMI database. The GOME products will have a long-term guarantee through the GOME-2 instrument on the METOP satellites in the EUMETSAT Polar System (EPS). The EPS programme is funded until 2016.

An Ozone Monitoring Instrument (OMI) will be supplied to the US EOS/AURA (NASA) mission for measuring the distribution of O_3, SO_2, NO_2, BrO in the earth's atmosphere. The launch of EOS/AURA is scheduled for mid 2003. The lifetime of the mission is expected to be five years. A scientific team at KNMI is preparing the ground infrastructure for the production of total ozone columns, ozone profiles, cloud information and information on the distribution of aerosols.

Furthermore, the following specific scientific activities for sea and land surface research are undertaken:

- NOAA-AVHRR. An operational system has been set up at KNMI to process locally received raw AVHRR data into *Sea Surface Temperature* (SST) images of all European waters and a large part of the North Atlantic Ocean. This process is fully automatic and in real-time. *Normalised Difference Vegetation Index* (NDVI) images of Europe are also routinely produced. The persistent cloud cover above Europe urges the need for using composite techniques in order to obtain more complete SST and NDVI maps. KNMI therefore produces weekly SST and NDVI composite maps using all images for a period from Monday to Monday. All weekly SST and NDVI maps are archived in digital form at KNMI. Detailed information can be found on http://www.knmi.nl/organis/wm/rdw/en/AVHRR_products.html.

[1] Reference is made to the GCOS-15 (WMO/TD No 685). The GCOS Plan for Space-based Observations, Version 1.0, June 1995 (GCOS-15) is available at http://www.wmo.ch/web/gcos/publist2.html#plan while GCOS space-based observations requirements can be found by specifying GCOS as the user in http://sat.wmo.ch/stations/_asp_htx_idc/Requirementsearch.asp.